Applied Economics and Policy Studies

Xiaolong Li
Chunhui Yuan
John Kent *Editors*

Proceedings of the 6th International Conference on Economic Management and Green Development

Springer

Applied Economics and Policy Studies

Series Editors

Xuezheng Qin, School of Economics, Peking University, Beijing, China

Chunhui Yuan, School of Economics and Management, Beijing University of Posts and Telecommunications, Beijing, China

Xiaolong Li, Department of Postal Management, Beijing University of Posts and Telecommunications, Beijing, China

The Applied Economics and Policy Studies present latest theoretical and methodological discussions to bear on the scholarly works covering economic theories, econometric analyses, as well as multifaceted issues arising out of emerging concerns from different industries and debates surrounding latest policies. Situated at the forefront of the interdisciplinary fields of applied economics and policy studies, this book series seeks to bring together the scholarly insights centering on economic development, infrastructure development, macroeconomic policy, governance of welfare policy, policies and governance of emerging markets, and relevant subfields that trace to the discipline of applied economics, public policy, policy studies, and combined fields of the aforementioned. The book series of Applied Economics and Policy Studies is dedicated to the gathering of intellectual views by scholars and policymakers. The publications included are relevant for scholars, policymakers, and students of economics, policy studies, and otherwise interdisciplinary programs.

Xiaolong Li · Chunhui Yuan · John Kent
Editors

Proceedings of the 6th International Conference on Economic Management and Green Development

Springer

Editors
Xiaolong Li
Department of Postal Management
Beijing University of Posts
and Telecommunications
Beijing, China

Chunhui Yuan
School of Economics and Management
Beijing University of Posts
and Telecommunications
Beijing, China

John Kent
Department of Supply Chain Management
University of Arkansas
Fayetteville, NC, USA

ISSN 2731-4006 ISSN 2731-4014 (electronic)
Applied Economics and Policy Studies
ISBN 978-981-19-7825-8 ISBN 978-981-19-7826-5 (eBook)
https://doi.org/10.1007/978-981-19-7826-5

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023
This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Contents

Research on the Analysis and Strategy of American Inflation in the Context of COVID-19 1
Yuxin Wu

Analysis of China's Beauty Brand Marketing Strategy and Sales Model 9
Yinglan Yao

Modeling and Economic Analysis of Wind-Marine Current-Biogas Integrated Energy System 19
Chengyan Li

An Analysis of Puma's Global Marketing in the COVID-19 Era 35
Zichun Pan, Kaiyan Wang, Yuechun Wang, and Ruonan Zhao

The Time-Varying Impact of COVID-19 on the Telecom Industry 51
Yi Zhu

The Importance of Compensation from Different Aspects: A Study of Akamai Inc. 65
Si Chang

2022 Russo-Ukrainian War and the Subsequent Sanction in Relation to Commodity Volatility 75
Ji Yu, Ying Xie, and Zihan Yin

The Impact of New Energy Vehicle Batteries on the Natural Environment and Recycling Method 81
Ziyang Huang

The Pollution of Face Masks to Marine Ecology Under the Epidemic 91
Xuping Gong

Comparison of Carbon Emissions of Gasoline Vehicles and Electric Vehicles 101
Chenxi Huang, Zhiying Ou, and Xiaotian Yu

The Impacts of Offshore Oil Spills on Marine Life and Humans and Solutions 113
Mengyao Wang

A Case Study of the 2021 Pulitzer Prize-Winning Articles in Feature Writing Based on Narrative Communication Theory 125
Suya Xie

A Comparative Study of Green Purchase Behavior Between Chinese and American Consumers in College: An Examination of Collectivism, Perceived Peer Pressure, and Environmental Concerns 135
Sijia Peng

A Prediction upon Deep-Sea Gigantism Characteristics of Crustaceans in Respond to Future Global Climate 147
Jianing Yang

A Study on HR Risk of Didi Under the Sharing Economy 161
Yingyin Shao

Activation and Reconstruction of Emergency Supply Chain Crisis Under Crisis Events 169
Xinyu Li

Advantages and Disadvantages of Online Celebrity Marketing 179
Shiqi Chen

Analysis of China's Blind Box Economy—Taking POP MART as an Example 189
Xuemeng Wu

Analysis of How Investors Use Ratios to Pick Stocks Using Three Sample Stocks from the Financial Sector 197
Xinyu Wang

Analysis of Social Media Marketing Strategy: The Case Study of China and the US 205
Nuqian Tang

Analysis of Stocks in the Top Ten Weightings of the Nasdaq 100 213
Yiming Zhao

Analysis of the Enterprise Supply Chain in This Modern Age—From Digital Transformation to Visualization and Sustainability 229
Chuhan Qin

Analysis of the Impact of the Health Status of CDC Staff on Job Performance During COVID-19 Epidemic 239
Wen Zhan

Analysis of the Internet Industry Based on SWOT Model and Porter's Five Forces Model—Taking Amazon as an Example 247
Mingyang Zhou

Analysis of the Traditional Energy Revolution Under the Carbon Neutrality Target 255
Wang Han

Analysis and Optimization of Queuing Problem in Barbershop 265
Bingyu Feng

Analysis of the Impact of Crossover Brand Co-branding on Consumer Purchasing Behavior 271
Mengtong Wang

Analyze the Business Value of Niche Products Based on Long-Tail Market Theory 285
Dongni Liu

Asymmetric Information Analysis on Supply Chain Finance's Profit Model: Based on E-Commerce Platform JingDong 295
Xinqing Fang

A Review of Riders' Job Satisfaction in Takeaway 303
Sha Sijia

Can NFT Refresh the Field of Digital Copyright Protection? The Positive Role and Potential Risks of NFT in Digital Copyright Protection 311
Yining Li

The Importance of Content Marketing in Media 319
Xinyuan Huo

Communication Problems Between Parent–Child 329
Yanan Wang

Commuting Mode Choices in Small Cities of China: A Case Study of Qianshan 339
Tianran Chu

Consumer Rights and Business Ethics in E-Retail Business-Study of China's E-market 351
Haoqin Yin

Covid-19 and Internet Medical Platforms: Opportunities and Challenges 361
Ye Liu, Yufei Chen, Jiale Zhou, Shaoxuan Zheng, and Yixuan Jiang

COVID-19 Influence on the Environment and the Travel Industry 373
Wenkai Duan

Current Situation and Digital Development Trend of E-Commerce Live Streaming in China 381
Shuting Yang

Difference Analysis and Suggestions on the Application of Quantitative Methods in Public Policy Analysis Between China and the United States 391
Zhanfeng Lin

Duration in the Bond Market and Application 401
Chaoyuan Jia

Eco-Friendly Hydro-Power: Turbulent 411
Peixuan Shao

Effects of Population Aging on Japan's Economic Growth 421
Zekai Zhao

Explain Disposition Effect with Loss Aversion and Regret 429
Tong Xue

Exploration of the Appointed Guardianship System of the Civil Code 445
Shihan Zhong

Exploring the Influence of Social Pension Insurance on the Elderly's Subjective Well-Being 459
Xiao Yongqi

Exploring Tourism's Recovery Under the Post-COVID-19 Epidemic 465
Feng Zhao

The Comparison Between Stock Market and Bond Market 473
Junzhe Huang and Qianwen Qin

How Does New Media Affect Business Negotiations? 481
Haotian Wang

Body Language in Business Negotiation 489
Ruimeng Guo

National Culture and Business Negotiation 497
Lisi Liu

Analysis of the Impact of Cultural Differences Between China and the United States on International Business Negotiations 507
Ruihan Jin, Jiahui Song, Qiyu Wang, and Yuanqing Wang

World Medical Economy Development: The Covid-19 Self-Testing Kits and Qualified Medical Manufactories 517
Zhixuan Rong

New Oriental Hedging Strategy Analysis 527
Zhaoyang Xue

Analysis of Billiard Hedging Strategies 535
Yuchu Zhang

Rethinking Online Travel Agency: Dealing with Public Health Emergencies 543
Ziyi Yang

Research on the Relationship Between Executive Compensation and Firm Performance: A Case Study of Panel Data of Chinese Firms 557
Mingtao You

Hedging Strategy Case Analysis—Southwest Airlines 565
Boao Yu

Green Finance Policy Promotes Corporate Green Innovation 573
Diao Junchen and Zhang Guosheng

Green Engineering Management of Photovoltaic Technology Under Climate and Terrain Differences 583
Ruiheng Hu

Hazards and Management of Covid-19 Nucleic Acid Detection Kit and Management 593
Runqi Zou

Health Monitoring and Maintenance of Bridges 603
Boyuan Wang

Hedge Analysis of ZTE 617
Yinghui Zhang

Hedging Strategy Analysis of Southwest Airlines 627
Xiao Han

How Brand Storytelling is Changing to Target the Generation Z in the Digital Age 635
Xiyu Zhang, Han Jiang, Wenzhen Li, and Wanmin Zheng

How to Alleviate the Aging Problem in China? Accessibility Building Strategies and Smart Accessibility Community 649
Haiyue Zhang

Insight into International Trade Law Mechanism: What is the Future for the WTO 657
Shiyun Liu, Yiqi Yu, Zhongqi Lou, and Yuhan Liu

Air Pollution and Earnings Management 677
Kexin Zhang

Linear Programming Approach in Agricultural Production-Land Allocation 697
Xuan Liang

New Energy Vehicle Research on Marketing Strategy in China 707
Yiran Liu

Non-fungible Token (NFT): Introduction, Current Market and Legal Problems 717
Qunyao Jin

Research on the Impact of Non-interest Income Innovation on Bank Performance 727
Yujia Wu and Shaonan Zhu

Portfolio Optimization for Banks in the Hong Kong Stock Market 741
Jingyi Jiang

Portfolio Optimization for Five Representative Companies in China ... 751
Ruitao Guan, Haotian Lan, Yingjun Li, and Che Zhou

Portfolio Strategies for Different Types of Households Under the Impact of COVID-19 759
Chen Zhong

Portrait Analysis of Salesperson's Personal Traits: Using the Big-Five Model as an Example 765
Jingyi Chen, Shijie Ma, and Dan Xu

Pre-establishment National Treatment and Negative List Model: From BIT Negotiations to Negative List of Shanghai Pilot Free Trade Zone 779
Dongxu Chen

Re-examining the Existence of the Environmental Kuznets Curve: Evidence from Six Kinds of Canadian Air Pollutions 789
Feiling Lu

Research and Analysis on Influence Factors of Consumers' Online Purchasing Behavior After Pandemic in Perspective of Mental Accounting 801
Xinjia Chen

Research on Business Model and Normalization of Data Factor Trading Market 815
Hongqi Ruan and Xiaolong Li

Research on College Students' Consumer Behavior Characteristics and Marketing Strategy Optimization of Estee Lauder 829
Liqi Shi

Research on Digital Transformation Based Luxury Brands Marketing Strategy 839
Yujia Cao

Research on Information Disclosure of Logistics Corporate Social Responsibility: Response to the COVID-19 847
Yanrong Li and Jiani Guo

Research on the Consumer Psychology and Marketing Strategies of Lululemon in the Asian Market 857
Siyu Li

Research on the Economic Impact of the Olympics on Host Countries 867
Yuzheng Li

Research on the Impact of Nintendo Advertising on Brand Globalization 877
Tongtong Liu and Tongyu Ouyang

Research on the Indicator for Measuring Nitrous Oxide Emission from Crop Residue 891
Leshan Song, Shuching Yang, Kexin Wang, and Yixuan Huang

Research on the Influence of L'Oréal Paris's Marketing Strategies on Chinese Consumers 905
Tianjun Yang, Kaiyi Yuan, and Zhe Zhang

Research on the Influencing Factors of Shipping Industry Based on Linear Regression Model 915
Ruixing Liang

Research on the Market Development Strategy of Sports Apparel Companies Based in Canada 925
Wenman Jia

Research on Fast Fashion Industry Under Sustainable Development Model: Based on ZARA's SWOT Analysis 935
Yijia Zhu

Research on Industry and Carbon Emission Gradient Under the Background of Carbon Emission Peak in the Beijing-Tianjin-Hebei Region 943
Zijian Zhou, Borui Cui, and Huichun Che

Research on Intelligent Digital Management Model of Metropolitan Museum of Art in the Era of "Cloud Exhibition-Visit" 955
Danyue Zhou

Research on Renewable Energy Supplement in DC Data Center 973
Langzhou Jin

Research on the Influence and Countermeasures of Third-Party Payment on Commercial Banks—Evidence from China 985
Muhan Liu

Review of Economic Impact of COVID-19 on China's Economy: Positive and Negative 997
Zhan Chen

Review of Research on Employee Innovation with AMO Theory 1005
Tian Xintong

Review of the Effect of Family Ownership on Capital Structure 1015
Zehao Chen, Siyuan Zhang, and Jiaqi Wang

Risk Management in Shipping Industry 1025
Xiaoxiao Dou

A Survey of Research on the Effect of Corporate Investment Opportunities on Capital Structure 1035
Shengbo Zhang, Zitong Zhao, and Yujuan Zhang

Spatial Distribution of COVID-19 and Its Influential Factors in the City of Philadelphia 1047
Yilin Lyu and Zicheng Zhao

Study on the Characteristics and Strategies of Chinese College Students' Group Tennis Consumption Structure 1059
Haotong Xu

Studying the Causes of Overconsumption Among Post-90s Consumers in Mainland China 1067
Linlin Huang

Study on the Cultural Participation Mechanism in Virtual Museums from the Perspective of Interaction Rituals 1073
Wang Wanjia and Dong Meixiao

SWOT Analysis of Digital Transformation of Inclusive Finance of Chinese Commercial Banks 1085
Xiaoke Pu

Tesla's Global Talent Strategy Research and Prospects 1097
Ziyi Jie, Tsz Hong Ma, Xing Wu, and Meng Xia

The Application of Newsvendor Model with Empirical Data—A Case Study of the Specialized Wholesale Market in Wuhan, China 1109
Qiaoyang Liu

The Blue Ocean Strategy of Mixue Ice Cream and Tea During Market Saturation Crisis in the Milk Tea Industry 1117
Ningqi Hu, Xin Liu, Ke Mu, Yi Shen, and Mingya Zhang

The Current Situation, Issue and Constructive Approaches of the A-Share Market 1129
Xianghui Dong, Shiqi Lin, and Xiaojin Tong

The Effectiveness of Allocation Model Regarding to Kidney Transplantation 1137
Tianxiang Huang, Shuxin Zhu, and Leyan Huang

The Enlightenment of American Property Tax to China's Property Tax 1155
Qiwei Yan

The Financial Statement Analysis of PepsiCo 1163
Yueling Zhang

The Good Offices of VW's Acquisition of Porsche and the Prospects for Post-acquisition Growth 1177
Kaiqi Hu, Xiaoying Lin, and Yang Shan

The Impact of Corporate Social Responsibility on Corporate Financial Performance Under the Internal Control Adjustment 1187
Yuanmei Luo

The Impact of COVID-19 on US Tech Companies 1197
Xiaoyu Fu, Yule Shi, and Jingyi Yang

The Impact of Higher Education Expansion on the Labor Force Absorption Capacity for College Graduates in China: A Panel Data Analysis 1207
Shan Liu

The Impact of the COVID-19 on the Mood of Hotel Employee 1217
Moxuan Yao

The Importance of Celebrity Endorsement: A Case Study in China ... 1225
Siye Wu

The Influence of Culture on International Business Negotiation 1237
Shiyang Shen

The Influence of Digital Marketing on the Traditional Fashion Industry and Its Prospects 1247
Xinyu Wang

The Influence of New Media on Consumers in the Information Age ... 1257
Jason-Feng Pei Hao

The Influential Factors on Consumer Purchase Intention: A Case Study on MINISO 1265
Shuya Lin

The Relationship Between Frequency of Problem Exposure, Purchase Intention, and Price Premium for Sustainable Attires Among Chinese Commuters 1279
Haotian Xiang, Eric Xu, Zhaoning Huo, and Juyao Lee

The Relationship Between GDP Growth Rate and Stock Market During the Two Epidemic Outbreaks in China 1293
Yuning Zhang

The Situation, Problems and Solutions to Chinese Banking 1305
Jiayue Tang

The Technology and Applications of RIE and DRIE Processes 1313
Jiangpeng Li

Theoretical Development of an International Carbon Auction Mechanism 1323
Haoping Qiu

The Conflict Between Paper Industry and Plastic Industry and the Future Development Prospects Under the Background of China's "Plastic Ban" 1335
Shiyi Wang

The Effectiveness Factors on Purchase Intention in the Marketing Process of Original Children's Clothing Brands 1345
Yuran Yuan

Three Rounds to Ensure Japan a Smarter Vaccination Appointment System 1361
Dongli Wang

Tourism Prediction in Canada and the US Based on a Modified GM (1, 1) Model Considering COVID-19 Effect 1373
Dongting Yang and Jinjin Yang

Using Beneish M-Score and F-Score to Detect Financial Fraud 1383
Baiyi Hou, Ruisi Lin, Xinyu Li, Zhetong Liu, and Jingwen Zheng

What Are the Value-Creating Ramifications of the Recycling Textile Model Within Africa, Compared with the Conventional Model? 1401
Ziheng Lei, Yiheng Huang, Zhewen Yan, Yulong Ou, and Yumei Cui

What Can Chinese Universities Learn from American Universities About Endowment Management 1413
Jingxi Shi

What Types of Policy Convergence Have Been Created During Global Financial Crisis in 2008? 1427
Ruiying Li

Influences of Human Activities on Coral Reef Ecosystems in Sanya, China 1435
Xinyu Lin

Co-modeling and Optimal Control of a Solar Power Integrated with Variable Load Energy Management System and Battery Energy Storage System 1453
Xuanhe Zhang

The Relationship Between the Evolution of Buildings and the Environment in China 1469
Yitong Dai

The Impact of Data Analytic on Marketing Models in the Digital Economy—The Case of Online Education Institutions 1483
Yilin Dai

A Study on the Impact of Food Prices on Tobacco and Alcohol Consumption: A Case Study of CHNS Data in China 1493
Linghao Lou

Analysis of Challenges and Opportunities in Today's Global Talent Management Development 1503
Haoxuan Wang

Analysis on the Difficulty of Controlling Repugnant Markets 1511
Fulin Jiang

Factors Influencing Changes in Estimated Food Insecurity Rate of Developing Countries Before and After COVID-19 1521
Yunfei Xu

The Impact of the Pandemic on International Soccer Clubs Such as FC Barcelona 1533
Yufeng Hao

Research and Analysis of Business Operation Mode Innovation 1543
Xinjie Wu and Jiaqi Zhang

An Analysis on Human Resource Management in Small and Medium-Sized Enterprises 1553
Yuwei Deng

Research on Investment Characteristics of Strategic Investors in China 1563
Yuanhang Peng

Research on the Fraud of U.S.-Listed Chinese Stocks 1575
Yumeng Peng, Yan Fu, Tianhao Jiang, Xiaofan Fan, and Xuefei Meng

A Kidney Matching System Balancing Utility and Equity 1603
Shiqi Chen

The Association Between Physical Activity and Sleep Characteristics in People Aged 65 and over: National Health and Nutrition Examination Survey (NHANES) 2017–2018 1621
Minghui Wang and Jinyi Liu

County-Level Covid-19 Influencing Factors Difference Between Metro and Non Metro Areas in USA 1631
Hongjian Zhu, Xinyi Wang, and Yinan Chen

Supply Chain Finance and Blockchain Technology 1653
Yishu Wang

An Empirical Study on Portfolio Selection in Hong Kong Stock Market 1663
Peizhao Yu

Portfolio Optimization in Different Industries in the Hong Kong Financial Market 1673
Xun Zhang

Research on Marketing Strategy of Luxury Hotel 1685
Chengyu Luo

How Culture Could Affect the Negotiation 1697
Haoze Wang

Carbon Emission Accounting of Soda Production by Solvay Process ... 1707
Beijia Yuan

Research on the Analysis and Strategy of American Inflation in the Context of COVID-19

Yuxin Wu

Abstract The Covid-19 pandemic has changed people's lives in the past years. People have changed their habits to adapt to the world after the pandemic. The inflation rate is a critical index that represents the level of life quality of people. Global incidents always play an important role in changing the inflation rate. The Covid-19 pandemic is one of the most influential incidents in people's daily life in the past decades. This paper mainly researches and discusses the reasons for the increasing inflation rate in the United States in the context of the Covid-19 pandemic. Still, this paper tends to pay more attention to how these factors affect the living expense of people but also how a country's economy goes during the pandemic. Moreover, this paper also considers the literature, which focuses on the economic policy set to relieve the inflation. As important resources to get a more accurate and comprehensive conclusion proposes several feasible solutions on the analysis of the after-pandemic economic policy to alleviate the detrimental inflation in the United States.

Keywords Covid-19 pandemic · Inflation · United States

1 Introduction

1.1 Research Background

The Covid-19 pandemic has changed people's lives in the past years. People have changed their habits to adapt to the world after the pandemic. More importantly, the virus affects people's "physical life" (like the social distance and other similar policies) and affects people economically. People may find their money is not as "worthy" as before. This leads to people needing to spend more money to maintain

Y. Wu (✉)
Computer Science Department, Worcester Polytechnic Institute, Worcester, MA 01609, USA
e-mail: ywu8@wpi.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_1

their living quality. In other words, people's living expenses, which could be represented as the inflation rate, have changed a lot these years. Inflation is the rate of changes in prices. Increasing the inflation rate means people must pay more for the same services or goods. Meanwhile, it lowers people's purchasing power.

Referring to the latest report from the Bureau of Labor Statistics, the annual inflation rate, measured as CPI (consumer price index), was 8.6% in May, reaching its highest number in the recent 40 years. This unexpected high inflation rate caused many serious negative social problems and incidents. Firstly and most importantly, it puts a pervasively negative influence on purchasing power. In 1970, people spent $0.25 on a cup of coffee on average. However, a cup of coffee's average cost reached $1.85 in 2022. The cost has almost increased by 7 times in the past 52 years. The same story has happened not only to coffee but in almost everything in people's daily lives. After that, inflation may hurt people in the lower class disproportionately. Lower-income people spend more of their earnings on food or other necessities than higher-income people. Meanwhile, the lower incomes also have the fewer cushion to help them against the loss of purchasing power derived from inflation. A more serious result of this phenomenon might be the exacerbated inequality between different classes.

1.2 Literature Review

This paper focuses on finding out the "why" and "how" of this phenomenon, the rising inflation rate in the US after/during the Covid-19 pandemic. This paper also gives suggestions on how to solve and avoid similar problems in the future. This report focuses on the influence of the Covid-19 pandemic on living expenses. It also reviews some cases in people's daily life to go through and explain how and why their living expenses have changed. This report helps people to understand how the pandemic has affected their life on the economic side.

Most studies, which focus on topics similar to my report, merely focus on the macroeconomic influence of the Covid-19 pandemic. They tend to explore and explain the influence of one or more governments instead of people's daily lives. Akbulaev, Mammadov, and Aliyev state that their study's conclusion is for leaders of a large company or a country to help them make management decisions (Akbulaev et al. 2020). Maital and Barzani almost do the same study, which means they only focus on some conceptual ideas of the macroeconomic influence of the pandemic. Some studies focus on how the pandemic influences people's actions (Maital and Barzani 2020). Laato et al. demonstrate people's unusual purchasing behavior during the pandemic, which is also a critical factor that may influence the living expenses in people's daily life (Laato et al. 2020).

This paper focuses on similar topics to them. Still, it tends to pay more attention to how these factors affect the living expense of people but also how a country's economy goes during the pandemic. Moreover, this paper also considers the literature, which focuses on the economic policy, which is set to relieve inflation, as important

resources to get a more accurate and comprehensive conclusion on the analysis of the after-pandemic economic policy.

1.3 Research Framework

This paper starts by figuring out how the Covid-19 pandemic has changed people's lives and how these changes influence people economically, which may lead to a rise in the inflation rate (or Consumer Price Index as a proxy of inflation). It goes through cases to explain how the governments, the communities, and individuals adapt to the Covid-19 pandemic. Then this paper analyzes the economic consequences and the following inflation caused by their adaptations. Then, how the economic policy, set by governments or communities, works to relieve inflation and its negative influences is discussed in this article. The function and methodology of the policy are also analyzed in this paper. At the end of this paper, it concludes with the causes of the after-pandemic inflation and the related economic policy to solve and relieve it.

2 Methods

This paper uses literature search, content analysis, and case study as its main research method. It analyzes contents and data from journals, thesis, industrial reports, and websites. The investigation and research method involves obtaining relevant materials directly by investigating and understanding the objective situation and analyzing these materials.

The research method that this research (or report) uses is using other reliable and related literature as references to get new conclusions on its topic. The literature covers macroeconomic, microeconomic, and other factors influencing living expenses. Apart from only referring to other literature, this paper concludes by researching some crucial cases and indexes related to the US inflation rate. Some other examples of topics of the reference literature are: have your living expenses increased or decreased during the Covid-19 pandemic; what specific living expenses have contributed the most to the increment or decrement of your living expenses during the Covid-19 pandemic; do you think the increment or decrement of your living expenses is a long-term change, or you think it is a short-term change. This paper gets a solid, clear, and comprehensive conclusion on how the Covid-19 pandemic influenced people's daily living expenses using these research methods. Then this paper may analyze the related problems of the rising inflation rate in the US.

3 Results

3.1 American Inflation in the Context of COVID-19

There have been several catastrophic pandemics in modern human history: the Asiatic flu or Russian flu pandemic in 1889, the Influenza pandemic in 1918, the H2N2 pandemic in 1957, and the H3N2 pandemic in 1968. Maital and Barzani believe each has caused serious negative physical and economic influences on human society (Maital and Barzani 2020). The Covid-19 pandemic, which began in Wuhan, China, and then spread worldwide rapidly, is another harmful catastrophe that people must face in the twenty-first century. According to the paper of Park, Villafuerte, and Abiad, the value of assessment, which the Covid-19 pandemic has impacted, has passed $2.0 trillion, equal the 2.3% of the global GDP (Park et al. 2020). Shortly, this number may climb to $8.8 trillion, which equals 9.7% of the global GDP. The annual inflation rate, known as the consumer price index, is 8.6% in May 2022, reported by the Bureau of Labor Statistics, which has reached its highest rate in the past 40 years. A high inflation rate may lead to significant opposed impacts on the development of the economy and the quality of people's daily life.

3.2 Reasons for Inflation

Several reasons cause inflation. According to the different factors, inflation may be classified into different types. The inflation caused by the Covid-19 pandemic is both cost-push and demand-pull. These two kinds of inflation and their causes will be discussed below. Other particular factors may also contribute to the high inflation rate in the US. A good example could be the Ukraine war. But the war itself is not an explicit or implicit consequence caused by the Covid-19 pandemic. This paper mainly discusses the direct or indirect reasons generated by the Covid-19 pandemic that increased the inflation rate.

The cost-push inflation is caused by the decrement in the aggregate supply of goods and services. The reasons for the decrement could be the increment in the production costs or other factors exacerbating the production process. Balleer et al. conclude that the production efficiency or activities have been severely affected by the Covid-19 pandemic since the expected global economic growth rate, 2.5% in 2020, is an inaccurate expectation compared to the actual global economic growth rate, minus 0.9% in 2020 (Balleer et al. 2020). The pandemic policy, which restricts people from moving or gathering, also harms the production of goods. Good examples could be found in the research of Akbulaev et al. (2020). Some international companies, like Apple, Microsoft, and Google, cannot produce specific parts of their products and use OEM services. They suffered from an inevitable decrease in production since their factory in China was almost all closed because of the strict lock-down and quarantine policy. Apart from the immediate influence stemming from the lock-down

and quarantine policy, some long-term obstructive impacts may also be generated. Coibion, Gorodnichenko, and Weber believe that people always underestimate or ignore the long-term influences that continue in the production process (Coibion et al. 2020). They argue that the lock-down or quarantine policy may alter the work-flow and production process, which may permanently change production efficiency and rate.

Demand-pull inflation is caused by the aggregate demand for goods and services increment. The increasing aggregate demand for goods and services may signal a rapidly developing economy. However, the increment caused by the Covid-19 pandemic and its consequences does not mean the positive thing just mentioned. The pandemic or any other emergent or negative public incident may lead to abnormal purchasing activities, resulting in an aggregate demand increment. Laato et al. argue that the considerable unusual purchasing activities indicate that the purchasing demand of people after the pandemic has soared a lot (Laato et al. 2020). The online information sources easily influence people's purchasing activities that they used to know and learn new stuff about Covid-19. Then this kind of information "teaches" what actions should be initiated by the people. In other words, they give suggestions on people's purchasing behaviors. Lacto et al. found that information related to Covid-19 and its consequences strengthens people's intention to make excess or unusual purchasing, which leads to the growth of the aggregate demand (Laato et al. 2020). The uncertainty and anxious emotions generated by people's concern about the Covid-19 pandemic or any other adverse social incident are also crucial to the increasing aggregate demand for goods and services. Dietrich et al. believe that people tend to buy more things than before, which increases the demand for goods to protect themselves from encountering the same or similar social incident (Dietrich et al. 2022). Meanwhile, after people's anxious emotions had decreased, an adequate number of people chose to buy more goods or services to "compensate" for their anxiety before, making the higher demand longer in society. Moreover, Meyer, Prescott, and Sheng believe that the low expectation of purchasing behaviors from factories and firms also caused the decrement in the aggregate supply of goods and services, which made the inflation case even worse (Meyer et al. 2022).

Apart from the two common reasons for inflation, the unexpected high inflation rate in the US, which occurs during and after the Covid-19 pandemic, has its particle causes. Jordàet al. suggest that the federal and some state governments' considerable fiscal support measures, used to counteract the economic collapse due to the COVID-19 pandemic, are responsible for the abnormal increment in the inflation rate (Jordà et al. 2022). Yeyati and Filippini also argue that financial support plays an important role in the increasing inflation rate. More precisely, it may explain the 3% increment in the inflation rate (Yeyati and Filippini 2021). These spending measures are used to assure the development and the normal trade/purchasing behaviors in the economy and prevent the economy from falling into the dilemma of deflation, which may depress the spending and severely weaken the economy.

4 Discussion

How to solve or relieve inflation? Whether the inflation is caused by this Covid-19 pandemic or any other causes, this question has always been difficult for society and governments. There is no perfect policy that could solve inflation in one day. But according to the experiences humans used to combat inflation, and the analysis, which includes more useful information about this Covid-19 pandemic inflation, this paper may give several suggestions or advice on how to solve or relieve this Covid-19 pandemic inflation in the US.

4.1 Improving the Production of Goods and Services

First, for cost-push inflation, which this Covid-19 pandemic inflation classified as, improving the production of goods and services is always a critical measure to fight against it. In other words, the question transfer to a "how to make America produce again" question? One of the most effective methods to boost production is stopping this pandemic and enabling people to return to work, as before Covid-19. However, before coming up with a precise solution to stop the pandemic, there is one more critical question that the federal or state governments should answer: "what is the definition of stopping the pandemic". With the increasing vaccination rate, some industries or factories have already been back to normal production as before the pandemic. However, a noticeable number of people held different opinions on "if they could go back to work under safe and decent conditions" at the time. This results in a severe loss of production among all states. If governments could give persuasive statements that convince most people to back to their position, production would climb back to the normal level soon, which may alleviate the loss of production and boost the supply of goods and services.

4.2 De-escalating the Trade War

De-escalating the trade war might be another efficient method for the policymakers to alleviate the high inflation. The high tariffs put an obstacle on multitudes of imported goods from China. Although President Biden tried to ease some of them under his administration, there are still about $300 billion of imported goods from China imposed with tariffs, as a part of the trade war, by President Trump when he was in the White House. De-escalating the tariffs lowers some of the prices of the imported goods and lets people consider them to take them home, which means that the supply of the goods increases to some extent. Another alternative measure of de-escalating the trade war could be to improve America's supply chain. The methodology of these measures is straightforward after the "de-escalating measures" have been discussed.

The supply chain improvement makes the US less dependent on imported goods from any single country or region, like China. In other words, the pressure of the tariffs imposed during the trade war would be relieved. Then people's demand for goods could be fulfilled again, with the help of more affordable goods imported from other countries or regions.

4.3 Decrease the Amount of Stimulus or Rescue Financial Support

Another efficient way to relieve the inflation is that the policymakers might need to stop or decrease the amount of stimulus or rescue financial support to the public. The unconditional financial support or stimulus may exacerbate inflation and increase economic inequality, which could worsen this case again. Instead, with the limited stimulus or rescue financial support, the policymakers may consider imposing more taxes on wealthy investors. According to the Bureau of Labor Statistics, the richest 10% of people consume as much as the bottom 40% aggregated. The tax could be used on the lower classes to maintain their quality of life and protect themselves from disruptions. In this case, the 10% richest people's excess demand for goods or services is alleviated. Meanwhile, the lower classed people, who usually act as producers, may get a much more stable environment to let them finish their job under healthy and safe conditions.

Lastly, some of the causes that generate inflation are long-term, which deliberate economic actions or enactments could solve. However, some other causes have only short-term impacts, which means these kinds of causes may disappear after enough time after the pandemic. A good example could be the unusual purchasing activities mentioned in this paper. This kind of abnormal behavior may disappear after the public does not have anxious emotions as much as before or in the early stage of the Covid-19 pandemic. Therefore, the unusually high demand for goods and services may also return to the normal level after giving enough time for the public to become accustomed to life with Covid-19.

5 Conclusion

The increasing inflation caused by the Covid-19 pandemic is not only cost-push inflation but also a demand-pull one. The pandemic decreased the aggregate supply of goods and services and increased the aggregate demand for goods and services simultaneously. Meanwhile, the federal and state governments' fiscal support exacerbates the inflation case. This paper proposes several feasible solutions to alleviate the increasing inflation rate. De-escalating the trade war, increasing the production of

goods and services, and decreasing the amount of financial support are all reasonable methods to solve this problem.

This paper presents some significant measures for policymakers to improve the unhealthy economic environment caused by the increasing inflation rate in the United States. It also analyzes the complicated relationship between the Covid-19 pandemic and the increasing inflation rate. This would help the stakeholders and policymakers make better management decisions.

This paper has a few limitations in itself. This article mainly uses secondary data from other research and papers instead of primary data. For any future studies, based on this paper, interviews and questionnaire surveys are all good measures to get the primary data, which could give a more comprehensive understanding of this topic to the readers.

References

Akbulaev N, Mammadov I, Aliyev V (2020) Economic impact of COVID-19. Sylwan 164(5). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3649813. Last accessed 2022/07/10

Balleer A et al (2020) Demand or supply? Price adjustment during the Covid-19 pandemic. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3642392. Last accessed 2022/07/10

Coibion O, Gorodnichenko Y, Weber M (2020) The cost of the covid-19 crisis: lockdowns, macroeconomic expectations, and consumer spending, No. w27141. National Bureau of Economic Research. https://www.nber.org/papers/w27141. Last accessed 2022/07/10

Dietrich AM et al (2022) News and uncertainty about COVID-19: survey evidence and short-run economic impact. J Monetary Econ. https://www.sciencedirect.com/science/article/pii/S0304393222000216. Last accessed 2022/07/10

Jordà Ò et al (2022) Why is US inflation higher than in other countries? FRBSF Econ Lett 7. https://www.frbsf.org/wp-content/uploads/sites/4/el2022-07.pdf. Last accessed 2022/07/10

Laato S et al (2020) Unusual purchasing behavior during the early stages of the COVID-19 pandemic: the stimulus-organism-response approach. J Retail Consum Serv 57:102224, https://www.sciencedirect.com/science/article/pii/S0969698920304598. Last accessed 2022/07/10

Maital S, Barzani E (2020) The global economic impact of COVID-19: a summary of research. Samuel Neaman Institute for National Policy Research, pp 1–12. https://www.neaman.org.il/EN/Files/Global%20Economic%20Impact%20of%20COVID-19_20200322163553.399.pdf. Last accessed 2022/07/10

Meyer BH, Prescott B, Sheng XS (2022) The impact of the COVID-19 pandemic on business expectations. Int J Forecast 38(2):529–544. https://www.sciencedirect.com/science/article/pii/S0169207021000509. Last accessed 2022/07/10

Park C-Y, Villafuerte J, Abiad A (2002) An updated assessment of the economic impact of COVID-19, No. 133. Asian Development Bank. https://www.adb.org/sites/default/files/publication/604206/adb-brief-133-updated-economic-impact-covid-19.pdf. Last accessed 2022/07/10

Yeyati EL, Filippini F (2021) Social and economic impact of COVID-19. https://www.think-asia.org/handle/11540/13776. Last accessed 2022/07/10

Analysis of China's Beauty Brand Marketing Strategy and Sales Model

Yinglan Yao

Abstract The main reason why Chinese beauty brands have become so popular in recent years is due to e-commerce, such as live streaming, Kol promotion, and online shopping. It is well-known that e-commerce is of great help to Chinese beauty brands. The rise of internet celebrities and social media has given Chinese beauty brands a broad reach. So in recent years, China's beauty products sales have qualitative changed. In contrast to the previous decade, Chinese beauty brands have made significant progress. This can not be separated from e-commerce can not be separated from the improvement of quality. This paper mainly introduces the marketing strategy of well-known beauty brands in China. Their primary way of marketing or e-commerce. The current strong competitiveness of each brand has a different way of marketing. Each brand has its unique advantages, as well as product innovation.

Keywords Beauty brand · Marketing strategy · Sales model · China

1 Introduction

China has made outstanding beauty achievements in recent years compared with a few years ago. China's beauty has a leap in development. The main reason is the rise of e-commerce so that our traditional retail channels and many industry business models face unprecedented significant changes. E-commerce for the cosmetics industry not only creates many goods, a convenient shopping experience, and low-cost new sales channels but also saves a lot of store development. As a result, traditional cosmetics brands and distributors have a strong incentive to move online. Ten years ago, the beauty market in China was dominated by Japanese, Korean, European, and n brands. Chinese-made cosmetics were not popular ten years ago, and the quality of their products cannot be compared with that of many foreign brands. People mainly buy l'oréal, Olay, Nivea, Lancôme, Estée Lauder, and so on, these

Y. Yao (✉)
Pace University, New York, NY 10038, USA
e-mail: yy68035n@pace.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_2

European and American brands because the Chinese think that foreign brands have a good guarantee of quality. At that time, the main consumer group of cosmetics in China was low-income people because of low prices.

With the rise of domestic cosmetic brands in China. Nowadays, young Chinese people have a strong tendency to choose products based on the recommendations of popular beauty bloggers, and many domestic cosmetic brands are constantly improving the quality of their products, taking away many consumers. Chinese-made cosmetics are popular with consumers. One of the weapons of these home-grown brands is online interaction with consumers. They distribute many promotional videos on short video platforms and answer various questions and requests in the comments section.

According to the National Bureau of Statistics of the People's Republic of China data, the total retail 2021 cosmetics in China was 402.6 billion yuan, up 14% yearly. China's cosmetics market has huge potential, and some domestic cosmetics are becoming more popular with Chinese consumers, gradually forming a certain competitive advantage.

Most Chinese cosmetics use new media sales channels to expand to new consumer groups. In recent years, live tape, content e-commerce, social group, and other emerging sales models continue to emerge. These new media sales channels have good user stickiness. Sellers through sharing the actual use of cosmetics experience, mining the social attributes of related products to guide users to consumption. With a diversified sales model, Chinese cosmetics continue to increase their market share.

2 Literature Review

These are references to other scholars' research reports and papers. This shows that China's beauty development has great potential, and the current Chinese beauty brand has made significant progress. The article mainly studies the development and sales channel of Chinese beauty make-up. In recent years, the rapid growth of the beauty industry and sales channels have gradually increased. So the brand has also made further progress (https://baijiahao.baidu.com/s?id=1738014679166908924&wfr=spider&for=pc). Judydoll is a beauty brand loved by young people in China. Its eye shadow color matching is novel and unique. Its main sales channels are e-commerce, such as Taobao, JD.com, and Douyin (https://www.xhangdao.com/news/content-204-d6.html).

Five to ten years ago, Chinese people bought major beauty brands that were European, American, Japanese, and Korean brands. At that time, Chinese-made beauty and make-up had not yet emerged, but in recent years with the development of e-commerce, Chinese-made brands gradually improved a lot (https://baijiahao.baidu.com/s?id=1699979424528637498&wfr=spider&for=pc). With the rise of Chinese culture and beauty channels increased. Sales of beauty products in China have gradually increased, and the quality of beauty products has also improved more (https://baijiahao.baidu.com/s?id=1728314449367974110&wfr=spider&for=pc). A few years ago, Japanese and Korean brands were popular with Chinese consumers. However,

with the rapid development of Chinese beauty brands in recent years. Chinese people are increasingly buying domestic brands, and many Chinese beauty products have surpassed those of Japan and South Korea (http://www.geekpark.net/news/275388). China has been up and down for five thousand years, and the development of Chinese beauty also has thousands of years of history. Each makeup period has different characteristics from the Xia, Shang, and Zhou dynasties until now (https://m.qinxue365.com/makeup/544529.html). In ancient China, eye shadow, Blush, lipstick, etc. In the Qing dynasty, China launched the first beauty brand, followed by the launch of many brands. After 2000, European, American, Japanese, and Korean beauty brands to the Chinese market. The Chinese people deeply loved these foreign brands at that time (https://baijiahao.baidu.com/s?id=1695638944312342329&wfr=spider&for=pc).

Huaxi is a beauty brand with Chinese characteristics; its packaging and design are traditional Chinese. Its main sales channel is e-commerce, mainly in live sales. It has also worked with many KOL to keep sales growing (https://www.niaogebiji.com/article-127000-1.html). Perfect Diary is one of the top 10 selling make-up brands in China. Its primary sales model is with Kol and star promotion, short-video promotional disassembly, and live on various social platforms. This is a great way to increase brand awareness (Media Forum 2020). Douyin inside, there are internet celebrities to teach makeup and sell products. Internet celebrities and celebrities recommend products called the "Fans" economy through the survey of the leading consumer groups for female college students (Wang 2020).

Through the scholar's research, China's different beauty brands have a great marketing strategy and what is China's beauty major consumer group. With the development of the market economy and e-commerce, China's beauty brand sales hit a new high.

3 Discussion

3.1 China Beauty Market Trend

In recent years, China's beauty market has been full of vitality, showing new development characteristics. First, rapid growth and extensive coverage. The market scale of China's beauty and make-up industry is gradually approaching a trillion level. Third, with the rapid development of the male beauty market, the major brands compete to enter. Forth is the rapid rise of Chinese beauty brands. Chinese brands in raw materials, formula, technology, and other aspects of progress.

Trend A. In the 1980s, in China, the reform and opening up and the rise of the consumer market. Chinese cosmetics market began to grow barbarically. It created many firsts: "The first styling mousse," "The first sunscreen," and "The first-hand cream." Taihō, Yue-sai, young nurses, and the new generation of domestic brands also rose in this period. However, the spring wind of reform has brought ambitious international brands into the Chinese market. In the late 1980s, China's domestic brands

suffered unprecedented competition after entering two global giants, Procter & Gamble and Unilever. In the 1990s, Avon, Seine-et-Marne, Unilever, estã © Lauder, and other European cosmetics giants entered and carved up most of the Chinese market. Domestic beauty of the fade, and from the beginning of the 1990s staged. In 1990, the modern cosmetics store was born, and cosmetics store began to go on the stage of history. At the beginning of 2004, Shiseido invested 220 million yuan in the operation of the CS channel, helping the store to establish the membership system and management background. It can be said that the mature marketing model of the Chinese CS channel can not be separated from Shiseido's deep cultivation of the Chinese market. In 2008, Shiseido signed up 5000 CS stores in China. During the same period in the make-up area, Maybelline in the major cosmetics stores can be described as the l'oréal group behind it in 2009, for the CS channel launched a particular plan. After implementing the scheme, L'Oréal will supply goods directly to the member stores and provide promotional support. Sixteen months later, L'Oréal added more than 1000 stores. Foreign Beauty brands, in addition to the profound cultivation of the CS channel in the era of television media, are also willing to spend much money to do marketing. In the 1990s, Olay, good at marketing, caught the CS channel's bonus period. Procter & Gamble Group hired A-list stars such as Maggie Cheung, Anita Yuen, and Maggie Q to shoot advertisements and make the brand famous. In 2004, Olay beat Taihō to become the largest skincare brand in the Chinese market, with a 12.38% skincare market share. In the second wave of cosmetics, when foreign companies smashed marketing and channels and foreign companies almost monopolized the middle-and high-end cosmetics market, local brands experienced only the first few years of vigorous development. Finally, because of the lack of brand operation and channel construction ability. We can only fight in the low-end market. The Chinese domestic beauty cosmetics brand can not escape the fate of overseas capital acquisition.

Trend B. "China's beauty and make-up market sales will exceed 1 trillion yuan by 2025," said an article in the U.S. based women's wear daily. China has become key to the growth of global beauty and beauty companies because driven by rising household incomes, a steady influx of newcomers, and the evolution of local brands. In recent years, China's beauty market has been full of vitality, showing new development characteristics. First, rapid growth and extensive coverage. The market scale of China's beauty and make-up industry is gradually approaching a trillion level. Third, with the rapid development of the male beauty market, the major brands compete to enter. Fourth is the rapid rise of domestic beauty brands. Domestic brands in raw materials, formula, technology, and other aspects of progress, emerging a perfect diary, Huaxi a large number of new domestic brands. The unprecedented development of China's cosmetic industry results from multiple factors.

As China's economy grows, the principal contradiction in today's society has transformed into one between the people's increasing need for a better life and unbalanced and inadequate development. Beauty products meet the social needs of consumers. More and more excellent foreign cosmetic brands are entering China and bringing advanced production technology, novel marketing methods, and unique

product concept to the Chinese cosmetic market. To promote the industry chain to mature and perfect gradually, and to a certain extent, the cultivation of the Chinese beauty market consumers. China's cosmetics consumer groups gradually expand. With the rapid development of the economy, the Chinese People's household income level continues to improve, increasing consumption capacity, and the demand for beauty products will expand. In addition, some beauty brands in the first and second-tier cities opened up markets after the end of deep cultivation and in other cities. It has access to more sustained positive growth momentum—the rapid expansion of new social and marketing platforms such as live broadcasts. The rise of social media such as Little Red Book, Internet celebrity live broadcasts with goods, Kol… It has strongly promoted the development of China's beauty market.

3.2 E-Commerce on the Impact of China's Beauty

Live eCommerce gives new domestic brands a chance to rise quickly, enabling them to complete the capital accumulation and word-of-mouth accumulation in the early days of their start-ups, which is the new hope of the times for domestic cosmetics. The development of the live broadcast industry and the rise of the new generation of consumer power represented by the post-90s seems to let the Chinese beauty brands see Hope. The live streaming industry has been running wild since 2016. This year, more than 300 online live streaming platforms have emerged in the country, and e-commerce platforms have also started to enter the market. Mushroom Street launched its live-streaming function in March; two months later, Taobao live-streaming went live, and by 2018, short video platforms were adding fuel to the fire. Want to do live e-commerce? First, brand influence is significant; enough exposure and superior quality can directly affect the reputation and brand influence.

Impact A. With the rapid development of the e-commerce economy, beauty consumers are becoming younger and younger. Moreover, the market has created different online beauty products according to consumer demand, making the market more diversified. Young women are often referred to as beauty products by bloggers on social media platforms. So this is why consumers are getting younger and younger. In 2019, the proportion of consumers aged 18–24 was the largest among our domestic cosmetic brand consumers, reaching 55%, but the ratio of consumers in this age group is smaller than that of the whole cosmetic consumers, the proportion of 25–29-year-old consumers of domestic cosmetic brands is 32%, which is higher than that of the whole cosmetic consumers, young consumers under the age of 30 are the main consumers of domestic cosmetic brands. The major social platforms, such as Douyin, Little Red Book, micro-blog, etc., often have bloggers recommend products to share their favorite things. These young women buy many products recommended by bloggers because they trust their favorite bloggers. That's why Kol is so important today.

Impact B. Also, because of this epidemic in 2020, the offline stores of the beauty and makeup retail industry were temporarily closed, and the resumption of work was delayed. Consumers' desire for beauty products weakened, and the beauty brands not only lost their profits in the offline territory but still had to pay rent, staff salaries, and other costs; some enterprises had a severe cash flow emergency. After the epidemic's transformation, the beauty industry from the entity gradually transformed to online, consumers recognized, but also significantly impacted the offline physical beauty retail industry. Price war, supply and demand, and other factors, so that the offline physical beauty industry has lost a lot, one after another onto the road of live e-commerce, but also let the beauty industry's development has a ray of hope. Douyin, a live and short videotape goods representative, has been the beauty industry's leading marketing and sales scene. China's beauty products have achieved low prices and high quality, and in this internet age, all products are transparent. Little Red Book, Tiktok, Weibo, and so on are all popular social platforms. There will be a blogger recommended products and live; people can order directly. That is why sales of beauty products in China can rise.

With the rise of social media e-commerce and beauty-related Kol, Chinese consumers are turning to e-commerce platforms to offer a more convenient and wide selection of beauty products. According to the network economic and social data, in 2019, our beauty cosmetics e-commerce industry transactions reached 15.16 billion yuan. In 2019, when live streaming of e-commerce blossomed, OMG became the hottest buzzword of 2019, along with its creator, Li Jiaqi. A very intuitive data is that in 2016, the live e-commerce market was 19 billion; in 2019, this number became 433.8 billion. According to third-party data from Alibaba, the country's largest online shopping platform, the GMV of beauty products rose 31.17% year on year in 2020 due to the epidemic; based on this, the volume of China's cosmetic e-commerce transactions in 2020 reached 19.88 billion yuan, the growth rate of decline compared with 2019. In 2020, the capital will still pay full attention to the online beauty market. According to the extensive e-commerce database (data.100EC.CN) of e-commerce of "E-commerce digital treasure," 2021 from January 2020 to March 29, 2020, there were 26 investment and financing incidents in e-commerce with a total financing amount exceeding 3.16 billion yuan. Content e-commerce, represented by Tiktok and Little Red Book, is the most popular new e-commerce model in recent years. Merchants' products are marketed through live broadcasts by bloggers and stars, or they record short videos to write reviews and grow grass for consumers. Finally, consumers directly participate in the platform to buy. E-commerce provides cosmetics enterprises with an efficient and economic sales channel, which not only saves a large number of offline shop operating costs, it can also offer a full range of services such as consumer data collection, product demand feedback, and consumer spending analysis. Therefore, increasingly cosmetic enterprises seize this market opportunity to expand their e-commerce retail business scale gradually.

Popular beauty brand marketing strategy apart from the development of the domestic market, domestic beauty brand marketing has also made a name for itself in the overseas market. Earlier this year, Jeffree Star, one of America's top beauty bloggers, released the First Beauty Review Video of 2022 on a social networking

site. The Chinese brand, Huaxi, was reviewed, and the test title directly used the "World's most beautiful makeup" praise. After the release of Sister J's video, it once ranked fourth in the global trend list, and the traffic on Huaxi's overseas official website was directly pulled up to the black five-level by J sister's evaluation of good use of "Concentric lock lipstick," and other products sales rose the most. In March 2020, the company began marketing its products overseas. On the first day of its launch on Amazon.com in Japan, the company entered the top three in lipstick sales, a jump to become Japan's favorite Chinese makeup TOP1. With the first crab Huaxi eat, domestic beauty makeup began the "Tide out of the sea." According to CNB DATA, the global beauty industry's 2020 growth rate of 23%, and domestic beauty cosmetics overseas growth is more than 10 times, so 2020 is also considered our domestic beauty overseas the first year.

3.3 Popular Beauty Brand Marketing Strategy

Most of the brands are mainly in e-commerce. The first brand is Huaxi Zi. Huaxi is different from other brands because of the Oriental women's skin characteristics and make-up requirements and its focus on pure natural extract ingredients. Cosmetics use the Oriental white porcelain relief process, to create an exclusive texture. It is mainly aimed at young women, so it works with many well-known variety shows. Its main selling methods are web platforms, such as live streaming and shopping sites. Sales reached 329.7 billion yuan in 2020.

As we all know, the blogger is amazing grass with goods. One of the most classic cases is Jiaqi Li. With Jiaqi's signature words like "buy it," "Buy it," and the shocking effect of his demonstration. Huaxi cooperated with Jiaqi Li live for the first time, leading to a rocket-like sales rise. At the same time, Huaxizi also strikes while it is popular, so Douyin and other platforms continue to invest in marketing resources in the small red book. At present, HuaxiZI has swept through all the major new retail platforms. So far, Huaxi does not have an online physical store to develop its layout. It has formed a solid and experienced online marketing and promotion team and made new progress in KOL cooperation.

In addition to the development of the domestic market, domestic beauty makeup is also emerging in the overseas market. Earlier this year, Jeffree Star, one of America's top beauty bloggers, released the First Beauty Review Video of 2022 on a social networking site. The Chinese brand, Huaxi, was reviewed, and the test title directly used the "World's most beautiful makeup" praise. After the release of Jeffree's video, it once ranked fourth in the global trend list, and the traffic on Huaxizi's overseas official website was directly pulled up to the black five-level by Jeffree's evaluation of good use of "Concentric lock lipstick," and other products sales rose the most. In March 2020, the company began marketing its products overseas. On the first day of its launch on Amazon.com in Japan, the company entered the top three in lipstick sales, a jump to become Japan's favorite Chinese makeup TOP1.

The perfect diary is a vibrant, affordable brand. Its main customers are students since most products cost less than 100 yuan a unit. It enters the market at a low price; for example, it enters the need to do the promotion, buys one gets one free, the second 9.9 yuan. Around the target, users began working with Kol and stars' major platforms in the early days.

The perfect diary marketing strategy lies in the fact that after laying all the essential data and gaining a certain amount of trust from the users. It invited Jelly Lin, Nana Ou-yang, Angela Chang, and other star real-name systems to recommend its products to users. It is resulting in explosive articles. It's a way to make the perfect diary Smash, and many consumers are turning to it.

In 2017, Judydoll officially moved into Tmall's flagship store and sold more than 10 million units on singles day. Behind the increase in sales is a good way of Judydoll marketing, mainly to take the star endorsement and Kol cooperation. He took the KOL live co-broadcast way to sell goods. Judydoll has raised four financing rounds since its inception and opened its flagship stores in many Chinese cities in 2019.

Judydoll, after the internet analysis of eye shadow demand, is vast and the primary production of monochrome eye shadow. Accurate product positioning is the foundation of Judydoll's success. To let consumers see more extensive and in-depth content, Judydoll has done graphics, live broadcasts, videos, reviews, and so on through multiple channels on social media and sales platforms, the realization of marketing content from diversification. Among them, Little Red book is one of the main platforms for growing grass. There are 313,000+ fans on Little Red Book's account, with 437,000+ likes and collections; the number of notes about "Judydoll" also reached 70,000+. At the same time, Judydoll, to stabilize development, also began to actively layout offline channels. It accelerates upgrading physical stores for consumers to bring a more high-quality experience.

4 Conclusion

It is the same for both men and women, so the cosmetics industry has excellent potential for development, and according to the different needs of people for products, high-end brands and small and medium-sized brands are developing in the industry. In the future, men and teenagers will also be included in beauty product consumption. Although they are only a small group of consumers. In the future, people will pay more and more attention to their appearance, as well as the spread of the Internet. There will be a growing demand for cosmetics.

The cosmetic industry is forming an industry with an initial appearance scale, full of vitality and vigor. In an economic downtrend, the size of the beauty industry is still maintaining steady growth: online e-commerce, especially the rapid development of social e-commerce channels. In recent years, our cosmetics have become a significant category of department stores, and it is predicted that over 50% of our online cosmetics channels will be 2024. The reason for the rise in online penetration of cosmetics is that brands have increased their efforts in online channels to

open flagship stores on the platform, and department stores through small app stores, live streaming, community marketing, and other means, increasing brand promotion, improve sales performance.

The Internet is another battleground for cosmetics auctions. Most international brands offer e-commerce services, publishing information, and closing deals online. In the next few years, there will be more high-quality and competitive beauty professional media, professional information has become the industry hot DM newspaper survival space, space expansion, and a small number of media will be eliminated. Online e-commerce will become the beauty trade platform highlights, and beauty as the film, television and documentary theme will become many cosmetics enterprises and brands of new advertising models. Integrated marketing communication theory will become the industry's mainstream. In the future, the quality of Chinese cosmetics will be better and better, so in the future, Chinese cosmetics will be loved by people worldwide. The prospect of beauty is excellent. Now, people are pursuing beauty more and more. The quality of life has also been improved. Food, clothing, housing, and transportation are no longer a problem in our lives, the U. S. industry has been prevalent, and now the U. S. industry is more segmented.

References

(2020) The marketing strategy and success of the Perfect Diary. Media Forum 4, pp 1–4

Analysis of Judydoll's marketing strategy, 5/13/2021. https://www.xhangdao.com/news/content-204-d6.html

China's beauty market is booming, 7/11/2022. https://baijiahao.baidu.com/s?id=1738014679166908924&wfr=spider&for=pc

Counter-attack international brands, the rise of China's beauty, 5/17/2021. https://baijiahao.baidu.com/s?id=1699979424528637498&wfr=spider&for=pc

Huaxizi's marketing strategy disassembly (beauty brand marketing strategy), 6/8/2022. https://www.niaogebiji.com/article-127000-1.html

"Kick out" Korean and Japanese, how is the rise of Chinese makeup, 3/23/2021. http://www.geekpark.net/news/275388

The history of Chinese make-up, 7/13/2022. https://m.qinxue365.com/makeup/544529.html

The history of cosmetics in our country can be traced back three thousand years, 7/13/2022. https://baijiahao.baidu.com/s?id=1695638944312342329&wfr=spider&for=pc

Wang Z (2020) The influence of short videos marketing on female college students' consumption. Econ Res 3(425):1–3

When the rise of Chinese cosmetics can achieve the corner overtaking, 3/26/2022. https://baijiahao.baidu.com/s?id=1728314449367974110&wfr=spider&for=pc

Modeling and Economic Analysis of Wind-Marine Current-Biogas Integrated Energy System

Chengyan Li

Abstract China's renewable energy power generation prospects are broad. Therefore, this paper proposes a new energy system that adapts to social development. The system can effectively control energy consumption and further improve energy utilization efficiency. To a certain extent, it can cope with challenges such as surge in energy demand, environmental pollution, and climate change. The use of this system has a certain mitigation effect on coastal areas where electricity is deficient. Not only is it beneficial to the local area economically, but it can also reduce damage to the environment while ensuring power stability. This study proposes a wind-marine current-biogas integrated energy system by summarizing the existing single-energy generation models and some other types of integrated energy systems. At the same time, according to the references, the economic benefits of this system are analyzed. The addition of biogas power generation reduces the instability of marine current power generation and wind power generation to the system. The results show that, in actual production and life, a reasonable allocation of the proportions of the three energy sources can maximize the power generation efficiency of the integrated energy system within a certain cost range.

Keywords Integrated energy system · Wind-marine current-biogas · Renewable energy generation

1 Introduction

After the proposal of China's new energy policy, the market prospect of renewable energy power generation technology has become more extensive, and the new integrated energy system will also be more in line with the needs of social development. Therefore, this paper proposes a wind-marine current-marsh gas integrated energy system.

C. Li (✉)
Central South University, Yuelu Street, Yuelu District, Changsha 410083, Hunan, China
e-mail: 570634885@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_3

Wind power is one of the most mature, large-scope development conditions and commercial development prospects in the field of environmentally friendly power. China's wind power industry is developing rapidly. In 2020, China's wind power generation capacity reached 466.5 billion kWh, an increase of 60.8 billion kWh compared with 2019, a year-on-year increase of 14.99%.

Compared with some major countries in the development and use of marine current energy, the use of marine current energy resources in my country is still in its infancy, and there is still great potential to be explored in terms of technology, policy, and industrial chain (He et al. 2019). The problems currently faced mainly include the following aspects: immature technology development, high power generation cost, and damage to the seabed ecological environment.

According to statistics, the aggregate sum of agrarian waste assets that can be used for biogas production in the country is about 1.404 billion tons each year, and 73.6 billion m^3 of biogas can be produced, which can replace about 87.6 million tons of standard coal. Therefore, the development of rural biogas can reduce the proportion of coal consumption, fill the natural gas gap, and further optimize the energy supply structure (Figs. 1 and 2).

The wind-marine current-biogas integrated energy system uses three types of renewable energy to form a system, which can complement each other's advantages and is suitable for coastal areas where electricity is scarce (Liu et al. 2022; Yang et al. 2020). This system can effectively control energy consumption and further improve energy utilization efficiency, which is of great significance to cope with severe challenges such as surge in energy demand, environmental pollution, and climate change.

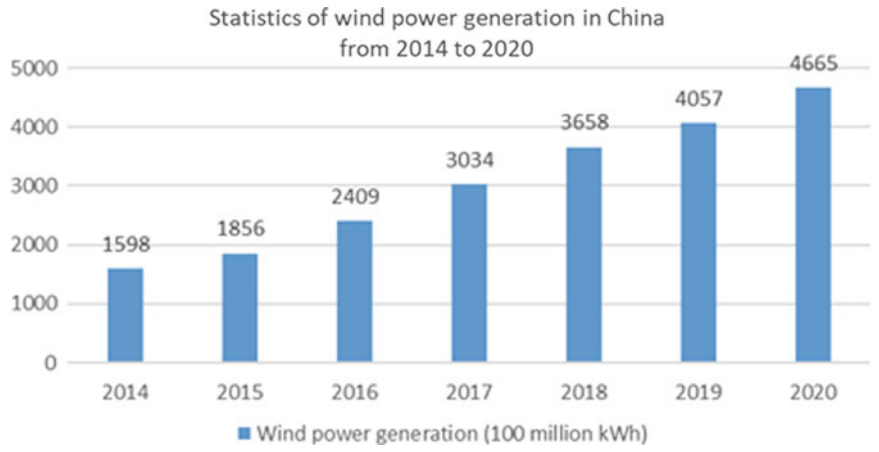


Fig. 1 Statistics of wind power generation in China from 2014 to 2020 (Z. Consulting 2021)

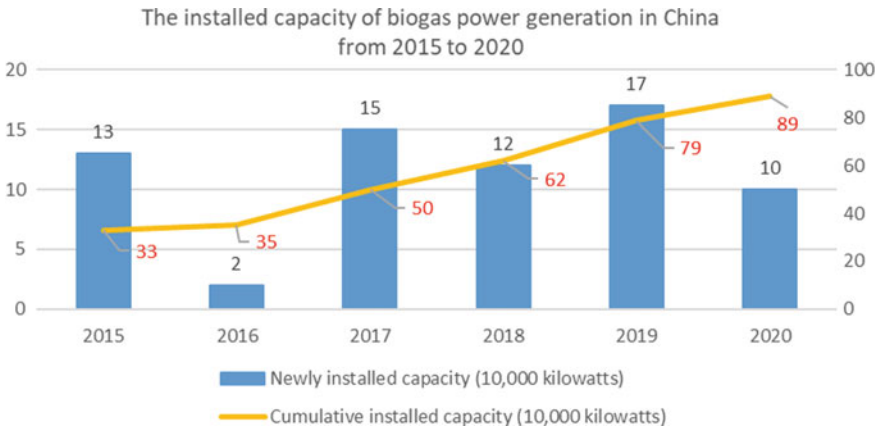


Fig. 2 The installed capacity of biogas power generation in China from 2015 to 2020 (B. E. I. P. Association 2021)

2 Literature Review

Wind energy has no fuel requirements for thermal energy. Once a wind farm is laid out in a suitable location, it is only necessary to monitor and maintain the activity of the wind turbines to acquire a steady flow of electrical energy (Chongyu et al. 2021). But wind energy lacks stability, cannot be stored, and wind farms are relatively remote. Offshore wind energy decreases significantly in spring and increases in most areas in winter or autumn (Sun et al. 2021). Most of China's coastal areas in the coming decades will improve resource stability and reduce risks because of its high abundance of offshore wind energy (Tian et al. 2021).

Marine current power is moderately affected by changes in weather, timing and magnitude, and thus is highly predictable in nature and broadly insensitive to climate change (Neill et al. 2021). Although China has abundant marine current resources, it largely lags behind other renewable energy sources. For example, China's largest and only commercial marine current power station JFPS. Due to improper site selection, low energy density and high development costs, 81.83% of the emergy investment was used for marine current energy capture and conversion, accounting for only 16.54% of the total project expected cost (Jiang et al. 2021).

Biogas power generation provides farmers with clean energy; protects the ecological environment (especially forest vegetation); improves the sanitation of villages and farmers' lifestyles; improves the quality of agricultural products; and increases farmers' income. However, there are some problems with biogas power generation (Zhang and Xu 2020). For example, the storage of biogas poses a great safety hazard, the technology for biogas processing in rural areas is limited, and the policy needs to be improved, resulting in low enthusiasm for using biogas for power generation (Xu et al. 2021).

In the existing wind-biogas integrated energy system, from the perspective of the power generation ability of technical indicators, the wind power generation fluctuates greatly, and the power generation ability of the biogas power generation is relatively stable (Wu et al. 2021). Marine current energy is a relatively stable energy source, and offshore wind energy is also more abundant, so this comprehensive energy source has certain volatility resistance (Talukdar et al. 2021; Liu and Bahaj 2021). But marine current power stations and offshore wind turbines are more expensive and more difficult to maintain, a problem that needs to be addressed.

3 Modeling Methods

3.1 Wind Power Model

Wind power generation is to use the wind to drive the blades of the windmill to rotate, and then increase the speed through the speed increaser to drive the generator to generate electricity (Chen et al. 2021). The power of the wind turbine mainly depends on the wind speed.

$$P_{WT} = \frac{1}{2}\rho\pi R^2 C_P V^3 \tag{1}$$

In formula (1), ρ is the air density in kg/m^3, V is the wind speed in m/s, R is the turbine blade radius in m, and C_P is the power coefficient (Fontenot and Bing 2019).

However, the wind turbine cannot go below a certain speed, usually this speed is called cut-in velocity V_{ci}. At the same time, the wind turbine also has an upper limit speed, which is called cut-out velocity V_{co}.

$$P_{WT} = \begin{cases} 0 & V < V_{ci} \ or \ V \geq V_{co} \\ P_N \times \frac{V^3 - V_{ci}^3}{V_{co}^3 - V_N^3} & V_{ci} \leq V < V_N \\ P_N & V \geq V_N \end{cases} \tag{2}$$

In formula (2), P_N is the rated electrical power and V_N is the rated wind speed (Fontenot and Bing 2019).

Set the cut-in velocity V_{ci} as 3 m/s and cut-out velocity V_{co} as 25 m/s. Adjust P_N to be 5 kW and assume V_N to be 12 m/s.

According to (2), the data in Table 1 can be obtained, and then Fig. 3 can be obtained according to the data in Table 1.

Due to the uncertainty of wind power generation, it is necessary for researchers to select appropriate models and make certain predictions of wind conditions when studying integrated wind power generation systems.

Table 1 Table of power corresponding to wind speed

V (m/s)	2	2.5	3	3.5	4	4.5	5	5.5
P_{WT} (kW)	0	0	0	0.0057	0.0133	0.023	0.0352	0.0501
V (m/s)	6	6.5	7	7.5	8	8.5	9	9.5
P_{WT} (kW)	0.068	0.089	0.1136	0.142	0.1744	0.2112	0.2525	0.2987
V (m/s)	10	10.5	11	11.5	12	12.5	13	
P_{WT} (kW)	0.35	0.4067	0.4691	0.5374	5	5	5	

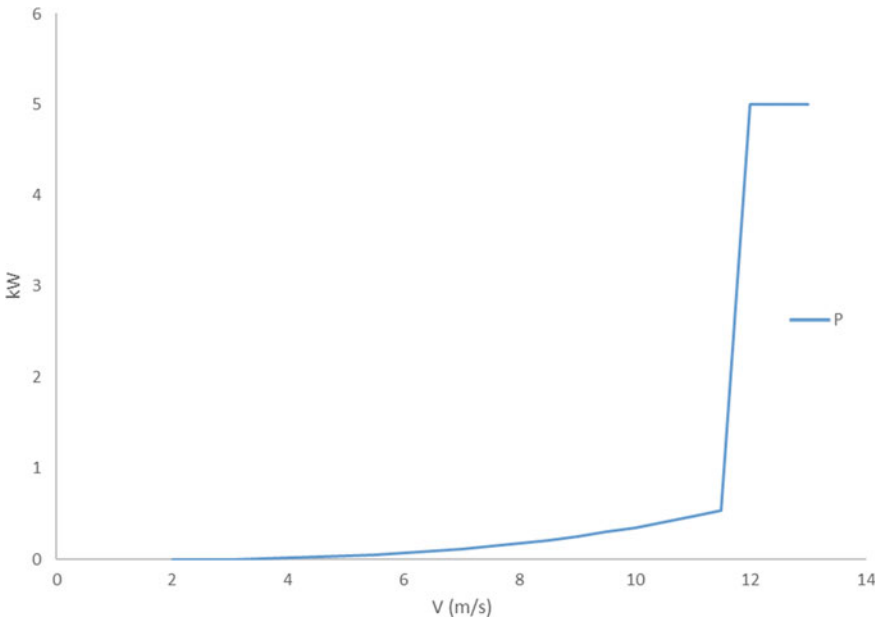


Fig. 3 The relationship between wind speed and power

3.2 Marine Current Power Generation Model

Marine current power generation is the direct use of the gravitational action of the sun and the moon to form a regular periodic movement of the marine water on the earth (Liu and Bahaj 2021).

The law of periodic variation of tidal flow velocity can be expressed as:

$$v = V_m\left(1 + K\sin\frac{2\pi t}{T'}\right)\sin\frac{2\pi t}{T} \tag{3}$$

T' is the period between spring tide and neap tide; T is the period of the tidal current; $V_m = (V_s + V_n)/2$ is the average flow velocity of the tidal current, V_s and

V_n are the maximum flow velocity of the spring tide and neap tide, respectively; K is the tidal velocity fluctuation coefficient (generally 0.2), K can be expressed as:

$$K = \frac{V_s - V_n}{V_s + V_n} \tag{4}$$

When studying marine current energy generation, we should start with the analysis of tidal hydrodynamic energy. The relationship between the power of the marine current energy generator and the flow rate is shown in (5) (Jiaqi 2018):

$$P = \frac{1}{2} C_P \rho A V^3 \tag{5}$$

where P is the mechanical power obtained by the generator from the marine current, C_P is the power utilization coefficient of the generator, ρ is the average seawater density in the test sea area, A is the cross-sectional area of the energy capture device of the marine current power generation system, V is the average flow rate.

In fact, we usually only care about more than v_{start}, so formula (3) can be simplified as:

$$v = V_m \sin \frac{2\pi t}{T} = V_m \sin \omega t \tag{6}$$

Figure 4 is a plot based on partial tidal current velocity-energy density data measured in the Zhoushan waters of Zhejiang, China. The curve is similar to the characteristics of the fan, and the power obtained by the turbine depends on the C_p under the condition of a certain frontal area, seawater density and tidal flow velocity. It can be seen that for different tidal flow velocity v_i, there is a specific turbine speed-output power characteristic curve corresponding to it, $v_1 < v_2 < v_3$ in the figure.

3.3 Biogas Power Generation Model

The biogas power generation system is mainly composed of a biogas power generation module, which is mainly consists of a biogas process treatment system, a biogas generator set, a biogas auxiliary power generation equipment and a biogas waste heat recovery system. The biogas power generation directly generates electricity for the AC load of the livestock house. In the case of meeting the power consumption of the livestock house, the excess power can be stored in the vanadium battery (Abanades et al. 2022). The structure diagram of the biogas power generation system is displayed in Fig. 5.

Biogas power generation, installed power-generating capacity can be in accordance with the (6) and (7) (E. m. Worker 2018):

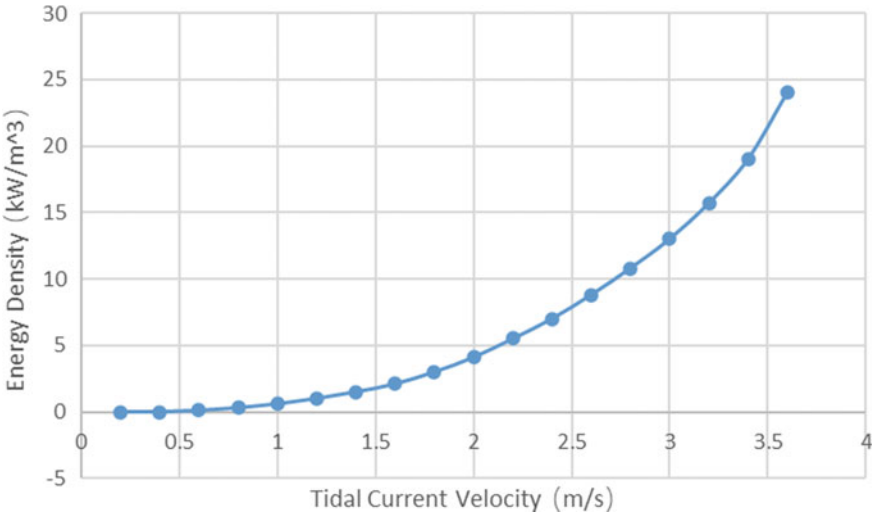


Fig. 4 Energy density versus velocity of tidal current

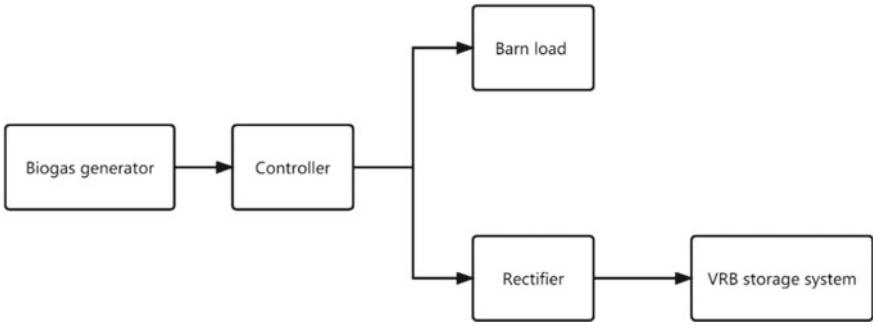


Fig. 5 Structure diagram of biogas power generation system (Yanlin 2020)

$$Q_e = \frac{V H_u \eta}{3600} \tag{6}$$

$$P = k\left(\frac{V H_u \eta}{3600 * t}\right) \tag{7}$$

where Q_e is biogas power generation, kWh/d; P is the total installed capacity of the power station, kW; k is the comprehensive ratio coefficient between installed capacity and generator efficiency, with the range of 1.08–1.20; V is the volume converted from daily biogas production to standard condition, m^3/d; H_u is the low calorific value of biogas, kJ/m^3; t is the daily power generation time, h/d; η is the generator efficiency; 3600 kJ/kWh is the conversion coefficient.

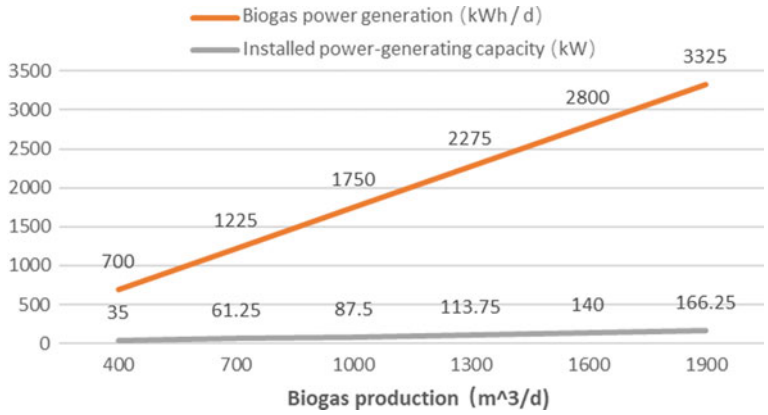


Fig. 6 Influence of biogas production on power generation and total installed capacity

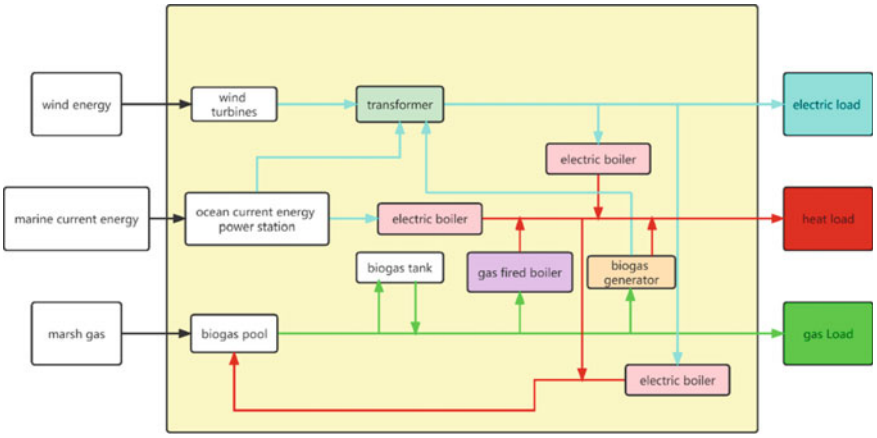


Fig. 7 Supply framework of wind-marine energy-biogas integrated energy system

If there is a biogas project, the calorific value of biogas is 21,000 kJ/m, and the power efficiency η is 30%. Set daily continuous power generation, namely power generation time is 24 h, k value 1.2. Table 2 is available according to different biogas production:

Figure 6 can be drawn from Table 2.

Temperature is the most important factor affecting anaerobic fermentation. Within a certain temperature range, temperature has a positive effect on fermentation efficiency.

It can be concluded that the amount of biogas power generation is closely related to season, day and night, and weather. Therefore, it is necessary to select the appropriate biogas generator set by calculation.

Table 2 The table of biogas power generation and installed capacity corresponding to biogas production

Biogas production	Biogas power generation kWh/d	Installed power-generating capacity kW
400	700	35
700	1225	61.25
1000	1750	87.5
1300	2275	113.75
1600	2800	140
1900	3325	166.25

3.4 Wind-Marine Current-Biogas Integrated Energy System

The wind-marine current-biogas integrated energy system uses the complementary characteristics of wind energy, biogas and current energy in terms of reliability, stability, economy, environmental protection and schedulability to solve the problem of electricity consumption in coastal areas with insufficient power (Da 2020).

The wind-marine current energy-biogas integrated energy system proposed above is shown in Fig. 7.

The wind-marine current-biogas integrated energy system is a new energy supply solution that can make full use of local renewable resources to achieve multi-energy supply to remote areas or special energy supply areas such as islands.

It has many advantages over traditional microgrids:

1. In terms of system stability, biogas is easy to store and can offset the impact of fluctuations through energy complementation.
2. In terms of economy and practicability, wind-marine current-biogas system gas storage tanks are easy to construct and low in cost, which is more conducive to popularization in various places.
3. In terms of energy diversity, this comprehensive energy system is multi-energy complementary, has high energy efficiency, and can provide stable and independent power supply.
4. In terms of wide application, heat energy to solve the problem of overwintering of biogas digesters and the problem of high waste rate of digesters.

Due to the existence of these advantageous characteristics, this integrated energy system is of great significance in terms of technical feasibility and implementation benefits.

4 Economic Benefit Analysis

4.1 Economic Benefits of Wind Power

The cost of wind power generation is composed of non-system cost and system cost, which is the general term for all human, material and financial resources consumed at each stage in the whole process from the start of the project to the end of the project. Non-system costs are separated into construction costs, operating costs, incidental costs and scrapping costs.

The economic benefits of wind power generation are electricity sales revenue plus subsidies minus system costs and non-system costs, and tax payments are also required.

The analysis shows that the on-grid price per kilowatt-hour has the greatest sway on the cost-effectiveness of wind power generation, followed by equipment cost and wind energy resources, and the project life cycle factor has a greater impact on economic benefits than environmental benefits (Xiaoli 2019).

4.2 Economic Benefits of Marine Current Power Generation

Although there are many types of current energy generators, and power collection and export schemes vary, a typical current energy device array field will include the following components: generators and other on-site power balancing equipment, dynamic cables, subsea connectors and Other underwater electrical equipment, submarine cables, offshore substations, onshore substations and grid-connected equipment (Chul Hee and Su Jin 2020).

The actual cost of electrical system components is difficult to give: first, they vary greatly over time, and second, they may also vary from project to project. Among the various devices, dry plug connectors and wet plug connectors are more expensive.

The cost of submarine cables varies widely due to several factors that affect the cable and the overall cost of installation. These include: material costs (mainly copper and steel), access fees (especially for remote locations), subsea conditions (affecting installation methods), downtime (depending on prevailing weather), and equipment availability (depending on market demand) (Zaidi et al. 2021).

The breakdown of investment costs is shown in Fig. 8.

4.3 Economic Benefits of Biogas Power Generation

According to my country's technical conditions, biogas power generation still needs to be supplemented by 15% diesel, and the rest is biogas. Therefore, diesel can also

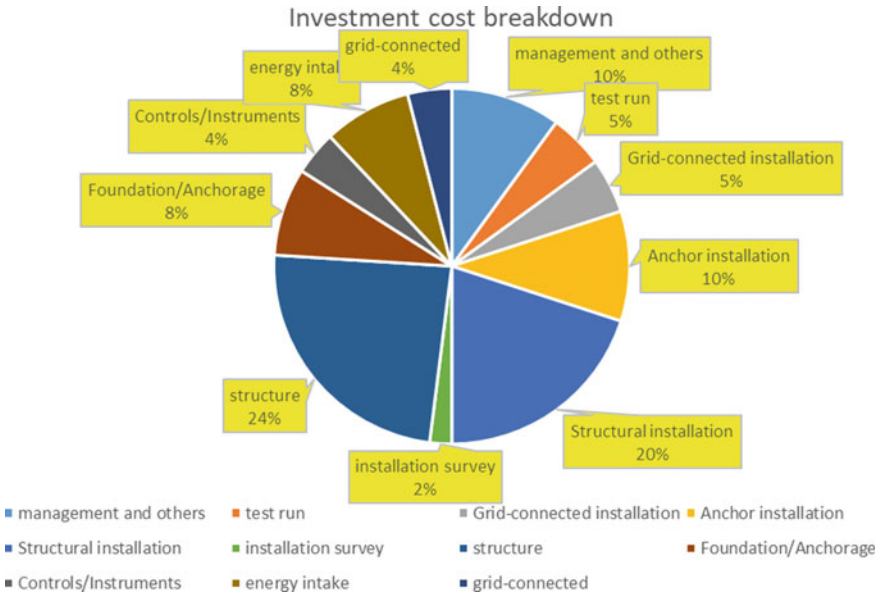


Fig. 8 Investment cost breakdown

be saved, which is of incredible importance to solve the lack of energy in our country, change the appearance of rural areas, and work on the quality of life of farmers.

The following analysis takes a pig farm with an annual output of 100,000 commercial pigs as an example. The specific costs are shown in Table 3.

For rural households, simple devices can be selected to make the cost less high, and the cogeneration method can be used to maximize the use of energy.

Table 3 Cost breakdown

Category	Amount
Fermentation equipment, desulfurization tower and pipeline	710,000 yuan
Gas tank	180,000 yuan
Annual labor cost	84,000 yuan
100 kW generator	45,600 yuan
Oil consumption per kWh	0.012 yuan
Average cost of repairs per kWh of electricity	0.021 yuan
Cost of diesel fuel per kWh of electricity	0.241 yuan

4.4 Integrated Energy System Economic Benefits

This integrated energy system can provide electricity, heat and biogas. However, the initial investment in these projects is huge, so the government needs to concentrate on construction. For small remote villages by the sea, the output of this project will be significantly greater than the input, which is of great significance for driving people towards a happy life (Lu et al. 2022).

The economic benefits of this wind-marine current-biogas integrated energy system include promoting economic growth, benefiting from electricity bills, heating benefits and peak shaving and valley filling.

Social Benefit. The operation of this system can not only create profits and taxes, increase fiscal revenue, stimulate economic growth, but also help to improve energy structure, and promote regional development. While promoting the consumption of renewable energy, this system is also conducive to local environmental construction and resource development.

Environmental Benefit. This integrated energy system has little pollution to the environment because wind power generation and marine current power generation are clean energy sources. Although animal manure pollutes the environment, due to the existence of biogas digesters, manure can be used efficiently and damage to the environment can be reduced.

Electricity Benefit. Considering the different ways of investing in distributed power plants, there are three main ways to make profits: First, when the system operator contributes in full, the operator will amortize the entire investment at the initial stage of the project to each kWh of electricity over several years, plus Second, when the user invests in distributed power generation in full, the system operator can pay the user one-time or batches according to their own investment in technology and raw materials during the project investment and construction stage. Charge fees; thirdly, when investing proportionally, as in the first case, the operator will amortize the electricity according to its own capital contribution and charge the electricity fee to the user.

The price of electricity is determined according to local governments in combination with local conditions. According to the "Notice on Improving the Residential Time-of-use Electricity Price Policy" recently issued by the Shandong Provincial Development and Reform Commission:

Time period division: Peak section 8:00–22:00, valley section 22:00–8:00 the next day; the heating period peak section 8:00–20:00, valley section 20:00 to the next day 8:00.

Electricity Price Standard. On the basis of the present ladder electricity price standard, the electricity price in the peak section will be increased by 0.03 yuan per kWh (tax included, the same below); the electricity price in the valley section will be reduced by 0.17 yuan. That is, the electricity price of the first peak section is 0.5769 yuan, and the electricity price of the valley section is 0.3769 yuan. The second

and third peak and valley electricity prices are increased by 0.05 yuan and 0.3 yuan respectively on the basis of the first peak and valley electricity prices. Among them, the valley section of the heating period. The electricity price was adjusted from a decrease of 0.17 yuan to a decrease of 0.2 yuan. That is, the first-grade peak electricity price is 0.5769 yuan, the valley electricity price is 0.3469 yuan, and the second and third peak and valley electricity prices remain unchanged (C. E. P. Website 2022).

Distributed power generation follows the model of "self-generated and self-consumption, and the surplus is handed over to the power grid". When the distributed power generation has excess power, the system operator can purchase this part of the power from users and sell it to the power grid to earn part of the price difference.

To sum up, the electricity fee income includes three parts: distributed generation electricity fee, microgrid fee and distributed surplus electricity price difference.

Heating Benefit. In this comprehensive energy system, users can basically achieve self-sufficiency in heating. Users can obtain heat through biogas combustion or through electric boilers. If the district's integrated energy system uses electric heating, the heating benefit is covered by the electricity bill.

Peak Shaving Income. Since the system operator has a large number of monitoring devices at the user end and the energy supply end, it can carefully describe and analyze the user's energy consumption behavior characteristics, and provide an optimized energy consumption plan, so that the user can reduce the load or transfer the load at a specific time. Partial load to reduce the user's electricity cost.

5 Conclusions

This paper briefly introduces the theoretical model of the wind-marine current energy-biogas integrated energy system. Simultaneously, the economic benefit of this system, as well as the application place and application prospect are also analyzed. The wind-marine current energy-biogas integrated energy system is of extraordinary importance to the optimization of the energy structure, the improvement of energy supply efficiency, and the safe and stable operation of the energy system.

In the future, we can use technical means to make this integrated energy system more intelligent and improve the power generation efficiency of the system.

References

Abanades S et al (2022) A conceptual review of sustainable electrical power generation from biogas. Energy Sci Eng 10(2):630–655

B. E. I. P. Association (2021) Analysis of installed capacity, power generation and development direction of biogas power generation in China in 2020. Available: https://baijiahao.baidu.com/s?id=1706601496584596831&wfr=spider&for=pc

C. E. P. Website (2022) The time-of-use electricity price policy for Shandong residents will be implemented on May 1! Available: http://mm.chinapower.com.cn/tynfd/gnxw/20220413/143712.html
Chen H, Zuo Y, Chau KT, Zhao W, Lee CHT (2021) Modern electric machines and drives for wind power generation: a review of opportunities and challenges. IET Renew Power Gener 15(9):1864–1887
Chongyu Z et al (2021) Optimal allocation of onshore wind power in China based on cluster analysis. Appl Energy 285:116482 (9p)
Chul Hee J, Su Jin H (2020) Review on tidal energy technologies and research subjects. China Ocean Eng 34(1):137–150
Da X (2020) Research on multi-energy complementary modeling and cooperative operation optimization of distributed integrated energy microgrid. PhD, Hunan University
E. m. Worker (2018) Calculation method of power generation and installed capacity of biogas generator set and application of gas flow meter in it. Available: https://www.163.com/dy/article/E0LKTQJD0511BTU4.html
Fontenot H, Bing D (2019) Modeling and control of building-integrated microgrids for optimal energy management—a review. Appl Energy 254:957–77
Jiaqi W (2018) Modeling and simulation research of island microgrid power supply system based on ocean current energy. Master, Zhejiang University
Jiang CB et al (2021) High-resolution numerical survey of potential sites for tidal energy extraction along coastline of China under sea-level-rise condition. Ocean Eng 236, Art. no. 109492
He CX, Gu J, IOP (2019) Suggestions on promoting China's energy sustainable development in the new era. In: 3rd International Workshop on Renewable Energy and Development (IWRED), vol 267, Guangzhou, Peoples Republic of China
Liu H, Bahaj AS (2021) Status of marine current energy conversion in China. Int Marine Energy J 4(1):11–23
Liu H, Fan Z, Xie H, Wang N (2022) Distributionally robust joint chance-constrained dispatch for electricity gas heat integrated energy system considering wind uncertainty. Energies 15(5)
Lu C et al (2022) Reduced health burden and economic benefits of cleaner fuel usage from household energy consumption across rural and urban China. Environ Res Lett 17(1)
Neill SP, Haas KA, Thiebot J, Yang Z (2021) A review of tidal energy—resource, feedbacks, and environmental interactions. J Renew Sustain Energy 13(6)
Sun R, Zhang T, He Q, Xu H (2021) Review on key technologies and applications in wind power forecasting. Gaodianya Jishu/High Voltage Eng 47(4):1129–1143
Talukdar BK, Deka BC, Goswami AK (2021) Reliability analysis of an active distribution network integrated with solar, wind and tidal energy sources. Int Trans Electr Energy Syst 31(12)
Tian YC, Kou L, Han YD, Yang XD, Hou TT, Zhang WK (2021) Evaluation of offshore wind power in the China sea. Energy Explor Exploit 39(5):1803–1816, Art. no. 0144598721992268
Wu T, Bu SQ, Wei X, Wang GB, Zhou B (2021) Multitasking multi-objective operation optimization of integrated energy system considering biogas-solar-wind renewables. Energy Convers Manag 229, Art. no. 113736
Xiaoli HTZ (2019) Cost-benefit analysis of wind power generation—taking Zhangjiakou as an example. Chin Foreign Energy 24(05):21–25
Xu J, Liu Z, Dai J (2021) Environmental and economic trade-off-based approaches towards urban household waste and crop straw disposal for biogas power generation project—a case study from China. J Cleaner Prod 319
Yang C, Gao FK, Dong MY (2020) Energy efficiency modeling of integrated energy system in coastal areas. J Coast Res 995–1001
Yanlin X (2020) Research on the combined power generation system of photovoltaic-temperature difference-biogas energy in livestock house. Master, Northeast Agricultural University
Zhang CQ, Xu YL (2020) Economic analysis of large-scale farm biogas power generation system considering environmental benefits based on LCA: a case study in China. J Cleaner Prod 258, Art. no. 120985

Zaidi S, Abbas MK, Saleem S, Khan BM, Haider S (2021) Renewable tidal power generation significance challenges. In: 2021 International Bhurban Conference on Applied Sciences and Technologies (IBCAST), 12–16 Jan 2021. IEEE, Piscataway, NJ, USA, pp 835–40

Z. Consulting (2021) Analysis of the development status and future development trend of China's wind power industry in 2020. Available: https://www.chyxx.com/industry/202105/952141.html

An Analysis of Puma's Global Marketing in the COVID-19 Era

Zichun Pan, Kaiyan Wang, Yuechun Wang, and Ruonan Zhao

Abstract Puma is one of the well-known sportswear brands. It's reasonable and rigorous in product design, as well as long-term clear objectives in market segmentation and distribution channel management. However, in the 1980s and 1990s, Puma was far behind Nike, Reebok, Adidas, and other clothing giants in marketing and sales. The research analyzed the strengths and weaknesses of the Puma brand from the inside, based on SWOT. From the external analysis, the existing threats, competitive situations, and development opportunities in the market are all analyzed. Based on the perspective of 4Ps Marketing Theory, this study analyzed the market for Puma products and studies the strategies for products, pricing, placement, and promotion. Puma's main market is Asia. Further this paper made a discussion based on the SWOT analysis and give some suggestions on further marketing strategies. The implication as well as contribution were discussed later and limitation and future study were also included.

Keywords Puma · Marketing mix theory · SWOT

Z. Pan, K. Wang, Y. Wang, R. Zhao: These authors contributed equally.

Z. Pan
JBJI Economic, Jinan University, Guangzhou 511486, China

K. Wang
Economics and Management, Zhejiang Sci-Tech University, Hangzhou 310018, China

Y. Wang
Economics and Management, University of Putra Malaysia, Yunnan 653100, China

R. Zhao (✉)
International Business, Xi'an Jiaotong-Liverpool University, Suzhou 215028, China
e-mail: Ruonan.zhao19@students.xjtlu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_4

1 Introduction

1.1 Research Background

Puma is a well-known sportswear company, founded in Germany in 1948 (http://textilegoglobal.com/xwzx/yw/70109.html). The group owns brands like Puma, Cobra Golf, and Tretorn, and this paper will only focus on its Puma brand (https://baike.baidu.com/item/PUMA/620783).

In the past 30 years, Puma's turnover has increased nearly 20 times, from 141.9 to 3163.3 million euros in 2021 (https://about.puma.com/en/this-is-puma/history). This is undoubtedly a great success. As a world-famous sports brand developed from a small shoe factory, this achievement is not only related to its products but also because of its marketing strategy, which plays a crucial role. Besides, Puma was once selected as one of the 50 most valuable clothing brands in the world in 2020, which confirmed the outside world's recognition of Puma's marketing strategy (https://about.puma.com/en/sustainability/social/covid-19-supply-chain).

The paper object, Puma, which belongs to the sports brand market, will be discussed in this article about its global marketing strategy during the COVID-19 pandemic. The global pandemic of coronavirus disease in 2019 has had an unprecedented impact on Puma (https://fashionunited.com/executive/management/puma-swings-to-loss-as-covid-19-hits-sales-scraps-full-year-outlook/2020072934703). Taking the second quarter of 2019 as an example, the net loss in that quarter was 114.8 million euros, and the sales decreased by 30.7% (https://about.puma.com/en/newsroom/corporate-news/2020/2020-03-11-corona). Otherwise, not only that, the epidemic has also had many negative impacts on Puma's supply chain and procurement (https://www.statista.com/statistics/268466/footwear-sales-of-puma-worldwide-since-1993/). But in Puma's 2021 annual report, although some self-owned and operated stores and partner stores were temporarily closed due to government measures on the epidemic, looking at Tables 1 and 2 as a whole, Puma's sales in 2021 are still higher than in 2020, not only in the breakdown by distribution channels, but also in the breakdown by product divisions (https://annual-report.puma.com/2021/downloads/puma-ar-2021_annual-report.pdf).

Table 1 The net sales of the group are broken down by distribution channels (€ million) (https://annual-report.puma.com/2021/downloads/puma-ar-2021_annual-report.pdf)

	2021	2020
Footwear	3163.6	2367.6
Apparel	2517.3	1974.1
Accessories	1124.5	892.7
Total	6805.4	5234.4

Table 2 The net sales of the group are broken down by product divisions (€ million) (https://annual-report.puma.com/2021/downloads/puma-ar-2021_annual-report.pdf)

	2021	2020
Wholesale	5080.6	3809.9
Retail	1724.8	1424.5
Total	6805.4	5234.4

1.2 Research Gap

While there has been much research on Puma's apparel brand strategy and SWOT analysis, Puma's global environment has also changed due to the emergence of COVID-19 and the new globalization changes in the COVID-19 era. The dramatic changes in the COVID-19 global environment require every company to respond in real-time and change its traditional approach. The logistics and offline service industries have been hit hard, and the Internet has become a popular communication channel. At the same time, consumers' shopping behaviors and purchasing tendencies also change from diverse and complex to simple and frugal (Mehta et al. 2020).

Therefore, the research gap analyzes Puma's brand strategy in the COVID-19 era. Moreover, the research topic is how to market Puma in the global market in the COVID-19 era.

Exploring on this issue can close the last research gap and provide a specific case analysis for developing the garment industry in the COVID-19 era. Also, it provides more effective suggestions for Puma's sustainable development in the whole industry.

1.3 Fill the Gap

In this case study, the marketing strategy of Puma, its marketing mix theory, and SWOT Analysis will be discussed. First, the fierce competition and future opportunities in the Puma market will be analyzed by SWOT Analysis. Through marketing mix theory, Puma's main market is the Asian market. Then they investigate whether they can explore the emerging markets in Asia and seek to significantly expand their market share. And whether it can increase its sales in these regions by paying attention to the changing patterns of these industries and catering to the public accordingly. In terms of the product, this research will determine whether Puma considers leaving the sports industry to focus on the company that produces products in the lifestyle field and develops new customer markets. In terms of promotion, although Puma has sponsored numerous sporting events and backed numerous celebrities and sports heroes, this is insufficient in comparison to competitors, so focusing on their other strategies to respond in the following paragraphs, this research plan will focus on how Puma can keep its competitive advantage and expand its market share. And how to boost effectiveness, brand awareness, and sales in order to boost profits?

The marketing mix theory and a SWOT analysis will be utilized to investigate these issues in the following research (https://thesocialgrabber.com/market-segmentation-of-puma/).

2 Literature Review

2.1 Marketing Mix Theory

Over the past decades, most of the research in the marketing area paid particular attention to the marketing mix theory to measure the enterprise's marketing strategy. In 1953, Neil Borden showed the rudimentary of the marketing mix theory, which was used to provide a comprehensive consideration of the effects generated by different marketing factors. At the beginning of the 1950s, Professor McCarthy was able to define in more detail the marketing factors which were mentioned in this theory into four parts: price, product, place, and promotion. This is also referred to simply as the 4Ps combination of marketing (Meissner and McCarthy 1960). In 1967, Kotler further determined the marketing method with this theory as the core.

However, with the development of marketing mix theory, the concept of big marketing was put forward. In 1986, Kotler added two factors, which are political power and public relations, to the controllable factors for enterprises to conduct marketing activities, thus forming the marketing 6Ps. On the basis of 4Ps, 6Ps gave more consideration to the market factors that enterprises needed to consider and control to develop in the international market (Philip 1986).

2.2 Important Results

Place. According to Kotler, the factor considered, "Place," considered that the enterprise did not sell directly to customers but sold through different distribution channels. In the process of distribution, enterprises need to consider how to distribute and where to set up the distribution location to maximize the economic benefits of the enterprise (Philip 1986).

Therefore, this part focuses on the role of distribution channels in improving product sales. In 2022, Frenando demonstrated that distribution channels refer to a series of enterprises or intermediaries that deliver goods or services to buyers or end consumers through these channels. This process includes wholesalers, retailers, distributors, and even the Internet (https://www.investopedia.com/terms/d/distribution-channel.asp).

Good distribution channel planning has an important impact on the promotion of purchase intention. Hadi in 2019 showed that Apple had tapped more potential users by opening its own outlets, that was, Apple

stores. In addition, Apple's online portal has also played a great role in improving Apple's performance, becoming one of Apple's most profitable channels (https://www.researchgate.net/publication/336471791_THE_EFFECT_OF_MARKETING_MIX_ON_ORGANIZATIONS_PERFORMANCE). As Luenendonk Last emphasized in 2019, if the company did not have a detailed distribution channel plan, the sales volume would be reduced and the cost would be high (https://www.cleverism.com/place-four-ps-marketing-mix/).

Product. Overall, quality and service effect on the consumer's purchase.

Product Quality. Lei Lei in 2020 demonstrated that through exploring Luckin coffee in the Internet environment, consumers would be more willing to buy when the quality of raw materials was ensured and the production process was strengthened (Lei 2020). In 2020, Yu Zhaolei published an article that Yantai Enbang Electronic Technology Co., Ltd. received many complaints about the quality of ink jet machines. Therefore, it was very important to ensure the quality of the products sold to maintain customers (Yu 2020). By distributing questionnaires to a sample of Medical Equipment Technologies employees in Al-Saaeda Company in 2018, Thabit and Raewf discovered that the most important factor in increasing customer satisfaction was the quality of products (Thabit and Raewf 2018).

Product Service. Lei Lei in 2020 also showed that providing customers with a personalized shopping experience (such as opening personalized experience venues, parent–child coffee interaction centers, providing private customization, etc.) would attract more maverick young people (Lei 2020). The study of L'Oreal's marketing strategy in China carried out by Zhang Lisha in 2019 found that establishing brand services that adapt to Chinese consumers could enhance consumers' willingness to buy, such as adopting beauty consultant-style consumer services to deepen consumers' understanding of products and give consumers a comfortable experience, in order to increase the sales success rate (Zhang 2019). On the basis of the national unified regulations from 2016 to 2018, Wang Yangmuzi conducted a questionnaire survey on customer satisfaction among the customers who visited the sales field of a real estate project in 2020. He concluded that because the service of the sales staff on the case site was not timely and professional enough, the consumers who visited the case site ultimately lacked the overall sense of cognition and their purchase intention was low (Wang 2020). By analyzing the effect of marketing mix variables for Wardah products in Pekanbaru, Wibowo and Arsyelan were able to show that it should strengthen its product line by flooding the target market so that it was often and easily seen by consumers and could add distribution lines to maintain product availability in the market (Asdi and Putra 2020).

Price. In terms of price, it is not easy to simply lower prices or increase discounts in a short period, and Puma is a sports apparel brand, which can be matched with coats, pants, shoes, and bags, so bundling sales is a good choice.

In 2002, Stremersch and Tellis systematically defined and classified bundling strategies. They defined bundling strategies as "overall sales of two or more independent products", whereas "independent products" were defined as "products that already existed separately in separate markets" (Stremersch and Tellis 2002).

By data analysis of the experimenters' integrated bundle pricing optimization model for multiple products, Fang et al. in 2017 showed that customers with lower consumption levels preferred lower commodity prices and larger bundle sizes (Fang et al. 2017). In addition, when the product cost is high, it is best to bundle a small number of products at a high price and vice versa. Also, in 1997, Chen put forward a balance theory of product bundling, which showed that bundling is not only a way to differentiate products but also a balanced strategy for rival companies, so that the leading enterprises producing homogeneous products could still make profits in the fierce price competition (Chen 1997).

In 2004, Oppewal and Holyoake assumed that bundling was more advantageous in regions with more competitive or similar products. They conducted an experiment in which volunteers were asked to shop for a beach holiday. The results showed that consumers were more likely to buy bundled goods or not buy at all when there were more competitors nearby (Oppewal and Holyoake 2004).

Promotion. In 2018, Hitesh Bhasin demonstrated that Puma had identified personal characteristics, such as motivation, lifestyle, and fitness level, in order to attract customers from different market segments (http://www.marketing91.com/marketing-strategy-puma/). It is committed to these parameters to promote its brand and make it more attractive to end customers. In an MBA school team in 2021, they showed that Puma, in order to improve its competitiveness, sold its items at a lower price than its competitors (https://www.mbaskool.com/marketing-mix/products/17274-puma.html). Last but not least, it has exploited celebrities to promote its products, as well as the most up-to-date digital platform approaches to promote its items. An article published by K. J. Somaiya school in 2021 said Puma, in addition to celebrity endorsements, had created a number of fascinating and innovative campaigns to attract customers (http://www.coursehero.com/file/p36emkhp/The-promotional-and-advertising-strategy-in-the-Puma-marketing-strategy-is-as/). The peel-off sticker campaign, which is part of the "Run the Streets" campaign, is one example. During the campaign, they placed 2000 stickers in the shape of Puma's logo on Singapore's Bugis subway station. These stickers offered a 30% discount on Puma purchases. Puma is well-represented on digital platforms and social media, in addition to television advertisements and print media. By drawing on the concept of promotion for Puma, Aditya and Shastri found that Puma sold its products at lower prices than its competitors to give them competition. It has also exploited celebrities to promote its products, and it has applied the most recent digital platform techniques to promote its products (https://iide.co/case-studies/marketing-strategy-of-puma/).

2.3 Summary

Collectively, these studies outline that the factors which strengthen consumers' purchases are proper distribution channels, high product quality and service, bundling strategies, using celebrities to promote its products, etc. Also, these aspects are indispensable for Puma. As for the COVID-19 outbreak globally, how Puma could act in the epidemic situation should be thought about.

3 Method

3.1 Research Design

This paper will employ the qualitative analysis method and SWOT as an analysis tool to assist the analysis.

First of all, qualitative analysis refers to the method of collecting and analyzing non-digital data and generating deep insights and new ideas about research problems through understanding concepts, views, or experiences (https://www.scribbr.com/methodology/qualitative-research/). The use of qualitative case study is a well-established approach to relying on a small part of high-quality data information to get detailed opinions through the details of information, which is also the reason why qualitative analysis is applied in this paper (https://vittana.org/23-advantages-and-disadvantages-of-qualitative-research).

SWOT (i.e., strengths, weaknesses, opportunities, and threats) analysis refers to an analysis tool utilized to evaluate the company's current situation and external environment so as to formulate clear and efficient strategic planning. Among them, strengths and weaknesses emphasize the analysis of the company's internal factors, while opportunities and threats focus on the company's external environmental factors (https://www.investopedia.com/terms/s/swot.asp). The main advantage of Manuels's Effe States's SWOT analysis is that it objectively and fairly focuses on the current situation and challenges of the company, so that it can give a comprehensive and complete summary of strategic guidance (https://ssacltd.com/insight/benefits-of-swot-analysis/). As this article aims to analyze Puma's strategy for the whole world market under the epidemic situation, SWOT analysis can not only analyze Puma's internal strategy but also give a comprehensive analysis and assessment of the external environment, that is, the epidemic situation.

3.2 Puma

Puma is a German sports brand founded in 1948. Sportswear, sports shoes, and sports articles are among its products. Puma also involves football, running, training, racing,

and sports-inspired life series. Puma is also a well-known sports brand, ranking second only to Adidas and Nike. Puma has been adhering to the "Forever Faster" brand and is committed to influencing the traditional sports industry by combining fashion and sports.

The COVID-19 epidemic confronted Puma with a number of difficulties during 2020 that impacted practically every aspect of operations. The supply chain faced difficulties when several suppliers' plants had to close due to the epidemic in China in January or were unable to operate at full capacity. People adopt hygienic procedures at their offices, warehouses, and retail outlets to guarantee the security and health of their clients and staff. Large athletic events were either canceled or delayed as the virus moved to other parts of the world, and the majority of their owned and operated stores had to close entirely or in part in the second quarter. The new lockdown and travel restrictions hurt business in the fourth quarter, even though the third quarter was once again very strong. All of these adjustments required swift responses from us. The Puma guiding principle was to weather and handle this catastrophe in the short term without compromising forward momentum in the middle. As a result, they came up with three main goals: to minimize the expected fall in sales; to protect the supply chain; to cut expenses; and to ensure liquidity.

Puma continued to invest in a full line of products for the next season and recruited a number of new marketing partners to ensure that the brand did not lose momentum. Football player Neymar Jr., one of the most accomplished athletes of his generation, and Puma inked a long-term pact in September. The Puma KING football boot, which was previously worn by Puma football giants like Pelé, Cruyff, and Maradona, was worn by Neymar Jr. Puma also welcomed English singer and songwriter Dua Lipa as a women's ambassador, who will appear in important campaigns for the brand. Winnie Harlow joined the Puma family in early 2020 and has already headed the marketing campaigns for several new footwear franchises, including the KYRON and the MILE RIDER.

The articles were searched from the COVID-19 outbreak in December 2019 to the COVID-19 era. Puma markets worldwide were included in the study because COVID-19 has affected countries in most ways. The subject was chosen because the global market has a certain uniformity and cannot be affected by the regional specifications that may arise from a separate analysis of a particular region. In addition, Puma is currently an international brand, so the analysis of this subject can better adapt to Puma's goal of product standardization.

3.3 SWOT Analysis

Strength. In terms of place, Puma has responded well to the negative impact of the epidemic through its strong e-commerce store. Puma has three distribution channels: wholesale, retail stores, and e-commerce stores owned and operated by Puma. In the face of the epidemic, Puma's e-commerce channel has

played a great driving role (https://www.mbaskool.com/marketing-mix/products/17274-puma.html). Taking the fourth quarter of 2020 as an example, the total turnover of Puma's retail stores and e-commerce increased by 19.3% to USD 502 million, which was driven by the strong growth of e-commerce (https://about.puma.com/en/newsroom/corporate-news/2021/02-24-2021-q4-results). Even in 2020, when almost all Puma businesses in China have disappeared for nearly six weeks from the end of January, e-commerce is still operating under the effect of the serious epidemic and has become the only channel for Puma to operate in China during this period of time (https://about.puma.com/en/newsroom/corporate-news/2021/02-24-2021-q4-results).

In terms of products, Puma has developed premium products such as compressed tees or apparel using drycell technology to allow people to exercise in a dry and safe way while exercising, reducing the risk of injury, which strengthens consumers' willingness to buy. And Puma sells its products in more than 120 countries through subsidiaries and retail, which increases brand awareness and attracts more customers (https://ir.uitm.edu.my/id/eprint/50750/).

Puma's prices are in the middle of the pack among sportswear brands, and it has more customers who can afford it than Nike and Adidas. Its price, if nothing else, has made Puma the preferred choice for students and workers with limited means.

Puma's apparel sales have grown dramatically over the years, reaching more than 2.5 billion euros in 2021, while its footwear division remains the company's biggest profit generator (https://ir.uitm.edu.my/id/eprint/50750/). Figure 1 shows Puma's footwear sales worldwide from 1993 to 2021 (in a million euros), which shows a healthy growth rate. Moreover, they have been focusing on aggressive expansion, which could lead to higher growth in the coming year.

In terms of advertising creative strategy, Puma pays attention to emotional appeal, supplemented by rational appeal. Their slogan is "always be yourself". Puma has generated unique emotions for commodities or enterprises in the way of emotional appeal. The key to Puma's success is constantly testing and trying many different activities on social media and publishing different posts to promote them.

Puma has 762k followers in India and 11.7 million followers on Instagram (https://www.statista.com/statistics/268466/footwear-sales-of-puma-worldwide-since-1993/). They also have various pages on Instagram, like Puma Women, Puma Motor Sports, Puma Football, and Puma Sport Style, which show their diversified products. The features of these pictures are that stars or athletes take photos in their clothes, which makes fans of athletes or stars want to buy the same model. For example, a famous star like Rihanna, when she spoke for Puma, many consumers poured in, which would arouse the herd mentality of most consumers. Puma chooses ambassadors according to their stories and common beliefs, aiming to humanize the brand. The cooperation with Fenty x Rihanna is a wonderful series, which has brought a lot of attention to the brand. Puma chooses ambassadors according to their stories and common beliefs, aiming to humanize the brand. That's why this wonderful series of Fenty x Rihanna has come into being. At the same time, it has brought a lot of attention to the brand and a lot of attention to the brand.

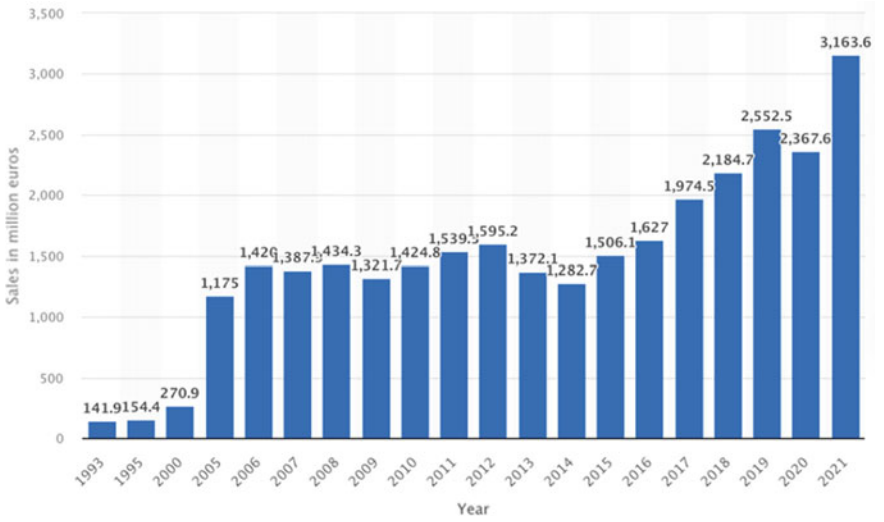


Fig. 1 Puma's footwear sales worldwide from 1993 to 2021 (in million Euros) (https://www.statista.com/statistics/268466/footwear-sales-of-puma-worldwide-since-1993/)

Puma's team also created some great social media activities on Facebook, not just promoting beautiful sneakers or clothes. For example, the "See Only Great" campaign aims to bring light to this uncertain world. "She Touched Us." This event aims to empower women around the world. It's all about confidence, style, and the power of nature.

Weakness. In terms of products, in the sportswear industry, Puma has strong competitors in terms of product quality and product service, which makes it difficult to have loyal customer groups.

In the pandemic era, the Internet is growing faster than ever, and this environment has spawned many influential clothing industries with trendy clothes that are cheaper than Puma. Moreover, because they do not have the burden of offline marketing, they can offer more discounts or events online, which can be a disadvantage for Puma in significant markets.

Puma relies only on the group's external unified advertising and various promotional activities to maintain market attention. There is no high-level, independent public relations promotion and advertising release for itself. Such a strategy will inevitably lead to a decline in consumers' attention and loyalty to Puma. In today's increasingly fierce market competition, Puma wastes the opportunity to expand further, extend and sublimate its excellent brand image.

According to the survey, consumers are more willing to buy Adidas, Nike shoes and clothing, and Puma just with a try mentality (http://iide.co/case-studies/marketing-strategy-of-puma/). It can be seen that consumers' loyalty to Puma is not high, which may be due to the lack of marketing activities and brand culture communication, so consumers do not have good contact with Puma.

Opportunity. In terms of products, Puma's products have many styles with various colors, sizes, and shapes, and the target customers range from professional athletes to fitness personnel, which increases the selectivity of customers and attracts more customers to buy products. What's more, Puma has always been committed to brand sustainability. Producing products from sustainable raw materials will strengthen the brand, and more environmentalists will favor it.

People's incomes have increased a lot compared to the last decade. They also showed a strong interest in upgrading to buy quality goods in all industries. Puma can take advantage of this opportunity to launch high-quality clothing with higher quality or lower prices, thus transforming these potential customers into direct consumers and gaining more sales.

It has a great opportunity to increase its business in new developing markets in Asia. According to the current changing trends, they can improve their businesses in India, Vietnam, Mexico, etc. to increase their global footprints.

Threaten. In terms of place, Puma faces great external threats. Puma's offline sales channels have been severely damaged due to the epidemic. First of all, many offline stores have been suspended due to epidemic control in some countries and regions. Taking China as an example, due to restrictions imposed by local authorities, most of Puma's own and operated stores and cooperative stores in China were temporarily closed in February, 2020 (https://about.puma.com/en/newsroom/corporate-news/2020/2020-03-11-corona). By the end of March 2020, about 80% of Puma's own and operated retail stores and most of its retail partners' stores will be closed. Therefore, the brand lost more than half of its sales in April 2020 compared with the same period last year (https://about.puma.com/en/newsroom/corporate-news/2021/02-24-2021-q4-results). In addition, many countries in the world have closed their offline stores due to the epidemic. For example, in March 2020, all Puma stores in Germany were forced to suspend business (https://ir.uitm.edu.my/id/eprint/50750/). Even though Herzogenaurach emphasized that most of Puma's stores in Europe operated normally under the effect of the epidemic, these companies shortened their business hours in accordance with the regulations of the authorities, which also had a negative impact on Puma's offline store sales.

On the other hand, due to the restrictions on customers' travel generated by the epidemic, the sales volume of offline stores that did not suspend business also decreased significantly due to the decrease in passenger flow. Puma stated that in 2020, the passenger flow of Puma in European countries will be significantly reduced. In addition, other Asian markets, such as Singapore, Malaysia, Japan, and South Korea, usually benefit from Chinese tourists. Therefore, when the Chinese government implements restrictions on going abroad, their sales have also been seriously adversely affected (herzogenaurach1). In addition, since the sales volume of Puma in the Asian market accounts for nearly one third of its total sales volume, the epidemic is undoubtedly a huge source of crisis for Puma in the Asian market (https://www.cityam.com/CORONAVIRUS-OUTBREAK-SPORTSWEAR-GIANTS-PUMA-AND-ADIDAS-WARN-ON-TRADING-IMPACT/).

In terms of products, there are many counterfeit Puma products on the market, and customers buying counterfeit products will reduce their willingness to buy Puma,

which will cause Puma to lose many potential customers and infringe on intellectual property rights.

Puma has plenty of alternatives in terms of price, and consumers have both more expensive and cheaper options. Competitors such as Converse, Reebok, Nike, and Adidas threaten Puma's ability to expand its market or secure customers. Sportswear consumers do not have to buy Puma, threatening Puma's ability to expand its market or secure customers.

The changing economic situation has brought significant changes to the previously calm market. This could hamper Puma's decision to open new offline retail stores worldwide and be a significant obstacle to their expansion.

Online sales have grown year over year as a result of the expansion of the Internet and the emergence of online shopping. A significant number of independently owned brands by online celebrities have formed, particularly in the Chinese market. Their strategy is to use their own clout and low pricing to entice customers to stick with their apparel brands. This is surely an unpleasant circumstance for Puma to enter the Chinese market because the majority of young people currently choose them, which is highly useful for young people to choose fashion companies.

4 Results and Discussion

From the SWOT analysis of Puma, it can be found that Puma's overall strengths outweigh its weaknesses. Puma not only has strong distribution channels and superior product technology but also uses reasonable prices to attract more middle-class people and keeps up with fashion trends, using hot social software to promote products. However, Puma is also facing problems such as stronger competitors, a lack of its own independent advertising, over-reliance on online sales, and uncontrolled counterfeit products, which are resulting in a loss of customers.

Promotion is very important in the analysis of Puma, and it has a profound impact on consumer purchase intention. Based on the above analysis of Puma, some recommendations are made.

In the marketing strategy of Place, Puma cleverly exploited e-commerce strategy to solve the dilemma brought by the epidemic. Even though the government's restrictions on offline stores are becoming more and more relaxed during the epidemic period, the operation of online stores can still continue to develop and improve. The impact of the Puma epidemic on offline stores is described in the literature review. Well-designed distribution plans can make the company even stronger. In the face of the adverse impact of the epidemic on Puma's distribution channels, Puma successfully recovered from Puma's low sales due to the impact of the epidemic to a certain extent through the good use of its e-commerce channels.

For strong competitors, Puma can stand out from a group of competing products by increasing technical input and improving the product innovation level. And to resist counterfeit and shoddy products on the market, Puma can exploit legal weapons to safeguard its rights and interests through legal channels.

Faced with Puma's strengths and opportunities, it needs to capture the benefits of a mid-range price position to stabilize its consumer base. It needs to meet the needs of the public in the epidemic era for quality and low prices, expand the potential consumer group, and bring in more revenue. In the face of Puma's weaknesses and threats, it needs to constantly innovate new products, cater to new trends, and continue developing e-commerce in the epidemic era, not to be replaced and enhance customer loyalty.

One suggestion on promotion is to increase the breadth of the brand; another one is to increase the depth of the brand. It is clear that the slogan "just do it" of Nike is deeply rooted in the hearts of the people. Puma can also publicize the brand itself. People can follow the slogan of Puma by always being themselves and having a logo to promote, so that people can remember the brand's advertising language and the brand can have a group of loyal consumers.

And according to the analysis, the effect of the Puma marketing mix theory on consumers is the same as what is reviewed in the literature. This paper is universal based on social status, but there may still be exceptions in some countries due to relevant policies.

5 Conclusion

In the context of the global epidemic era, this paper studies Puma's marketing strategies and explores how Puma can learn from each other and survive the COVID-19 outbreak. This paper analyzes and summarizes the marketing mix theory, analyzes Puma from multiple angles with the qualitative analysis method and SWOT model, and finally concludes that Puma's strengths outweigh its weaknesses in the pandemic era, but there is still much to be done. In the current environment, Puma should identify problems that still exist in the development of the enterprise, to improve the quality of the products with stable customers, electricity, and other online sales markets to alleviate the impact of the epidemic outbreak of all kinds of emergencies and their impact on the offline stores to expand brand effectiveness and strengthen brand propaganda. Today, as a non-top sportswear brand, Puma needs to meet consumer demand and adapt very quickly to the impact of the epidemic, which can enable Puma to increase sales and survive.

This paper, to some extent, makes up for the research blank of Puma's marketing strategy in the context of the epidemic era and is a practical application of brand strategy in the clothing industry. The research on Puma can provide a theoretical basis for the future development of garment enterprises and also help and reference for other scholars in similar research.

There are a lot of deficiencies in this paper in terms of access to information, which can refer to less information because content cannot be completely objective due to the lack of available information. The specific analysis of the market still has some incomplete considerations. In future research, the accuracy and diversity

of data sources may be assured to improve the quality of the document. Finally, hopefully this document will provide practical help and referrals for other peers.

References

Asdi A, Putra AHPK (2020) The effect of marketing mix (4P) on buying decision: empirical study on brand of Samsung smartphone product. Point View Res Manag 1(4):121–130
Baike. https://baike.baidu.com/item/PUMA/620783. Last accessed 2022/5/30
Chen Y (1997) Equilibrium product bundling. J Bus 70(1):85
CityAM website. https://www.cityam.com/CORONAVIRUS-OUTBREAK-SPORTSWEAR-GIANTS-PUMA-AND-ADIDAS-WARN-ON-TRADING-IMPACT/. Last accessed 2022/6/24
Cleverism website. https://www.cleverism.com/place-four-ps-marketing-mix/. Last accessed 2022/6/17
Coursehero.com website. http://www.coursehero.com/file/p36emkhp/The-promotional-and-advertising-strategy-in-the-Puma-marketing-strategy-is-as/. Last accessed 2022/5/31
Fang Y, Sun L, Gao Y (2017) Bundle-pricing decision model for multiple products. Procedia Comput Sci 112:2147–2154
Fashionunited.com website. https://fashionunited.com/executive/management/puma-swings-to-loss-as-covid-19-hits-sales-scraps-full-year-outlook/2020072934703. Last accessed 2022/5/30
IIDE website. https://iide.co/case-studies/marketing-strategy-of-puma/. Last accessed 2022/5/31
Investopedia website. https://www.investopedia.com/terms/d/distribution-channel.asp. Last accessed 2022/6/17
Investopedia website. https://www.investopedia.com/terms/s/swot.asp. Last accessed 2022/6/24
Ir.uitm.edu.my website. https://ir.uitm.edu.my/id/eprint/50750/. Last accessed 2022/6/24
Lei L (2020) Research on RX coffee 4P marketing strategy in internet environment
Marketing91 website. http://www.marketing91.com/marketing-strategy-puma/. Last accessed 2022/5/31
MBA Skool-Study.Learn.Share. website. https://www.mbaskool.com/marketing-mix/products/17274-puma.html. Last accessed 2022/6/24
Mbaskool website. https://www.mbaskool.com/marketing-mix/products/17274-puma.html. Last accessed 2022/5/31
Mehta S, Saxena T, Purohit N (2020) The new consumer behaviour paradigm amid covid-19: permanent or transient? J Health Manag 22(2):291–301
Meissner F, McCarthy E (1960) Basic marketing: a managerial approach. J Mark 42(4):103
Oppewal H, Holyoake B (2004) Bundling and retail agglomeration effects on shopping behavior. J Retail Consum Serv 11(2):61–74
Philip K (1986) Harvard Business Review. In: Philip K (ed) Conference, vol 64, no 2
Puma.com website. https://annual-report.puma.com/2021/downloads/puma-ar-2021_annual-report.pdf. Last accessed 2022/6/18
PUMA SE website. https://about.puma.com/en/this-is-puma/history. Last accessed 2022/5/30
PUMA SE website. https://about.puma.com/en/sustainability/social/covid-19-supply-chain. Last accessed 2022/5/30
PUMA SE website. https://about.puma.com/en/newsroom/corporate-news/2020/2020-03-11-corona. Last accessed 2022/5/30
PUMA SE website. https://about.puma.com/en/newsroom/corporate-news/2021/02-24-2021-q4-results. Last accessed 2022/6/24
PUMA SE website. https://about.puma.com/en/newsroom/corporate-news/2020/2020-03-24-measures. Last accessed 2022/6/24
ResearchGate website. https://www.researchgate.net/publication/336471791_THE_EFFECT_OF_MARKETING_MIX_ON_ORGANIZATIONS_PERFORMANCE. Last accessed 2022/6/17

Scribbr website. https://www.scribbr.com/methodology/qualitative-research/. Last accessed 2022/6/24
SSAC Advisory & Professionals website. https://ssacltd.com/insight/benefits-of-swot-analysis/. Last accessed 2022/6/24
Statista website. https://www.statista.com/statistics/268466/footwear-sales-of-puma-worldwide-since-1993/. Last accessed 2022/5/30
Stremersch S, Tellis GJ (2002) Strategic bundling of products and prices: a new synthesis for marketing. J Mark 66(1):55–72
Textilegoglobal.com website. http://textilegoglobal.com/xwzx/yw/70109.html. Last accessed 2022/5/30
Thabit TH, Raewf MB (2018) The evaluation of marketing mix elements: a case study. Int J Soc Sci Educ Stud 4(4):100–109
The Digital School website. http://iide.co/case-studies/marketing-strategy-of-puma/. Last accessed 2022/6/24
Thesocialgrabber.com website. https://thesocialgrabber.com/market-segmentation-of-puma/. Last accessed 2022/6/18
Vittana.org website. https://vittana.org/23-advantages-and-disadvantages-of-qualitative-research. Last accessed 2022/6/24
Wang Y (2020) Analysis on the marketing strategy of H real estate project based on 4P marketing theory
Yu Z (2020) The research on the 4P marketing strategy of Yantai Enbang Company' marking machine
Zhang L (2019) Research on L'Oreal's marketing strategy in China

The Time-Varying Impact of COVID-19 on the Telecom Industry

Yi Zhu

Abstract Since the beginning of 2020, COVID-19 has severely impacted human life to the extent of the whole world. This paper aims to find out the time-varying impact of COVID-19 on the telecom industry. The daily patient increased in China and oversea is used to reflect the extent of COVID-19. The data of Shenwan index from Feb. 3rd, 2020 to June 17th, 2022 is analyzed through the VAR model and the ARMA-GARCH model to find the impact. According to the result, it is shown that the effect of COVID-19 conducts from oversea to domestic. Although the impact is waning, it will still last for several years. Such impact will bring risks as well as chances. During these years, the telecom industry is on the upswing of development, having great potential. Governments are suggested to catch the chance to accelerate the digital transformation, while investors are suggested to seize investment opportunities.

Keywords COVID-19 · Telecom industry · VAR model · GARCH model

1 Introduction

The full name for COVID-19 is Corona Virus Disease 2019, which is a kind of novel coronavirus starting to pandemic worldwide at the end of 2019. Till now, the number of confirmed COVID-19 cases worldwide has reached 536 million while the death toll has reached 6 million. Considering the rapid and widespread coverage, relatively high death rate, and severe sequelae, the government of various countries had to declare quarantine policies, which led to the stop of work and production as well as traffic and logistics. It was reported that in March 2020, the US stock hit a circuit breaker four times in ten days while the stock market in the UK and Japan suffered respectively declines of 10 and 20% (Zhang et al. 2020). COIVD-19 had a worldwide impact not only because its widespread but also because the global market is taking an important part in the economy. The quarantine policies caused both the

Y. Zhu (✉)
Baruch College, The City University of New York, New York, NY 10010, USA
e-mail: yi.zhu2@baruchmail.cuny.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_5

stagnation of domestic production and other countries in the same industry chain because of the disruption of logistics. As the worldwide quarantine policies blocked the flow of goods on the international market, the supply chain of products from raw material to final goods fractured (Alkahtani et al. 1662). This kind of fracturing decreased sales while increasing the cost such as warehousing costs, resulting in the downward of many highly globalized industries. Considering highly globalized industries nowadays play a great role in the economy, the impact of COVID-19 maybe even more obvious as it dealt a heavy blow to this kind of industry.

As one of the most globalized industries, the telecom industry is severely impacted by COVID-19. Since stock can intuitively respond to the external stimulus on the market, the Shenwan index of the industry vividly showed the impact of COVID-19 on the industry. With the development of 5G technology and the concept of a meta-universe, the telecom industry has entered a new era. In such an era of alternation between the old and the new, the impact of COVID-19 may be enlarged and have a more obvious effect on future development. Such impact had a two sides effect. On one hand, the physical communication equipment industry such as 5G base stations and data centers suffered a lot because of the limitation on the supply chain. For example, the lack of chips results in stagnation of all related products in the industry and caused a decline in production orders. While on the other hand, new businesses such as telecommuting, video communications, and virtual reality were given a good chance to develop because of the quarantine policies. For example, Zoom's full-year revenue for fiscal 2021 was $2151.4 million, up 326% year over year. How these two contradictory factors act in different fields of the same industry is a question worthy of discussion. Once the impact of COVID-19 on the telecom industry is figured out, the potential risks and the development direction of the industry may both be clearer. Summarizing the past and predicting the future enables people to be prepared in advance to resist risks or seize opportunities, thus promoting the development of the industry and the whole economy.

This paper will focus on the time-varying impact of COVID-19 on the telecom industry, using VAR model and ARMA-GARCH to analyze the data in a quantity way. Based on the telecom industry index and the daily added patients of COVID-19 in China and globally, the paper can figure out how COVID-19 is impacting the industry in the past and speculate on its future impact. The paper will first introduce the meaning and source of the data. Then the data model will be introduced to get the result of daily volatility and the future trend of the telecom industry caused by COVID-19. Finally, the paper will give some suggestions to the policymakers and investors based on the result of the data model.

2 Literature Review

The impact of COVID-19 on the finance and economy is a widely discussed topic in the paper. The extant paper can be divided into a few categories: focusing on the market reaction, the policy, and the future industry trend.

First, most existing papers focus on the market reaction. Papers focusing on the market reaction usually pay great attention to the stock fluctuation. Since the stock price shows investors' willingness in trading them, the price can reflect investors' knowledge of the market situation. This kind of knowledge is the combination of cognition of the present and the expectation in the future, which will form a market reaction. Moreover, since the stock price is institute numbers, it can be analyzed in a quantitative method, which may be considered more visual and objective. These papers take the idea that stock can be a significant sign of the market reflection and uses the stock price fluctuation to represent the time-varying impact of COVID-19. *COVID-INDUCED ECONOMIC UNCERTAINTY* uses stock market volatility as raw material, finding that about half of the forecasted output contraction reflects a negative effect of COVID-induced uncertainty (Baker et al. 2020). However, these papers usually focus on the whole stock market of a country or an area to see the impact of COVID-19 on a broader financial and economic situation. For example, a paper researching the stock market in Saudi finds that the impact of COVID-19 is insignificant no matter the return or volatility (Wasiuzzaman 2022). Considering this paper will focus on the telecom industry, while still taking stock price as the reflection flag, this paper only analyzes the telecom sector. Such focus will help the investors who are interested in this industry to have a more specific and concentrated analysis as well as help them to make further decisions.

Second, some existing papers focus on the policy. The paper focuses on the policy and usually discusses the impact of COVID-19 from a macro perspective. In these papers, macro-control done by the government is usually discussed. Usually, the macro-control is divided into two parts: economic recovery and economic development. In the economic recovery part, the government aims at dispensing the negative impact of the epidemic as soon as possible. The usual measures include the resumption of work and production, the restoration of the overseas market, assistance and subsidies to affected enterprises, and the provision of special loans (Wang et al. 2020). The economic recovery plan is conducted to ensure residents' income and employment as well as the annual economic income target. In the economic development part, the government aims at deciding the weaknesses needed to be remedied and the future direction benefiting the development. The weakness is primarily concentrated in the medical industry while the development direction takes digitization as a key. Once the digital economy becomes the key target of economic development, considering digitization is closely related to the telecom industry, these policies will greatly affect the industry from hardware facilities to software platforms (Codreanu 2021). This paper will refer to and summarize the policy discussed in the extant paper to analyze the subsequent continuing impact of COVID-19 has been subsided.

Finally, besides the macro forecast, many extant papers about the future trend focus on a specific industry, which can be a good reference for this paper. According to the papers focus on the telecom industry, the general trend of developing 5G will not be hindered by the unstable production caused by COVID-19. With the resumption of work and production, the construction of 5G steps into the designed path again. And at the same time, COVID-19 will accelerate the construction of information and communication infrastructure and promote the upgrading of network

intelligence (Liang 2020). For example, even after the end of quarantine, people's living and working habits have already changed. Online business has become a necessity, which assists the development of virtualization business. The development of such a business needs the support of hardware equipment as well as powerful data processing capability. All these demands can be the future developing trend for the telecom industry. However, these papers usually do qualitative analysis instead quantitative ones, which may not visually reflect the degree of change and hinder the accurate measurement of development space. So, this paper will use models to prove the potentiality brought by COVID-19 and come into a more intuitive extent of change.

3 Model Specification

3.1 Data Resource

This paper aims at revealing the time-varying impact of COVID-19 on the telecom industry in a quantitative method. This paper uses the daily increase of new crown patients to represent the changes in the epidemic situation and uses the stock price to represent the industry response to COVID-19. All the data are collected from the platform named Choice financial data terminal, which is a Professional financial data analysis and investment management software under Oriental Wealth.

The beginning date of the data recorded is Feb. 3rd, 2020, which is the first day of stock trading after the Chinese New Year. At that time, the government had paid great attention to COVID-19, issuing the policy of city closure and isolation, and people realized the severity of the COVID-19. From then on, the impact of the new crown broke out in an all-around way. The ending date of the data recorded is June 17th, 2022, which is the date the paper is written.

The resource for the daily increasing number of Chinese patients is from the Chinese National Health Commission while the resource for the daily increasing number of oversea patients is from the WHO. The total increase of COVID-19 patients is the sum of daily increases in China and oversea. The impact of COVID-19 will increase as its scope of influence has become wider. So, the daily increase of patients can be a good standard to measure the epidemic degree.

The resource of the stock price of the telecom industry is from the telecom sector of the Shenwan index. Shenwan index is an industry stock index released by Shenwan Hongyuan securities research, which is referred by many other domestic security companies to do industry analysis (Li 2008). Shenwan has 28 primary industries and telecom is one of them. In the telecom industry, the index includes telecom equipment as well as telecom communication operation. Considering the authority, representativeness, and generality, this paper uses the Shenwan index as the stock price to represent the impact of COVID-19. The fluctuation of stock price can be one of the most obvious signs that reflect the impact of events on the industry because

the stock price is the investors' perception of the expected value. So, the price of the stock can vividly show how the telecom industry is impacted by COVID-19 at a quantitative level.

3.2 Sample Unit Root Test (ADF Test)

The stationarity of time series data must be tested first before any analysis about it is done since there is no need to study an unsteady sequence. The unit root test is one of the most effective and widely used ways to check the stationarity of the sequence.

The formula to test the stationarity is:

$$x_t = c_t + \beta x_{t-1} + \sum_{i=1}^{p-1} \varnothing_i \Delta x_{t-i} + e_t \tag{1}$$

If $\beta = 1$, there is the unit root, meaning that the time series is not stationary and there is no need to analyze. If $\beta \neq 1$, there is no unit root and the further analysis of the time series is meaningful.

The original hypothesis of the ADF test assumes that $H_0 : \beta = 1$ while its alternative hypothesis assumes that $H_1 : \beta < 1$. The $ADF\ test = \frac{\hat{\beta}-1}{standard\ deviation\ of\ \hat{\beta}}$. If the calculation result is too large, meaning that it will reject the original hypothesis, which assumes that the time series is not stationarity. Or, the P-Value can be used to decide whether to reject the original hypothesis or not. If the P-Value < 0.05, the original hypothesis will be rejected and further analysis of the time series can be done.

In this paper, the new confirmed cases in China and global are both stationary time series. Although the telecom index is not stationary, its log rate of return is stationary, which means it can use the yield telecom index to do further analysis (Table 1).

Table 1 ADF test

Variables	t-statistic	p-value
New confirmed cases, the global	− 5.3190	0.0001***
New confirmed cases, China	− 8.3890	0.0000***
Telecom index	− 2.7610	0.2117
Telecom index, yield	− 16.2050	0.0000***

3.3 VAR Model Setting

In 1980, Sims put forward the Vector Autoregression model, whose short name is VAR model. It is a model that predicts multiple variables as a system, which enables the prediction to be mutually consistent.

For a VAR consisting two time series variation $\{y_{1t}, y_{2t}\}$, the formula is:

$$\begin{cases} y_{1t} = \beta_{10} + \beta_{11} y_{1,t-1} + \cdots \beta_{1p} y_{1,t-p} + \gamma_{11} y_{2,t-1} + \cdots + \gamma_{1p} y_{2,t-p} + \varepsilon_{1t} \\ y_{2t} = \beta_{20} + \beta_{21} y_{1,t-1} + \cdots \beta_{2p} y_{1,t-p} + \gamma_{21} y_{2,t-1} + \cdots + \gamma_{2p} y_{2,t-p} + \varepsilon_{2t} \end{cases} \tag{2}$$

When the number of time series variations increases and the corresponding variables are written as column vectors, the formula becomes:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \gamma_{11} \\ \beta_{21} & \gamma_{21} \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \end{pmatrix} + \cdots + \begin{pmatrix} \beta_{1p} & \gamma_{1p} \\ \beta_{2p} & \gamma_{2p} \end{pmatrix} \begin{pmatrix} y_{1,t-p} \\ y_{2,t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \tag{3}$$

The reason that this paper chooses VAR model to do the analysis is that this model is flexible and is not exactly based on the financial theory, which means the factors are not limited to economic ones and more affecting time-series variations are able to be added into the model. In this paper, when analyzing the impact of COVID-19, one of the most important factors is the daily increase of patients, which is not an economic factor. With this VAR model, this important un-economic factor can be included in the model to analyze the impact of COVID-19 on the telecom industry.

3.4 ARMA-GARCH Model Setting

In 1982, Engle pointed out that there is also special heteroscedasticity in time series data, that is, autoregressive conditional heteroscedasticity, whose short name is ARCH. However, when there are several parameters, the sample size will be a loss. To solve this problem and forecast more accurately, in 1986, Bollerslev put forward GARCH model.

The formula of $GARCH(p, q)$ is:

$$\alpha_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \delta_{t-1}^2 + \cdots + \gamma_p \delta_{t-p}^2 \tag{4}$$

The use of GARCH model depends on the need of the analysis. In this paper, the ARMA-GARCH model is used, whose aim is to forecast both yields and volatility at the same time. When the mean of the GARCH equation is set as ARMA, it becomes a random process, whose mean value satisfies ARMA process and the residual satisfies GARCH process. In this process, the result will show the mean value as the expected return and the variance as the risk at the same time.

4 First Section Empirical Results and Analysis

4.1 VAR Order Identification

After setting a VAR model, the order identification of *P* must be done in order to decide the optimal choice in the lag period. After inputting the instructions in the Stata, the order identification of *P* can be chosen based on the significance, which is marked by an asterisk logo. In general, the *P* should be a value of moderate. If *P* is too small, the residuals may be autocorrelated, leading to inconsistent parameter estimation. If *P* is too big, the number of parameters to be estimated increases and the degree of freedom decreases, reducing the validity of the model parameter estimation.

Based on the principle to identify the order identification and the VAR model identification done by Stata, the order identification should be 7 since its LR, AIC, HQIC are all marked by asterisk logos, which means no matter take which of them is the standard, the P is the same. As a result, in this case, the lag order of the VAR model is seven.

After setting the VAR model and identifying the order selection, a test must be done in order to make sure that the residuals are not autocorrelated and are normally distributed, which means the VAR system is a stationary process.

After inputting the data into Stata, Fig. 1 VAR stability shows that all the roots of the companion matrix are inside the unit circle, which means the VAR model whose *P* is seven is stable and further analysis can be done based on this model (Table 2).

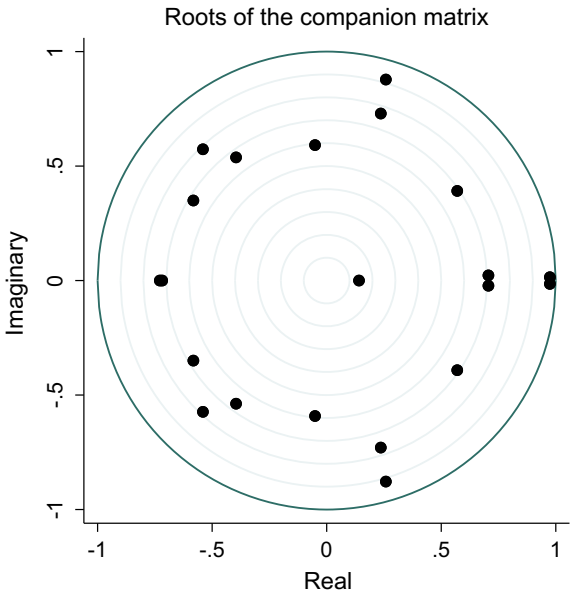


Fig. 1 VAR stability

Table 2 VAR model identification

Lag	LL	LR	df	*p*	FPE	AIC	HQIC	SBIC
0	− 473.5110				0.0010	1.6837	1.6927	1.7067
1	944.908	2836.8000	9	0.0000	0.0000	− 3.2964	− 3.2605	− 3.2045
2	944.9080	117.9100	9	0.0000	0.0000	− 3.4730	− 3.4101	− 3.3120
3	1003.8600	64.5910	9	0.0000	0.0000	− 3.5553	− 3.4655	− 3.3253
4	1036.1600	106.7300	9	0.0000	0.0000	− 3.7120	− 3.5954	− 3.4131*
5	1089.5200	34.3450	9	0.0000	0.0000	− 3.7409	− 3.5973	− 3.3730
6	1106.7000	35.6520	9	0.0000	0.0000	− 3.7721	− 3.6016	− 3.3352
7	1124.5200	45.4020*	9	0.0000	0.0000*	− 3.8205*	− 3.6231*	− 3.3146
8	1147.2200	8.1275	9	0.5200	0.0000	− 3.8031	− 3.5787	− 3.2282
9	1151.2900	11.6190	9	0.2360	0.0000	− 3.7918	− 3.5405	− 3.1479
10	1157.1000	10.840	9	0.2870	0.0000	− 3.7792	− 3.5009	− 3.0663
11	1162.5200	7.8075	9	0.5540	0.0000	− 3.7612	− 3.4560	− 2.9793
12	1173.8900	12.9310	9	0.0930	0.0000	− 3.7557	− 3.4237	− 2.9049

4.2 Impulse Response

Based on impulse response estimates, it is clear that COVID-19 has impacted the telecom industry in both China and globally, but the extent of effects is different.

In terms of the Chinese epidemic, when the number of confirmed COVID-19 cases increased by 1% in the current period, the return rate of the communications industry will change significantly in the next six periods. In the first three periods, the yield fell by about 0.2%, and then turned positive, which is also around 0.2%. Accordingly, the impact of the domestic epidemic on the communication industry will be positive and negative offset. With the passage of time, the effect gradually decreased around the 10th phase and finally disappeared. This impulse and response result is consistent with the fact that the COVID-19 brought both risks and chances to the telecom industry. Based on this result, it is estimated that after 10 phases, the industry will enter into a new stable stage. At that time, the residual effects of the COVID-19 have been eliminated and the accelerated digital transformation caused by the epidemic has been completed (Fig. 2).

In terms of the global epidemic, the number of confirmed COVID-19 cases worldwide will lead to continuous fluctuations in the profitability of the communications industry in the future. Although this effect will gradually diminish and disappear over time, it will last significantly longer. This result indicates that the communication industry is more affected by the global epidemic. There is evidence showing that the anticipated real effects will be amplified through financial channels (Ramelli and Wagner 2020). Since the industry is highly globalized, the COVID-19 and quarantine greatly lead to the stagnation of materials, goods, and capital, which leads to the rupture of the supply chain and capital chain. Such negative effects will soon cause Chinese industries to suffer industry turmoil.

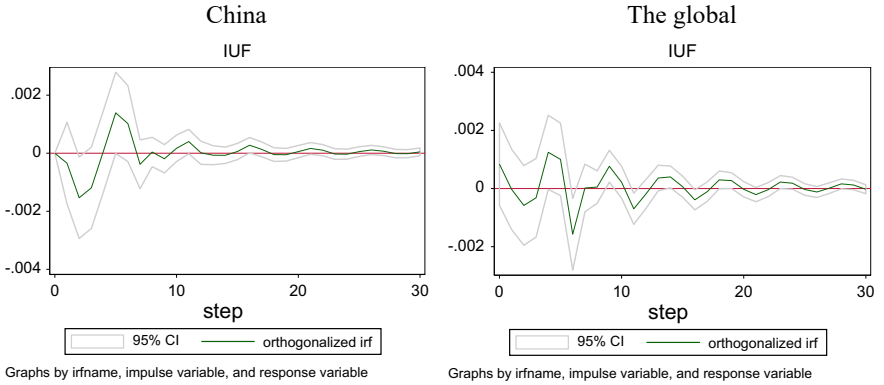


Fig. 2 Impulse and response

4.3 ARMA Order Selection

The use of ARMA model requires that it should be a stationary time series. As a result, the order identification must be done to make sure that the time series can be further analyzed.

According to the result of PACF and ACF, the larger order corresponding to the point that goes beyond the confidence interval can be chosen as the order selection. As a result, the order identification of PACF and ADF can both be 14 (Fig. 3).

4.4 ARMA-GARCH Estimation Results

After using ARMA-GARCH model, the yields and volatility can be predicted at the same time. According to the variance equation estimation results of ARMA-GARCH model, the number of COVID-19 confirmed cases in the current period did not cause the daily volatility of the return rate of the communications industry to increase (Table 3).

Combined with the pulse diagram, the conclusion can be drawn: COVID-19 has a time-varying impact on the yield of the communications sector but has little impact on daily volatility. If the COVID-19 is not eliminated, its impact will be a long-lasting and continuous process, which means the volatility in the telecom industry brought by the COVID-19 has become a stable trend and will not be faded in a short term.

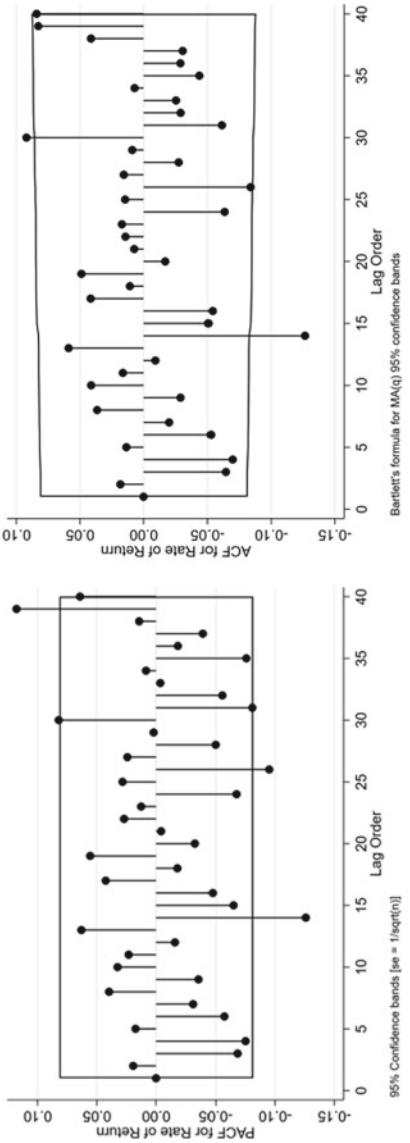


Fig. 3 PACF and ACF

Table 3 ARMA-GARCH estimation results, variance equation

Variables	(1)		(2)	
	Coef.	Std. err.	Coef.	Std. err.
New confirmed cases				
The global	− 0.0001	0.0005		
China			− 0.0001	0.0005
GARCH				
ARCH (− 1)	0.0624***	0.0160	0.3768***	0.1333
GARCH (− 1)	0.9218***	0.0172	0.9460***	0.01640
Constant	− 10.1824***	1.9881	− 13.7244***	0.7797

5 Discussion

With the quantitative data analysis according to the VAR model and ARMA-GARCH model, the paper not only proved the reliability of the extant paper but also gives more information in detail. The outcome of the model is consistent with the analysis that COVID-19 brought both risk and opportunity to the telecom industry, but it gives a more accurate on how long will these impacts last. According to the model, the greatest change of yield in the telecom industry is accurate in the first six phases and the effect of the positive and negative offset will end in the tenth phase. Such exact period prediction has not been shown in other papers.

For governments, it is a good chance to develop digitization since COVID-19 not only reflects the necessity of digitalization but also has laid the foundation for such change. The government needs actions to revitalize the economy. Considering that digitalization has already been listed on the development plan, the paper suggests that paying more attention to the telecom industry may be a good choice. The policies such as long-distance working have already changed people's living habits and the necessity of a sound digital information system is clearly shown (Gao 2022). Developing the telecom industry is a thing.

For investors, the time node makes it clear how long investors have to insist on in such a turbulent situation and how much time is left for them to catch the chance of investing. The great impact of COVID-19 will last for at least 6 phases. During that time, huge benefits are accompanied by huge risks, so investing in the right subsection is important for investors. At that time, compared to traditional telecom businesses, digital businesses such as long-distance office software and visual communication may be a better choice. After the sixth phase, traditional physical equipment can be taken into consideration because the negative effect of COVID-19 caused by a broken supply chain has faded. At that time, with the policy of digital transformation, the demand for the telecom industry will increase in both hardware and software (Chen 2021). The good chance of investing will last until the tenth phase. After that, the impact of COVID-19 will be eliminated and the demand and yield in that industry may return to a normal scale.

However, there is room for improvement in this paper. The Telecom industry is a general term. There are still many sub-sections included in it as well as many related upstream and downstream industries. To get a comprehensive cognition and forecast of the industry's future, more detailed work should be done. It is recommended that the impact of COVID-19 in each sub-section or related industries should be taken into consideration.

6 Conclusion

COVID-19 brings a great impact on both the oversea and Chinese telecom industries. From the aspect to an extent, the impact of COVID-19 is more obvious oversea. As a result, the effect of the negative impact of COVID-19 is transmitted from abroad to China, setting up a reaction on a global scale. China suffers a lot at the beginning of COVID-19. Over the first three periods, yields fell by about 0.2%. However, positive impacts are also brought about. The yield soon turns to be positive, also around 2%. The positive and negative effects strongly act on the telecom industry during the first six periods, making the return rate change greatly during that period. It is shown that the positive and negative effects will offset each other. As time passes by, it is estimated that after about ten phases, such an effect will gradually reduce and eventually disappear. Although the same effect will also happen oversea, it will take a longer time to eliminate the impact of COVD-19. The increase in COVID-19 patients doesn't cause the increase in daily volatility of returns in the telecom industry. The insignificant daily volatility shows that the impact of COVID-19 will be a long-term steady impact applied to the telecom industry.

References

Alkahtani M, Omair M, Khalid QS, Hussain G, Pruncu C (2021) A COVID-19 supply chain management strategy based on variable production under uncertain environment conditions. Int J Environ Res Public Health 18(4):1662

Baker S, Bloom N, Davis S, Terry S (2020) COVID-induced economic uncertainty. NBER working papers, 26983

Chen Y (2021) The impact of COVID-19 on the telecom operation market and its prospects. Communications World, 3, pp 13–14

Codreanu C (2021) The benefits of digitization for small and medium enterprises. Department of Economics, 28, pp 100–106

Gao W (2022) Video conferencing will become a habit after the COVID-19. China Brand, 5, pp 54–55

Li Q (2008) Structural test and factor analysis of the effectiveness of Chinese stock market. J Zaozhuang Univ 25(1):34–40

Liang X (2020) How are operators affected by the COVID-19. Communications World, 6, pp 30–31

Ramelli S, Wagner AF (2020) Feverish stock price reactions to COVID-19. Rev Corp Financ Stud 9(3):622–655

Wang K, Zhou W, Liu Y, Zhang B (2020) The impact of COVID-19 on the development of China's information and communication industry. China Telecommunications Trade (4), pp 30–32
Wasiuzzaman S (2022) Impact of COVID-19 on the Saudi stock market: analysis of return, volatility and trading volume. J Asset Manag 23(4):350–363
Zhang D, Hu M, Ji Q (2020) Financial markets under the global pandemic of COVID-19. Finan Res Lett 101528

The Importance of Compensation from Different Aspects: A Study of Akamai Inc.

Si Chang

Abstract In today's society, more and more companies are focusing on how to maximize the benefits of their company using compensation concepts. This paper examines the importance of compensation by analyzing Akamai Technologies' executive compensation changes from 2015 to 2021 and comparing Akamai to Meta and draws three important conclusions. First, pay for performance as part of the compensation plan addresses agency issues and motivates employees to work hard, while the presence of base pay provides an incentive for employees to be reluctant to work. In addition, the company's compensation philosophy protects the interests of both employees and the company. It aligns the interests of shareholders and employees, attracts competent people, maintains fairness in the workplace, and regulates the behavior of employees. Finally, the paper discusses that compensation in ways other than money is also an important factor of attracting talent. It is more stimulating for employees to be rewarded according to the benefits each individual needs than to be rewarded with money only.

Keywords Compensation · Incentive · Performance-based

1 Introduction

Today, compensation is becoming a strategic lever for companies. As trends in the job market continue to change, companies are constantly adjusting the compensation they assign to employees to determine whether they are paying fair or competitive compensation compared to other companies. It must be complete and at the level of employee satisfaction. In order for employees to come and contribute to the organization, the organization needs to offer attractive enough conditions. In today's war for talent, competitive compensation can help companies attract or retain quality management team talent. In addition, it can motivate employees to

S. Chang (✉)
University of Toronto, Toronto, Canada
e-mail: norachangsi.chang@mail.utoronto.ca

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_6

work hard and produce excellent performance. An effective compensation policy is critical to a company. Performance-enhancing compensation practices are designed to increase employee productivity through greater accountability while highlighting performance differentials across employees (Samnani and Singh 2013).

There are several key trends in compensation management. First, more companies are starting to use long-term incentives. Originally, companies rewarded good employees by paying them a one-time bonus. Companies now offer long-term compensation incentives such as stock or options to better align the interests of the employee and the company. Besides, firms have focused much more on other benefits than monetary rewards. For example, some companies offer compensation in the form of insurance, pensions, and employee discounts.

2 Definition

2.1 Definition of Compensation

Research provided the definition of compensation in his research. Compensation is the reward that workers receive for their service or contribution to the organization (Salisu et al. 2015). It's sum of an employee's monetary and non-monetary income supplied by an employer. It is paid in wages, salaries, and employee perks such as paid vacations, insurance, maternity leave, free travel, retirement benefits, and so on. Bonuses, profit sharing, extra compensation, recognition prizes, and sales commission are all included. Non-monetary benefits can also include a company-paid automobile, stock options in some cases, company-paid housing, and other non-monetary yet taxable income items. Compensation is a type of compensation system that companies offer to employees in exchange for their willingness to undertake various professions and duties inside businesses. Compensation management is a broad strategy that aims to assist a business to optimize the value of its available personnel. The ultimate objective is to reward the appropriate individuals the most for the most important reasons (Larbi 2014).

2.2 Definition of Incentive

Incentives are rewards offered for achieving pre-determined goals that are closely tied to performance and have a beneficial impact on the employees' objectives and organizational success. Incentives are used to drive people to perform better, and they reward variations in performance. Incentives are prizes that are given in addition to the base compensation or salary, and they are generally directly tied to performance. They are awarded to motivate employees to go above and beyond standard performance

goals. They encourage people to contribute above and beyond the typical level of expectation (Osibanjo et al. 2014).

2.3 Definition of Performance

Employee performance is defined as the successful execution of a job, duties, or assignment by a selected employee or group of employees based on a set of performance objectives and an indication of efficiency and effective resource use (Dewhurst et al. 2010).

Employee performance will influence the organization's fate. Employees indirectly increase profit through hard effort and strong performance in raising productivity (Acero and Alcalde 2020).

2.4 Agency Problem

In today's society, the fairness of executive compensation levels has become a point of debate. The main problem is the lack of transparency of information about board remuneration. The board of directors and managers can create agency problems due to conflicts of interest. Directors are paid differently depending on their skill sets, knowledge, and human capital such as experience. This explains the variation in compensation within companies. The study shows that the size of the firm is the variable that best explains the differences in compensation between firms. In addition, the compensation of non-executive directors appears to be set for a group of individuals as a whole, while the compensation of executive directors is based more on the unique characteristics of the firm. This paper examines the determinants of directors' remuneration in Spanish-listed companies based on drawing on agency theory and human capital theory. The authors use a multilevel approach to determine which types of variables (firm-level variables or director-level variables) have the greatest impact on explaining differences in directors' remuneration (Kadir et al. 2019).

3 Method

The authors used the Secondary Data Analysis approach because it is suitable for answering analytical questions and does not require money and a lot of time to collect data. Akamai Technologies was used as the subject of this article because of its typical compensation structure and the completeness of the data it can provide. The article compares the change in management compensation at Akamai Technologies from 2015 to 2021. Akamai executives' compensation consists of base salary and stock.

First, by looking at the percentage of base salary and stock respectively to total compensation for each year, it is concluded that stock, as an incentive reward, is increasing year over year. The number of base salaries has not changed significantly over the years and is relatively stable. Next, the compensation philosophy of this company was analyzed. The compensation philosophy was included as part of the study because Akamai's philosophy has remained largely unchanged in recent years. This indicates that these compensation philosophies must be largely beneficial to the company's compensation distribution. Finally, another subject, Meta Corporation, was added as a cross-sectional comparison. By comparing the stock value, company size, and future prospects of the two companies, it is shown that compensation is not the only factor considered by competent candidates when choosing a company.

4 Data

Akamai Technologies, Inc. was founded in the United States in 1998. It is headquartered in Cambridge, Massachusetts. It is a U.S. content delivery network (CDN), network security, and cloud services provider specializing in online and Internet security. The company launched its commercial services in April 1999 and was listed on the Nasdaq Stock Market on October 29, 1999. The company's turnover has been on an upward trend, reaching $2.3 billion in 2016. Akamai has one of the world's largest distributed computing platforms, the Intelligent Edge Platform, which hosts 15–30% of the world's Web traffic. Akamai has deployed the most widely distributed and highly decentralized Akamai has the most widely distributed and highly decentralized content delivery network (CDN) in the world with approximately 325,000 servers in nearly 1500 networks in 130 locations. The company leases capacity on its own operating servers to customers who want to speed up their sites by delivering content from locations near their users. Each year, the Company issues a proxy statement and an informational statement containing detailed executive compensation data and other important compensation-related information. Base salaries for Akamai Board members have remained the same since 2015 at $50,000. Performance-based compensation (e.g., stock) represents 75% of total compensation, and Akamai maintains the majority of stock awards in its compensation program.

This paper uses Akamai Technologies as the primary study, compares its compensation plans from 2015 to 2021, analyzes the setup and changes in its compensation plans, as well as this company's compensation philosophy, and explores the reasons behind these plans. Meta and Akamai are also compared to analyze the pros and cons of attracting talent at both companies to examine the importance of compensation plans for companies.

5 Results

5.1 Performance-Based Salary Can Solve Agency Problem

Performance-based pay can motivate employees to work harder. The poor compensation and benefits will lead to low performance and that will lead to low satisfaction level that will increase absenteeism in employee and the outcome will decrease (Acero and Alcalde 2020). Take Akamai as an example. Akamai has released proxy statements from 2015 to 2022. Akamai's compensation for members of the Board of Directors consisted of base salary (paid in cash) and stock awards. Non-employee directors receive an annual income of $300,000 per year, of which $75,000 is paid in cash and $225,000 is issued to them in the form of DSUs. The Chairman, Vice Chairman, and Lead Director of the Board are entitled to receive an additional $40,000 in annual compensation, of which $20,000 is paid in cash and $20,000 is paid in DSUs. Different committee chairs receive different amounts of additional compensation from the Company. Most of the compensation is awarded in the form of stock. For NEOs, their compensation consists of a base salary, a cash bonus, and a long-term incentive, of which the base salary is only a small part. The company prefers to use a large number of RSUs to get shareholders to work harder and improve performance because the company's performance affects the value of the stock and ultimately the benefits that shareholders receive at the end of the day. However, in 2017, the company introduced TSR as a measure of the equity incentive plan. In addition to that, for performance-based incentives like RSUs, the company converted the original vesting period to a three-year cliff vesting period. And, by making the company's financial metrics the sole target for distributing awards, Akamai better aligns the interests of NEOs with the company's principles. It is clear to see that Akamai, as a large, developed technology company, insists on using stock as part of compensation and increases the percentage of total compensation in stock each year.

5.2 Compensation Philosophies Are Indispensable for Companies

The compensation philosophy is a guiding statement based on the company's values, direction, and strategic goals. It regulates the behavior of employees and prevents them from doing things that are not in line with the company's philosophy.

Akamai Inc. has six compensation philosophies. (1) Pay for performance. The compensation philosophy of the company always helps align executive compensation with performance. Employees are paid for their performance. The compensation is directly related to employees' performance and Akamai's profitability. (2) Stockholder alignment. Executives should have the same interest as the long-term interests of the stockholders through stock-based compensation. Therefore, mismanagement and low employee productivity can be inhabited. (3) Long-term focus. Short-termism

will undervalue the ability of the company to invest and grow. (4) Balance. Long-term incentive compensation should reward the suitable balance of short- and long-term financial business results. (5) Competitive. The company makes sure the total compensation is strong enough to be competitive in the market in order to attract and motivate a competent management team, which can maximize the company's performance. (6) Responsibility. Compensation should take compensate based on each executive's responsibility to act following the company's ethical objectives all the time. No interest should compromise this value.

So, the benefits of a compensation philosophy are obvious. First, it helps companies attract and retain competent people. In today's society, where the battle for talent is increasingly fierce, high salaries are just a gimmick to attract new talent to a company, and there will always be companies that offer higher salaries. Only when those people see that the company's compensation concept is in line with their own ideas, the company will stand out from the crowd. Compensation philosophies increase employee satisfaction because they are in line with employees' perceptions and are fair and transparent. This motivates employees to perform more efficiently and with quality. Employees are also motivated to stay in the company and achieve better results. Secondly, the compensation philosophy monitors the company to achieve equal pay for equal work. This means that employees who do essentially the same job are paid the same, eliminating unfairness and discrimination in the workplace, and strongly protecting the interests of employees. The compensation concept protects both the interests of employees and the interests of the company.

5.3 The Combination of Multiple Pay Structures is Key to Attracting Talent

When choosing to join a company, salary is the most intuitive and the first factor that capable people will take into account. A high salary will certainly attract many people, but other compensation plans are also a point of concern for candidates. When employees are rewarded based on their excellent work performance, some need a bonus, but others may need other benefits. Although a package including many costly benefit options might be the most costly, its value to employees might fall short of the value attached to a less costly package of benefits that is better tailored to employee needs or values (Gerhart and Milkovich 2022). For example, an employee with children may prefer to be compensated with an extra vacation so he can spend more time with his children, or some older people may prefer to be compensated with post-retirement benefits rather than money. In these cases, a monetary reward is not as attractive and motivating. In addition, the size of the business, its market value, and future growth are also important. A wise and capable person will choose a company that is large, stable, and has a future worth investing in. A company that combines these criteria has more potential and value so that those who join the company have room to become better and receive a better compensation package. Small, unstable

companies are likely to be suddenly crushed in a competitive business battle and have a hard time recovering.

Compare Akamai to Meta, which is a huge technology company with about 60,000 people, but Akamai is relatively smaller with about 8600 people. Meta also includes security in its director compensation plan for the most and least-equity directors. Obviously, those who can afford to do so will prefer Meta. Meta is also a technology company, but its large size and potential for a bigger future make it stand out in the battle for talent.

6 Discussion

According to Cooke, base pay as a fixed variable can be seen as control while performance pay as a variable can be seen as an incentive (Cooke 1999). The base salary guarantees a fixed income for each employee regardless of the degree of their effort, while the performance-based salary is totally depending on employees' work performance. Pay for performance is set up so that employees know that the harder they work the more they will be rewarded. The positive effect of incentives is used as a lead to show employees what organization wanted to accomplish and what they assess and prioritize as significant to their work (Acero and Alcalde 2020). Companies set up performance-based pay to provide clear guidelines on the criteria for performance evaluation, leading them to accomplish the goal that matters to the organization. Agency will be solved in this way. Companies align their interest with employees' interests by tying their rewards with firms' profitability since they both want companies to prosper and the stock price to rise. Akamai recognizes the importance of pay for performance, which is why it insists on maintaining stock at about 75% of total compensation. This allows for a high degree of alignment between the interests of shareholders and employees.

A good compensation plan cannot be achieved without a sound compensation philosophy. The compensation philosophy conveys the culture of the company. It communicates to employees the concepts and behaviors that the company promotes and opposes. The fundamental requirement is that the compensation philosophy provides for a consistent, aboveboard approach to pay (Aronoff et al. 2011). Fairness and transparency are essential requirements of the compensation philosophy. This protects the rights of employees while providing clearer guidance on what is important to the company.

When rewarding employees, companies should also arrange different strategies depending on the specific needs of the employees. Some people need a promotion, some choose to have more bonuses, and some want more vacation time. When a candidate chooses between companies, he will not only consider the company's salary and benefits, but the company's prospects are also very important. Competent candidates will choose a larger and more stable platform to develop their strengths.

7 Conclusions

Compensation plans for large companies have been widely studied and discussed from the past to the present. There is a lot of literature on this subject in the academic field, but there is little analysis of the compensation philosophy and the impact it has when salary is combined with other pay structures. This paper summarizes the functionality of compensation plans and their associated factors in companies by comparing Akamai's executive compensation plans from 2015 to 2021 longitudinally and comparing different companies' compensation plans horizontally.

This evidence shows that a compensation plan is one of the most important parts of a company. It can help companies solve agency problems. When a significant portion of compensation comes from performance, the interests of individual employees become aligned with those of shareholders. Employees' hard work will affect the company's profitability, and the company's profitability will provide significant rewards to employees. At this point, employees will not just be limited to the momentary benefits of slacking off, they will want the company to be profitable as much as the shareholders do. A good and reasonable compensation plan is very attractive to capable people. Their competence and effort will be guaranteed. A compensation plan helps the employer to have good control over the company's expenses. It attracts and retains competent candidates for the company and remains competitive for the employer because quality people believe they deserve better. When a great package meets a scarce talent, they hit it off. It also motivates employees to work hard to get more in return. At the same time, since parts of the compensation plan are performance-based, the more capable the employee is, the more he or she will be rewarded, and then the under-performers will quit because they don't get paid what they expect over time. This helps the company filter out unproductive and unskilled employees and improves the overall performance of the company. More importantly, it creates a fair opportunity for salary increases. Compensation plans are based on a compensation philosophy. The compensation philosophy helps employees better understand the company's corporate culture and also gives them a clear mechanism for salary increases. The compensation philosophy is fair and transparent and protects the interests of each employee while regulating them not to do things that are not in line with the company's philosophy. The compensation plan includes not only monetary compensation, but now candidates also value other benefits included in the plan. Employees in different life circumstances desire different rewards, and it is only effective to provide the benefits they need. The size and market value of a company and its future growth potential are also important factors in a candidate's choice to join a company. People prefer to join large, stable, growing companies for superior compensation plans.

However, there are some shortcomings in this study. First, most of the examples in this paper are limited to one company, Akamai, and the conclusions are not generalizable or representative. It may be similar to companies in the technology sector, but it may be different from other industry sectors. Second, other pay structures are discussed in this paper, but Akamai, as the main subject of the study, has no

special other benefits for executives, which is not convincing enough. Future studies that consider these shortcomings and include a larger sample to study the impact of compensation plans could increase the generalizability of the findings and provide more insight into the issue.

References

Acero I, Alcalde N (2020) Directors' compensation. What really matters? J Bus Econ Manag 21(1):180–199. https://doi.org/10.3846/jbem.2020.11788

Aronoff CE, Mcclure S, Ward JL (2011) Family business compensation. Springer. Palgrave Macmillan. Retrieved 7 July 2022, from https://doi.org/10.1057/9780230116009.pdf

Cooke EF (1999) Control and motivation in sales management through the compensation plan. J Mark Theory Pract 7(1):80–83. https://doi.org/10.1080/10696679.1999.11501822

Dewhurst M, Guthridge M, Mohr E (2010) Motivating people: getting beyond money. McKinsey Quarterly (1), 12–15

Gerhart B, Milkovich GT (2022) Employee compensation: research and practice. Center for Advanced Human Resource Studies. Retrieved 6 July 2022, from file:///Users/apple/Downloads/Employee_compensation_research_92_26.pdf

Kadir AA, Al Hosani AAHH, Ismail F, Sehan N (2019) The effect of compensation and benefits towards employee performance. Research Gate. Retrieved 7 July 2022, from https://www.researchgate.net/profile/Fadillah-Ismail/publication/336337211_The_Effect_of_Compensation_and_Benefits_Towards_Employee_Performance/links/60e2f449a6fdccb74506d5c5/The-Effect-of-Compensation-and-Benefits-Towards-Employee-Performance.pdf

Larbi A (2014) Effect of compensation management on employee performance at the St. Michael's Catholic Hospital, Pramso. Retrieved 7 July 2022, from https://d1wqtxts1xzle7.cloudfront.net/50350074/-submit-with-cover-page-v2.pdf?Expires=1657179037&Signature=HxHsqIQYfT6xyD1NhrsNrbQaLBl~DALu8I4eVKycr4MYuBcpTELcEdLWeOdp0zvLdSLPRRe5TnZTllnHNzqJjR0-JpSyLCBseQmlfU-P5-zs18ZsmzZwihJh9HzYp2taikT~nT~UPqDh4~AzlEtDbrC38roP78Pknt85YF6bfkGGFYyzsgn8TsWlnf~2yxm7HxuXY1nORNnU6EcWllRCE0HjUtnFzsiMskQelWovHl1u~hrxhCvPbBGHYFyNkud2fQlFVb5WMJGumi7sQmw8brVicMtxBnGMDumjCBgeqSbxQOtxImhaOtNrwdRC~PY-QuIbsGEzMobqmNj~23haMw__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA.

Osibanjo OA, Adeniji AA, Falola HO, Heirsmac PT (2014) Compensation packages: a strategic tool for employees' performance and retention. Leonardo J Sci. Retrieved 7 July 2022, from https://images.template.net/wp-content/uploads/2018/02/065_0848.pdf

Salisu JB, Chinyio E, Suresh S (2015) The impact of compensation on the job satisfaction of public sector construction workers of Jigawa state of Nigeria. Bus Manag Rev 6(4):10–11

Samnani Al-K, Singh P (2013) Performance-enhancing compensation practices and employee productivity: the role of workplace bullying. Hum Resour Manag Rev JAI, 14 Sept 2013, https://www.sciencedirect.com/science/article/pii/S105348221300048X?via%3Dihub

2022 Russo-Ukrainian War and the Subsequent Sanction in Relation to Commodity Volatility

Ji Yu, Ying Xie, and Zihan Yin

Abstract Russia is a European leading exporter of commodities like nickel, wheat, and so forth, and its export volume ranked 7th in Europe in 2020. We use principal component analysis within the range of time from April 1st, 2021 to April 27th, 2022, to do a comparison of the price changes during this time period. The Russo-Ukrainian war and sanction led to huge turmoils in those commodity markets. Commodities like nickel, aluminum, corn, soybean, wheat, gold, silver, oil, LNG, and silver are obviously affected by the Russo-Ukrainian war and sanction. The EURO STOXX 50 and the ruble to U.S. dollar exchange rate are also influenced by the incident and its following sanction. The impact can be observed by their price changes, which will be discussed in this article. As commodities are geopolitically vulnerable, the finding of this paper can be used by investors as an alternative reference to analyze the price changes caused by war and sanction and make investment strategies wiser.

Keywords Commodity market · Commodity price volatility · Russo-Ukrainian war · Principal component analysis

1 Introduction

The commodity market is where people buy, sell and trade raw materials and primary products. There are three categories of commodities: hard, soft, and energy. Hard commodities refer to the resources that must be mined or extracted, like gold. Soft commodities are agricultural products, like corn.

J. Yu (✉)
Department of Finance, Shandong University, Weihai 264200, China
e-mail: 478739905@qq.com

Y. Xie
Department of Math, Syracuse University, Syracuse, NY 13244, USA

Z. Yin
Department of Accounting, Southwestern University of Finance and Economics, Chengdu 611130, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_7

In the first quarter of 2022, Russia invaded Ukraine and the action was announced by President Putin on February 24th. The Russo-Ukrainian conflict was triggered by Russia's desire to prevent Ukraine from joining the North Atlantic Treaty Organization (NATO). Consequently, western countries announced a series of sanctions, including economic sanction targeting Russia. Meanwhile, the Russo-Ukrainian war and its following sanction are significant factors in the markets' volatility.

Russia is the second-largest exporter of crude oil and the 4th largest exporter of LNG in the world. Besides, Russia is also the world's top exporter of wheat, and its soybean exports reached 1.38 million tons in 2021. In addition, Russia has the 4th largest export of aluminum and the 5th largest export of nickel production in the world.

The outbreak of the Russo-Ukrainian conflict in early 2022 was a hot topic recently. We intend to study the price changes of commodities resulted from the Russo-Ukrainian conflict. We chose nickel, aluminum, corn, soybean, wheat, gold, silver, oil, LNG, and silver to represent the whole commodity market. We also study the changes of the ruble to U.S. exchange rate and the EURO STOXX 50, since they also fluctuate intensely after the war. The principal component analysis is applied to help us explain the price changes in the list of commodities, ruble, and the EURO STOXX 50.

2 Literature Research

In Cross-Regional production chains, competitive regionalism, and the deepening of regulatory fault lines in Euro-Asia (Balmaceda and Westphal 2022), the article reveals that a conflict between the growing regionalism course and chains of production which have already existed would wreak havoc. This provides us with the reason why the war between Russia and Ukraine and sanction from western countries on Russia affect the production and prices of commodities severely.

Besides, Changes in the EU's Geopolitical Position and Energy Doctrine in Light of the Ukraine Invasion (Polak and Polakova 2022) contends that Europe can not only diversify supplies but also reduce its aggregate demand for Russian imports while strengthening its strategic position. This embodies the means of sanction imposed on Russia by European countries, and also partly explains the significant decrease in the volume of Russian commodities exported to European countries. The reduced export volume resulted in higher prices of commodities like nickel, aluminum and so forth.

In addition, from Investigating the impact of geopolitical risks on the commodity futures (Mitsas et al. 2022), the author contends that the impact of geopolitical risks to the commodity futures is useful in regulating the efficiency of CME and ICE. Therefore, geopolitical hazard have a non-negligible influence on commodities and the research of them has pronounced research value.

Moreover, in Energy Crisis: Metals at Historic Highs (Energy Crisis: Metals at Historic Highs | GoldBroker.com 2021), this article claims that the prices of metal

commodities, such as aluminum, nickel, gold and silver, are particularly sensitive to fluctuations in energy markets. In fact, on average, energy accounts for roughly one-third of input costs for the metal. The price changes of these commodities even affect each other. For example, 73% of silver is extracted from other metals, like zinc (Silver, Explained 2022). As a result, if the price of zinc changes, silver's price changes as well. From the stoxx.com, the EURO STOXX 50 is defined as a representation of supersector leaders in Europe, which reveals that the change of the EURO STOXX 50 is highly relevant to the fluctuations of the commodity market.

Principal component analysis can be used as a method which is conducive to the data analysis process more visualized (Sartorius 2020), which projected the main advantage of principal component analysis. To apply this research method to this article, we chose two articles, respectively the Term Structure of Crude Oil Futures Prices: a Principal Component Analysis (Lautier 2005), and which types of commodity price information are more useful for predicting US stock market volatility? (Liang et al. 2020). One identifies the movements of the crude oil futures prices' curve and the contribution of components to volatility, and the other uses the principal component analysis to investigate the factors influencing the U.S. stock market.

Furthermore, data collected starts from February 24th, 2022, when the conflict between Russia and Ukraine began (100 Days of War in Ukraine: A Timeline n.d.).

3 Data

News used was mostly retrieved from Reuters, a website which provides financial news and is one of the largest news agencies in the world. We compile the daily closing prices of commodities from Wind, Investing.com, and Yahoo Finance. All missing data is filled with previous value.

The Wind is an authoritative provider of financial data in mainland China. Investing.com is the world's 4th largest financial website, providing real-time quotes and financial news information. Yahoo Finance also provides financial data.

4 Methodology

The basic idea of principal component analysis (PCA) is to explain the internal structure among multiple variables by a few principal components (PC). That is, deriving a few PCs from the original variables (reducing the number of dimensions) while making them retain as much information as possible about the original variables and be uncorrelated with each other.

The PCs are calculated with Python. We put 12 PCs in this analysis since the 12 PCs are comprehensive enough to explain the changes in the whole market.

The specific steps of the algorithm are as follows:

Table 1 Result of PCA

	Nickel	Aluminum	Corn	Soyoil	Wheat	Urea	Brent	Gold	LNG	Silver
PC1	0.35	0.32	0.34	0.28	0.36	0.23	0.35	0.3	0.22	0
PC2	0.02	− 0.17	0.04	0.31	− 0.04	− 0.41	− 0.07	0.23	− 0.46	0.56

- Let X be the matrix X
- Calculate the covariance matrix of the matrix X
- Calculate the eigenvalues and eigenvectors of the covariance matrix
- Select the largest k eigenvalues and their eigenvectors.

We can get PC1 to PC12 from the above steps (Table 1).

5 Analysis

From Table 2, we can get the information that PC1 and PC2 in total represent 83.1% of the variance of all 12 assets over the period. We graphed both PC1 and PC2, which account for most of the variance of the 12 PCs. However, the rest of the 10 PCs slightly affect the prices of commodities, since each of their variances is all below 6%, which has a significantly low contribution (Fig. 1).

According to Chart 1, PC1 is tracking the Russian invasion, increasing steadily as the probability of invasion increased, then spiking up when the invasion occurred. And then, it has a decreasing trend, since the impact of the war was not as profound as people thought. Consequently, PC1 can be regarded as the war, which affect the supply of commodities. Besides, PC2 can be seen as the sanction. It sometimes moved in different directions from the PC1, but it is not unrelated to it. The sanction imposes threat on the public and then influences their demand of commodities.

Looking at Chart 1, PC1 and PC2 reached their local minimum on June 17, 2021, and June 18, 2021, respectively. Due to the Federal Reserve's upward revision of economic growth, commodity prices plummeted at this time.

PC1 and PC2 changed in the opposite directions from September 6th to October 20th, 2021. Russian threats of invading increased the chance of war but were useful in negotiating favorable terms and reduced sanction from 2014.

Prior to the war, PC1 mostly increased from September 2021 to February 2022. Europe's energy crisis had caused metal production to decline, resulted in the higher price of metals. Besides, since 73% of silver comes from the refining of metals (Silver, Explained 2022), the price of silver rose as well during the energy crisis. Furthermore,

Table 2 Variance of PCs

PC	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12
Variance %	61.0	22.1	5.5	3.8	2.5	1.4	1.1	0.9	0.7	0.4	0.3	0.2

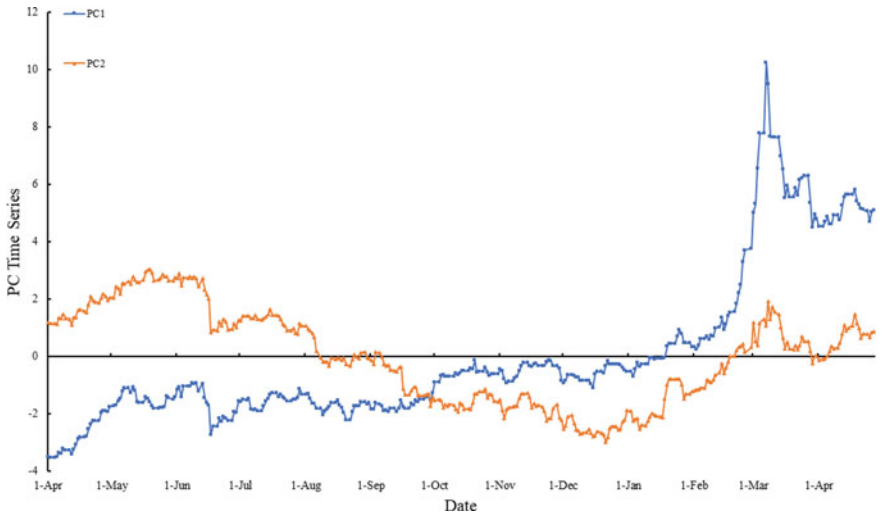


Fig. 1 Movement of PC1 and PC2 within the time period

military clashes in Ukraine caused the public to panic and **companies started to hoard agricultural products**. This tension of impact of invasion pushed agricultural prices to a higher level. Besides, tensions in the Black Sea and cancellation of cargo flights had worried market participants that supply flow could be cut off.

PC2 increased at the end of 2021 because of the shortage of Russian energy supply. Also, shortage of natural-gas storage volume resulted in the inability of European countries to impose severe sanction on Russia's energy.

After February 24th, 2022, the beginning of the war, there was a strong risk aversion because of the war. People increased their demand for precious metals and then prices of precious metals rose. Also, metal supply from Russia to other European area declined and the possibility of logistical shutdowns pushed nickel prices higher. Therefore, the metal prices went up.

PC1 reached its peak on March 7th because of the imminent third round of peace talks between Russia and Ukraine. PC1 dropped to its lowest point since March 1st on March 29th due to initial signs of progress in the negotiations between Russia and Ukraine, which dampened demand for commodities.

PC2 was mostly decreasing in 2021 and started to increase at the beginning of 2022. The sanction of the EU, the U.S., and several other countries targeting Russia started on February 21st to respond to Putin's decree. Simultaneously, Russia hit back at western sanction by imposing export bans that covered exports of agriculture and so forth. Meanwhile, people's risk aversion and precious metal prices continued to rise, contributing to the increasing trend of PC2 from February 24th to March 7th.

After March 7th, 2022, Russia has continued to impose counter-sanction while sanction from the West have been tightening. Under this circumstance, there is an increasing trend in PC2.

6 Conclusion

Both war and sanction have large impacts on the commodity market. However, this impact can go in different directions with various magnitudes. The direction of price changes depends on people's expectations of the future market. Generally, the war has a greater influence on people's expectations. The supply reacts to the war as well, since it is closely related to the war. Following the change of commodities' supply, prices of commodities also fluctuate in face of the war. When it comes to the sanction, it makes the public panicked, resulting in the change of the demand of commodities. Considering the variation trend and principal components of commodity's prices, investors can make prediction of the expected returns of investing based on our result.

References

100 days of war in Ukraine: a timeline (n.d.). www.cbsnews.com; https://www.cbsnews.com/news/ukraine-russia-war-timeline-100-days/

Balmaceda M, Westphal K (2022) Cross-regional production chains, competitive regionalism, and the deepening of regulatory fault lines in Euro-Asia. Rev Policy Res. https://doi.org/10.1111/ropr.12469

How Russia's War Is Impacting Global Metals Prices (n.d.) OilPrice.com. Retrieved from 14 May 2022. https://oilprice.com/Metals/Commodities/How-Russias-War-Is-Impacting-Global-Metals-Prices.html

Lautier D (2005) The term structure of crude oil futures prices: a principal component analysis. Banque et Marchés, vol 2005-5, pp 72–80. https://www.researchgate.net/publication/5088832_Term_structure_of_crude_oil_futures_prices_a_principal_component_analysis

Liang C et al (2020) Which types of commodity price information are more useful for predicting US stock market volatility? Econ Model 93:642–650. https://doi.org/10.1016/j.econmod.2020.03.022

Mitsas S, Golitsis P, Khudoykulov K (2022) Investigating the impact of geopolitical risks on the commodity futures. Cogent Econ Finan 10(1). https://doi.org/10.1080/23322039.2022.2049477

Polak P, Polakova B (2022) Changes in the EU's geopolitical position and energy doctrine in light of the Ukraine invasion. Society. https://doi.org/10.1007/s12115-022-00700-4

Sartorius (2020) What is principal component analysis (PCA) and how it is used? Sartorius. https://www.sartorius.com/en/knowledge/science-snippets/what-is-principal-component-analysis-pca-and-how-it-is-used-507186

Silver, Explained (2022, June 9) Global X ETFs. https://www.globalxetfs.com/silver-explained-2/

STOXX (2016) STOXX digital | EURO STOXX 50®. Stoxx.com. https://www.stoxx.com/index-details?symbol=SX5E

The Impact of New Energy Vehicle Batteries on the Natural Environment and Recycling Method

Ziyang Huang

Abstract At present, new energy vehicles mainly use lithium cobalt acid batteries, Li-iron phosphate batteries, nickel-metal hydride batteries, and ternary batteries as power reserves. These types of cells will cause a certain degree of irreversible environmental impact (mainly from the anode, cathode, and electrolyte of the battery) without treatment. The production and treatment of batteries is still the main problem faced by the current new energy vehicle industry. This paper summarizes the main treatment methods for the waste batteries of new energy vehicles. This paper, through the example of the new energy vehicle battery and untreated battery environmental hazards, put forward the corresponding solutions. New energy vehicle batteries include Li cobalt acid battery, Li-iron phosphate battery, nickel-metal hydride battery, and three lithium batteries. Untreated waste batteries will have a serious impact on the environment. Large amounts of cobalt can seep into the land, causing serious effects and even death to plant growth and development, which can lead to a significant reduction in land yield. And cobalt-contaminated plants can cause a variety of diseases when eaten by humans. The production of batteries will produce a large number of greenhouse gases. At present, the commonly used waste battery treatment methods are echelon utilization, disassembly, recycling, and reuse. In the future, batteries will develop toward the concept of perfect batteries proposed by Buchmann in 2001, and the treatment of waste batteries will be improved. Social demand for new energy vehicles will continue to increase, and attention to battery processing and production will largely reduce the damage to the environment.

Keywords Battery · Cobalt pollution · Environmental pollution · Echelon utilization · Disassemble · Recycle and reuse

Z. Huang (✉)
School of Architecture and Built Environment, University of Nottingham, Nottingham NG7 2RD, UK
e-mail: ssyzh4@nottingham.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_8

1 Introduction

Oil prices have risen as non-renewable resources such as oil have dwindled. The global demand for new energy vehicles is also increasing. New energy car is mainly used in electric power, as a kind of clean energy that can effectively reduce the pollution to the environment, although the current thermal power in the world's dominant position in electric power production, considering that most of the new energy vehicles, such as a user is in the evening electricity using slack period charge (current electricity storage cost is higher, such as wind, Hydroelectric power generation in the slack period of the electricity is mostly wasted), new energy vehicles are still an effective solution to the resource shortage of a good way. With the consume and elimination of vehicles batteries, how to effectively deal with the elimination of the battery becomes very important and urgent.

At present, new energy vehicles mainly use lithium cobalt acid batteries, Li-iron phosphate batteries, nickel-metal hydride batteries, and ternary batteries as power reserves. These types of cells will cause a certain degree of irreversible environmental impact (mainly from the anode, cathode, and electrolyte of the battery) without treatment. Lithium cobalt batteries, for example, contain a large amount of cobalt. If a large number of cobalt seeps into the soil, it will inhibit the growth of plants. When the concentration of cobalt reaches 10 mg/L, it can lead to the death of crops, which will seriously affect the yield of farmland. Products with high cobalt content can also damage human and animal health. In addition, the production of batteries will also produce a large number of greenhouse gases, which can be alleviated by improving the manufacturing technology and production requirements of manufacturers.

This paper mainly lists the basic information of four commonly used batteries of new energy vehicles, including structure, material, and efficiency. It also points out the impact of untreated waste batteries on the environment and the pollution caused by battery production. Further, put forward the corresponding solutions.

2 The Types of Batteries

2.1 Lithium Cobalt Acid Battery

The Li cobalt acid battery contains 36% cobalt, the cathode material is Li cobalt oxides ($LiCoO_2$) and the copper plate is coated with a mixture of carbon graphite, conductor, polyvinylidene fluoride (PVDF) binder and additives which located at the anode (Xu et al. 2008). Among all transition metal oxides, according to the high discharge and charge voltage (1.2 and 2.2 V), the lithium cobalt oxides are considered the suitable choice for the cathode material (Li et al. 2015). The advantages of the battery include stable structure, outstanding comprehensive performance and high specific capacity. But it will still be difficult to make cars with lithium cobalt batteries widely available because lithium cobalt is expensive, toxic, and has half the

theoretical gram capacity, which will undoubtedly increase the cost of making cars. Therefore, batteries are still mainly used in some small electronic products, such as music players and radios (Lei et al. 2009).

2.2 Li-Iron Phosphate (LIP) Battery

The cathode material of the LIP battery is Li_xFePO_4 which is cheap and environmentally friendly, and the anode materials is lithium, the charge process can be written as Eq. (1). And this chemical reaction is reversible when discharge (Padhi et al. 1997).

$$LiFePO_4 - xLi^+ - xe^- \rightarrow xFePO_4 + (1-x)LiFePO_4 \quad (1)$$

Comparing battery performance at different states of charge at different temperatures, capacity increases faster with storage temperature than with state of charge. Lithium depletion degrades cell performance mainly due to anode side effects, whereas at the cathode level, depletion is not significant (Omar et al. 2014). LIP battery is stabilized, but the energy density is lower than other automotive batteries. When the temperature is low, the charging efficiency is reduced. And if the temperature is too low, it will affect the battery capacitance. So, the Li-iron phosphate battery is not suitable for driving in cold climates which will shorten the battery life.

2.3 NiMH Battery

NiMH batteries rely on a chemical reaction between the cathode (nickel hydroxide, NiOH) and the anode (alloy). It could be used in EVs and E-devices due to its energy density comparable to lithium ion and its environmental friendliness (no highly toxic metals) (Kandananond 2018; Bertuol et al. 2009). But its high manufacturing cost, the use of it is not as widely as LIP batteries.

2.4 Ternary Li Battery

The cathode of the battery consists of nickel, cobalt and manganese. Therefore, the ternary Li battery combines the advantages of a variety of batteries. The electrolyte of ternary Li battery is a mixture of organic solvent, polymer, and Li salt, so it has the advantages of both solid electrolyte and liquid electrolyte (Su 2021). Figure 1 shows the structure of the ternary lithium battery. Compared with lithium cobalt acid batteries, ternary lithium batteries have higher safety and cold resistance. It is more suitable for the development trend of EVs batteries in the future. The main disadvantage of this battery is that it cannot provide high voltage stably.

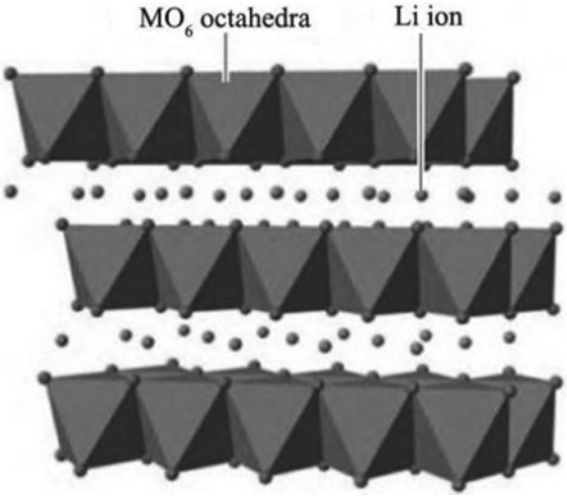


Fig. 1 The ternary lithium battery structure (Richard 2022)

3 Environmental Impact of Untreated Waste Batteries

3.1 Increasing Production

The environmental influence caused by Li-ion battery could increase with the demand of the battery. Figure 2 shows the production of Lithium-ion batteries in China from 2016 to 2021, data from huaon.com (Huaon.com 2022). With the development of EVs, the production of Li batteries is also growing rapidly. This is followed by the increasing demand for the upgrading of waste lithium battery processing technology, and the environmental problems which could be caused by the growth of lithium battery production.

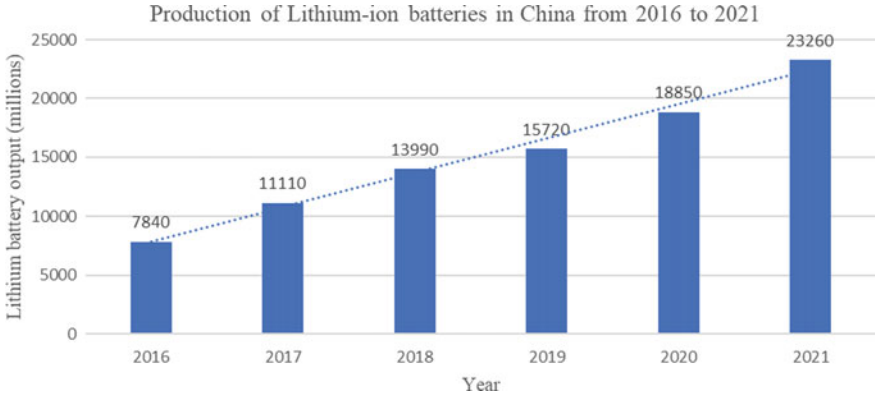


Fig. 2 The production of Lithium-ion batteries in China from 2016 to 2021 (Huaon.com 2022)

3.2 Carbon Mission in Production

Most new energy vehicles are powered by lithium batteries (a few are nickel-metal hydride), and lithium battery production requires a lot of carbon dioxide emissions. Even though electric cars are zero-emission, battery production still produces pollution. The mining and refining of battery materials and the manufacture of batteries, modules, and packs require large amounts of energy, which can contribute to greenhouse gas emissions. Typically, the carbon footprint of producing EV battery types is estimated at 61–102 kg/kWh CO_2 emissions (Transport & Environment 2022). Take the Tesla model battery as an example, the size of the battery is about 100–150 kWh, which means producing a battery of Tesla requires 6100–15,300 kg CO_2 emissions. The global sales 6,750,000 new energy vehicles in 2021 (EV volume 2022). For production new energy vehicles should be 4,117,500–10,327,500 t in 2021 (Assume that all new energy vehicles sold are produced in that year), take the average data could be 0.0072225 Gt. The global CO_2 emissions in 2021 is 36.3 Gt (IEA 2022). Carbon dioxide emissions from the production of new energy vehicle batteries accounted for 0.02% of the annual total. One hectare of forest can absorb 8400 tons of carbon dioxide a year (Chuzhou meteorological 2022). So it would take 860 ha of forest to be carbon neutral to produce batteries for neVs (about 1200 football fields).

3.3 The Impact of Batteries Materials and Electrolyte

At present, lithium batteries are commonly used for new energy vehicles. There are many kinds of lithium batteries, such as lithium cobalt batteries. Cobalt is a heavy metal, so it has a certain impact on the environment. Li-manganese and Li-iron batteries have less impact on the environment, but the electrolyte in the battery (mainly composed of dimethyl sulphate, diethyl carbonate and vinyl carbonate) has an impact on the environment if it seeps out. If the battery is landfilled or discarded without treatment, within a month, the harmful substances in the spent battery will corrode and perforate into the soil and water, causing irreversible pollution to the environment. The pollution caused by battery largely depends on the manufacturing technology and production requirements of the manufacturer. The pollution potential of batteries varies greatly. Therefore, to gain enough space to reduce the environmental influence of waste batteries, avoiding the most polluting formulations is a good way (Moreno-Merino et al. 2015). Lithium cobalt battery contains a large amount of cobalt, high concentration of cobalt obviously inhibits the growth and development of plants, so the cobalt pollution in soil is more and more widely concerned by people. Studies showed that the contents of macro elements in plant organs increased significantly in cobalt contaminated soil (Kosiorek and Wyszkowski 2021). When the concentration of cobalt in soil solution was 0.10–0.27, 1.00 and 5.90 mg/L, it was toxic to tomato, flax and beet, respectively. At a cobalt concentration of 10 mg/L,

crops can die (Polaris Environmental Remediation Network 2022). Agricultural products with high cobalt content will also damage the health of humans and animals, causing damage to the heart and pancreas, and reducing the ability of thyroid to concentrate iodine. As a common electrolyte, improper handling of dimethyl sulphate can also cause environmental pollution. Like all strong alkylation reagents, dimethyl sulphate is highly toxic and can cause serious harm by skin contact or inhalation. If the body comes into direct contact with leaked dimethyl sulphate, it is easily absorbed through human organs such as the skin. The initial presentation is mucosal inflammation of sensory organs and airways. Serious damage to the airways, including pulmonary edema, may occur if large amounts are ingested (Rippey and Stallwood 2005).

4 Recycling Method

A variety of heavy metals contained in waste batteries, if not recycled and properly treated, toxic substances will accumulate in the environment, and eventually accumulate in the body is difficult to eliminate, the recycling and utilization of waste batteries, has become important and continue to be pushed over and implemented. This part will introduce two ways of battery recycling including: Echelon utilization, and disassemble, recycle and reuse.

4.1 Echelon Utilization

Echelon utilization involves inspecting and detecting waste power batteries, separating them into classes, repairing or recombining them into cascade products that can be used elsewhere. Waste batteries can be utilized in a step-by-step manner, thus extending their life and maximizing their residual value, promoting the development of new energy, easing recycling pressure caused by the excessive number of waste batteries, and reducing the industrial cost of electric vehicles. The new energy vehicle industry will grow as a result. Echelon utilization of waste power battery for EVs can bring huge economic benefits in Chinese market. However, there are great difficulties in many aspects, including but not limited to formulating reasonable product standards and improving and popularizing the recycling of used batteries (Zhang et al. 2020). The good news is that the range of products and applications of echelon utilization is increasing further in the market. At present, the application scope of this product includes backup power of information base station, energy storage, low-speed power supply and other scenarios, and commercial communication has been realized in many fields (Hu et al. 2021). The main hierarchical utilization mode of used batteries in China is to collect used batteries from automobile users and automobile scrap factories, and then screen the collected batteries. The third step is to produce recycled materials from recycling enterprises and provide them to battery

material enterprises. Finally, it is produced by relevant enterprises and supplied to automobile enterprises.

New factory batteries perform better than old batteries, but conditions of use and end-of-life guarantees are different. Therefore, before processing, the current state of the battery and its own condition need to be evaluated, which will greatly affect the efficiency and quality of the subsequent process. The remaining life of the battery will determine the arrangements for subsequent processes and the areas in which products made from the battery will be utilized. It is still a difficult problem to judge the safety of waste batteries.

4.2 Disassemble, Recycle and Reuse

This method is more direct than echelon utilization. The method is to pulverize and disassemble waste batteries and classify them according to the type of materials. Then the classified material is screened, and the reusable material is put into production again. The basic of the waste lithium battery crushing and disassembling and recycling treatment equipment lies in the whole process of automation, which will crush the lithium batteries of multiple types and specifications to develop in the direction of environmental protection and intelligence.

However, at present, there is no standardized recycling system for used power batteries, and there are still many opportunities for improvement in industrial development models, standards, and technologies. In terms of recycling and utilization of waste power batteries, both the power battery industry chain and the new energy vehicle industry chain have weak links in green development.

5 Conclusion

As demand of people for new energy vehicles increases, the number of batteries used in new energy vehicles is also increasing. Every year, many waste batteries are thrown away without treatment, which is damaging to the environment. The commonly used new energy vehicle batteries are lithium cobalt acid battery, lithium iron phosphate (LIP) battery, NiMH battery, and ternary lithium battery. Among them, lithium cobalt acid battery and ternary battery have good use effect, mainly because they can provide relatively stable voltage and high energy density. Lithium cobalt oxide batteries are commonly used in small electronic devices. The ternary battery is more in line with the development trend of future cars, and this kind of battery has higher safety and cold resistance. The lithium iron phosphate battery is greatly affected by temperature, and the manufacturing cost of NiMH battery is too high, so the use range of these two batteries is small. The production of batteries produces large amounts of greenhouse gases, such as carbon dioxide. Untreated lithium cobalt battery when the casing is broken, large amounts of cobalt can seep into the ground and cause serious damage to

plants. And plants contaminated with cobalt can cause damage healthy when eaten by humans. Two common treatment methods of waste battery including echelon utilization, disassembly and recycling were illustrated. Echelon utilization is more commonly used at present, which can make use of the residual value of waste batteries to a large extent. The development of batteries in the future will move towards the direction of perfect batteries and produce a new type of batteries with high energy density, high safety, and no pollution, which will effectively avoid environmental pollution caused by waste batteries. This paper mainly studies the impact of new energy vehicle batteries on the natural environment, obtains the current problems through examples and data, and puts forward some solutions.

References

Bertuol DA, Bernardes AM, Tenório JAS (2009) Spent NiMH batteries—the role of selective precipitation in the recovery of valuable metals. J Power Sour 193(2):914–923

Chuzhou meteorological. https://czqxj.net.cn/qihou_79188. Last accessed: 10 June 2022

EV volume. https://www.ev-volumes.com/country/total-world-plug-in-vehicle-volumes/. Last accessed: 10 June 2022

Hu S, Jiang X, Wu M, Wang P, Li L (2021) Analysis on Echelon utilization status of new energy vehicles batteries. IOP Conf Ser Earth Environ Sci 651(2):22035

Huaon.com. https://www.huaon.com/channel/trend/801313.html. Last accessed: 10 June 2022

IEA. https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2. Last accessed: 10 June 2022

Kandananond K (2018) The application of system identification method to characterize the performance of NiMH batteries in hybrid vehicles. In: MATEC web of conferences, vol 198, 4006

Kosiorek M, Wyszkowski M (2021) Macroelement content in plants after amendment application to cobalt-contaminated soil. J Soils Sediments 21(4):1769–1784

Lei S, Chen H, Liu J, Tang Z (2009) Research progress on modification of lithium cobalt oxide cathode material for lithium battery. Hunan Nonferrous Metals 25(5):6

Li X, Yang Z, Fu Y, Qiao L, Li D, Yue H, He D (2015) Germanium anode with excellent lithium storage performance in a germanium/lithium–cobalt oxide lithium-ion battery. ACS Nano 9(2):1858–1867

Moreno-Merino L, Jiménez-Hernández ME, de la Losa A, Huerta-Muñoz V (2015) Comparative assessment of button cells using a normalized index for potential pollution by heavy metals. Sci Total Environ 526:187–195

Omar N, Monem MA, Firouz Y, Salminen J, Smekens J, Hegazy O, Gaulous H, Mulder G, Van den Bossche P, Coosemans T, Van Mierlo J (2014) Lithium iron phosphate based battery—assessment of the aging parameters and development of cycle life model. Appl Energy 113:1575–1585

Padhi AK, Nanjundaswamy KS, Goodenough JB (1997) Phospho-olivines as positive-electrode materials for rechargeable lithium batteries. J Electrochem Soc 144(4):1188–1194

Polaris Environmental Remediation Network. https://huanbao.bjx.com.cn/news/20151104/678085.shtml. Last accessed: 12 June 2022

Richard. https://www.upsbatterycenter.com/blog/cobalts-lithium-ion-batteries/. Last accessed: 9 June 2022

Rippey JCR, Stallwood MI (2005) Nine cases of accidental exposure to dimethyl sulphate—a potential chemical weapon. Emergency Med J EMJ 22(12):878–879

Su Y (2021) Comparative analysis of lithium iron phosphate battery and ternary lithium battery. J Phys Conf Ser 2152(1):012056

Transport & Environment. https://www.transportenvironment.org/discover/ev-batteries-are-getting-cleaner-and-cleaner-2-3-times-better-2-years-ago/. Last accessed: 10 June 2022
Xu J, Thomas H, Francis RW, Lum KR, Wang J, Liang B (2008) A review of processes and technologies for the recycling of lithium-ion secondary batteries. J Power Sour 177(2):512–527
Zhang H, Huang J, Hu R, Zhou D, Rashid ur Khan H, Ma C (2020) Echelon utilization of waste power batteries in new energy vehicles: review of Chinese policies. Energy (Oxford) 206:118178

The Pollution of Face Masks to Marine Ecology Under the Epidemic

Xuping Gong

Abstract The outbreak of the Novel Coronavirus has led to a surge in need of face masks, which endangers the safety of Marine life. This article discusses how masks pollute the marine environment, and what the consequences of Microplastic pollution disrupt the ecological balance of marine life. It also provides constructive advice on the recycling and reuse of masks. After exploring the composition and filtering mechanism of masks, it can be found that the core structure of different types of masks contains a large amount of polypropylene to form the non-woven part of the main body. Masks are damaged in water due to weathering and erosion, releasing a large number of microplastics, which can have a huge negative impact on marine ecology. These include lethality to marine organisms, inhibiting population growth and development, and even altering the genetics of organisms. At the same time, due to the food chain, microplastics absorbed by marine organisms can accumulate in humans, leading to more serious consequences. In order to reduce the microplastic pollution caused by masks, this paper puts forward several suggestions for the recycling and reuse of masks, which are related to building materials, electricity, instrumental supplies, collection box, and gas-phase Advanced Oxidation Process (gAOP). This paper hopes to find better methods to balance Personal protective equipment (PPE) and marine environmental pollution in years to come and hopes to reduce the disadvantages of microplastics on marine ecology.

Keywords Microplastic · Face masks · Marine pollution · Treatment

1 Introduction

Since the novel Coronavirus pandemic in 2019, causes high demand for medical supplies, increasing consumption of face masks may have a profound effect on the global marine environment. The potential possibility for face masks to pollute the

X. Gong (✉)
Institute of Oceanography and Atmospheric Sciences, Ocean University of China, Qingdao, China
e-mail: gxp@stu.ouc.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_9

oceans is intrinsically tied to the composition of the masks, microplastics, and garbage recycling, which are vital global environmental issues contemporarily. The main purpose of this article is to explore the pollution factors of masks on the marine ecological environment and their negative effects on the marine ecology. Besides, some advanced recycling and utilization measures can be proposed. COVID-19 has been enveloping the world, and the number of infected people has only increased, so our demand for masks has also continued to increase. Since the masks themselves are difficult to recycle, the masks we have used will cause potential pollution to the marine ecological environment. If the potential contamination of the marine environment by masks is not predicted, it could accumulate and cause serious problems. Moreover, the face mask pollution issue may arise people's awareness of microplastics and recycling.

Many scholars have carried out some work about face masks and microplastics. According to Avio et al. (2017), disposable face masks that are used every day around the world are disposed of as garbage, turning them into thousands of tons of plastic waste, about 10 percent of which end up in the ocean (Avio et al. 2017). Recent research (Torres and De-la-Torre 2021) has shown that masks do cause certain marine ecological pollution to the marine environment or coastal areas. Qualitative observations were made of discarded masks on Lima streets and beaches in Lima, Ankeshi, Libertad, and Piura (Fig. 1) (Torres and De-la-Torre 2021). They found that some cities have caused marine pollution due to improper treatment of mask wastes. Another research showed that the release amount of the polymer material in the mask into the aquatic environment under certain weathering conditions (Shen et al. 2021). A billion microplastics could be released in just one fully air-dried mask in a flowing water environment. However, the harm of microplastic and the specific harm to marine ecology caused by microplastics in the face masks and the methods for preventing and controlling mask pollution are not reflected in the above papers.

To combine the microplastics of face masks with the negative impact on the marine environment and raise some available methods for recycling and utilization, after analyzing the composition of the masks, how the marine environment is affected by microplastics is classified, which allows people to predict the future consequences of intemperate face masks abandon. Meanwhile, some implementable methods of mask recycling and reuse are proposed as well.

2 Face Masks

2.1 Compositions of Face Masks

Commonly used protective masks are composed of two parts: the mask body piece and the appendages. As Fig. 2 shows, the body piece of most types of face masks is composed of 3 layers of material: spun-bonded nonwoven waterproof layer, melt-blown nonwoven filter layer, and spun-bonded nonwoven moisture-absorbing layer

Fig. 1 Abandoned face masks on the streets and beaches of Piura, Ankeshi, La Libertad and Lima are causing serious ecological damage (Torres and De-la-Torre 2021)

from inside to outside. The mask appendages are ear straps, cartilage strips, and sponge pads.

The part used to prevent water penetration and filter impurities are made of polypropylene, a super-fine fiber that does not contain woven fabric, it is the main component of disposable masks, accounting for more than nine-tenths of the total, while $[COC_6H_4COOCH_2CH_2O]$ (PET) and $(C_{10}H_8N_2O_2 \cdot C_6H_{14}O_3)_n$ (PU) is the primary material of ear bands, PP/A wire made of zinc and plating, PE/A wire made of zinc and plating or aluminum tape is the common material of nosebands.

Fig. 2 Structure of different types of masks

2.2 Filter Mechanism of Face Masks

Masks are mainly made of different materials due to their different sizes. Medical masks and non-medical masks have different dustproof effects due to different materials. Polypropylene (PP) and non-woven microfiber are the core materials of most masks, which are the core materials of the part of a mask used to insulate from penetration, more than nine-tenths. The ear strap is mainly made of PET and PU, pen bag is mainly Pp/Steel wire of zinc and plating, PE/Steel wire of zinc and plating or caterpillar is the main material made of pen bag (Fig. 3).

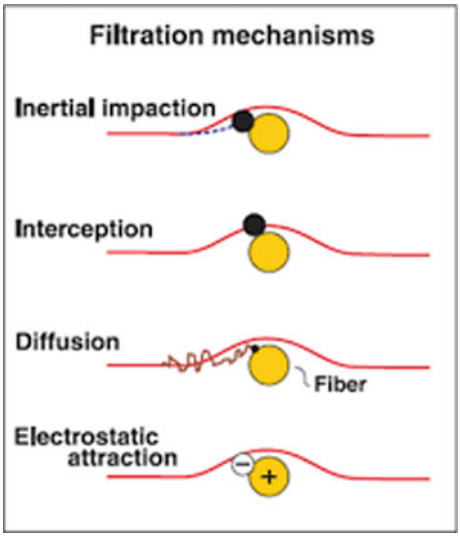


Fig. 3 The four filtration mechanisms of the face masks (N95 Respirators and Surgical Masks | Blogs | CDC 2020)

First, inertial impaction means that dust particles, bacteria, and viruses moving with the airflow maintain their tendency to move and hit the PP fibers. Secondly, when a particle of a certain size moves along the flow line just near the surface of the PP fiber if the distance from the flow line to the surface of the fiber is equal to or less, it will be intercepted. To the diffusion, because of the force exerted on the particles by the thermal motion of the gas molecules, the particles undergo Brownian motion, so that the trajectory of the particles flowing with the fluid deviates from the flow line to a certain extent than the radius of the particle, the particle is deposited on the surface of the fiber. The last one is Electrostatic attraction. The presence of friction and other factors will make the PP fibers become electrically charged, and small uncharged dust or other electroactive particles will be electrostatically attracted to the surface when passing through these fiber clusters and can be filtered out.

2.3 Environmental Impact of Masks—Microplastics and Their Release

The study of the Microplastics can easily be released into the environment during the use of disposable protective masks by Xianchuan Chen et al. used samples from 18 different brands of masks and identified the surface by microlaser Raman spectroscopy, and all mask samples were made of polypropylene. The test results show that the Microplastic contamination can creep in through masks Compared with the unused masks, the use of masks can significantly increase the release of microplastics. Although there are significant differences in the microplastic release of different brands of masks, there is no significant difference in the microplastic release of masks with different protection levels (Chen et al. 2020).

The release of microplastics may be related to the production process of nonwoven fabrics. Usually, the production of nonwoven fabrics includes two processes: spunbonded and melt-blown as mentioned before. (1) spunbonded process is to make the fine silk leaving the spinneret stretch by airflow to form a filament, laying on the net curtain. (2) Melt-blown process is to make the dissolved body of the spinneret hole blown into ultra-fine short fibers under the action of high-speed hot air, flying at a very high rate to the condensation net curtain belt or roller to form a fiber network, the fiber network is reinforced by thermal bonding or its bonding into nonwoven fabrics (Tao et al. 2020). Since the fibers that make up the nonwoven fabric are extremely fine, they tend to break off and form microplastics. The process of mask use further exacerbates the mechanical wear and tear between the fibers, which leads to the formation of more microplastics. In addition, masks may intercept microplastics in the air during use, thus increasing their microplastic carrying capacity.

3 Microplastic Pollution in Marine Environment

3.1 Lethal Effect

The lethal effect is the worst and most direct impact of microplastics exposed to the ocean. It reduces the survival rate of marine life and leads them to death. The survival rate of Amphipod American hook shrimp had a clear dose–response relationship with the content of PE at 10–27 μm and PP at 20–75 μm. As the exposure dose of microplastics increased, the mortality of hook shrimp also gradually increased (Au et al. 2015). Mortality of the Sea bass also increased significantly from around 30 to 44% with increasing exposure to microplastics whose size is between 10 and 45 μm (Mazurais et al. 2015). In the chronic toxicity study, the researchers found that the water contained 0.05 and 0.5 μ of PS, the death rate of *Tigriopus japonicus* greatly grew with increasing exposure (Lee et al. 2013). The larval survival rate of *Tripneustes gratilla* will sharply decrease at the exposure dose of 300 microplastics/mL of 10–45 μm PE microplastics (Kaposi et al. 2014).

3.2 Impede Growth and Development

Ingestion of microplastics will have adverse effects in the process of biological growth. This study shows that the hatching rate of fertilized eggs and the body length of fish larvae exposed to microplastics are significantly reduced (Lönnstedt and Eklöv 2016). In addition, the greater the weight and size of the worm, the higher the concentration of Kaposi et al. (2014) microplastics in the water. After being ingested by marine organisms, microplastics will accumulate in the digestive tract of organisms and hinder digestion. Therefore, animals have a strong sense of satiety, reducing their food intake. Then, it ends with a reduction in the amount of energy buried in the body. The energy source required for the growth of the body is not fully supplemented, thus affecting the growth and development of organisms.

3.3 Genes and Inheritance

Microplastics can also affect gene expression in living organisms and cause genotoxicity. The results of genomics studies have shown that exposure to microplastics in the sea can alter gene expression in oyster germ cells (Sussarellu et al. 2016). Another study conducted experiments on the effect of microplastics on two generations of copepod zooplankton, After comparison with the control group, although the 0.5 μm PP did not have a significant effect on the survival of the mother generation (Lee et al. 2013). The survival rate of progeny was significantly reduced, indicating the potential genotoxicity of microplastics.

3.4 Risk to Human Health

Microplastic waste needs several years to be degraded by biology. That means that it will stay in the body of marine life for a long time, which may probably end up in the body of human beings due to the food chain. The terrigenous pollutant is dominated resource of the marine microplastics. Microplastics discharged into the sea can be redistributed to the environment through runoff and water recycling, which may lead that a large range of daily food not only seafood, and salt, but also drinking water and beverage containing the microplastics. Human, at the end of the food chain, is most likely to accumulate a large quantity of microplastic.

4 Face Masks Treatments

4.1 Building Materials

The disposable masks are made of non-woven polypropylene. Surgical masks and other types of masks are used in different fabrics. Spun-bond polypropylene for the surgical masks and melt-blown polypropylene for others (Ammendolia et al. 2021; Aragaw 2020). Polyester or nylon are used to make earrings for the mask, and plastic substrates are the main material for the mask, which have poor thermal conductivity, waterproof, heat, and other advantages. All the above characteristics are needed for building materials (Idrees et al. 2022). After disinfecting the used mask, divide the mask into two parts (blue and white parts in Fig. 4) and crush them. Then it is mixed, and then a certain amount of cement is added after mixing, compacted, and polished into the required concrete slab.

4.2 Burned for Electricity

The main ingredient of masks is polypropylene. Polypropylene consists mainly of carbon and hydrogen. When fully burned, it produces only water and carbon dioxide and generates a lot of heat. Collected large quantities of waste masks and then disposed of them at specific combustion power plants. But today widespread use of masks is a product of the Times. When the covid-19 ends, many of the factories that burn waste masks to generate electricity will close due to a lack of raw materials. Therefore, this method has great limitations on The Times.

Fig. 4 Method of treating mask for concrete (Idrees et al. 2022)

4.3 Industrial Supplies

The masks are made of polypropylene, ribbon metal, and elastic fibers. The recycled polypropylene can be made into automobile parts, such as dashboards and fenders (Gu et al. 2016). Metals can be recycled and remade into jewelry. Elastic fiber can be recycled into kitchen rags.

4.4 Waste Mask Collection Box

Although there are many treatments for masks, these methods are based on the masks that have been collected and sorted. Is there a low-cost, efficient, and rapid way to collect masks? To promote waste mask collection box may be an excellent way to deal with it, the sketch of the collection box is shown in Fig. 5. The waste masks collection box includes an outer box and an inner box. An upper cover is rotated on the outer box. The inner wall of the outer box is equipped with an ultrasonic atomizer and an ozone generator for sterilization. Set up three sterilization devices, through the spray disinfectant, alcohol, and UV to aseptic used masks on the surface of the virus, the collected waste masks virus eliminated, and unity in the form of ozone from the bottom of the penetration recycling masks, to prevent repeated transmission and infection caused by the virus, masks boxes are conveniently placed at the same time, meets the requirements (Sangkham 2020).

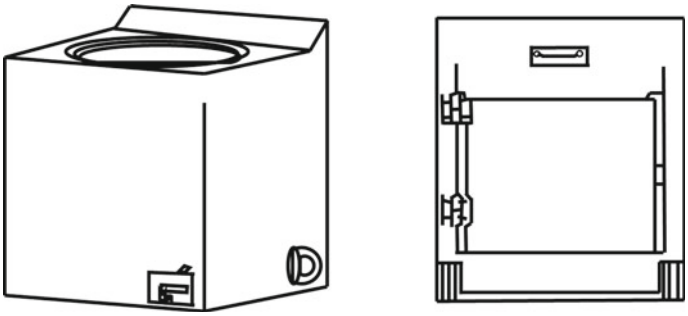


Fig. 5 The sketch of the waste mask collection box

4.5 The Advanced Form of Meteorological Oxidation

There is also a new mask treatment method, called advanced form of meteorological oxidation. Gaop is used to purify N95 and surgical masks it has beneficial effects on wiping out the vitality of novel coronavirus, the propagules, and spores of bacteria affecting the mask function (Hasani et al. 2021). But this method has not been tested on a large scale because it is still being studied. If it can be used more widely, it may be an effective way to dispose of masks in the future.

5 Conclusion

The microplastic issue is one of the most crucial problems of the current society. However, since the COVID-19 outbreaks, microplastic emissions will increase with the consumption of masks. By analyzing the connection between face masks and microplastic, the impact of masks on the ocean can be seen. The non-woven part of the mask, that is, the main part, is mainly composed of polypropylene. When masks are released into the marine environment without proper treatment, masks can release large amounts of microplastics during weathering and erosion. Moreover, microplastics can have extremely serious effects on marine life, including but not limited to direct death, hindering food intake so that organisms cannot take in enough energy, and genetic alterations. People accumulate microplastics indirectly through food chains. In addition, small and large particulate microplastics can easily cause ecological damage in the ocean and the microplastics can easily be attached to the surface, not only serious threats to the survival of marine organisms but also extensive marine ecological hazards. People should pay more attention to the treatments of face masks which can be divided into recycling and reusing. Even if there are more and more advanced mask reuse technology, the recycling of face masks should also gain more attention. Besides, quantitative analysis and comparison of microplastics can be further studied.

References

Ammendolia J, Saturno J, Brooks AL, Jacobs S, Jambeck JR (2021) An emerging source of plastic pollution: environmental presence of plastic personal protective equipment (PPE) debris related to COVID-19 in a metropolitan city. Environ Pollut 269:116160–116160

Aragaw TA (2020) Surgical face masks as a potential source for microplastic pollution in the COVID-19 scenario. Mar Pollut Bull 159:111517

Au SY, Bruce TF, Bridges WC, Klaine SJ (2015) Responses of *Hyalella azteca to* acute and chronic microplastic exposures. Environ Toxicol Chem 34(11):2564–2572

Avio CG, Gorbi S, Regoli F (2017) Plastics and microplastics in the oceans: from emerging pollutants to emerged threat. Mar Environ Res 128:2–11

Chen X, Xiong X, Wu C (2020) Study on the potential of microplastic release into the environment from disposable protective mask use. Environ Prot 48(23):53–55

Gu F, Hall P, Miles N (2016) Development of composites based on recycled polypropylene for injection moulding automobile parts using hierarchical clustering analysis and principal component estimate. J Cleaner Prod 137:632–643

Hasani M, Campbell T, Wu F, Warriner K (2021) Decontamination of N95 and surgical masks using a treatment based on a continuous gas phase-advanced oxidation process. PloS One 16(3):e0248487

Idrees M, Akbar A, Mohamed AM, Fathi D, Saeed F (2022) Recycling of waste facial masks as a construction material, a step towards sustainability. Materials 15(5):1810

Kaposi KL, Mos B, Kelaher BP, Dworjanyn SA (2014) Ingestion of microplastic has limited impact on a marine larva. Environ Sci Technol 48(3):1638–1645

Lee KW, Shim WJ, Kwon OY, Kang JH (2013) Size-dependent effects of micro polystyrene particles in the marine copepod *Tigriopus japonicus*. Environ Sci Technol 47(19):11278–11283

Lönnstedt OM, Eklöv P (2016) Environmentally relevant concentrations of microplastic particles influence larval fish ecology. Science 352(6290):1213–1216

Mazurais D, Ernande B, Quazuguel P, Severe A, Huelvan C, Madec L, Mouchel O, Soudant P, Robbens J, Huvet A, Zambonino-Infante J (2015) Evaluation of the impact of polyethylene microbeads ingestion in European sea bass (*Dicentrarchus labrax*) larvae. Mar Environ Res 112:78–85

N95 Respirators and Surgical Masks | Blogs | CDC (2020, 14 Augustus) Centers for disease control and prevention. Geraadpleegd op 23 Juni 2022, van

Sangkham S (2020) Face mask and medical waste disposal during the novel COVID-19 pandemic in Asia. Case Stud Chem Environ Eng 2:100052

Shen M, Zeng Z, Song B, Yi H, Hu T, Zhang Y, Zeng G, Xiao R (2021) Neglected microplastics pollution in global COVID-19: disposable surgical masks. Sci Total Environ 790:148130

Sussarellu R, Suquet M, Thomas Y, Lambert C, Fabioux C, Pernet MEJ, Le Goïc N, Quillien V, Mingant C, Epelboin Y, Corporeau C, Guyomarch J, Robbens J, Paul-Pont I, Soudant P, Huvet A (2016) Oyster reproduction is affected by exposure to polystyrene microplastics. Proc Natl Acad Sci 113(9):2430–2435

Tao YL, Chen X, Xiang K (2020) Application of polypropylene materials in medical masks. Rubber Plast Technol Equipment 46(8):33–36

Torres FG, De-la-Torre GE (2021) Face mask waste generation and management during the COVID-19 pandemic: an overview and the Peruvian case. Sci Total Environ 786:147628

Comparison of Carbon Emissions of Gasoline Vehicles and Electric Vehicles

Chenxi Huang, Zhiying Ou, and Xiaotian Yu

Abstract Electric vehicles are promoted by many countries as alternative products of gasoline vehicles in recent years since they are widely regarded as low-emission green vehicles by the society. However, after a series of investigation and research, it is found that the carbon emissions of electric vehicles in the whole process are not as small as what the public think, carbon emissions of electric vehicles depend on a variety of factors like the manufacturing regions, energy source, etc. By analyzing the sources of carbon emissions during the production and use of various types of vehicles, combined with relevant research data, this paper compares the carbon emission levels of gasoline vehicles and electric vehicles at various stages as well as the emissions in different countries and regions. Through comparative analysis authors draw relevant conclusions on greenhouse gas emissions level of the two types of vehicles. Overall, electric vehicles do have lower emissions than gasoline vehicles in life-cycle process. Electric vehicles that are used in developed regions have lower carbon emissions than those used in developing regions. Another conclusion is that the carbon emissions are lower in places with cleaner electricity sources, this article has compared the carbon emissions of electric vehicles in different states of the United States, the discussion shows that states with a higher proportion of renewable energy have lower carbon emissions in general.

Keywords Electric vehicles · Gasoline vehicles · Carbon emissions · Renewable energy · Greenhouse gases · Pollution

C. Huang, Z. Ou, X. Yu: These authors contributed equally.

C. Huang
Department of Environmental Engineering, Harbin Institute of Technology, Harbin 150001, China

Z. Ou (✉)
Department of Civil and Environmental Engineering, Michigan State University, East Lansing, MI 48824, USA
e-mail: ouzhiyin@msu.edu

X. Yu
The Experimental High School Attached to Beijing Normal University, Beijing 100032, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_10

1 Introduction

Electric vehicle is a vehicle with broad prospects for development in the future. Compared with traditional vehicles, the biggest difference is that electric motors replace internal combustion engines, making the emissions of the whole use process lower. There are a lot of people in recent days, including electric vehicle manufacturers, that are trumpeting the advantages of low pollution of electric vehicles, which is a topic that are worth to be discussed (Qiao et al. 2017). The main purpose of this study is to make a comparison of the carbon emission between gasoline vehicles and electric vehicles in the whole life cycle under the condition that electric vehicles are vigorously promoted now. During the process of study, we compare the carbon emissions of two type of vehicles on the basis of data analysis, so as to determine which type of car is more environmentally friendly, and then judge whether the so-called low emission of electric vehicles conform to public awareness.

There have been many relevant studies on the comparison of carbon emissions between the two kinds of vehicles before. However, most of these studies are just limited to the analysis of a single field, such as the comparison of micro processes with the statistical data of fuel carbon emissions and production process. There are few articles to study the macro carbon emissions from the perspective of the whole vehicle life process, which is also a lack of cases at present. In addition, in these previous studies, the models of vehicles are different, and the data analysis methods are also diverse. This review adds the comparison of emissions of electric vehicles and gasoline vehicles in different countries and regions, trying to show the overall picture of these two vehicles from the perspective of environmental protection.

In this review, we plan to conduct the study in three stages. First, the article will introduce the carbon emission links in the life cycle of gasoline vehicles and electric vehicles. Then, the detailed data of carbon emissions generated by gasoline vehicles and electric vehicles in the whole life cycle are used to make a specific comparison, as well as the comparison between different regions. Finally, some predictions of the development of electric vehicles in the future are listed.

2 Carbon Emissions in Different Stages

2.1 Fashion Industry Pollution

From the resources we find, carbon emissions of petrol cars conclude 2 components, which are called vehicle manufacture and fuel emission.

Manufacturing. Manufacture emission, also named the upstream discharge, covers about 4 parts: raw material extraction, material production, vehicle component production and vehicle assembly. Commonly, automobile industry chain involves many other industries like metallurgy, electricity, machinery, chemistry and so on.

Table 1 CO_2 emission coefficient of some kinds of fuels (Peng et al. 2020)

Fuel	Emission coefficient (kg/L)
Diesel oil	2.651
Petrol	2.341
Gas	2.750

There are some examples: when the company produces a car, it needs about tons of steel for spare parts and structures of cars, which discharges the CO_2 in furnaces. Also, electricity is also a necessity, considering electroplating, welding and other processes.

Fuel Emission. Fuel emission can be split into two parts. For the direct emission of fuel, Eq. (1) is the reaction equation of the combustion of fossil fuel.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O \tag{1}$$

The main component of gasoline is octane. Octane reacts with oxygen after ignition and produces carbon dioxide and water, which is a major source of human carbon emissions. Many governments set standards and regulations to limit this part of emission. In carbon emission calculation, different types of fuel emission coefficient can be calculated by mass balance method according to fuel density and carbon content (Eq. 2).

$$k = \frac{44\rho C_F}{12} \tag{2}$$

In this formula, k is the emission coefficient which represents CO_2 emissions per liter of fuel consumed; ρ stands for fuel density, and C_F is the proportion of carbon in each fuel. Table 1 is the coefficient of some widely-used fuels calculated by this formula.

In addition to carbon dioxide emissions from direct combustion of automobile fuel, there are some invisible carbon emissions in the process of producing fuel, what we call indirect emission of fuel, such as fuel production, extraction and refining. These processes consume a large part of energy and at the same time emit CO_2. This part should also be calculated when it comes to the CO_2 emission of petrol cars.

2.2 Electric Vehicles

For carbon emissions of electric vehicles, the overall lifetime emissions are mainly composed of 2 parts: Manufacturing and fuel (electricity) production.

Manufacturing. Electric vehicles have higher emissions compared to traditional gasoline vehicles in terms of manufacturing, and most of them are coming from battery production. When dividing the manufacturing carbon emissions over the

lifetime of a gasoline vehicle, it is assumed that 40 g of carbon dioxide will be emitted for every kilometer, which is about 60% less than electric vehicles. This is not only because gasoline cars have lower manufacturing carbon emissions, but also the fact that they have a greater lifetime mileage. In most of the cases, lithium-ion batteries are used as power source of electric cars, there are a several of upsides about these batteries, including high energy and power efficiency, durable product life cycle, and favorable environmental properties (Hao et al. 2017). However, lithium-ion batteries are more material-intensive compared to combustion engines, it could count up to 30% of the weight of an electric car, which accounts for one-third of its cost and half of the CO_2 emissions during the manufacturing of an electric car (Hall and Lutsey 2018). Lithium is mainly stored in hard rock mines and underground, in order to get it, people have to excavate it by using CO_2-emitting fossil fuels. It is estimated that 15 tons of CO_2 are produced for every ton of mined lithium. The process of manufacturing batteries is another source of CO_2 emissions, to synthesize the required materials for production, the temperature has to be in the range between 800 and 1000 °C, the most cost-effectively way to reach it is to burn fossil fuels, thus more CO_2 is added to the environment.

Fuel Production. Vehicles that are running only on electricity do not have any tailpipe emissions, which is also known as direct emissions. However, emissions may be produced during the generation of electricity in a power plant. The amount of carbon emissions for fuel production is not the same in every place, it depends on types of energy the place is using for electricity generation. Generally, geographic areas that are more reliant on renewable energy will have a lower carbon footprint in this part.

3 Comparison of Carbon Emissions

3.1 Energy Consumption

The energy consumption of the two types of vehicles is calculated based on 260,000 km in the full life cycle, as shown in Fig. 1. The life cycle energy consumption intensity was consisted of fuel cycle energy consumption intensity and vehicle cycle intensity. The life cycle energy consumption intensities of the gasoline vehicle and the electric vehicle are 70.7978 tec per vehicle and 57.0746 tec per vehicle respectively. From Fig. 1, it could be found out that although the energy consumption of electric vehicles in vehicle cycle is higher than gasoline vehicles, the energy consumption of gasoline vehicles in full life cycle is still the highest, which means electric cars can achieve certain energy-saving effects.

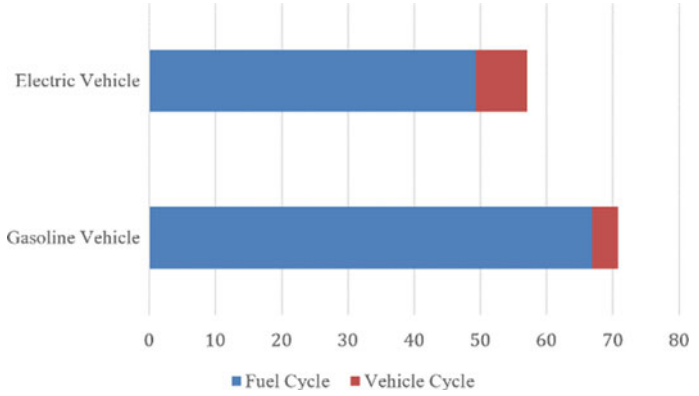


Fig. 1 Life cycle energy consumption intensity (tec/vehicle) (Ha 2020)

3.2 Carbon Emission

The full fuel cycle and vehicle cycle of gasoline vehicles and electric vehicles are analyzed and a comparison is made between them in this part.

Fuel Cycle. Gasoline in the well-to-pump (WTP) phase of carbon emissions is mainly produced in mining and fuel processing, the Table 2 shows all kinds of terminal energy gasoline produced at all stages of the WTP of greenhouse gas emissions (the conversion of CO_2 equivalent). The WTP stage of electric energy is also divided into two processes: raw material exploitation and fuel processing. The calculation results of greenhouse gas emissions generated in each stage of electric energy WTP are shown in Table 2, and all data are converted into carbon dioxide equivalent.

By integrating the data, the CO_2-equivalent comparison of gasoline vehicles and electric vehicles in the WTP phase is shown in the Fig. 2. It can be seen that in the WTP stage, the greenhouse gas emission of electric vehicles is much larger than that of gasoline. The result is just on the antithesis of the prevail belief that electric car will emit less greenhouse than that of gasoline car. We suppose the surprisingly result is because of the energy used to produce electric energy in China was not clean, and the data used to calculate the result might outdated in some degree.

Since in pump-to-wheel (PTW) stage, pure electric vehicles use electric energy as the power source and do not produce greenhouse gas emissions during the formal process, only the greenhouse gas emission intensity generated by gasoline in PTW stage is calculated, which is 236.3 g CO_2 equivalent per kilometer. The GHG emission intensities of fuel products consumed by traditional internal combustion engine vehicles, pure electric vehicles and hybrid electric vehicles in PTW and WTP stages were integrated to obtain the GHG emission intensities generated by the three vehicles in the well-to-wheel (WTW) life cycle, as shown in Table 3. It can be seen that the greenhouse emission intensity produced by pure electric vehicles in the fuel cycle is the highest, followed by hybrid electric vehicles and traditional internal

Table 2 Carbon emission of gasoline and electric energy in the WTP phase (g CO_2-eq/gce) (Ha 2020)

		Raw coal	Raw petroleum	Natural gas	Gasoline	Fuel oil	Diesel	Total
Gasoline	Raw material production	1.89E−01	6.98E−02	2.45E−01	1.84E−03	2.34E−03	8.45E−03	5.16E−01
	Fuel processing	2.67E−01	4.34E−03	7.43E−03	9.34E−06	1.78E−02	2.56E−03	2.99E−01
	Total	4.5E−02	3.89E−01	5.29E−03	2.25E−06	2.78E−05	1.56E−02	8.16E−01
Electric energy	Raw material production	2.45E−01	1.99E−03	3.29E−03	5.43E−04	3.56E−04	8.01E−03	2.59E−01
	Fuel processing	6.23E+00		8.34E−02				6.31E+00
	Total	6.48E+00	1.99E−03	8.67E−02	5.43E−04	3.56E−04	8.01E−03	6.57E+00

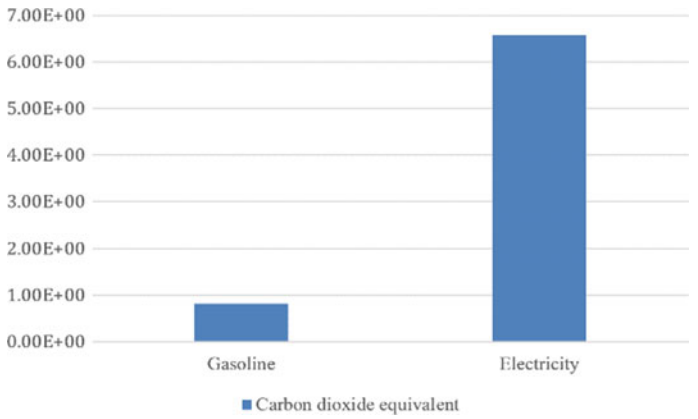


Fig. 2 Greenhouse gas emission intensity in WTP phase (g CO_2-eq/gce) (Ha 2020)

combustion engine vehicles. We speculate that the reason for this phenomenon is that China's power generation structure is still dominated by fossil energy. Therefore, efforts should be made to improve the power generation structure in order to reduce the carbon emissions generated in the whole life cycle of electric vehicles. China should give priority to the promotion of solar cells in North China (Yu et al. 2018).

Vehicle Cycle. Greenhouse gas emission intensity of the two energy vehicles in the vehicle cycle include vehicle body material, power battery, parts production, body scrap and battery scrap is shown in Table 4. It can be seen that the electric vehicle emits more greenhouse gases than gasoline vehicles in vehicle cycle.

Life Cycle Carbon Emission. Finally, the life-cycle carbon emission calculation results of vehicles are shown in the Fig. 3. It can be seen that pure electric vehicles still have the highest GHG emission intensity.

Table 3 Greenhouse gas emission intensity in fuel cycle (g CO_2-eq/km) (Ha 2020)

	Gasoline vehicle	Electric vehicle
Greenhouse gasses emission	326.46	372.51

Table 4 Greenhouse gas emission intensity in vehicle cycle (g CO_2-eq/km) (Ha 2020)

	Vehicle body material	Power batery	Parts production	Body scrap	Battery scrap	Total
Gasoline vehicle	57.89	–	24.23	1.02	–	83.14
Electric vehicle	57.91	28.99	20.28	0.91	7.36	115.45

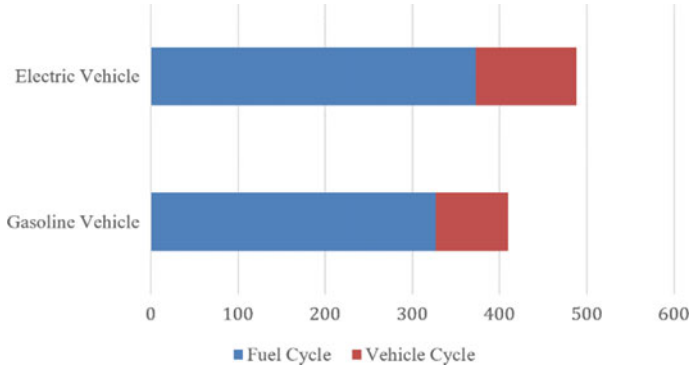


Fig. 3 Greenhouse gas emission intensity in full life cycle (g CO_2-eq/km) (Ha 2020)

4 Different Regions

Battery electric vehicles do reduce emissions compared to internal combustion engines vehicles, but it is not the same in every place (Vliet et al. 2011). Reduction of emissions for electric vehicles is highly dependent on the regions they were produced, as well as the places they were used. The article compares the use stage between these vehicles in the United States, but even in the same country, their emissions will be different in different stages. The reason that leads to this is because each place has different sources that are used to generate electricity, if the place mainly uses renewable energy as an electricity source, for example, solar and hydro energy, carbon emissions for the generation of electricity will be lower than those using fossil fuels.

It has been found that carbon emissions of an electric vehicle are highly related to the local electricity sources, generally, they are negatively related. According to the United States Energy Information Administration, there are 5 major renewable energy sources: Solar energy, geothermal energy, wind energy, biomass energy and hydropower. Based on this classification, the relationship between CO_2 equivalent emissions and energy sources for electric cars is shown in Fig. 4. Take the United States as an example, the average annual emission for each electric vehicle is 3932 pounds of carbon dioxide equivalent, carbon emission of an electric car will change based on the different regions they are being used. In states like North Dakota and Michigan, the average emission is relatively high due to the electricity sources they use, in these places, coal and oil are still the most common energy sources, fossil fuels accounted for above 60% of their electricity sources, correspondingly, carbon emission is higher than other places during generation of electricity. On the contrary, electric cars in places like California and Washington have lower annual carbon emissions, these states use natural gas and hydro energy as their primary electricity sources, as a result, emissions of electric cars are significantly lower. However, there is also some exception that a place with a higher percentage of renewable energy

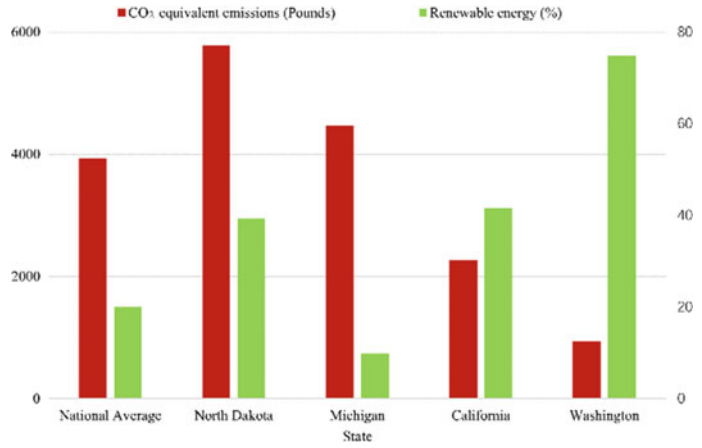


Fig. 4 Annual emissions of CO_2 equivalent and energy sources for electric vehicles in different regions in the United States (https://afdc.energy.gov/vehicles/electric/emissions.html)

sources still has relatively high carbon emissions, because the efficiency and intensity of renewable energy will change based on types.

Carbon emissions of electric cars also change from country to country. In general, it will be lower in developed countries. As shown in Fig. 5, Europe has the most significant reduction of carbon emissions for electric cars. Battery electric vehicles produce about 80 g of carbon dioxide for each kilometer driving by using life-cycle analysis, which is about 30% carbon emissions as compared to internal combustion engine vehicles. However, in developing countries like China and India, carbon emissions for electric vehicles are still between the range from 150 to 200 g for per kilometer driving, about twice as much as carbon emission of electric vehicles in Europe (Bieker 2021). The amount of carbon emissions of electric vehicles in each region will have a slight reduction in 2030 if current policies are maintained in the next 10 years, but none of them could meet the carbon emission standard made by the Paris Agreement. More work needs to be done in order to achieve the planning scenario (Wolfram and Lutsey 2016).

5 Conclusion

In the whole life cycle (including fuel cycle and vehicle cycle), electric vehicles have a lower amount of carbon emissions than gasoline vehicles in the whole life cycle process except for production, the energy consumption intensity of gasoline vehicles is still the highest. However, the differences are not as much as the public once thought, carbon emissions of electric vehicles come mainly from the manufacturing and recycling states, how to reduce the emissions of producing vehicles' batteries

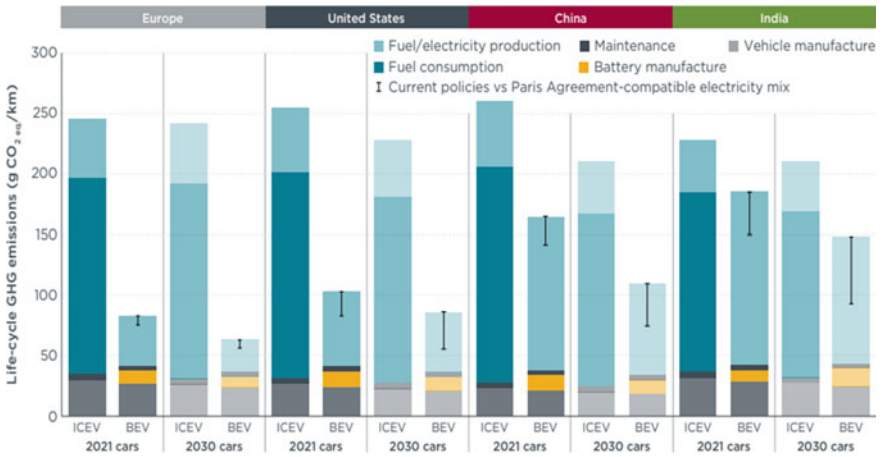


Fig. 5 Comparison of GHG emissions for ICEV and BEV in different regions (Bieker 2021)

and waste disposal are the biggest problems for current electric vehicles. There is also other literature suggesting that the life cycle emissions of electric vehicles sold in the future will be much better than those sold today. And the current recycling stage of electric vehicle battery brush zero is very few, but in the next few years, the scale of electric vehicle battery recycling will greatly increase, direct recycling of batteries can reduce carbon dioxide emissions, and will achieve the purpose of energy saving. The cost of production of the battery will also decrease in few years. Additionally, there are huge differences between each region. Research shows that carbon emissions of electric vehicles tend to be lower in developed places, as well as places with higher portion of renewable electricity supply.

References

Bieker G (2021) A global comparison of the life-cycle greenhouse gas emissions of combustion engines and electric passenger cars. Communications 49(30):847129-102

Ha N (2020) Life cycle assessment of electric vehicles' carbon emission and its impact on the environment. NCEPU, MA thesis

Hall D, Lutsey N (2018) Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions. ICCT Briefing, pp 1–12

Hao H, Mu Z, Jiang S, Liu Z, Zhao F (2017) GHG emissions from the production of lithium-ion batteries for electric vehicles in China. Sustainability 9(4):504

Peng M, Liao Q, Zeng L, Wang J (2020) Carbon reduction calculation of new energy vehicles in road operation. J Guangdong Univ Technol 37(2):39–44

Qiao Q et al (2017) Comparative study on life cycle CO_2 emissions from the production of electric and conventional vehicles in China. Energy Procedia 105:3584–3595

U.S. Department of Energy. Alternative Fuels Data Center. Emissions from electric vehicles. https://afdc.energy.gov/vehicles/electric/emissions.html

Van Vliet O, Brouwer AS, Kuramochi T, van Den Broek M, Faaij A (2011) Energy use, cost and CO_2 emissions of electric cars. J Power Sources 196(4):2298–2310
Wolfram P, Lutsey N (2016) Electric vehicles: literature review of technology costs and carbon emissions. The International Council on Clean Transportation, Washington, DC, USA, pp 1–23
Yu A et al (2018) Life cycle environmental impacts and carbon emissions: a case study of electric and gasoline vehicles in China. Transp Res Part D Transp Environ 65:409–420

The Impacts of Offshore Oil Spills on Marine Life and Humans and Solutions

Mengyao Wang

Abstract At present, marine pollution has gradually become a big issue of environmental pollution, in addition to the pollution caused by plastic waste, marine oil spills are also a very serious source of pollution. Oil spill can not only cause large-scale pollution of ocean, but also continue to affect for a long time. This article mainly analyzes the composition of oil and discuss the influence of oil spill impacts on fish, seabirds and humans. Proposes four relatively common oil spill treatment plans, including booms, skimmers, burning and using dispersant, and summarizes the policies issued by the government for the oil spill in 1973. For petroleum, the main component is hydrocarbon organic. In addition to the influence of volatile substances, the leakage of aromatic hydrocarbon (PHAs) into the seawater will cause lesions in the eyes and reproductive systems of fish and soft vertebrates. In addition, the components left on the surface of seawater will also lead to birds who live in the polluted or surrounding area get persecution and result in heavy feathers or accidental ingestion of oil during feather trimming and death. Secondly, the pollution of seawater will also cause some oil components to remain in the body of marine organisms and through the food chain the accumulated toxic components will affect humans. In addition, the contamination of seafood can also have an economic impact on the people who live by the sea and feed on the sea. Although relative institutions have made correlated policies to prevent and solve the oil spill, oil spills are still happening and bring influence on environment. Therefore, it is significant to analyze oil spills effects and increase people awareness of ocean protection.

Keywords Offshore oil spill · Oil composition · Seawater pollution · Impacts on marine life · PHAs impacts

M. Wang (✉)
Chemical and Environmental Engineering, University of Nottingham, Nottingham NG7 2RD, UK
e-mail: ssymw1@nottingham.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_11

1 Introduction

In recent years, marine pollution is gradually become one of the biggest environmental problems in the world, because marine system occupies more than 70% of the earth surface and, around 97% water on the earth are coming from the ocean, human lives are also linked with the ocean system (Oil spills: A major Marine Ecosystem Threat 2022). Therefore, marine pollution is a serious problem that people face now. It is known that the usage of ocean mainly includes the acquisition of food and using as marine transportation equipment. For the latter, ocean is utilized as a popular transportation equipment, which brings more choices for people to travel and creates many benefits. However, at the same time, the harm people bring to the ocean is inevitable. For instances, plastic litters in the ocean and overfishing of marine life. Except these marine problems, oil spill can be also considered as another form of marine pollution, which will be the core topic of this article. Although oil spill is not occurred as frequently as other type of pollution, the impact of oil spill can affect a large area of ocean, in addition, toxic substances in the oil will also affect a range of wildlife that live depend on the seawater, such as, algae, whales and seabirds (US Department of Commerce 2022). Furthermore, if there is a leakage of oil happens over the ocean, the oil will not be removed as quickly as expected, which may lead the stop floating oil sink into the seawater and do a long-term harm on the ecosystems. Therefore, it is significant to do the analyzation of oil spill impact on marine system and human.

Generally, most pollutants in the ocean are comes from many different points. For example, coastline, where people live along, drainage water and waste disposal water from factories next to the rivers and lakes. In the following, these pollutants through runoff and finally flow into the ocean. In contract with these pollutants, oil spill comes from only a single source, the reasons behind oil spill were generally including oil leak from containing tank or accidents happened on the offshore ship, such as, hurricane, typhoon (National Oceanic and Atmospheric Administration 2022). However, whatever the cause of the oil leak, pollutants from oil spill will bring serious environmental problems to a large area of the ocean and the nearby coast like Fig. 1 shows.

This article will first introduce the main components of the spilled oil and give basic information of the hydrocarbon organics in the oil. Next will mainly explore the oil spill impacts on marine environment, including pollution of seawater, pollution of marine life and, indirect or direct impacts on human. Moreover, although the oil spill will affect a lot of various marine species, the main analysis here is the influence on fish and seabirds. Finally, this article proposes four solutions to marine oil spills including booms, skimmers, burning and using dispersant. Besides, simply introduces the related governmental policies in 1973 to prevent oil into navigable water and using double-wall equipment.

Fig. 1 Gulf after oil spill (What would the economic cost … 2022)

2 Formation and Components of Oil

2.1 Formation of Oil

Generally, the generation of oil can be divided into two groups, including biological sedimentation and petrochemical oil. However, the former method is more acceptable by most of geologists, which indicates the petroleum formation is similar with natural gas. Both of petroleum and natural gas are generated because of biological remains and algae in ancient time. When being rotted, these biological remains and algae mixed with soil and being buried under sedimentary rocks. After a long period of high pressure and high temperature, oil shale was formed. In the following, oil shale was degraded into liquid and gaseous hydrocarbons, which penetrated rock formation to form oil field. Another method believes that oil is generated from the carbon itself in the crust of earth, which has nothing to do with biology, in this method, the oil is renewable. Therefore, no matter which method forms the oil, the main component of oil contains hydrocarbons, including alkanes, naphthene and aromatics. In addition, petroleum also contains a small amount of non-hydrocarbon components (Chap. 5, Drilling 1983).

2.2 Hydrocarbon Components in Petroleum

The hydrocarbon that makes up petroleum mainly include alkanes, naphthene, and aromatic hydrocarbons. Among them, alkanes are saturated compounds, which have

the characteristics of low density and best viscosity-temperature, which is also the main reason why petroleum can be used as lubricants and fuels. Second, cycloalkanes have better chemical stability but worse than aromatic hydrocarbons. They are unsaturated hydrocarbons with higher density and higher auto-ignition points. In addition, cycloalkanes contain polycyclic and monocyclic. If there are more rings, the viscosity of substances is stronger, if there are more rings, the viscosity of the substance is poorer. Aromatic hydrocarbons are an important part of petroleum. They are usually composed of one or more benzene rings. They are usually dense but insoluble in water. In order to remove aromatic hydrocarbons, people usually choose to use large particles to adsorb them on the surface. Removed from the solution. Although aromatic hydrocarbons can dissolve some organic substances, because of their high toxicity, it is necessary to pay attention to the dosage when making products. Unsaturated hydrocarbons with very little content in petroleum components are generally produced in secondary processing, and the cracked products contain more olefins, which have poor chemical properties and can be easily oxidized into gums (Hydrocarbon 2022; Klett and Korous 1965).

2.3 Non-hydrocarbon Components

Non-hydrocarbon components have very little content in petroleum, which mainly includes sulfur compounds, oxygen compounds and nitrogen compounds. Therefore, when refining petroleum or making products, these substances need to be moved first, because of their toxicity (Hegazi and El-Gayar 2017).

3 Oil Spill Impacts

3.1 Oil Spill Impacts on Seawater

Once the oil spilled in the ocean, it will have react as shown in Fig. 2. First the floating oil will be spread quickly on the seawater surface according to the component and its relative density, then the formed oil on the surface will keep its cohesive ability and broke into make many fragments by the waves and currents. When the wind blows over the surface, the floating oil will be blown away quickly and cause large-scale pollution. In some cases, the floating oil would reach the coast and bring contamination to terrestrial habitats (Oil spills: Impact on the ocean 2022). For the oil on the sea surface, some of the substances contained large volatile components in the oil will be evaporated first, for example, light ends in petrol, kerosene and diesel oil. The remaining heavier substances in oil on the will be left on the surface of the sea and become more viscous, which may through dispersion, emulsification, dissolution and oxidation processes extend chemical and physical influence on environment.

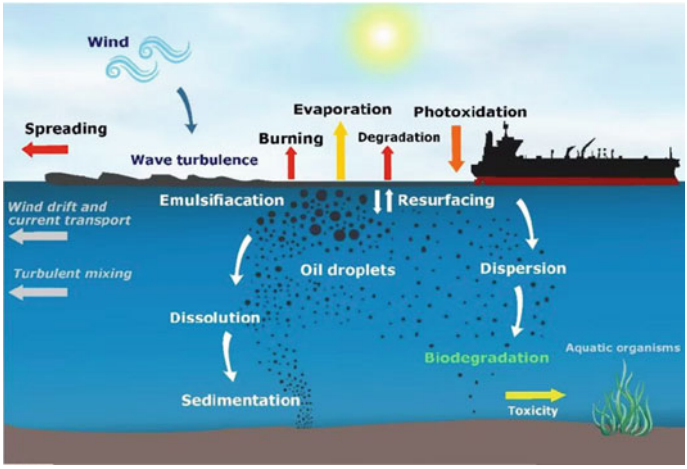


Fig. 2 Processes of oil reaction after leakage (Gateway and FACTS 2022)

When heavier fragments after being broke, they may drop into the sea, however, when these fragments mixed with water and go back the water surface, a very thin membrane might be formed, which can increase the oil contact area of water. This is the first step that spilled oil get dispersion into the seawater, in the following, this also sets the stage for the next step in oil-polluted seawater. When the oil is spread on the water in a large area, some water droplet will be combined with oil fragments in the ocean, this phenomenon can be also called emulsion, these emulsions can make oil fragments become more viscous and persistent than original, therefore, increase the contamination volume of oil debris in the water by the three or four times the original volume (Gateway and FACTS 2022).

3.2 Oil Spill Impacts on Marine Life

Polycyclic Aromatic hydrocarbons (PAH) is one type of aromatic hydrocarbons, which can also dissolve into ocean and cause PAH pollution to ocean and affect marine organisms. Some scientists have studied the effects of PAHs on aquatic animals and the properties of bioaccumulate toxicity, these different PHAs structures can be found in Fig. 3. Marine animals like fishes, the formation of carcinogenic properties is closely related to the marine environmental (Bunton 1996). In addition, the carcinogenic properties of PAHs to marine animals have been published (Honda and Suzuki 1363). Furthermore, fish are particularly sensitive to the levels of PAHs at two developmental stages. One is during the embryonic period, and another is during cardiac development period (Cherr et al. 2017). At the first stage may cause the embryo of the fish to fail to survive, and the second period will destroy the heart function of fish, so that the heart function of fish will be affected and cannot obtain

oxygen (Honda and Suzuki 1363). Except these two, PAHs contained in crude oil will affect the genes of fisheye development and function, as well as eye morphology (Magnuson et al. 2018). However, it is known, vision plays an important role in most type of fishes in their life (Colicchia 2007). Visual impairment will cause fish to be unable to avoid danger and prey, and it will be difficult for them to survive in the food chain. According to these influences, the effect of PAHs on the seawater prevents fish from forming embryos at the early stage. This may lead to fewer species of fish, and many endangered species may also become extinct. In fish that have already completed development, the more PAH levels accumulated in the body, the more serve the impairment of the heart function, furthermore, when comparing with fish, invertebrates have lower metabolic capacity, which means PAHs can influence a broad range of marine life (Honda and Suzuki 1363).

In addition to the fish that live in the sea, seabirds will also be another important victim of oil pollution. If the oil floats close to the coast, then the seabirds living on the shore will be the first to be harmed. In addition, seabirds could come to the sea to hunt for food, if their feathers stained with oil, which will be a serious problem for them. First, their feathers are used for protecting them from water and insulate from outside, if there are oil on their feathers, which is hard for birds to regulate the body temperature when expose under the nature, even sink into the water due to the heavy feathers (The effects of oil spills on birds... 2022). In order to clear the oil on birds'

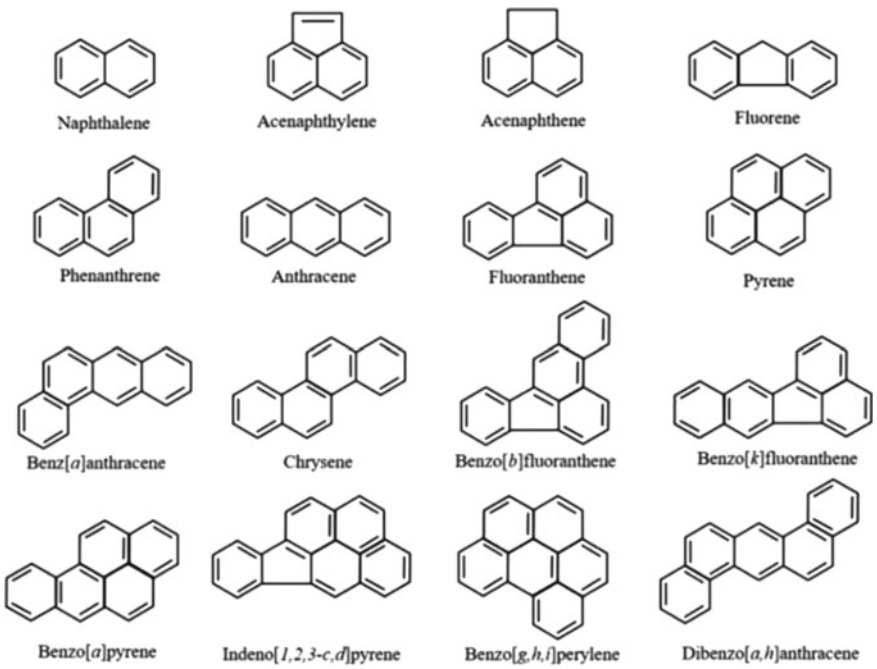


Fig. 3. 16 types of polycyclic aromatic hydrocarbon (PAHs) (Honda and Suzuki 1363)

Table 1 Frequency of corresponding oil situations of seabirds (Tran et al. 2014)

Oil condition	Frequency
Live and not visibly oiled	814
Live and visibly oiled	861
Dead and not visibly oiled	2930
Dead and visibly oiled	1822
Dead and unknown	800
Live and unknown	2

feathers, some of them might comb through the mouth, ingest oil can even kill them outright (The effects of oil spills on birds 2022).

In 2010, the biggest spill happened in the Gulf of Mexico, which is called Deepwater Horizon spill. About 205 million gallons of oil was spilled into the ocean and 11victims were counted at that time (There were 137 oil spills … 2018). Some research had been done to find the relationship of birds and Deepwater Horizon oil spill in the same year, in Table 1, bird oil condition and the number of each group can be compared, as the table shows, the total number of dead birds with oil plus unexplained deaths is less than the total number of dead birds without oil, the reason behind can be guessed as these birds could be possibly killed by eating polluted water or food (Tran et al. 2014). Except the death birds that have been counted, it is hard to know the effects the toxins left in the body will have on the birds in the future. Furthermore, oil spill impacts on environmental are irreversible and will cause long-term damage. If the oil floats close to the coast or on the seawater surface, many species of birds will lose their habitats, such as, turtles, dolphin, seabirds and whales (Edmond 2022).

3.3 Oil Spill Impacts on Human

As the top of food chain, there will be a growing number of toxic components in the oil that have not been decomposed. Therefore, marine oil spill is also very harmful to human beings, first, most of the human live along the coast are relying on the capture of seafood. The pollution of oil spill is extensive and ling-term. If people eat contaminated seafood, which will obtain the most direct impact.

Apart from preying on marine life, researchers did research on oil impacts on human health, who are the residence live along the oil spill area. Except the Deepwater horizon oil spill impacts, A place along the Amazon River called Ecuador that is deeply affected by oil extraction and oil dumping (What do we know about … 2022). During 1972–1993, approximately 30 billion gallons oil and other wastes were released into the environment there, the sum of the oil dumps is almost 140 times larger than the Gulf of Mexico (What do we know about how … 2022). Which lead people cannot obtain water from the water supply system, most of them collect water from rain, wells and small stream (Maurice et al. 2019). Researchers collected

the domestic water from south region and compared with the water around the local oil company of Ecuador found there are high levels of Escherichia coli in water, as well as high in zinc, aluminum and manganese, which can have a terrible impact on health (Maurice et al. 2019). Additionally, the water collected from the oil camps has been found that toluene levels higher than natural. When humans ingest water for a long time, it is easy to gain cancer (Maurice et al. 2019). Furthermore, some published self-report from people with long-term exposure to natural gas or oil show that, they have varying degrees of respiratory problems, skin or eye irritation and neurological problems. Moreover, the closer people live to the leak point, the more serious the symptoms are. Research shows these effects are irreparable and cause reproductive damage as well as cancer (What do we know about … 2022).

Furthermore, socially speaking, if people living by the sea cannot eat the seafood, they will not be able to maintain their live, poverty and hunger are likely to occur, which will slow down or even reverse social development (Charlotte Edmond 2022). In addition, cleaning up oil and remediating the pollution caused by the oil in the ocean also require a large amount of money. For example, an oil spill happened on the northern coast of British Columbia in the past, which used $24 billion to do the cleanup work, and also cause $308 million lose (What would the economic … 2022).

4 Solutions and Prevention Policies

4.1 Solutions Towards Oil Spill

Once there is oil spill happens over the ocean, the first solution is to control the oil float on the surface, oil booms are the most popular method to do the job, which works as a fence that can isolate the oil and prevent oil quickly spread and float away. However, this method can work under the limited condition, of the oil has been broke into different fragments or has been floated away by the current, oil booms will be hard to successfully employed. For the oil, which has been confined into the boom, a cooperated equipment is skimmer, which can be effectively used as a vacuum cleaner and suck all the confined oil from the water surface as Fig. 4 shows, in addition, these collected oil can be recycled to use. Furthermore, sorbents are another method to move the oil spilled in the marine, it can be soaked under the water and absorbed the pollutants then this absorbed oil can be recovered to prevent wastage (Agarwal 2022).

Burning can be considered as another method, which can effectively remove 98% oil spill and prevent the oil being spread broadly. However, the burning fume over the surface may damage marine life and cause environmental problems, besides, lungs and eye will receive irritations (Charlotte Edmond 2022; Agarwal 2022). If the oil has not been collected by booms, using dispersant to increase the surface of water and molecule containing surface then, the oil can be degraded by microbes more easily. Furthermore, when oil molecule combined with water will also contain considerable

Fig. 4 Skimmer is collecting floating oil (Oil spills 2022)

sands and stones and form tarballs, these tarballs will float towards coast, however, they will also cause second pollution to ocean and bring toxicity to marine organisms (Agarwal 2022).

4.2 Related Policies

In 1973, 'clean Water Act' has mentioned the regulation of oil spill pollution that government must response to oil emissions from facilities not related to transportation, the purpose is to prevent and control the released oil flow into the navigable waters and adjacent coastlines (Environmental Protection Agency 2022). For equipment, using safe barrel handling procedures, when loading and unloading barrels, people should take care and follow the correlated regulations, others, when transfer the oil, drum funnel should be used, and all the equipment and tanks should be double walled (Oil spill prevention … 2022).

5 Conclusion

The impacts of oil spill over the ocean are irreversible and will have a long-lasting influence on not only marine organism, but also people and the whole ecosystem. Because the composition of oil contains large amounts of hydrocarbon organics and heavy metal elements especially aromatic hydrocarbons, both of which can cause serious diseases to organisms. Such as seabird living in polluted areas died from ingesting oil and residents in Ecuador become ill. Although the floating oil over

the surface can be cleaned up by oil booms, skimmers, burning or through adding dispersant can reduce the oil spread velocity, the influence on humans and marine organisms can be accumulated in the body leading to genetic damage or damage to organs, such as lungs, heart. For fish, long-term pollution also led to poor water quality and eventually extinction of species and damage to the food chain. Despite many countries with oil spills has promulgated relevant documents to deal with and prevent oil spill over the sea, there are still a great number of oil spill cases happening in the world. Therefore, the most important factor to protect marine from oil spills is to raise human awareness of environmental friendliness and play respect attitude towards the ocean.

References

Agarwal M (2022) 10 methods for oil spill cleanup at sea. Marine Insight. https://www.marineinsight.com/environment/10-methods-for-oil-spill-cleanup-at-sea/#1_Using_Oil_Booms. Last accessed 17June 2022

Bunton TE (1996) Experimental chemical carcinogenesis in fish. Toxicol Pathol 24(5):603–618

Chapter 5 Drilling (1983) In developments in petroleum science, vol 16. Elsevier Science and Technology, pp 95–105

Cherr GN, Fairbairn E, Whitehead A (2017) Impacts of petroleum-derived pollutants on fish development. Ann Rev Ani Biosci 5(1):185–203

Colicchia (2007) Vision of fish in air. Phys. Educat. 42(2):189–192

Charlotte Edmond SW (2022) This is how oil spills damage our environment. World Economic Forum. https://www.weforum.org/agenda/2021/10/oil-spill-environment-ocean/. Last accessed 16 June 2022

Environmental Protection Agency. EPA. https://www.epa.gov/oil-spills-prevention-and-preparedness-regulations/overview-spill-prevention-control-and. Last accessed 17 June 2022

Global Marine Oil Pollution Information Gateway FACTS What happens to oil in sea water? http://oils.gpa.unep.org/facts/fate.htm. Last accessed 18 June 2022

Hegazi, El-Gayar MS (2017) Role of non-hydrocarbon constituents in crude oils correlation and heavy fractions processing studies. Petroleum Chem 57(10), 838–842

Honda M, Suzuki N (2020) Toxicities of polycyclic aromatic hydrocarbons for aquatic animals. Int J Environ Res Public Health. 17(4):1363

Hydrocarbon (2022) Britannica academic, Encyclopædia Britannica, academic-eb-com.nottingham.idm.oclc.org/levels/collegiate/article/hydrocarbon/41720. Last accessed 15 June 2022

Klett R, Korous LR (1965) American society for testing materials and ASTM international (1965) Determination of trace hydrocarbon impurities in high purity chemicals from petroleum by gas chromatography. ASTM Int 319–328

Magnuson JT, Khursigara AJ, Allmon EB, Esbaugh AJ, Roberts AP (2018) Effects of deepwater horizon crude oil on ocular development in two estuarine fish species, red drum (*Sciaenops ocellatus*) and Sheepshead Minnow (*Cyprinodon variegatus*). Ecotoxicol Environ Saf 166:186–191

Maurice L, López F, Becerra S, Jamhoury H, Menach KL, Dévier M-H, Budzinski H, Prunier J, Juteau G, Ochoa-Herrera V, Quiroga D, Schreck E (2019) Drinking water quality in areas impacted by oil activities in Ecuador: associated health risks and social perception of human exposure. Sci Total Environ 690:1203–1217

National Oceanic and Atmospheric Administration. Homepage | National Oceanic and Atmospheric Administration. https://www.noaa.gov/. Last accessed 14 June 2022

Oil spill prevention, control and countermeasure (environmental) (2022) Policy Library. https://www.stmarytx.edu/policies/facilities-services/oil-spill-prevention-control-countermeasure-environmental/. Last accessed 17 June 2022

Oil spills: a major marine ecosystem threat. National Oceanic and Atmospheric Administration. https://www.noaa.gov/explainers/oil-spills-major-marine-ecosystem-threat. Last accessed 14 June 2022

Oil spills: impact on the ocean. Water Encyclopedia. http://www.waterencyclopedia.com/Oc-Po/Oil-Spills-Impact-on-the-Ocean.html. Last accessed 15 June 2022

The effects of oil spills on birds: Bird spot. British Birds | Bird Watching | Garden Birds | Bird Spot. https://www.birdspot.co.uk/helping-birds/the-effects-of-oil-spills-on-birds. Last accessed 16 June 2022

There were 137 oil spills in the US in 2018. see where they happened. Resource Watch Blog. https://blog.resourcewatch.org/2019/02/07/there-were-137-oil-spills-in-the-us-in-2018-see-where-they-happened/. Last accessed 17 June 2022

Tran T, Yazdanparast A, Suess EA (2014) Effect of oil spill on birds: a graphical assay of the deepwater horizon oil spill's impact on birds. Comput Stat 29:133–140

US Department of Commerce. How does oil impact marine life? National Ocean Service. https://oceanservice.noaa.gov/facts/oilimpacts.html. Last accessed 15 June 2022

What do we know about how oil spills affect human health? not enough. Amazon Frontlines. https://amazonfrontlines.org/chronicles/what-do-we-know-about-how-oil-spills-affect-human-health-not-enough/. Last accessed 17 June 2022

What would the economic cost of an oil spill be? Sacred Trust. https://twnsacredtrust.ca/concerns/economic-cost-oil-spill/. Last accessed 15 June 2022

A Case Study of the 2021 Pulitzer Prize-Winning Articles in Feature Writing Based on Narrative Communication Theory

Suya Xie

Abstract Based on the empirical evidence in narrative communication, this article argues that the journalists arrange the sequences of events in feature writings production to meet the audience's need for story coherence. Taken as a miniature of exemplary journalistic practice in feature writings, the 2021 Pulitzer Prize-Winning Articles in Feature Writing was examined, in order to answer how narrative communication theory operates. This paper applies Labov and Waletzky's narrative model and Bell's improved one, which is suitable for the analysis of news texts, and identifies the coherent expression in samples was manifest in temporal, causal, motivational, and affective orders. The entire narrative structure and the narrative cycle structure were presented within a temporal framework, and emotional content was structured within the communicative framework (Duncan 13:589–603, 2012). Interpretations are provided by interrupting the narrative to ensure rigorous logic, while the supporting evidence is avoided to increase the audience's immersion. This paper adds narrative paradigm theory on the basis of qualitatively and quantitatively research by other scholars and also advances the general understanding of narrative structures.

Keywords Narrative communication · 2021 Pulitzer prize · Feature writings · Labov · Waletzky's narrative model

1 Introduction

The early communication study was built around a core analysis of the information transmission process and effect. For instance, Schramm, who developed the system of communication education and mesh together communication theories and methodologies (Rogers 1997), advocates that communication should be seen as a transaction process, in which "senders" transmits messages to "receivers" through

S. Xie (✉)
Century College, Beijing University of Posts and Telecommunications, Beijing 102101, China
e-mail: miaainred@outlook.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_12

the adapter and receives feedback. To ensure the correct and large flow of information and achieve a better transmission effect, the "noises" in the transaction process should be eliminated (Guoren and Yan 2019). This mode of communication theory is biased towards empirical research, such as Hovland explored how communication behavior affects the audience's attitude through a series of empirical research, to produce a communication effect (Riley et al. 1953).

However, since the late 20 century, parts of social sciences, including communication study, were influenced by narratology, named "the narrative turn" or "the rhetoric turn" (Riessman 1993). The empirical research-based dominant paradigm was criticized by Peters for paying too much attention to solving practical problems, such as the strength of publicity effect, causing the communication study trapped in "intellectual poverty" instead (Peters 1986). A year later, W.R.Fisher wrote Human Communication as Narration: Toward a philosophy of reason, value, and action, aroused echoes among researchers as to gradually constructed the "narrative paradigm" of communication (Guoren and Yan 2019). The narrative communication theory focus on how do individuals assess the authenticity and persuasiveness of the narration they hear, experience, and believe. Fisher proposed that human beings, meanwhile, referred to as "homo narrans" by him, carry out communication by telling persuasive stories (Guoren and Yan 2019). Cragans and Shields have further detailed Fisher's findings, generalizing them into five hypotheses, and collated as narrative paradigm theory (Cragan and Shields 1995).

The above is a brief historical background introduction and literature review of narrative communication theory. What follows is a brief introduction to the selected cases in this paper, and how it applies to narrative paradigm research. Gaye Tuchman proposes that reporters should gather and structures "facts" in a detached, unbiased, impersonal manner in order to avoid defamation proceedings (Tuchman 1972). This objectivity "strategic ritual" has become one of the foundations of journalistic practice: procedural objectively describe the subjective feelings of others to complete the report in a narrative form. It removes journalists from participation, judgments, and feelings (Wahl-Jorgensen 2012). Therefore, the pursuit of objectivity does not make news works anti-narrative. On the contrary, it has become a narrative strategy in journalistic practice: through a series of strategic rituals, the "inevitable subjectivity" is carefully managed in an objective way (Schudson 1978).

Feature writing is a narration-conscious news genre, pertaining to "anecdotal leads, personalized story-telling and widespread invocation of emotion" (Wahl-Jorgensen 2013). Most feature writings shun the use of the inverted pyramid lead, which David Mindich argued as a stylistic element of the ideal of objectivity (Mindich 1998). In Karin Wahl-Jorgensen's study, the usage rate of using the inverted pyramid lead varied significantly among genres: none in the feature category (Wahl-Jorgensen 2013). Instead, writers do not arrange the materials according to the news value, but according to the chronological order, leading the reader's attention to the climax, so as to achieve the effect of "suspension" (Zhixing 1981). The Pulitzer Prizes winning articles are considered as "the most highly valued examples of journalistic practice" (Wahl-Jorgensen 2013). It is noteworthy that, as a news genre close to literary texts, the Pulitzer Prizes winning feature articles can neither represent the routine news

coverage nor reflect the diversity of the worldwide journalism practice. Still, the study may have contributed to identifying practices that are regarded as exemplars (English 2002).

The modest but original contribution of this paper is to add narrative paradigm theory on the basis of qualitatively and quantitatively researches by other scholars, to discuss the narrative communication mechanism in feature writings.

2 Literature Review

The narrative paradigm of communication is a theoretical system suitable for observing, comprehending, and analyzing media texts. Therefore, some scholars choose to use it as a rationale to analyze news stories. For instance, Zhang Shuning studied the narrative communication of convergence news products in the Web3.0 era, believed that the narrative innovation in news products is a deep synergy between content and technology (Shuning 2015). Sallyanne Duncan discussed the news stories based on "death knock" interviews and reveals that the coherent narrative was one of "unyielding anguish, emptiness and continuing loss" (Duncan 2012). Within the guidance of narratology theory and communication film theory, Udi Ben-Arie adapts the existing narrative-communication models and proposes a bi-directional communication structure for interactive storytelling systems (Ben-Arie 2009).

3 Methodology

To approach a useful analytical structure, this study used Labov and Waletzky's narrative model as the basis for structural analysis combined with discourse analysis. Labov and Waletzky's narrative analysis of oral versions of personal experience is canonical, raised to a code of linguistic discourse analysis (Johnstone 2016). Therefore, Labov's study has been applied in a wide range of sociological studies, especially in the analysis of personal narratives. It has also been criticized by linguists because it focuses on "identity formation, socialization, and social interaction" rather than the nature of language (Johnstone 2016). Based on his research, Bell compares personal narratives with news stories (Bell 1994).

This paper takes "narrative production as a communicative act" as the premise of the study (Rigney 1992). Narrative should be seen first and foremost as a communicative act performed by the narrator for some reason, wishing to convey information to others (Rigney 1992). Just as Chatman's narrative-communication model, the implied author consists of two elements: "the work created by the real author" and "the meaning the real reader gives to it" (Ben-Arie 2009), this paper believes themes of feature writings are chosen by "relevance" in journalistic practice. It is implicitly "tell-worthy" or "reportable", which is given by the assumed reader (Rigney 1992). As such, news creation is in response to audience demand. Instead of an "informative

story", it offers the audience an emotional engagement (Duncan 2012). Furthermore, the study of Sallyanne Duncan in the "death knock" (Duncan 2012) stories provided reference to the research methodology of this paper.

This paper attempt to explore how journalists select, combine and interpret a series of specific events through Labov and Waletzky's model. The samples selected for this article are from two freelance contributors Mitchell S. Jackson and Nadja Drost, who are the winners of the 2021 Pulitzer Prizes for Feature Writing. Twelve Minutes and a Life (Jackson 2020) was published in Runner's World on Jun 18, 2020, and "When can we really rest?" (Drost 2020) was published in The California Sunday Magazine on April 2, 2020. This paper examines the depiction over the range of the feature writing genre by applying six functions of Labov and Waletzky's model to the decomposed structure components of the feature stories above.

4 Case Study

Labov and Waletzky's model contains six narrative functions: the abstract, the orientation, the complicating action, the evaluation, the resolution, and the coda (Labov and Waletzky 1966). Besides, the abstract and the coda are optional.

Abstract. It preemptively "summarizes the central action and main point of the narrative" (Duncan 2012). Bell believed that the lead in news serves the same function as the abstract in the personal narrative (Bell 1994). Therefore, if a sample has a lead, this paper would classify it as the abstract function.

The lead of Twelve Minutes and a Life pointed to the core narrative of the story: Ahmaud Arbery, a black American, was gunned down while he went out for a jog (Jackson 2020). From the lead, the audience could see that this event-driven article was about an occurred newsworthy death. An innocent young black American was lynched, for jogging. It portrayed a sense of absurdity and denial.

"When can we really rest?" provided a lead, which briefly described the theme of this feature story: one of the most dangerous journeys in the world (Drost 2020). It hooked the audience in and allowed them to decide whether to continue from the opening sentence (Duncan 2012).

Orientation. It serves to set the scene for a personal narrative by describing "the characters, the location, the time and the initial circumstances of the event" (Duncan 2012). For journalists, who, what, when, and where are the basic facts that must be portrayed (Bell 1994).

In both narratives, the initial circumstances of the core narrative were an action, instead of a reaction. This represented the narratives focused on action and belongs to an event-driven story (Duncan 2012). In fact, the text of each "narrative cycle" (Duncan 2012) contained the basic elements: the abstract, the orientation, the complicating action, the evaluation, the resolution, and the coda. For example, the interspersed "Satellite narrative" (Jing et al. 2021) contained the same, such as Ahmaud Arbery's daily life with his family, friends, and team; the horrific violence the immigrants suffered in their homeland.

Complicating action. Labov and Waletzky propose that the action is told in the order in which it occurs as a series of events (Duncan 2012; Labov and Waletzky 1966). Through examining the "sequences of action that move the plot forward" (Chien 2018), this paper seeks to find how the samples arrange the sequences of events, which express the main conflict of the narrative (Reifsnyder 2004). By arranging the sequence of events journalists could adjust the rhythm of the narrative and control the mood of the audience, thus achieving the purposes of communication.

The narratives of the two samples were both in chronological order, that was, the complicating action was related to the temporal sequence. The structure of Twelve Minutes and a Life was more complex. Mitchell S. Jackson described two events at great length: the twelve minutes when Ahmaud Arbery was killed, as the core narrative; and Ahmaud Arbery 's life as the satellite narrative.

This narrative device of juxtaposing the normalcy with an unexpected event aimed to create an emotional engagement of the audience (Wahl-Jorgensen 2013). Mitchell S. Jackson let the core narrative alternate with satellite narratives, and both narratives proceed in chronological order (Fig. 1). Such a narrative rhythm allowed the reader to get closer and closer to Ahmaud Arbery's death while learning more and more about him. Such a description let the story jumped between the stadium, family, hopes, dreams, and heavily armed racists, killings, presenting "elegiacally beautiful and tragically maddening" for audience at the same time. It prompted the audience to make value judgments as well as empathic feelings for the protagonist (Jing et al. 2021). Besides, Mitchell S. Jackson also interrupted the narrative to explain background information. For example, in paragraph 15, Mitchell S. Jackson gave the background information: jogging remains a sport and pastime pitched to privileged whites. Why did the neighbors call 911 when he saw Maude was jogging? Why did McMichaels and William "Roddie" Bryan chase and killed Maude? Even if this was tragically maddening, Mitchell S. Jackson described the causal-logical to ensure the logical continuity of the narrative.

Compared with Twelve Minutes and a Life, the narrative structure of "When can we really rest?" was pithier, but shared the same characteristics. The narrative roughly followed the progress of the journey. In the same way, as Mitchell S. Jackson did, Nadja Drost interrupted the narrative to explain the background information, such as the horrible situations that immigrants had suffered, or the crisis they may face in the Darién Gap, in order to fasten the causal-logical, to raise audience's emotion, and to express motivations.

Evaluation. It is the element in personal narrative that separates a "directionless sequence of sentences" from a meaningful story (Bell 1994). It is considered as an element that expresses the narrator's comments and attitude towards the story (Chien 2018), answering the question "why is the story being told?". Evaluation often reveals the values of the narrative. In Bell's study (Bell 1994), evaluation is also required in journalistic practice. It focuses on the event and justifies the significance of the news story.

In Twelve Minutes and a Life, Mitchell S. Jackson did not remove himself from the participation, judgments, and feelings completely. Instead, beyond the subjective feelings of others, the narrator participated in the narrative as a character and

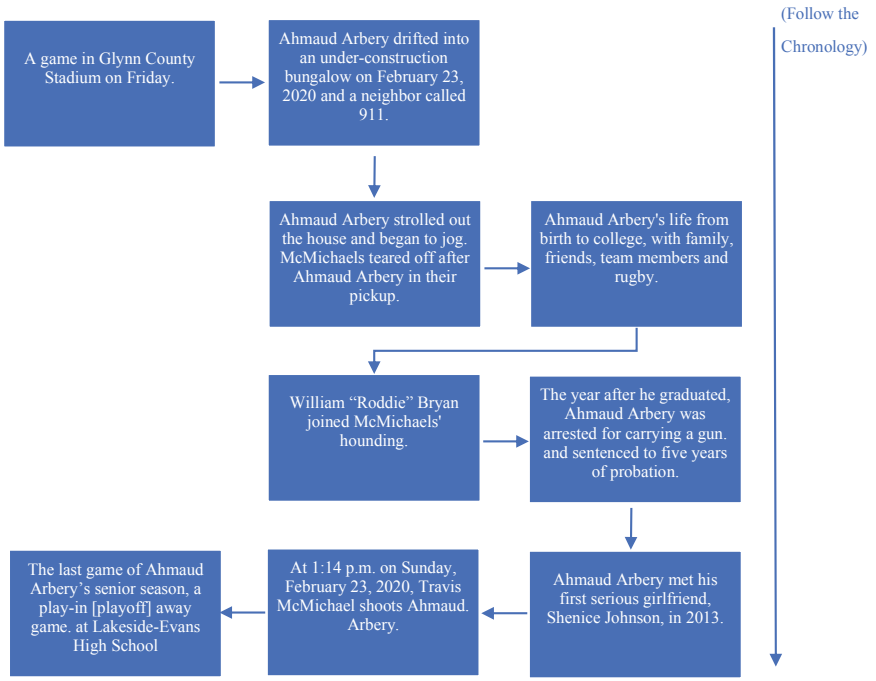


Fig. 1 The structure of the core narrative and the satellite narratives

expressed his attitudes toward the story. For example, in paragraph 18, Mitchell S. Jackson wrote a series of questions:

> Peoples, I invite you to ask yourself, just what is a runner's world? Ask yourself who deserves to run? Who has the right? Ask who's a runner? What's their so-called race? Their gender? Their class? Ask yourself where do they live, where do they run? Where can't they live and run? Ask what are the sanctions for asserting their right to live and run—shit—to exist in the world. Ask why? Ask why? Ask why?. (Jackson 2020)

Those interrogative sentences expressed the narrator's anger, doubt, and disappointment intensely and directly. Instead of being a hidden narrator; Mitchell S. Jackson had no inhibitions about making his attitudes known, reflecting humanistic concerns and the media's position (Jing et al. 2021). Whether it was the overt expression from the narrator or the description of the subjective feelings from others (especially the relatives of the victim), these emotions were characterized by coherence. Ahmaud Marquez Arbery's brother Marcus "Buck" Jr. thought he was tough, and Maud's best friend Akeem "Keem" Baker commented him as "fearless" on rugby field. Narrator believed that Maud's experiences proved his strong character. Also, Maud was the first to be thought of as the person who could help if his sister Jasmine was in serious trouble. Those comments came from different people, but all told the only character: how Ahmaud Marquez Arbery loved his parents, his wife, his brothers, his sisters, his rugby and jogging, and how he was loved by all

these people and things. Through these coherent emotional expressions, Mitchell S. Jackson portrayed the deceased as idealized and the bereaved as tragic (Duncan 2012).

"When can we really rest?" was also characterized by emotional coherence. Contrary to Mitchell S. Jackson, Nadja Drost never discussed her own attitudes in "When can we really rest?". Instead, she "outsource emotional labor", describing the emotions of "protagonists, individuals and groups" (Wahl-Jorgensen 2013). The very mixed group of immigrants had their own experiences and personalities and expressed different emotions during the dangerous journey. The emotional expression was predominantly negative. The immigrant's guide said he had seen the pain that could "break anyone's soul". George was flustered while he fell behind because of his injured ankle. And the pastor prayed uneasily for they had to leave a friend behind. Benita could not escape the tragedy of Cameroon and she was overwhelmed by fatigue and despair. When they walked out of the Darién Gap, all these were transformed into joy and a vision of the future. Within these emotional expressions, it was the collective memory of migrants. This was also the essence of the coherent narrative of "When can we really rest?".

Resolution. Resolution is the outcome of the story (Chien 2018). Bell believes that news stories do not always present a clear outcome, but those news with an outcome, such as sports news, will "follow the chronology of the personal narrative more closely" (Bell 1994). Twelve Minutes and a Life did not have a clear outcome of Ahmaud Arbery Case because the trial was not yet over at that time. Or the ongoing and unresolved grief could be seen as the resolution (Duncan 2012). On the contrary, "When can we really rest?" had one: after the group of immigrants slogged their way through the Darién Gap, Nadja Drost toke the destinations and plans of each immigrant as the end of the story.

Coda. It serves as "an optional conclusion" in personal narrative to return the tense to the present. Its functions are unnecessary in news narrative, "where the next contribution is another story" (Bell 1994).

5 Conclusion

This paper has argued that the exemplary journalistic practice arranges the sequences of events to ensure coherence. It was undertaken with the narrative communication paradigm well in mind. Labov and Waletzky's model is effective in both the entire text and the episodes within each text (Reifsnyder 2004), because the two different texts shared a common narrative structure, containing the basic function of the narrative cycle.

To develop the potential of narrative communication theory for the analysis of feature writings, this study takes "narrative production as a communicative act" as the premise. The narrative production was clipped and pasted a beginning, middle, and ending from the real events and made them as a presented cognitive structure (Rigney 1992). That is because the audience's predisposition is to believe that the

reality had the same degree of coherence that they encountered in the fictional story (Rigney 1992). The studied samples were characterized by the following findings:

The entire narrative structure and the narrative cycle structure in each episode were presented within a temporal framework, following the chronology.

Journalists interrupt the narrative to explain background information, especially those involved in characters' motivation, to ensure a coherent causal-logical.

The high emotional content was structured within the communicative framework. Therefore, the audience is able to identify a familiar core narrative to which they can connect and produce robust connectivity (Duncan 2012).

Without having to rely on the strategic ritual of objectivity, journalists do not frequently provide supporting evidence to ensure audience's immersion. This may be based on the idea that "the epistemic authority of the excellent journalist can be taken for granted" (Wahl-Jorgensen 2013).

This paper discussed the narrative communication mechanism in feature writings, attempt to answer how narrative communication theory operates in exemplary practices. However, these answers are confined to a particular genre of US journalism and do not discuss its applicability to the many other forms of journalism and communication, nor its applicability to the worldwide cultures, nor its changes over a long period of time. Those limitations are great regrets and may be a direction for future study.

References

Bell A (1994) The language of news media. Language 70(3):596

Ben-Arie U (2009) The narrative-communication structure in interactive narrative works. In: Joint international conference on interactive digital storytelling. Springer, Berlin, Heidelberg, pp 152–162

Chien HY (2018) News narratives as identity performance: a narrative analysis of Taiwanese and international news coverage of interracial intimacy. J Int Intercultural Commun 1–19

Cragan JF, Shields DC (1995) Symbolic theories in applied communication research Bormann. Hampton Press, Cresskill, Burke and Fisher

Drost N (2020) When can we really rest?. The California Sunday Magazine, April 2

Duncan S (2012) Sadly missed: the death knock news story as a personal narrative of grief. Journalism 13(5):589–603

English JF (2002) Winning the culture game: prizes, awards, and the rules of art. New Literary History 33(1):109–135

Guoren Z, Yan C (2019) Narrative communication: a story/humanistic perspective. Zhejiang University Press, Hangzhou

Jackson MS (2020) Twelve minutes and a life. Runner's World 18

Jing Z, Liang Z, Bin L (2021) Exploring the narrative strategy and communication effectiveness of the 104th Pulitzer feature article. J. Qiqihar Univ. (Philos Soc Sci Edn), 07:150–155, 161

Johnstone B (2016) 'Oral versions of personal experience': Labovian narrative analysis and its uptake. J Socioling 20(4):542–560

Labov W, Waletzky J (1967) Narrative analysis: oral versions of personal experience. In: Helm J (ed) Essays on the verbal and visual arts. proceedings of the 1966 annual spring meeting of the American ethnological society. University of Washington Press, Seattle, pp 12–44

Mindich D (1998) Just the facts: how objectivity came to define American journalism. New York University Press, New York
Peters JD (1986) Institutional sources of intellectual poverty in communication research. Commun Res 13(4):527–559
Reifsnyder K (2004) Encountering the enemy: two women's personal narratives from seventeenth-century Germany. Daphnis 33(1–2):267–284
Riessman CK (1993) Narrative analysis. sage, Newbury Park
Rigney A (1992) The point of stories: on narrative communication and its cognitive functions. Poetics Today 13(2):263–283
Riley MW, Hovland CI, Janis IL, Kelley HH (1953) Communication and persuasion: psychological studies of opinion change. Yale University Press, New Haven
Rogers EM (1997) A history of communication study: a biographical approach. The Free Press, New York
Schudson M (1978) Discovering the news. Basic Books, New York
Shuning Z (2015) the narrative communication of convergence news products in the Web3.0 era. Publ Commun Sci Technol 21(7):17–19
Tuchman G (1972) Objectivity as strategic ritual: an examination of newsmen's notions of objectivity. Am J Sociol 77:660–679
Wahl-Jorgensen K (2012) Subjectivity and story-telling in journalism: examining expressions of affect, judgement and appreciation in Pulitzer prize-winning stories. J Stud 14(3):305–320
Wahl-Jorgensen K (2013) The strategic ritual of emotionality: a case study of Pulitzer prize-winning articles. Journalism 14(1):129–145
Zhixing C (1981) News writing. The commercial Press, Taipei

A Comparative Study of Green Purchase Behavior Between Chinese and American Consumers in College: An Examination of Collectivism, Perceived Peer Pressure, and Environmental Concerns

Sijia Peng

Abstract Green products emerge and gradually take over a larger market share as consumer environmental awareness raises over time. Businesses attempt to reframe their products to become more environmentally friendly to meet customer demands. This paper examines three possible societal factors—collectivism and perceived peer pressure, and environmental concerns—that impact green purchase behaviors on college students in China and the United States. Although environmental issues are globalized, rather than regional, green purchase attitudes, intentions, and behaviors vary across cultures. Therefore, based on 91 college students in China and 48 in the United States, this study modifies a model of green purchase behavior with regression analysis from survey results. The results illustrate an overall positive correlation between collectivism, environmental concerns, and green purchase behavior. Although the correlation between environmental concern and green purchase behavior is similar in both countries, there is a stronger positive correlation between collectivism and green acquisition in the United States. However, perceived peer pressure makes little influence on green purchasing in both areas. Based on the predictions and hypothesis, this paper also discusses a few theoretical implications of the findings and can be applied to illustrate a future trend of green purchase.

Keywords Green purchase behavior · Consumer · Generation Z · Sustainability · Collectivism · Perceived peer pressure · Environmental concerns

1 Introduction

Over the last decade, consumer consumption damaged the environment severely by the depletion of natural resources (Joshi 2015). To minimize the harmful impact on our environment, more and more consumers are promoting sustainability, seeking

S. Peng (✉)
College of Art, Media, and Design (CAMD), Northeastern University, Boston, MA 02115, USA
e-mail: peng.sij@northeastern.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_13

for green products, in other words. In recent years, governments in both eastern and western countries are prioritizing the environmental issue and the Chinese government even implements several policies to support ecological protection (Chan 2001).

Current studies mainly concentrate on the adoption of green products globally, and thus little evidence exists to prove a similar result on Generation-Z. College students are a typical segmentation of generation Z, and they are normally well educated with environmental knowledge. Therefore, this academic research is centered around three possible influential factors that might affect green purchase behaviors among 139 college students in China and in the United States. With the quantitative survey, such findings will support business owners to diversify their green products' promotions based on cultures and act as reference for policy makers to amend and implement strategies on green purchase in the future for Chinese and US citizens. The remainder of the paper provides a theoretical background of the original model based on former literature and a description of the modified model with methodology and approach. Then comparative findings and discussions between nations are illustrated in the following section. Finally, the conclusion with limitations and future implications are provided.

2 Literature Review

As stated by Joshi and Rahman, green purchasing refers to the purchase of products that are eco-friendly and avoiding those that harm the environment (Chan 2001). Green purchase intention and green purchase behavior are two major measurements of green purchasing. Green purchase intention refers to the willingness of consumers to purchase a green product and green purchase behavior is considered to be a socially responsible behavior that involves ethical decision- making (Joshi 2015). A green product has a low negative environmental impact and is usually composed of "green corporate perception, eco-label, green advertising, green packaging, and green product value" (Kong et al. 2014). Green consumers are socially responsible since they believe their private acts would have a huge environmental consequence and hence, they tend to contribute towards the sustainability of the world (Joshi 2015).

In an attempt to explain the possible influencers of green purchase behavior, previous studies are centered on cultural values, eco-centric orientation and psychological determinants (Chan 2001). Chan (2001) proposed a model that man-nature orientation, collectivism, environmental knowledge, and ecological effect would contribute to the attitude towards green purchase behavior for Chinese consumers, and the attitude leads to the actual purchasing behavior, where green purchase intention acts as a mediator. Since Chan suggested a few previous research treated ecological affect and attitudes as similar, or even equivalent terms (Chan 2001), this study analyzes ecological affect through an attitude perspective. In addition, environmental

concerns are largely influenced by environmental knowledge and man-nature orientation, so the study only concerns the influence of collectivism and environmental concerns, which is a shortcut of the model proposed by Chan.

Originated from Hofstede (2011), collectivism vs individualism refers to the integration of individuals to primary groups. Societies with collectivism cultures tend to have a stronger tie between individuals: everyone has an unquestioning loyalty from birth to look after their families, including the extended families (with siblings, uncles, and grandmothers). Individualism tends to prevail in developed and Western countries (e.g., the United States), while collectivism prevails in less developed and Eastern countries (e.g., China) (Hofstede 2011). To maintain cohesiveness, people in a collectivist culture conform to the social rules and concern about their own behavior to avoid losing face within their groups (Chan 2001). That is, collectivistic persons are more likely to have a positive attitude toward environmentally friendly behaviors, such as recycling, because they intend to protect their positive face: being more cooperative, caring about nature of the whole society, and contributing to the group objectives over themselves' (Kim and Choi 2005). By contrast, individualists are less likely to participate in behaviors for resource conservation than collectivistic people, such as engaging in the adoption and purchasing of green products (Dunlap and Liere 1978). However, little evidence exists to prove the direct influence of collectivism on green purchase behaviors (Kim and Choi 2005).

H1: Collectivism directly and positively relates to the attitude toward green purchase. Collectivists are more likely to hold a positive viewpoint towards green purchase than non-collectivists.

H2: Environmental concerns directly and positively relate to the intention of green purchase. People who care more about the environmental issues are more willing for green purchasing than those who care less.

H3: Peer pressure directly and positively relates to the actual green purchase behavior. People who suffer more pressure from their peers are more likely to engage in green purchasing than who suffer less.

H4: Attitude towards green purchase directly and positively relates to the intention of green purchase. People who hold a positive viewpoint on green acquisition are more willing to buy green products than who hold a negative one.

H5: Intention of green purchase directly and positively relates to the actual green purchasing behavior. People who are more willing to buy eco-friendly products will buy more green products eventually.

3 The Proposed Model

Based on a past model in the Determinants of Chinese consumers' green purchase behavior by Chan, a modified model has been created to fit college students' green purchasing in China and in the US. This model largely depends on the literature reviews above. For instance, collectivists tend to comply with certain social rules to maintain harmony within groups, so individuals are likely to change their attitudes

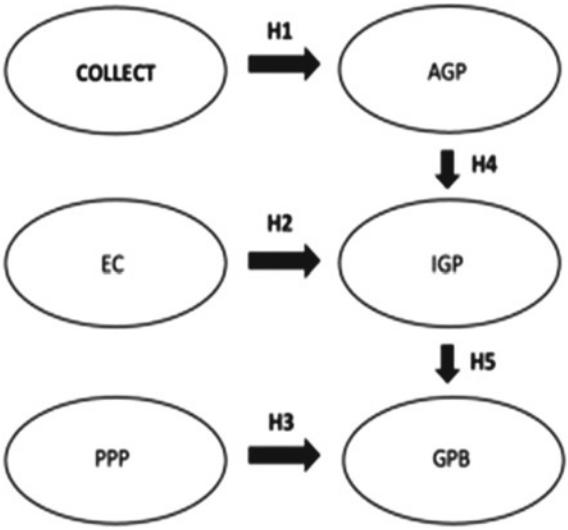


Fig. 1 The Proposed Model of Current Study. *Notes* COLLECT = Collectivism, EC = Environmental Concern, PPP = Perceived Peer Pressure, AGP = Attitude towards Green Purchase, IGP = Intention of Green Purchase, GPB = Green Purchase Behavior

to fit the group goals. Hence, it is presumed that collectivism has a causal link with the attitude toward a certain behavior, namely green acquisition. In addition, environmental concern is proposed to be related to green purchase intention since the ecological knowledge would contribute to both social and health consciousness of an individual, which motivates them to buy green products. Moreover, perceived peer pressure is inherently relevant to social norms, and such manners play a major role in purchasing green items. Since individuals' evaluations are strongly related to their preferences of performing a behavior, attitude and intention of green purchase is hypothesized to be positively related. Last, acting as "an immediate antecedent of behavior" and a mediator between attitude and behavior, green purchase intention is assumed to cause green purchase behavior (Chan 2001; Yadav and Pathak 2015) (Fig. 1).

3.1 Methodology and Approach

To validate the modified model, a survey was created and spread to college students in Beijing, China and Boston, United States. The questionnaire was originally developed in English and subsequently translated into Chinese with the same meaning to help the understanding of both Americans and Chinese respondents. Except for the demographic questions about age, nationality, and education level, the rest of the questionnaire measured each item by a seven- point scale from 1 to 7.

3.2 Collectivism (COLLECT)

To measure the extent of collectivism, the study refers to the conceptual framework created by Chen and West and employed a seven-point scale from "1 = Strongly Disagree" to "7- Strongly Agree". They concluded three major facets that underlie collectivism: (1) The tendency of a person to think about how his or her own behavior may be beneficial or costly to others. (2) Sympathy for others' success. A collectivist is more likely to share each other's achievements since their personal goals are embedded with the objectives of the group. (3) Sympathy for others 'failures. For the same reason, a collectivist is more likely to feel shame or guilt to the group if anyone in the group fails to achieve their common goals. Furthermore, the collectivism is weighted by its definition from Hofstede: Collectivism is a cultural value that people within the society are integrated into strong and cohesive ingroups (including both direct and distant relatives) and protecting them is an obligation from birth (Brewer and Venaik 2011).

3.3 Environmental Concern (EC)

The measurement of environmental concern is based on environmental attitude of consumers. Grounded upon the definition of EC, the more a consumer is concerned about the environment, the more obligated he or she will feel to solve the environmental issue. Therefore, environmental concern is measured with a general belief that has been widely used in previous studies: purchasing eco-friendly products, using recyclable packages, and properly disposing of non-biodegradable garbage indicate environmental attitudes (Chen and Chai 2010). Three survey questions were anchored with "1 = Strongly Disagree and 7 = Strongly Agree".

3.4 Perceived Peer Pressure (PPP)

Perceived peer pressure measurements were adopted from Abeele et al. (2014), evaluating the perceived pressure from adolescents' peers on participating in activities they do not necessarily prefer to engage in. Modified from the model of Buhrmeister's Network of Relations Inventory–Relational Quality Version (NRI-RQV), this research targeted peer pressure from friends in general, not a specific friend (Abeele et al. 2014). To assess the concept precisely, this study conducted a seven-point scale statement (1 = Never, 7 = Very often), other than five-point scale, to evaluate PPP.

3.5 Attitude Towards Green Purchase (AGP)

With reference to the Taylor and Todd (2000) approach, three semantic-differential statements coded by seven-point scales (1 = Strongly Disagree and 7 = Strongly Agree) were modified to gauge the global measure of attitudes.

3.6 Intention of Green Purchase (IGP)

Based on Chan's research, green purchase intention of consumers was judged by seven- point scales (1 = Strongly Disagree and 7 = Strongly Agree) (Chan 2001).

3.7 Green Purchase Behavior (GPB)

The study followed the general process of measuring actual green purchase behavior by Taylor and Todd. However, because of the time limitation, the current study required each participant to report their buying behaviors based on the previous month with evidence. Three behavioral measures were used: (1) a seven-point self-reported scale item (1 = Never, 7 = at every opportunity) to show the frequency on shopping green products; (2) a seven-point self-reported scale item (1 = None, 7 = Much money) to illustrate the money spent on green products; and (3) a seven-point self-reported scale item (1 = None, 7 = Many) to indicate the number of green products the consumer bought during the previous month (Taylor and Todd 2000).

4 Results

4.1 Descriptive Analysis

Among the 139 participants, 134 are undergraduate students aged from 18 to 24, and 5 are graduate students aged 25 and over. 91 of the respondents come from China and 45 were born in the US, in which 45 are white and 3 are black Americans. Relied on the proposed model, the means, standard deviations, and the reliabilities of the construct are listed in Table 1. The overall data were recorded and subsequently categorized with regard to the area of participants' colleges. The Cronbach's Alpha illustrates the coefficient of reliability, and the values are relatively high, representing an internal consistency of the data. Overall, the general and Chinese sample provide a good fit of the model where χ^2 is small and all factor loadings are statistically significant. However, four items (EC, PPP, IGP, and GPB) for the data of the United States are not statistically significant.

Table 1 Summary of measures, descriptive statistics, and factor loadings

	General	China	The United States
COLLECT—Mean	5.04	4.65	5.75
COLLECT—S.D	1.01	0.93	0.74
COLLECT—Alpha	0.59	0.64	0.70
COLLECT—Chi-Square, df	68.91, 18	37.34, 16	16.13, 8
EC—Mean	5.38	5.14	5.83
EC—S.D	1.14	1.12	1.06
EC—Alpha	0.79	0.60	0.76
EC—Chi-Square, df	69.99, 16	36.23, 13	12.38, 6
PPP—Mean	2.95	2.77	3.29
PPP—S.D	1.23	1.19	1.25
PPP—Alpha	0.80	0.22	0.82
PPP—Chi-Square, df	79.60, 15	61.09, 15	18.00, 10
AGP—Mean	5.58	5.23	6.23
AGP—S.D	1.10	1.10	0.78
AGP—Alpha	0.81	0.81	0.88
AGP—Chi-Square, df	80.67, 13	45.15, 13	17.63, 6
IGP—Mean	4.75	4.51	5.21
IGP—S.D	1.30	1.28	1.22
IGP—Alpha	0.83	0.93	0.89
IGP—Chi-Square, df	66.35, 16	60.13,16	9.75, 10
GPB—Mean	3.36	3.28	3.50
GPB—S.D	1.27	1.38	1.02
GPB—Alpha	0.64	0.73	0.68
GPB—Chi-Square, df	81.02, 16	47.80, 16	9.38, 8
Cronbach's Alpha	0.69	0.61	0.64

Notes All items were measured on a 7-point scale (1–7)

In terms of collectivism, Chinese respondents scored a lower mean than Americans, 4.65 and 5.75, respectively, which is opposite for the postulated cultural theory of eastern and western countries. Concerning the perceived peer pressure, college students in the US showed higher stress with their peers, scoring 3.29, 0.52 higher than Chinese college students. There was no significant difference between environmental concerns, attitudes, and intentions of green purchasing behavior of Chinese and the US students. The overall mean EC score was 5.38 out of 7.00, where the mean of AGP and IGP in general were 5.58 and 4.75, respectively. Although based on EC, AGP, and IGP, US scholars apparently had more green acquisition than Chinese students, the actual green purchasing behavior was not entirely translated from their concerns, viewpoints, and willingness of eco-friendly purchase. Along a seven-point

measurement scale, the mean score of GPB was 3.36, which is 1.39 lower than IGP and 2.22 lower than AGP through their self-reports.

4.2 Testing Hypotheses

Of the five hypotheses in the proposed model, all of them are statistically significant ($p < 0.05$) in Fig. 2. The correlation between variables were exhibited in Tables 2, 3 and 4, and no multicollinearity was discovered. Based on the significant correlations ($p < 0.05$), the current study verified the hypothesis with regression models. There was a strong direct and positive relationship between attitude towards green purchase and intention of green purchase (H4), where the slope coefficient is 0.850 and 52% of the intention could be explained by the attitude of green adoption. A relatively strong correlation was drawn by EC to IGP (H2), with a correlation coefficient of 0.538. Under investigation, there was a relatively weak correlation between IGP and GPB (H5) since the correlation coefficient was 0.546 and only 29.8% actual green behavior could be explained by their intentions. However, the correlation between COLLECT to AGP (H1) and PPP to GPB (H3) was especially weak, and they even became not statistically significant when analyzed by nation separately.

Cronbach's Alpha based on standardized items.

All factor loadings are significant ($p < 0.01$).

*Asymp. Sig. (p-value based on Chi-Square Approximation) is higher than 0.05, illustrating not statistically significant.

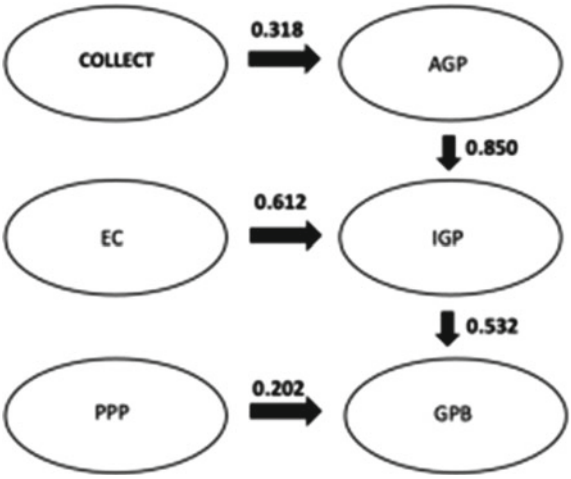


Fig. 2 Overall model fit and regression analysis. *Notes* *Slope coefficients are not statistically significant based on residual analysis and significant level ($p > 0.05$)

Table 2 Overall correlation matrix for latent constructs

	COLLECT	PPP	AGP	IGP	EC	GPB
COLLECT		0.134	0.000	0.000	0.000	0.150
PPP	−0.094		0.114	0.128	0.177	0.010
AGP	0.291	0.103		0.000	0.000	0.000
IGP	0.286	0.097	0.721		0.000	0.000
EC	0.308	−0.079	0.537	0.538		0.011
GPB	0.088	0.197	0.329	0.546	0.195	

Notes Correlations are in the lower triangle and significance level (1-tailed) are in the upper triangle

Table 3 Correlation matrix for latent constructs of China

	COLLECT	PPP	AGP	IGP	EC	GPB
COLLECT		0.003	0.000	0.000	0.017	0.073
PPP	−0.393		0.220	0.028	0.281	0.098
AGP	0.501	−0.114		0.000	0.000	0.207
IGP	0.474	−0.278	0.740		0.000	0.008
EC	0.307	−0.086	0.684	0.582		0.281
GPB	0.213	0.190	0.121	0.349	0.086	

Table 4 Correlation matrix for latent constructs of The United States

	COLLECT	PPP	AGP	IGP	EC	GPB
COLLECT		0.003	0.000	0.000	0.017	0.073
PPP	−0.393		0.220	0.028	0.281	0.098
AGP	0.501	−0.114		0.000	0.000	0.207
IGP	0.474	−0.278	0.740		0.000	0.008
EC	0.307	−0.086	0.684	0.582		0.281
GPB	0.213	0.190	0.121	0.349	0.086	

5 Conclusion

The general model on green purchase behavior of this study is acceptable and could act as an indicator in predicting green adoption of college students in China and in the United States. Attitude towards green purchasing will strongly influence the willingness of buying green products and environmental concerns will impact the intention as well. The intention will lead to a few green purchase behaviors, but other factors also exert strong impact on the actual purchasing. Collectivism and perceived peer pressure are weaker influencers on attitude and actual green purchasing respectively. This might partially because the generation-Z are likely to merge or find a balance point within different cultural values, especially for students who study abroad, resulting

in a similar evaluation on collectivism vs. individualism and perceived peer pressure. Although employing different measurements and scales, the overall level of knowledge and concerns on environmental issues of college students are higher than individuals in the past (Chan 2001).

The study presented in this paper examined three factors influencing green purchase behavior among college students and provided a deeper understanding of correlated items (AGP, IGP) within the younger generations. However, several limitations and gaps remained in the current study as well. It should be carried out in other geographic locations with a larger sample size since it only included few college students in China and in the United States. Specifically, Beijing and Boston are urbanized cities, so the conclusion might only be applied to well- developed cities, excluding rural areas, for instance. Moreover, since perceived peer pressure is a psychological implication, it can be gauged with more detailed measurements rather than three seven-point scale statements. It would be better for future research to discover the effect of subconscious factors on rising generations on green purchase and the subtle change from culture to culture in the twenty-one centuries.

Contingent on the current research and previous findings, it is hoped that policy makers shall continue educating younger generations on the environment and try to solve the discrepancy between green purchase intention and the actual behavior. Also, government and business owners in both nations should avoid their stereotypes on cultural values and welcome a mid-point between them to advocate environmental sustainability for the future society.

References

Abeele MV, Campbell SW, Eggermont S, Roe K (2014) Sexting, mobile porn use, and peer group dynamics: boys' and girls' self-perceived popularity, need for popularity, and perceived peer pressure. Media Psychol 17(1):6–33. https://doi.org/10.1080/15213269.2013.801725

Brewer P, Venaik S (2011) Individualism-collectivism in hofstede and GLOBE. J Int Bus Stud 42:436–445

Chan RYK (2001) Determinants of Chinese consumers' green purchase behavior. Psychol Mark 18:389–413. https://doi.org/10.1002/mar.1013

Chen TB, Chai LT (2010) Attitude towards the environment and green products: consumers' perspective. Manage Sci Eng 4(2):27–39. http://cscanada.net/index.php/mse/article/view/j.mse.1913035X20100402.002/1343

Dunlap RE, Liere KDV (1978) The new environmental paradigm. J Environ Educ 9(4):10–19. https://doi.org/10.3200/JOEE.40.1.19-28

Hofstede G (2011) Dimensionalizing cultures: the Hofstede model in context. Psychol Cul 2(1):2307–0919. http://mchmielecki.pbworks.com/w/file/fetch/64591689/hofstede_dobre.pdf

Joshi Y, Rahman Z (2015) Factors affecting green purchase behavior and future research directions. Int Strateg Manage Rev 3(1–2):128–143. https://doi.org/10.1016/j.ism.2015.04.001

Kim Y, Choi SM (2005) Antecedents of green purchase behavior: an examination of collectivism, environmental concern, and Pce. Assoc Consum Res 32:592–599. https://www.acrwebsite.org/volumes/9156/volumes/v32/NA-32

Kong W, Harun A, Sulong RS, Lily J (2014) The influence of consumers perception of green products on green purchase intention. Int J Asian Soc Sci 4(8):924–939. https://archive.aessweb.com/index.php/5007/article/view/2688

Taylor S, Todd P (2000) Decomposition and crossover effects in the theory of planned behavior: a study of consumer adoption intentions. Int J Res Market 12(2):137–155. https://doi.org/10.1016/0167-8116(94)00019-K

Yadav R, Pathak GS (2015) Intention to purchase organic food among young consumers: evidences from a developing nation. Appetite 96:122–128. https://doi.org/10.1016/j.appet.2015.09.017

A Prediction upon Deep-Sea Gigantism Characteristics of Crustaceans in Respond to Future Global Climate

Jianing Yang

Abstract "Global warming" is referred to as the long-term climate change in response to human activities, including the increased release of Carbon Dioxide, which leads to global average temperature increase. On the other hand, deep-sea gigantism is used to describe species with relatively large sizes compared to species related to them but instead reside in a mid-latitude ocean, shallow water, or on land. The explanation for the unique phenomenon includes Lower temperature, food scarcity, reduced predation pressure, and increased dissolved Oxygen. This paper examines deep-sea gigantism on crustaceans and how current existing deep-sea gigantism crustaceans would respond to an increased temperature by reviewing research upon Paleocene-Eocene thermal maximum and deep-sea gigantism crustaceans. To conclude the results in brief, from data presented by Paleocene-Eocene thermal maximum 56 million years ago, the current trend in Greenhouse gas emission would result in increased global Ocean temperature and dissolved Ocean Oxygen levels, contributing to the prediction of decreasing characteristics of deep-sea gigantism in marine crustaceans.

Keywords Deep-sea gigantism · Crustaceans · Marine ecology · PETM · Global warming · Evolutionary biology

1 Introduction

The climate of 2020 has continued in the trend of increasing global average temperature. NOAA (National Ocean and atmospheric administration) 's 2020 annual climate report suggests that since 1981, the combined land and ocean temperature has increased 0.18 degrees Celsius per year (NOAA National Centers for Environmental Information (NCEI) 2021). Such an increase in temperature results in adverse effects in realms of natural environments and the sphere of humans, including

J. Yang (✉)
Basis International School Shenzhen, Longhua, Shenzhen, China
e-mail: Tellurium1123@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_14

increased hurricanes and coastal storms while affecting the ecosystems of various extant species (Center for Climate and Energy Solutions 2021).

Global warming has been mostly influenced by the industrial release of carbon dioxide and greenhouse gases. Around 56 million years ago (56 Ma), one of the most extensively studied hyperthermal events known as the Paleocene-Eocene Thermal Maximum (PETM) has been used as a model for the increasing climate temperature of today.

Due to the similarity between the existing global warming and the global warming during PETM, this paper predicts the possible implication of climate-induced marine environment changes that affect existing crustaceans that exhibit deep-sea gigantism phenomenal.

The purpose of this research paper is to derive a prediction upon how global warming caused changes in the marine ecosystem affects the characteristics and prospects of general crustaceans that manifests deep-sea gigantism.

The scope of this research is to be set as existing crustaceans that are confirmed to be expressing characteristics of deep-sea gigantism.

2 Literature Review

2.1 Paleocene-Eocene Thermal Maximum and the Hypothesis

The Eocene, started from 56 million years ago (Ma) and lasted till 33.9 million years, is marked by a significant amount of "hyperthermal events," which are major perturbations in the global carbon cycle and global temperature, in both short (<104 years) and long (>106 years) scales. The Paleocene Eocene Thermal Maximum (PETM) is a hyperthermal event where the global temperature increases five to eight degrees Celsius and is followed by the long-term warming trend (McInerney and Wing 2011). The event lasted approximately 200,000 years ending around 54 Ma. By analyzing the amount of Carbon-12/Carbon-13 ratio in marine sediments dated around 56 Ma ago, it has been found that the ratio of Carbon-12/Carbon-13 sharply decreased around 55.5 Ma ago. C-12 in the form of Carbon that plants most use, and such a sudden decrease in ratio suggests that biogenic Carbon–Carbon molecules that have been utilized in plants-has been released into the atmosphere to a larger degree, thus implying that greenhouse gases (including CO_2 and Methane) are released on a larger scale (McInerney and Wing 2011). The amount of Carbon–Carbon released into the atmosphere is calculated by pairing the carbon-11, carbon-18, and carbon-13 data, which suggests that around 12,000 metric tons (Gt) of Carbon–Carbon is released over a 50,000 period, averaging to about 0.24 Gt per year (Gutjahr et al. 2017). The causes of PETM are debated. Hypothesis ranges from Carbon dioxide emissions increases due to the Kimberlite eruption starting in the Lac de Gras region of northern Canada to the mass release of Methane resulting from volcanic heat

activities (Patterson and Francis 2013; Svensen et al. 2004). Popular hypothesis also includes that a C-12 rich comet structured the earth that increased Carbon Dioxide levels (does not have solid evidence to confirm), increased burning of Peat (does not have solid evidence). The Orbital forcing hypothesis suggests that hyperthermal events happen on a regular basis, where the orbital increase in solar radiation accumulation would put the climate system post the threshold, resulting in a positive feedback loop upon the earth's climate (Lourens, et al. 2005). The Ocean circulation hypothesis suggests that Ocean circulation during the Paleocene Eocene boundary would have contributed to destabilization in methane hydrate, possibly releasing 2000 gigatons of Methane (Bice and Marotzke 2002).

The most research and debated hypothesis would be the Methane release theory. The Methane release theory suggests that the initial perturbation of increasing earth temperature is amplified by Methane Clathrates ($CH_4 \cdot 5.75\ H_2O$). Methane Clathrates, in their stable state, form ice-like solids to trap Methane. With an initial increase in temperature, the pressure required to keep Methane Clathrates in their stable form increases, resulting in the release of methane gas as Methane Clathrates destabilize. The research is heavily debated, with criticisms claiming that the Methane Clathrates exists in amounts smaller than it is enough to cause the temperature change expected in PETM, the timeline does not show a gap between two previous hyperthermal events and the PETM, and how the "top-down" diffusion of Methane and Carbon Dioxide does not match the plankton foram Carbon records. Supports of the theory involves numerical simulation suggesting that Carbon sedimentation and methanogenesis (microbes known as methanogens generating Methane) compensate for the small Methane Clathrates amount, as well as a study in 2016 suggesting that massive release of seabed methane has been a driver for PETM and CIE by analyzing bioapatite of terrestrial mammals (Gu et al. 2011; Gehler and Pack 2016).

Despite the discrepancy in the causes of PETM, the release of Carbon Dioxide and Methane in the current society is much higher than the estimated amount during the PETM, with 9.795 gigatons of Carbon–Carbon emitted from fossil fuel solely in 2014 (Global Carbon Emissions: A Statistical Snapshot 2020). With the similarity in the increase in average temperature compared to the current climate, PETM climate serves as a good existing model in predicting various effects of increased temperature on the earth.

2.2 Climate Change During PETM

During PETM, the climate is altered. Hydrological characteristics changed, where rain patterns decreased in lower latitudes and moisture were delivered to the Arctic (Pagani et al. 2006). By analyzing the Azolla fossils, researchers suggest that polar regions acquired subtropical temperature during PETM (Speelman et al. 2009). Unlike modern rainforests, Arctic Eocene rain forests were seasonal, thus has a different plant species colonizing the area compared to a modern rain forest (Grein

et al. 2011). Fossils well document such event, the most well-known evidence being palm tree fossils dated back to approximately 49 Ma existed in Wyoming, suggesting the significantly warm climate that resulted in plant expansion from its original ecosystems and location (McInerney and Wing 2011). Fossil evidence has also been found within the Arctic circle on Ellesmere and Axel Heiberg Island, Canada. The strata date back to 57–58 Ma, during the non-hyperthermal climate, where plant communities included the conifer family Cupressaceae, pine family Pinaceae, and other deciduous broad leaves and angiosperm flora (Willard et al. 2019). During the PETM, Arctic vegetation is documented to shift towards broadleaf forests and coniferous swamp forests with unseen plant fossils that include family Aceraceae (which includes palm trees) and genus Avicenna (Sudermann et al. 2021).With the fossil of Avicennia found in the Arctic circle, it is reasonable to induce those mangrove ecosystems once existed in Arctic areas, further suggesting the drastically different climate (temperature, precipitation, moisture) and the ecosystem due to PETM caused rise in global temperature.

2.3 PETM's Effects on Terrestrial Life

PETM affected life drastically, from foraminifera's extinction in the benthic Ocean to mammals' migration patterns on land. PETM affected life in both ways. First, it proliferated mammals, namely ungulates (Perissodactyla), the ancestor of the modern horse, in immigration to North America (Li et al. 2020). With fossil records and correlation to C-13 dating, researchers suggest a hypothetical migration route of primate Teilhardina during the first 2500 years of the PETM event. The migration route starts from a continuous forest in southern Asia to Europe, then to North America. Primate Teilhardina is the first True primates that appeared 55.5 Ma during the 100,000-year duration of PETM, being the ancestor to modern Teilhardina asiatica, Teilhardina belgica, Teilhardina brandti, Teilhardina americana, and modern Euprimates (Smith et al. 2006).

2.4 PETM's Effects on Marine Life

Though life on land proliferated, certain marine species have undergone great turmoil, namely benthic foraminifera, which underwent a 40% species extinction, later identified as the Benthic Extinction Event (Scheibner et al. 2005). Species under the order foraminifera have evolved through the PETM event, with the evolutionary event called the Large-foraminifera turnover (LFT). Large foraminifera is the most common PETM carbonate species, showing a diversification of species, adult dimorphism, and large shell size during the Paleocene-Eocene transition (Krautwig et al. 1998). The evidence of such evolutionary change includes a platform-basin transient in the Pyrenees, northern Spain, where researchers correlated PETM with LFT by

analyzing specimens of Alveolina Vredenburg and showing a high-resolution lithological correlation between LFT specimen and PETM continental deposits (Payros and Pujalte 2006). The LFT, unlike the benthic foraminifera, does not involve sudden extinction due to the difference in habitat and trophic nature. Large foraminifera thrives in the photic zone and has a symbiosis relationship with algae.

In contrast, the benthic foraminifera is independent of life and feeds upon other sources (Scheibner and Marzouk 2005). The short-term eutrophication of PETM resulted in the decline of extreme K-strategist Larger-foraminifera species and diversification of ecological strategies. The success of Large-foraminifera comparing to corals in the shallow water region is climatically related, where Large-foraminifera instead of corals have been favored in PETM hyperthermal events (Scheibner and Marzouk 2005).

Above is the general information regarding the cause and effects of PETM. However, to relate PETM to the prediction upon the future morphological trend of organisms that manifest deep sea gigantism, more context is required upon the marine ecosystem's response to PETM and existing principles used to explain deep-sea gigantism.

2.5 Marine Ecosystem's Response to PETM

Francisco J. Rodríguez-Tovar et al. researched PETM's effects upon the microbenthic community and the main ecosystem changes involved during PETM using iconological records from the Zumaia section in Northern Spain (Rodríguez-Tovar et al. 2011). In the research, the trover divides the environmental condition in the benthic Ocean into three intervals: Pre-PETM, syn-PETM, and post-PETM.

During Pre-PETM, the normal, rich microbenthic community suggests that the benthic Ocean is well oxygenated. Food availability is sufficient to support a healthy foraminiferal community. However, the Pre-PETM interval suggests decreasing species diversity in calcareous nannofossils and decreased stability in calcareous nannofossil assemblage. Such early trends coincide with time intervals where surface ocean temperature has begun to rise (Pujalte et al. 2006). In general, the Pre-PETM period has a benthic ocean ecosystem where Oxygen and benthic food source is available in supporting the species richness. Still, signs of temperature increase have shown with decreased stability and diversity in calcareous nannofossil species.

During the syn-PETM interval, gradual but rapid extinction of benthic foraminifera took place. With increased global temperature, seasonal rain, severe floods and storms occurred, increased sediment input, and increased sea level contributed to more nutrients being sent to the benthic ecosystem from above (Speijer and Morsi 2002). Therefore, an increase in Carbon–Carbon deposited during PETM would lead to oxygen depletion in the benthic ecosystem, resulting in a dysoxic condition that correlates with the Paleocene-Eocene Benthic foraminiferal extinction event (Thomas and Shackleton 1996).

During the post-PETM interval, there are two sub-intervals that have the study has described. In the first sub-interval, the environment is covered slowly, shown by the very low amount of mottled iconophobic in the fossil sample that correlates to the time interval after PETM. The nutrient amount and oxygen depletion diminished gradually, and the benthic food recovered. However, during such time intervals, the ecosystem did not recover enough that the benthic Ocean could support a normal macrobenthic community.

The second sub-interval in the post-PETM time shows a gradually recovering trend in a fall back of the temperature from PETM, as a fall back of Carbon-12/Carbon-13 ratio is observed (Alegret et al. 2009). A decrease in corrosion effects of carbonate shells is shown, and ocean acidification levels begin to fall back to normal (Alegret et al. 2009).

2.6 Deep-Sea Gigantism Definition and Example

Deep-sea gigantism, or abysmal gigantism, is the tendency for certain orders included in marine crustaceans to exhibit an increase in body size with an increase in the geographic latitude and depth of their environment evolutionary response (La Perna 2005). Such tendency is also seen in cephalopods, cnidarians, and Anguilliformes.

The deep-sea ecosystems coincide with other morphological adaptations, most likely due to the lack of light. Such adaptations in crustaceans include increased tentacle length, increased rate of eye disappearance as the Ocean goes deeper and decreased coloration in most species (Company et al. 2004).

Currently, the cause of deep-sea gigantism includes lower temperature increased food scarcity, reduced predation pressure, and increased dissolved oxygen levels in deeper waters (Gad 2005; Kleiber 1947; Harper and Peck 2016; Chapelle and Peck 1999).

Existing examples of organisms showing such tendency include giant isopods. Giant isopod belongs to the Bathynomus genus as A. Milne-Edwards, classified in 1879. The giant isopod closely resemble woodlouse, which are much smaller terrestrial isopods (though also found in semi terrestrially environments such as littoral zone and subterranean lakes) related to Giant isopod. The significant difference between body size while having resembled morphology makes giant isopod an ideal example in illustrating deep-sea gigantism.

3 Discussion

3.1 Prediction of Deep-Sea Gigantism Responding to Global Temperature Increase in Crustaceans According to Bergmann's Rule

Bergmann's rule states that within a taxonomical clade, population or species in higher latitudes exhibit a larger body size than those at the lower latitude. Though Carl Bergmann originally stated Bergmann's rule in 1847, where the rule is only applied to endotherm mammals, such pattern is observed in poikilotherm vertebrates and certain invertebrates by other researchers (Meiri and Dayan 2003). Over the years, it has been debated whether climate and temperature is the major component driving the body-mass changes in various taxa, instead of other factors including precipitation, seasonality, predation pressure, competition, prey size, and primary productivity. Seasonality and precipitation are the two most suggested factors for the alternative of Bergmann's rule (Orcutt and Hopkins 2013).

As the paper focuses on deep-sea gigantism, precipitation is beyond consideration. Seasonality is first proposed as that the body size of an animal is determined by the amount of overlap between peak resource production in the organism's environment and animal growth, resulting in larger individuals when seasonality is greatest due to the peak pulse of resources (Johnson et al. 2019). Seasonality is considered as the temperature of air and water in Johnson et al. research on Minuca pugnax, and Johnson's research suggests that temperature is the main factor affecting the sizes of M. pugnax (Johnson et al. 2019).

Bergmann's principle serves as an explanation for the phenomenon of deep-sea gigantism. Existing crustacean groups that present deep-water gigantism includes mysids, euphausiids, decapods, tanaids, isopods, and amphipods (Timofeev 1999).

In the research conducted by S. F. Timofeev, he analyzed Bergmann's principle and deep-water gigantism in marine crustaceans. As he explicitly stated, crustaceans inhabit a vast region of Ocean and latitude, ranging from the Arctic to the Antarctic, while inhabiting a wide range of ocean ecosystems from supralittoral to ultra-byssal. Thus, the wide range of marine crustaceans makes them a great example in illustrating Bergmann's principle as well as deep-water gigantism (Timofeev 1999).

In Timofeev's study, he reviewed previous research on Pelagic amphipods-hyperiids and Copepoda, a group of small crustaceans that lives in water of great latitude diversity, concluded that Bergmann's principle manifests in marine crustaceans in a particular way. As latitude increases, temperature decreases, resulting in smaller cell sizes in organisms. The small cell size results in a longer life span and thus a greater size due to longer development time.

Bergmann's principle manifests in Minuca pugnax, M. pugnax tends to have a larger size in higher latitude regions such as Massachusetts, medium size in Virginia, and the smallest average size M. pugnax is found in Georgia (Johnson et al. 2019). The temperature size rule, stating that organisms tend to have a larger size in colder

temperatures, is an explanation for such size variation (Jarośík et al. 2004). It is also suggested that such variation is phenotypic and not genetically related in most crustaceans. The temperature is the main factor in driving such a difference in size (Johnson et al. 2019; Stelzer 2002).

When it comes to the correlation between the Bergmann principle and deep-water gigantism, Timofeev proposed the same mechanism, where the increased lifespan due to low temperature would lead to the increased size of the organism. The only difference being that deep-water gigantism functions vertically in Ocean's latitude while Bergmann's principle focuses on the zonal nature of temperature distribution on earth (Johnson et al. 2019).

Bergmann's principle has been illustrated during PETM. Ostracods, a class of the Crustaceans, otherwise known as the seed shrimp, demonstrated a change in body size due to the increased temperature in the deep Ocean in PETM interval as suggested by research led by Tatsuhiko Yamaguchi (Yamaguchi et al. 2012).

In the research, Tatsuhiko Yamaguchi concluded that the body size of some ostracods species decreased during the PETM interval in the eastern North Atlantic. It is inferred that such dwarfism is due to decreased individual life spans and respiration rates (Yamaguchi et al. 2012). Following Timofeev's reasoning, it is reasonable to conclude that the Ostracods dwarfism event during the PETM interval serves as good evidence for applying Bergmann's principle into hyperthermal events where the temperature of the atmosphere rises.

Though certain research shows opposite results where Body size of deep-sea gastropod Troschelia Berniciensis tends to decrease as Ocean latitude increase, my research focuses on the response of existing deep-sea gigantism organism to the current global warming trend, which initially rules out the species that present the opposite trend of deep-sea gigantism (Olabarria and Thurston 2003).

As mentioned previously, PETM serves as a good model for today's global warming events and today's global warming event's effects upon crustacean morphology. Bergmann's principle suggests that deep-sea gigantism is largely due to temperature differences in different latitudes, both in different regions on earth and when applied to Ocean's latitude. As inferred from the Ostracode's response to PETM and Bergmann principle, it concluded that with increased average global temperature due to Carbon emissions, the Marine Crustaceans, especially Ostracode, are less likely to exhibit deep-ocean gigantism due to the decrease in average life span.

Prediction of deep-sea gigantism responding to global temperature increase in crustaceans in relative to the level of dissolved oxygen in the marine environment.

3.2 Prediction of Deep-Sea Gigantism Responding to Decreased Dissolved Oxygen Levels in Crustaceans

While temperature directly correlates to the decrease in crustacean size as suggested primarily by Bergman's rule, it also contributes to the decrease of dissolved oxygen levels in the marine environment, leading to a decrease manifestation of deep-sea gigantism in crustaceans. Though it is to be noted that Ocean temperature and stratification is not the only considered factor when considering the decreased dissolved oxygen levels. Researchers suggest that vertical and horizontal mixing, seasonal nutrient increase, nutrient runoff, freshwater runoff, along with other physical, chemical, and biological activities should be considered when analyzing the factors that influence dissolved oxygen levels in marine environments (Hull et al. 2008).

Dissolved Oxygen increases as Ocean latitude increases. With increased Ocean latitude, pressure increases, salinity levels decrease, and temperature decreases. As temperature decreases, water becomes denser, resulting in a higher capacity of holding Oxygen. However, a higher capacity of holding Oxygen does not necessarily result in higher Oxygen availability, which is influenced by ocean stratification, thermohaline circulation, and exposure of surface water to air (Dissolved Oxygen - Environmental Measurement Systems 2021). Research suggests that although oxygen capacity increases as temperature decreases, water in polar regions does not show higher dissolved oxygen levels, failing temperature to explain polar gigantism (Verberk and Atkinson 2013).

Deep-sea gigantism is different from polar gigantism. Deep-sea gigantism is sought to manifest due to the increasing water pressure as Ocean latitude increases which results in higher oxygen availability. However, polar gigantism takes place though oxygen level is lower in the poles. Deep-sea gigantism focuses on the vertical changes in one region instead of the earth's latitude difference (Mahaffey et al. 2020).When it comes to higher Ocean latitude in one single area, dissolved Oxygen and Oxygen availability increases, being one of the reasons that cause deep-sea gigantism.

During PETM, Ocean temperature and dissolved Oxygen changed. In the research led by Haijun Song et al. dissolved Oxygen during PETM interval is shown to drop from approximately 270 μM to around 230 μM, by using the equation of Benson and Krause, the equation of Sarmiento et al., and the seawater temperature value calculated from Phosphate δ18O values (Song et al. 2019). The research suggests that along with PETM, other warming periods also coincide with a decrease in dissolved oxygen levels.

A similar result is shown in research conducted by Micah J. Nicolo et al., where lithologic, Carbon isotopic, trace fossils were used as evidence (Nicolo et al. 2010). The research suggests that temperature increase is the major reason the dissolved oxygen level in ocean surface decreased. However, water column stratification and intermediate water methane oxidation were other factors that led to the hypoxic condition of PETM ocean.

Oxygen availability in different parts of the Ocean is greatly determined by stratification, which is the less-dense water going to the top of the denser water. Stratification creates a thermocline that separates the denser and colder water from the less dense and warmer water. When temperature increases with the current global climate trend, the surface water becomes less dense than deeper water with a lower temperature, intensifying stratification. When stratification increases, the denser and colder water in the deep sea would risk running out of Oxygen, hypoxia before seasonal patterns replenishes the deep ocean water with Oxygen.

In coastal regions, tides and currents are sources of energy that largely maintain the homogeneous dissolved oxygen level. At the same time, it is a completely different situation in the deep-sea where deep-sea gigantism crustaceans live. With relatively fewer ocean currents and tides, intensified seasonal stratification due to temperature increase is likely to intensify hypoxia in the deep Ocean, just like the dissolved oxygen levels in marine environments during PETM as mentioned before.

As been suggested by the research conducted by C. Mahaffey et al., there has been a measurable decline in dissolved oxygen levels in global Ocea caused by anthropogenic activities. Ocean warming has attributed to approximately 15% of the global decline in Oxygen. In the UK, for instance, observation has shown that ocean warming has been one of the factors that contributed to the oxygen deficiency in late summer at the North Sea (Mahaffey et al. 2020).

With today's global warming trend, it is predicted that the shallow water temperature would increase, stratification would intensify, both contributing to a hypoxia environment in the Ocean. Though it is still unsure that whether the deep-sea environment would experience a decrease in dissolved oxygen level due to increased global temperature because of monitoring difficulties, it is likely that the increased stratification and decreased global Ocean oxygen levels would contribute to the decreased deep-Ocean oxygen levels (Mahaffey et al. 2020). The decreased dissolved oxygen levels in the crustaceans' environment that manifests deep-sea gigantism would most likely contribute to the decreased manifestation of deep-sea gigantism in crustaceans.

4 Conclusion

From previous research results upon the response of the ecosystem to PETM, we conclude that the current Carbon emission rate would lead to an increase in global ocean temperature and a decreased dissolved Oxygen level in the marine environment. By analyzing the results and conclusion of research on deep-sea gigantism and crustacean's response to PETM condition, we conclude that according to Bergmann's principle, increased global Ocean temperature would make it less likely for crustaceans to exhibit deep-sea gigantism. Furthermore, research has shown that dissolved oxygen levels in the marine environment have fallen during the PETM time interval. In contrast, such decreased dissolved Oxygen levels are shown by research

to affect the maximum body size of crustaceans. Together, the increased temperature and decreased dissolved oxygen levels in the marine environment are likely to decrease the trend of deep-sea giantism in marine crustaceans.

References

Alegret L et al (2009) The paleocene-eocene thermal maximum: new data on microfossil turnover at the Zumaia section, Spain. Palaios 24(5):318–328. Available: https://doi.org/10.2110/palo.2008.p08-057r

Bice K, Marotzke J (2002) Could changing ocean circulation have destabilized methane hydrate at the Paleocene/Eocene boundary? Paleoceanography 17(2):8–1–8–12. Available: https://doi.org/10.1029/2001pa000678

Center for Climate and Energy Solutions 2021 Center for climate and energy solutions [Online]. Available: https://www.c2es.org/. [Accessed: 14 Oct 2021]

Chapelle G, Peck L (1999) Polar gigantism dictated by oxygen availability. Nature 399(6732):114–115. Available: https://doi.org/10.1038/20099

Company J et al (2004) Deep-sea decapod crustaceans in the western and central Mediterranean Sea: preliminary aspects of species distribution, biomass and population structure. Scientia Marina 68(3):73–86. Available: https://doi.org/10.3989/scimar.2004.68s373

Dissolved Oxygen—Environmental Measurement Systems (2021) Environmental Measurement Systems. [Online]. Available: https://www.fondriest.com/environmental-measurements/parameters/water-quality/dissolved-oxygen/. [Accessed: 14 Oct 2021]

GAD G (2005) Giant Higgins-larvae with paedogenetic reproduction from the deep sea of the Angola Basin? evidence for a new life cycle and for abyssal gigantism in Loricifera? Organ Div Evol 5:59–75. Available: https://doi.org/10.1016/j.ode.2004.10.005

Gehler PG, Pack A (2016) Temperature and atmospheric CO_2 concentration estimates through the PETM using triple oxygen isotope analysis of mammalian bioapatite. Proc Nat Acad Sci 113(28):7739–7744. Available: https://doi.org/10.1073/pnas.1518116113

Grein M, Utescher T, Wilde V, Roth-Nebelsick A (2011) Reconstruction of the middle Eocene climate of Messel using palaeobotanical data. Neues Jahrbuch für Geologie und Paläontologie – Abhandlungen 260(3):305–318. Available: https://doi.org/10.1127/0077-7749/2011/0139

Global carbon emissions: a statistical snapshot. Current History 119(813):41–41 (2020). Available: https://doi.org/10.1525/curh.2020.119.813.41

Gu G, Dickens G, Bhatnagar G, Colwell F, Hirasaki G, Chapman W (2011) Abundant early Palaeogene marine gas hydrates despite warm deep-ocean temperatures. Nat Geosc 4(12):848–851. Available: https://doi.org/10.1038/ngeo1301

Gutjahr M et al (2017) Very large release of mostly volcanic carbon during the Palaeocene–Eocene thermal maximum. Nature 548(7669):573–577. Available: https://doi.org/10.1038/nature23646

Harper E, Peck L (2016) Latitudinal and depth gradients in marine predation pressure. Global Ecol Biogeogra 25(6):670–678 2016. Available: https://doi.org/10.1111/geb.12444

Hull V, Parrella L, Falcucci M (2008) Modelling dissolved oxygen dynamics in coastal lagoons. Ecolog Modell 211(3–4):468–480. Available: https://doi.org/10.1016/j.ecolmodel.2007.09.023

Jarošík V, Kratochvíl L, Honék A, Dixon A (2004) A general rule for the dependence of developmental rate on temperature in ectothermic animals. Proc Royal Soc London. Ser B: Biolog Sci 271(4). Available: https://doi.org/10.1098/rsbl.2003.0145

Johnson D, Crowley C, Longmire K, Nelson J, Williams B, Wittyngham S (2019) The fiddler crab, Minuca pugnax, follows Bergmann's rule. Ecol Evol 9(24):14489–14497. Available: https://doi.org/10.1002/ece3.5883

Kleiber M (1947) Body size and metabolic rate. Phys Rev 27(4):511–541. Available: https://doi.org/10.1152/physrev.1947.27.4.511

Krautwig D, Hottinger L, Zankl H (1998) The lamellar-perforate, arborescent and coloured foraminifersMiniacina, homotrema, andSporadotrema. Facies 38(1):89–102. Available: https://doi.org/10.1007/bf02537359

La Perna R (2005) A gigantic deep-sea Nucinellidae from the tropical West Pacific (Bivalvia: Protobranchia). Zootaxa 881(1):1. Available: https://doi.org/10.11646/zootaxa.881.1.1

Li J, Hu X, Zachos J, Garzanti E, BouDagher-Fadel M (2020) Sea level, biotic and carbon-isotope response to the Paleocene–Eocene thermal maximum in Tibetan Himalayan platform carbonates. Glob Planetary Change, 194:103316. Available: https://doi.org/10.1016/j.gloplacha.2020.103316

Lourens L et al (2005) Astronomical pacing of late Palaeocene to early Eocene global warming events. Nature 435(7045):1083–1087. Available: https://doi.org/10.1038/nature03814

Mahaffey C, Palmer M, Greenwood N, Sharples J (2020) Impacts of climate change on dissolved oxygen concentration relevant to the coastal and marine environment around the UK. MCCIP Sci Rev 3153. Available: https://doi.org/10.14465/2020.arc02.oxy. Accessed 14 Oct 2021

McInerney F, Wing S (2011) The Paleocene-Eocene thermal maximum: a perturbation of carbon cycle, climate, and biosphere with implications for the future. Ann Rev Earth Planetary Sci 39(1):489–516. Available: https://doi.org/10.1146/annurev-earth-040610-133431

Meiri S, Dayan T (2003) On the validity of Bergmann's rule. J Biogeography 30(3):331–351. Available: https://doi.org/10.1046/j.1365-2699.2003.00837.x

Nicolo M, Dickens G, Hollis C (2010) South Pacific intermediate water oxygen depletion at the onset of the Paleocene-Eocene thermal maximum as depicted in New Zealand margin sections. Paleoceanography 25(4):n/a-n/a. Available: https://doi.org/10.1029/2009pa001904

NOAA National Centers for Environmental Information (NCEI) (2021) Ngdc.noaa.gov. [Online]. Available: https://ngdc.noaa.gov/. [Accessed: 14 Oct 2021]

Olabarria C, Thurston M (2003) Latitudinal and bathymetric trends in body size of the deep-sea gastropod Troschelia berniciensis (King). Marine Biol 143(4):723–730. Available: https://doi.org/10.1007/s00227-003-1116-6

Orcutt J, Hopkins S (2013) Oligo-Miocene climate change and mammal body-size evolution in the northwest United States: a test of Bergmann's rule. Paleobiology 39(4):648–661. Available: https://doi.org/10.1666/13006

Pagani M, Caldeira K, Archer D, Zachos J (2006) An Ancient Carbon Mystery. Sci 314(5805):1556–1557. Available: https://doi.org/10.1126/science.1136110

Patterson M, Francis D (2013) Kimberlite eruptions as triggers for early Cenozoic hyperthermals. Geochem Geophys Geosys 14(2):448–456. Available: https://doi.org/10.1002/ggge.20054

Payros X, Orue-Etxebarria, Pujalte V (2006) Covarying sedimentary and biotic fluctuations in Lower–Middle Eocene Pyrenean deep-sea deposits: Paleoenvironmental implications. Palaeogeography, Palaeoclimatology, Palaeoecology 234(2–4):258–276. Available: https://doi.org/10.1016/j.palaeo.2005.10.013

Pujalte V et al (2006) Correlation of the Thanetian-Ilerdian turnover of larger foraminifera and the Initial Eocene thermal maximum (IETM) confirming evidence from the Campo area (Pyrenees, Spain). Anuário do Instituto de Geociências 29(1):500–501. Available: https://doi.org/10.11137/2006_1_500-501

Rodríguez-Tovar F, Uchman A, Alegret L, Molina E (2011) Impact of the Paleocene–Eocene Thermal Maximum on the macrobenthic community: Ichnological record from the Zumaia section, northern Spain. Marine Geol 282(3–4):178–187. Available: https://doi.org/10.1016/j.margeo.2011.02.009

Scheibner RS, Marzouk A (2005) Turnover of larger foraminifera during the Paleocene-Eocene Thermal Maximum and paleoclimatic control on the evolution of platform ecosystems. Geology, 33(6):493. Available: https://doi.org/10.1130/g21237.1

Scheibner C, Speijer R, Marzouk A (2005) Turnover of larger foraminifera during the Paleocene-Eocene Thermal Maximum and paleoclimatic control on the evolution of platform ecosystems. Geology, 33(6):493. Available: https://doi.org/10.1130/g21237.1

Smith T, Rose K, Gingerich P (2006) Rapid Asia-Europe-North America geographic dispersal of earliest Eocene primate Teilhardina during the Paleocene-Eocene Thermal Maximum. Proc Nat Acad Sci 103(30):11223–11227. Available: https://doi.org/10.1073/pnas.0511296103

Song H, Wignall P, Song H, Dai X, Chu D (2019) Seawater temperature and dissolved oxygen over the past 500 million years. J Earth Sci 30(2):236–243. Available: https://doi.org/10.1007/s12583-018-1002-2

Speelman E et al (2009) The eocene arctic Azollabloom: environmental conditions, productivity and carbon drawdown. Geobiology, 7(2):155–170. Available: https://doi.org/10.1111/j.1472-4669.2009.00195.x

Speijer R, Morsi A (2002) Ostracode turnover and sea-level changes associated with the Paleocene-Eocene thermal maximum. Geology 30(1):23. Available: https://doi.org/10.1130/0091-7613(2002)030<0023:otaslc>2.0.co;2

Stelzer C (2002) Phenotypic plasticity of body size at different temperatures in a planktonic rotifer: mechanisms and adaptive significance. Funct Ecol 16(6):835–841. Available: https://doi.org/10.1046/j.1365-2435.2002.00693.x

Sudermann M, Galloway J, Greenwood D, West C, Reinhardt L (2021) Palynostratigraphy of the lower Paleogene Margaret Formation at Stenkul Fiord, Ellesmere Island, Nunavut, Canada. Palynology 45(3):459–476. Available: https://doi.org/10.1080/01916122.2020.1861121

Svensen H et al (2004) Release of methane from a volcanic basin as a mechanism for initial Eocene global warming. Nature 429(6991):542–545. Available: https://doi.org/10.1038/nature02566

Thomas E, Shackleton N (1996) The Paleocene-Eocene benthic foraminiferal extinction and stable isotope anomalies. Geolog Soc London, Spec Publ 101(1):401–441. Available: https://doi.org/10.1144/gsl.sp.1996.101.01.20

Timofeev S (1999) Population density and body size relationships in euphausiid crustaceans. [Accessed 14 Oct 2021]

Verberk W, Atkinson D (2013) Why polar gigantism and Palaeozoic gigantism are not equivalent: effects of oxygen and temperature on the body size of ectotherms. Funct Ecol 27(6):1275–1285. Available: https://doi.org/10.1111/1365-2435.12152

Willard D et al (2019) Arctic vegetation, temperature, and hydrology during Early Eocene transient global warming events. Glob Planetary Change, 178:139–152. Available: https://doi.org/10.1016/j.gloplacha.2019.04.012

Yamaguchi T, Norris R, Bornemann A (2012) Dwarfing of ostracodes during the Paleocene–Eocene Thermal Maximum at DSDP Site 401 (Bay of Biscay, North Atlantic) and its implication for changes in organic carbon cycle in deep-sea benthic ecosystem. Palaeogeogr Palaeoclimatol Palaeoecol 346–347:130–144. Available: https://doi.org/10.1016/j.palaeo.2012.06.004

A Study on HR Risk of Didi Under the Sharing Economy

Yingyin Shao

Abstract Under the background of the current "Internet plus" vigorous development, sharing economy may participate in the readjustment and configuration of part of the industrial structure. How to effectively manage innovation and value reconstruction for new platform enterprises applying the new economic model of "collaborative sharing" has also become an important issue that we focus on. This paper selects Didi Company with sharing economy connotation and human resource management characteristics as the starting point of the study. Literature research method, qualitative and quantitative analysis method and empirical analysis method are used to study the human resource management risks of Didi. Starting from the complexity and platform characteristics of human resource management in the sharing economy, relevant suggestions are put forward for potential risks. As an innovative combination of sharing economy and mobile travel, Didi's human resource management is expected to provide a new development direction for platform enterprises to innovate human resource management mode.

Keywords Sharing economy · Didi · Human resource management risk

1 Introduction

In recent years, in the era of Internet, sharing economy thinking and innovation and entrepreneurship policy encouragement, sharing platforms represented by Didi Chuxing show a trend of diversified development. As one of the core elements of the sharing economy platform, the new human resource management in the sharing economy era improves the openness, flexibility and scientific nature of human resource management. However, for platform-based enterprises in the sharing economy, the loose human resource management contracted by the platform and independently managed by the platform makes them face the risk of controlling

Y. Shao (✉)
School of Management, Wuhan University of Technology, Hubei 430070, China
e-mail: 1148045772@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_15

various idle social resources. Therefore, the new platform human resource management mode under the sharing economy should do a good job in risk prevention and human resource relief measures when the harmful results occur.

Didi is a representative enterprise in the new-type platform HR management, and many problems and risks caused by new-type "platform" human resource management are reflected in the operation process of Didi's platform.

2 Research Background and Purpose

2.1 Research Background

As of June 2019, China's online taxi users reached 337 million, 6.7 million more than at the end of 2018, accounting for 39.4% of the total Internet users. "Didi Chuxing" has changed the traditional way of taking a taxi, and established and cultivated a modern way of travel for users leading in the Internet era. Subvert the concept of roadside pick-up, integrate online and offline by utilizing the characteristics of mobile Internet, and optimize passengers' taxi experience to the maximum from the initial stage of taking a taxi to paying the fare online when getting off.

However, at present, the management of drivers who join Didi is limited to the form of network contract, which is undoubtedly relatively loose, and there are certain particularities in terms of salary incentive and labor relations. And in recent years, due to the lack of management, Didi company has been exposed to many negative news. Since 2016, there have been about 89 criminal cases involving Didi drivers, so "new human resource management" should not be ignored and risk prevention should be done.

2.2 Research Objectives

This paper discusses the risk response and reform measures of human resource management on the platform under the sharing economy by studying the model of Didi. It is hoped that based on the reference of the former research theory and the superficial study of Didi company model, it will contribute to the future development of the new "platform" human resource management model in the era of sharing economy.

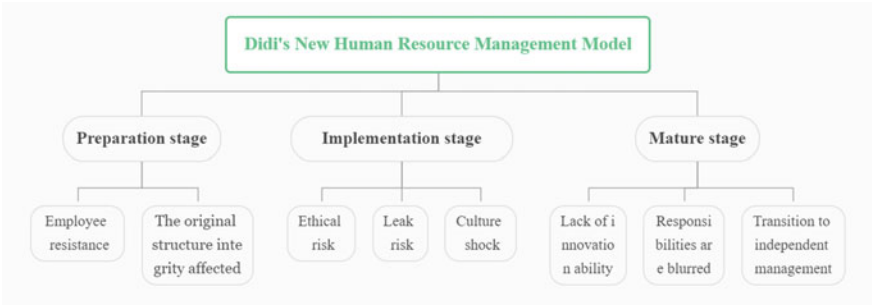


Fig. 1 Didi's new HR management organization chart

3 Current Situation of Didi's Human Resource Management

After the rectification of the rape and murder case, Didi no longer takes scale and growth as the measure of the company's development, and no longer "emphasizes operation over management". It has adjusted the relationship between management and operation and re-evaluated the business and management model of hitch car (Becker and Smidt 2016). In view of the existing problems, Didi is strengthening rectification, focusing on the construction and strengthening of the management system, and standardizing the driver terminal has become the focus of Didi's work (Fig. 1).

4 Characteristics and Risk Analysis of Didi's Human Resource Management

4.1 Characteristics of Didi's Human Resource Management

Internal cause and prevention—The risk behaviors of the company's personnel are hidden in the company itself, which can be predicted and prevented from the occurrence of corresponding risk events and reduce unnecessary losses of Didi. Hidden and sudden, the risks of HUMAN resource management are changeable, and the risks are constantly changing and accompanied by the transfer of possible risks (Becker and Smidt 2016). In the new platform human resource management, such changes will become very obvious. The transfer of risk changes makes it more difficult for Didi companies to manage human resources on the platform.

4.2 Risk Analysis of Didi's Human Resource Management

There are Adaptation Risks for Enterprise Employees. There are certain risks in internal management and employee management of Didi. Didi hopes to cooperate with online drivers for win–win results, but its current model is not mature enough in practical operation of adaptation and integration in the context of sharing economy. Drivers in different regions have obvious differences in service mode, ability, attitude and other aspects. Differential human resource management may discourage the enthusiasm of Didi employees. Once employees have high turnover intention, there will be a serious problem of human resource loss.

Risk of Potential Driver Losing Control. More than a third of Didi's drivers believe they are being squeezed by the company in terms of pay, according to a survey. Didi's new "platform" human resource management has single incentive means, employees lack community identity, and employees' personal value is divorced from the company's goal planning. The negative and lazy attitude may lead to the goal orientation of online employees favoring personal profit, and lead to the bad behavior of Didi drivers, which may lead to a vicious incident and potentially out of control for Didi (Lijun 2004).

Performance Pay Management. The poor effect of didi's rewards and punishments makes online employees sign up with the platform purely for profit. Once the employees on Didi's platform feel that didi's platform is unprofitable, they will give up using it, and the punishment means will have no restriction effect.

Passenger Safety Issues. First, in terms of personal safety, drivers who use Didi's software to take and snatch orders while driving tend to ignore the road conditions in front of the vehicle, which causes potential safety hazards. In addition, passengers enter a stranger's vehicle based on the platform's trust, leaving them isolated and isolated, which is very dangerous for female passengers who are alone (Kun 2015).

Secondly, due to the virtual nature of the network, Didi company does not properly assess the moral quality and business ability of drivers who sign online contracts, and there is information asymmetry between the company and employees, which is easy to lead to the occurrence of vicious acts such as fraud and robbery by criminals using Didi platform, seriously damaging the interests of passengers.

5 Countermeasures and Suggestions for Preventing and Controlling Human Resource Management Risks of Didi

5.1 Strengthen Risk Monitoring

Establish an Effective Early Warning Mechanism. When applying the new human resource management mode, it is necessary for Didi to carry out risk research, analysis and prevention and control on the new human resource management mode. On this basis, it pays attention to the research on risks, especially the summary of corresponding risk rules, so as to form risk prediction.

Therefore, in order to minimize the risk, Didi should make a comprehensive evaluation of its investigation and strengthen the company's forward-looking control and feedback through its own evaluation results.

Strengthen Internal Communication. With didi's internal organizational framework and position adjustment, it is natural that employees do not understand or even reject, which affects the cohesion of the company (Xirong and Mingbo 2016). Didi can set up a special agency to communicate with all employees, so as to save the company's human resource management costs, enhance its core competitiveness and improve its operating efficiency.

5.2 Adjust the Employee Supervision Mode

Strict Market Access and Supervision. For the market access system of ride-hailing platforms, drivers' competency should be strictly tested. In addition to the basic legal certificate examination, drivers' resumes should also be examined, focusing on the moral quality of drivers. Third-party credit investigation systems, such as banks and courts, should be introduced when appropriate. Cooperation with local public security agencies could also be strengthened to ensure that more qualified service providers were recruited.

Increase Insurance. To reduce the company's risk, Didi launched a 1.2 million yuan accident insurance in cooperation with Ping An Insurance. Increasing insurance can reduce the company's losses in the event of similar incidents, and can increase the constraints on drivers.

Strengthen the Management of Labor Contracts. The platform signs labor contracts with drivers, and both sides establish labor relations. The rights and interests of employees are protected by law, the platform is responsible for traffic accidents. Didi can also innovate the form of labor contract, clearly unify standards on important issues to reduce the occurrence of avoiding legal liability. Didi should strengthen

its legal awareness, keep abreast of changes in national policies, and timely modify relevant provisions to avoid illegal operations.

5.3 Improve Staff Management

Didi's management of employees should start with employment, reasonable assessment and evaluation should be carried out in the process of work, and outstanding employees should be motivated according to their work results to ensure a sustainable and positive working atmosphere within the company. Personnel recruitment and training content in Didi shall include: corporate culture training; Emergency handling of emergencies; Staff service awareness and skills, etc. At the same time, the software of Didi's platform should be optimized at any time to prevent any loopholes from being exploited, and the platform should set up logical procedures to prevent online drivers from brushing orders to ensure the authenticity of vehicle operation data (Xiaodong et al. 2016).

6 Conclusion

This paper studies the human resource management risks of Didi And draws the following conclusions:

First, Didi Chuxing breaks the disadvantages of the traditional travel industry, has the connotation of sharing economy, and has great development potential. Didi's new human resource management mode provides a new idea for the current platform enterprise innovation management mode. With the development and innovation of new employment mode and employment mode, enterprises should reform and innovate as soon as possible and take the initiative to adapt to changes.

Secondly, it can be seen from the above research process that Didi enterprise human resource management is facing great challenges and risks. It is an important task to strengthen the awareness of risk prevention and early warning and improve the level of risk management. At the same time, many human resource management risks exposed in the company indicate that the platform needs to establish a long-term mechanism for risk prevention and control, and promote the institutionalization, normalization and systematization of human resource risk management.

Third, Didi needs to develop and operate under the effective supervision of the government. Government should require drops data access regulation platform—a platform is a regulation as soon as possible by around the traffic administrative department of the Ministry of Transport and the preparation of the network data platform about car, real time control of the driver's identity through information means comprehensive, vehicle running track, and so on and so forth, for the first time found the problem, eliminate hidden dangers, to ensure the safety of passengers,

effectively guard against the risk. Moreover, relevant functional departments of the government should escort the development of online car-hailing enterprises.

In conclusion, drops the company is a new platform of new forms of Shared economy, its development direction in the context of the current still need to continuously explore, timely adjustment of human resource management risk response and reform measures, continuous innovation and perfect the employment and human resources management mode, in order to promote drops the healthy development of the enterprise.

References

Becker K, Smidt M (2016) A risk perspective on human resource management: a review and directions for future research. Human Res Manage Rev 26(02):149–165 (2016)

Lijun H (2004) Research on the risk of enterprise human resource management. Southern Economy 12:25–27

Kun Z (2015) Human resource management risk and countermeasures analysis of Chinese enterprises. Intelligence 02:336–337

Xirong C, Mingbo L (2016) Sharing economy and emerging human resource management model: a case study of Airbnb. Human Res Devel China 06:20–25

Xiaodong Y, Rong L, Hao C (2016) Exploration of human resource management mode under the background of sharing economy: a case study of didi. Human Res Dev China (06):6–11, 54.

Activation and Reconstruction of Emergency Supply Chain Crisis Under Crisis Events

Xinyu Li

Abstract In recent years, attention has been paid to the study of emergency supply chain under crisis events. This paper takes Wuhan's lockdown in 2020 due to COVID-19 as an example, takes journals, news reports and relevant policy documents as the main data sources, and uses grounded theory to study the activation and restructuring process of emergency supply chain. The study found that the original supply chain started to operate spontaneously after being stimulated by external events, including three elements: materials, sources and storage. However, the initial activated supply system could not meet the emergency demand and further reconstruction was required. The reconstruction process is led by conscious force, which mainly lies in node strengthening, chain strengthening and network shape remodeling. Meanwhile, it uses smart technology to construct intelligent emergency supply system. Finally, the paper discusses the theoretical value and practical significance of this research, and discusses the direction and form of future research.

Keywords Emergency supply Chain · Logistics · Grounded theory

1 Introduction

In 2020, the sudden outbreak of COVID-19 almost paralyzed all social production activities, and towns, cities, provinces and even the whole country began to be isolated, undoubtedly challenging the supply chain. In recent years, various types of unconventional emergencies such as natural disasters, accidental disasters and public health events have become seriously prominent, posing a severe threat to the daily life of citizens and the pace of national development.

When encountering a crisis event, the supply chain system will expose many problems in the process of operation, including materials can not be delivered to

X. Li (✉)
School of Foreign Languages, University of Electronic Science and Technology of China, Chengdu 611731, China
e-mail: Lixinyuvanessa@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_16

the destination on time, resulting in waste, low transportation efficiency and so on. Therefore, when an emergency occurs in a region, how to timely activate the existing supply chain and imminently rebuild the production and transportation lines are a critical issue worth pondering.

Contemporary scholars put forward the idea of establishing intelligent emergency supply chains, advocating the construction of government-led emergency management mechanisms, and forming a pattern of unified government command combined with extensive participation of individuals (Danqing 2021). Though very enlightening and provoking, the exact details are not analyzed, and how supplies accurately and quickly meet demand is not clearly illustrated. Hence this paper, based on dynamic and microscopic perspective, will elaborate in depth how to reduce intermediate running process, further activating and reconstructing the chain in context of emergency.

2 Literature Research on Emergency Logistics Supply Chain

The emergency logistics supply chain is a special logistics activity that adopts dynamic transportation network, flexibly adjusted to respond to vague demands for emergency supplies, aiming at maximizing time benefit and minimizing loss in the face of sudden events. Different from normal logistics supply chain, it belongs to unconventional logistics supply chain, which bears spatial utility, time utility and dynamic utility. At present, part of the research is based on the mathematical model of emergency supply chain research. The results mainly focus on transportation, the supply field, supply chain partner trust and other aspects, such as supply risk decision model and Robust Optimization concept. The other part mainly concentrates on the top-level strategic design, supply chain finance and the establishment of emergency supply chain management system. The current research emphasizes more on the introduction of theories and independent analysis of each link of the chain (Yang and Yongzhao 2021).

In the context of the present study, according to the specific characteristics of emergency materials, the emergency logistics management system classifies the materials and stratifies the transportation modes under different levels of importance. It lays emphasis on the top-level design of emergency support plan mechanism (Qiuhong 2020), establishing implementation and supervision institutions step by step, combining governments at all levels, social groups and individuals to make overall planning and trace logistics information through intelligent means, so as to play its role in the supply and guarantee of emergency supplies. On the basis of supply chain theory, material integration and warehousing distribution can be regarded as a network structure, and individuals and enterprises can be considered as a node of this network structure. System construction mainly relies on analyzing the advantages, disadvantages and development status of each node. This kind of theoretical

construction method is mostly based on the static perspective, dividing each link according to the form of supply chain. In the process of macroscopic construction of emergency system, it adopts the theoretical mode of preparation in advance, implementation during the event and improvement after the event, which lacks the pros and cons analysis and optimization of supply chain from the dynamic perspective.

This study will focus on the dynamic change process of supply chain from activation to reconstruction under the pressure of crisis events. From a more micro perspective, this paper pays close attention to the specific flow process of materials and the transformation of supply system, experiencing a change from the spontaneous improvement to self-conscious improvement.

3 The Study Based on Grounded Theory

In this paper, COVID-19 is selected as a case study. At the beginning of 2020, the outbreak of COVID-19 began in Wuhan, and Wuhan entered the "lockdown" state. How to quickly activate and reconstruct the supply chain and allocate a large number of supplies to corresponding demand points in a timely and rapid manner has become a formidable challenge. Therefore, this study selects this typical case and analyzes it based on grounded theory.

The research primarily adopts the method of literature research, and the data is extensively obtained from CNKI, People's Daily, official government website, Baidu and other channels, mainly including journals, news reports and relevant policy documents. While obtaining the sample data, this study analyzed the data and constantly completed the data. Through continuous theoretical sampling, eventually, 53 samples were included when preliminary saturation was reached, and through comparison of concepts and categories, flexibly referring to the relevant literature, four main categories were extracted from the original data, namely event attributes, activation of supply chain, reconstruction of supply chain, the major participants and the results. It consists of 13 categories and 22 subcategories.

4 Activation and Reconstruction of Emergency Supply Chain

4.1 Event Attributes

The attributes includes three dimensions: time, space and intensity. From these three perspectives, we will respectively analyze the attributes of the event that Wuhan had gone into lockdown stemming from the COVID-19 epidemic.

In terms of time attribute, the event occurred at the peak of population gathering during the Spring Festival, thus making it fairly difficult to prevent and control the

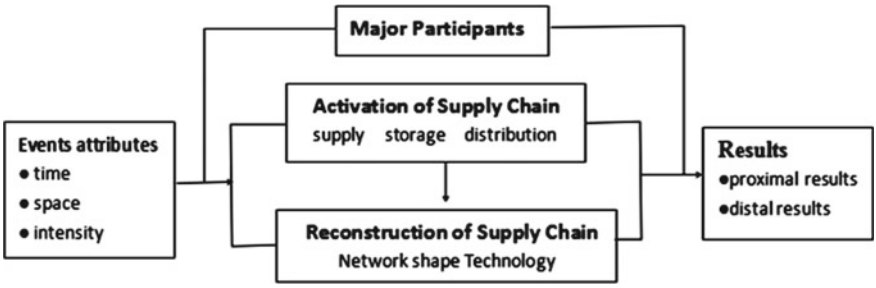


Fig.1 The process of supply chain activation and reconstruction

spread of the virus and burdened with greater intensity of material supply. Wuhan had been placed on lockdown for 76 days, and the epidemic has continued to this day, making the fight against the virus a "new normal". And from the perspective of space, the disease spread from Wuhan South China seafood market to the entire Wuhan city, involving a wide range of people from all walks of life. As to the intensity of this incident, Wuhan issued a level II public health emergency alert after the strike of the virus. In order to contain the further deterioration of the epidemic, Wuhan, as a large city with a highly residential density of more than 10 million citizens, had no choice but to shut down the city and fully entered the war state. This has caused a high degree of disruption to conventional practical activities, and the event itself is highly subversive. Moreover, the particularity and complexity of emergency supplies under the isolation background also led to the strong novelty of the event. In this case, it turns out the fact that the city, which was "closed down" due to the infectious disease, was especially unable to be completely self-sufficient in supplies. Timely supply and unimpeded transportation are the most critical parts to secure the daily operation of the city, which is also a test of the supply chain performance.

As a key link to meet the upstream and downstream demand of the supply chain, warehousing is a logistics activity that effectively plans, executes and controls the goods in and out, inventory, sorting, distribution and information in specific places with modern technology on the basis of certain materials. And then this paper will elaborate process of supply chain activation and reconstruction (see Fig. 1).

4.2 The Activation of Supply Chain

Supply chain activation refers to the spontaneous operation of the original supply chain system after being stimulated by external events, which includes three key elements, namely supply, storage and distribution. As the panic spread through, the lockdown of Wuhan had an adverse impact on the supply system. The irrational behavior of the masses, such as panic buying and spreading rumors of shortages on media platforms, has become the initial signal of an urgent need to activate the supply

chain. Subsequently, under the strong leadership of the CPC Central Committee, the COVID-19 headquarters was formally established, and the emergency supplies support mechanism was activated to instantly connect all links of the supply chain. As the basis of supply chain, the supply was scarce under the background of the closed city and the material flow was blocked. In order to meet a large number of material needs, enterprises that had stopped production activities began to resume work, and the production process was gradually getting back on track. Nevertheless, due to the deepening contradiction between supply and demand, the Wuhan government further established domestic and foreign material procurement teams to relieve the pressure (Xi 2021). Additionally, independent individuals and organizations from the society also enthusiastically made targeted or non-targeted material donations.

As a key link to meet the upstream and downstream demand of the supply chain, warehousing is a logistics activity that effectively plans, executes and controls the goods in and out, inventory, sorting, distribution and information in specific places with modern technology on the basis of certain materials. Therefore, the Wuhan Municipal government issued documents confirming that Wuhan Charity Federation and Wuhan Red Cross Society would officially receive the donations of materials and funds. However, given the limited storage capacity of Red Cross Society, it also issued the task of material storage to Hubei and surrounding warehouses, managing to initially realize the transfer of materials. In accordance with the characteristics and urgency of materials, the government and enterprises jointly responded quickly to build a multi-system emergency green channel for transportation, mainly including the air, road and railway systems. Tons of materials were sent to Wuhan, and then the PLA troops and social volunteers in Hubei delivered them to designated place.

On the whole, the supply network during the lockdown of Wuhan became a centralized collection. Among provinces and cities, support from 19 provinces is concentrated in Wuhan. From within the city, the Red Cross uniformly accepts foreign materials, also representing a highly centralized state.

After the rapid response and adaptation period, the activation of the supply chain has achieved initial success, largely meeting the needs of daily life and medical treatment. Whereas, as a protracted battle against the epidemic, activation is far from enough. Problems exposed in the current supply chain should be promptly solved, and system reconstruction and correction should be carried out.

4.3 The Reconstruction of Supply Chain

Current Deficiencies in the Supply Chain. Although the supply chain initially activated can work, there are defects in the chain nodes themselves, and the connection between nodes is not close enough, or even split.

The weak nodes mainly lie in an overloaded state of production, the tremendous pressure of single material supply point, and the obstructed storage and distribution of foreign materials. Among them, the Red Cross Society, as the critical node of material integration and storage, has limited storage capacity and is in an overburdened state

(Lei 2021). As an essential link of transfer and distribution, it lacks experience in handling emergency supplies, and the ambiguity of intermediate information makes it tough to accurately connect supply and demand. The ineffective operation of key nodes makes the entire supply chain short of efficiency.

The supply network is composed of series of single supply chains, and the connection between each key link in a single chain is the guarantee of the whole efficient supply. Nonetheless, the initial activated supply chain operation is hindered by intermediate links, including information imbalance and time difference between storage and distribution, insufficient overall transportation capacity and low transportation efficiency caused by the constraints of epidemic prevention policies (Ye 2020). These are mainly manifested in the separation of the right to receive and distribute materials between the Red Cross Society and the headquarters, the non-disclosure of material information, and the 14-day isolation of all road transport drivers entering Wuhan during the epidemic period, resulting in a shortage of transport capacity. And many social volunteers lack access to the voluntary service system, resulting in idle resources.

All these indicate that the original supply system is under load and needs further reconstruction to stimulate vitality.

Reinforcement of Network. Through the integration and analysis of sample data, it is found that the reinforcement of supply network principally depends on node strengthening, chain consolidation and network shape remodeling. Above all, strengthen the key nodes, increase the amount of material reserves, improve storage capacity, and enhance the transport efficiency. On this basis, each strengthened node will be more interlocked, then tighten the single chain by dredging obstacles. And equally, the original highly centralized network shape should be changed, and multiple circulation centers are encouraged to be added to relieve the pressure.

The strength enhancement of key nodes mainly lies in production, transportation and warehousing. Production is the most basic link in the supply chain. The government has issued policy support to speed up the resumption of work and production expansion, and sent enterprise specialists to supervise it. In emergency transportation, full-time personnel are assigned to be on duty all day to coordinate and solve the problem of emergency supplies transport vehicles passing through the province in real time (Xiangdong and Ran 2021). In terms of warehousing and distribution, the logistics station of the enterprise was temporarily used as the emergency storage center, and Jiuzhoutong Professional Management Company was responsible for the management of Red Cross materials, which shortened the time of materials in and out of storage to 2 h. In addition, as for the road transportation, in the most severe regions of the disease, buffer areas are set up between the epidemic area and the non-epidemic area, so that the material transport drivers do not have to enter the isolated area, so as to maximize the number of drivers to transport emergency supplies, improving the transport frequency and reducing the time of material transfer. The enhancement of single chain including material in and out, storage and distribution mainly depend on the rationalization and specialization of chain division to strengthen the connection among all links and improve the degree of close cooperation: The City Investment Company is responsible for loading and unloading

of the goods, Jiuzhoutong Pharmaceutical Logistics Company takes charge of logistics management of goods, classification and stacking, Wuhan Market Supervision Administration and Health Commission carry out the planned distribution of donated goods, and Wuhan Municipal Bureau of Statistics focus on data statistics.

Serves as a supply system for the network structure, the original material receiving and transferring pressure concentrated in a single point. To make the supply network efficient, it is considered necessary to set up myriad warehouse distribution and transfer centers, forming a multi-point network. In the course of reconstruction, Wuhan encourages more targeted donations and directly connect supply and demand with the aid of logistics companies. Moreover, special emergency materials destinations such as "Huoshenshan Hospital" receive donated materials directly instead of passing through Wuhan Red Cross Society. Different types of materials are transferred to different organizations for warehousing and distribution, and will no longer be concentrated in Red Cross Society. The optimization of the coordination mechanism improves the efficiency of supply and further guarantees people's living needs.

Empowerment of Technology. Technology, as power that can overturn the traditional inherent mode, plays a pivotal role in the process of reconstructing the supply chain. First of all, for the establishment of supply and demand channels, such as emergency supplies, social volunteers, technology serves as a bridge. For example, the establishment of a reliable and convenient platform provides institutions and individuals with mutual needs to seek help (Fangcao 2021). Secondly, the development of intelligent technology provides solutions to the original problem of end-point distribution, such as Meituan unmanned delivery vehicles, self-delivery cabinets, etc. During the lockdown period, owing to the evolution of intelligent technology, the daily life supplies in the community changed from unidirectional mode to a bidirectional interaction mode: "online ordering + community group buying + distribution to the community". QR code and other real-time tracking methods of material sources and whereabouts technology not only greatly increases the efficiency of intelligent monitoring, but also ensure public information transparency.

The reconstructed supply chain has been injected with great vitality. It rebuilt the grass-roots emergency response system and the public emergency management material information mechanism, optimized the infrastructure equipment, and better guaranteed the daily life of Wuhan people during the closure and medical supplies in the fight against the virus.

5 The Major Participants

This study is approximately divided into self-conscious force and spontaneous force. The self-conscious force mainly refers to the overall role played by the authorities, which calmly responded to the epidemic and resolutely took a series of prevention, control and treatment measures.

As for the spontaneous force, individuals, enterprises and social groups all play an indispensable role in material collection and transportation. Tens of thousands of community volunteers work at the distribution of "last 100 m". SF Express, JINGdong and other major express logistics companies in China have opened global and domestic green channels and assumed the responsibility of voluntary delivery (Xuwen 2021). Various social groups have initiated charitable activities. For example, a group of alumni associations represented by Wuhan University and Peking University actively coordinated overseas resources.

The two forces are well integrated with each other. And then Wuhan Government is committed to building an interaction and cooperation mechanism led by the government and widely participated by social forces, so that the two forces can play their respective roles and maximize the benefits.

6 Conclusion

Taking the blockade in Wuhan as an example, this paper interprets the dynamic issue of how to activate and restructure the emergency supply chain in the context of major emergencies. Based on the grounded research method, this study found that the activation and reconstruction of the whole supply chain are dominated by the government with extensive participation of social forces. By improving the deficiencies of each link, the rebuilt supply network better meets the material demand, promotes the construction of grass-roots emergency system and strengthens the construction of infrastructure.

Theoretically, this study focuses on how specific materials are transferred in the closed and isolated state based on more detailed micro particle view, and establishes a rapid response emergency logistics system and urban security mechanism under the state of emergency, providing experience for future public emergency response. In practice, when the load of the original supply system was found to be unable to meet the supply demand, this paper discussed how to strengthen each node of the supply chain in the emergency state, how to enhance the connection between nodes and keep smooth and coherent. The source of materials is based on production, and the supply is guaranteed by the purchase and donation of internal and external materials. In the process of material transfer, the original shape of supply chain network is upgraded to a multi-point network. Relying on the power of intelligent technology, intermediate links are reduced in warehousing and distribution, the connection and supervision of all nodes are optimized, and efficient coordination and cooperation mechanisms are established. The research also pays attention to the combination of self-conscious force and spontaneous force. The government is in the leading position, responsible for mechanism construction and force guidance, and the spontaneous forces such as enterprises, organizations and the public respond to the call of policy, cooperate extensively and make contributions.

As an exploratory study, this study has a limited number of cases, and only one case of Wuhan lockdown under the epidemic situation is selected. And in the future

study, the multi-case study method can be adopted. At all stages of the study, there is a lack of research on the influence of external events on mass psychology and then on the supply chain under the state of crisis, which needs to be included as a research variable in the future. Besides, this research background is set in China. Collectivism with typical Chinese characteristics is a vital guarantee for the central government to quickly activate and reconstruct the supply chain. There are obvious differences between China and other countries, and it lacks comparison between similarities and differences, which need to be further improved.

References

Danqing S (2021) Study on emergency smart supply Chain management under public health Emergencies. Bidding and Procurement Manage 39–42

Fangcao D (2021) Analysis on the current situation and countermeasures of emergency logistics under major epidemic situation. China Log Procurement 70–71

Lei W (2021) Context, cognition and strategy: the logic of technology embedding in organizations: a case study of Wuhan red cross In COVID-19 prevention and control. Strives Real 51–67

Qiuhong Z (2020) Construction of fractal emergency logistics management system and its guarantee mechanism for major emergencies. Jianghuai Forum, 13–20

Xi C (2021) Study on the operation of urban security system in the context of major public health emergencies: a case study of Wuhan during the "lockdown" of epidemic. Chinese J Emergency Manage 56–64

Xiangdong S, Ran W (2021) Provincial department of transportation blocked the spread of the epidemic to ensure the smooth transportation of materials. Commun Party Daily 19

Xuwen J (2021) Optimization of China's material transportation system under COVID-19. China Storage Transp 98–99

Yang C, Yongzhao W (2021) Research on the construction and strategy of emergency logistics supply chain based on emergencies. Railway Procurement Logistics 63–66

Ye Z (2020) Countermeasures for transportation of emergency supplies under Public health emergencies. Urban Transp 102–109

Advantages and Disadvantages of Online Celebrity Marketing

Shiqi Chen

Abstract The This paper aims to analyze celebrity marketing and highlight the advantages and disadvantages of product and service endorsements by famous individuals. Companies realized the value of hiring famous individuals in different sectors, including entertainment, sports, and politics, to promote their products and services. Companies hire celebrities to mention or use their products and services to create awareness and increase sales since their fans are compelled to try what their favorite celebrities are using. Consequently, celebrity endorsements generate positive press, create awareness around a product or service and influence consumer purchases. Nonetheless, companies risk losing much money, especially when a celebrity is involved in negative press. In some cases, fans might focus more on a celebrity rather than the products and services they are meant to advertise, leading to the loss of millions in advertisement capital.

Keywords Celebrity endorsement · Online marketing · Brands benefit

1 Introduction

The changing business dynamics have prompted companies to accept technology's important roles in reaching and engaging stakeholders. Companies have recognized celebrities' vast followers and opt to take advantage of such by adopting online celebrity marketing models. These celebrities appeal to the emotional and psychological aspects of decision-making (Berger 21a). Large multinational companies like Nike, Adidas, Colgate, and Coca-Cola have opted to use celebrities for marketing their products to different targeted audiences. For instance, companies use soccer celebrities like Cristiano Ronaldo, Neymar JR, and Lionel Messi to market their products by using multi-million-dollar endorsement deals. Other companies use

S. Chen (✉)
Wardlaw Hartridge School, Edison, NJ 08820, USA
e-mail: Shiqichen0617@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_17

celebrities from the film, music, and showbiz industries to face their brands or products to optimize popularity and create a strong brand position in the market. Despite the celebrities asking for higher compensation, companies are willing to sign multimillion endorsement deals to benefit from their influence in the market and their loyal followers and fans.

1.1 Celebrities Are Opinion Leaders

Opinion leaders significantly influence consumers' decision to buy products since customers often look for them for approval. Consumers consider opinion leaders as people with comprehensive knowledge about a product more than an average customer, giving them the power to change or shape the public's perception towards a given product (Berger a149). Companies consider celebrities as opinion leaders on a national and international level since they have vast followers and greatly influence such fans. Easy access to technology and the current culture has increased the power of celebrities since fans can easily emulate their loved celebrities. Fans follow and interact with their celebrities on social media platforms like Twitter, Instagram, Facebook, and Twitter. Celebrities continue to use social media as a tool to voice their opinions and maintain close relationships with their fans. They become catalysts who apply to human emotions to influence their decisions (Berger 149a). Moreover, the role of social media in the business world has grown into a disruptive advertisement tool that allows firms to maximize the concept of online celebrity marketing models. Thus, celebrities continue to enjoy unwavering influence through social media since tweets from a celebrity can become headlines in mainstream media like newspapers and televisions. Thus, celebrities have substantial power over their fans, making them the current powerful opinion influencers.

Social media marketing has become a major way for firms use to reach generation Z and millennial customers. The increasing trends of current generations using social media make them a critical tool used by celebrities to increase their influence and strengthen their voices and opinions in the community. Companies aim to take advantage of such increasing social media consumption and celebrity power to influence society's perception of their products and services and establish a strong brand position. The notion is that these successful and famous people have a significant influence that makes anything they touch turn into gold (Berger 21a). When celebrities tweet or post about the positive impacts they got when using a certain brand, it becomes a hit among their followers and generates substantial sales revenue or popularity. An illustration of strong celebrity power as opinion influencers was demonstrated by Cristiano Ronaldo in the Euros 2020. Cristiano Ronaldo is a famous football player who plays for Juventus. While representing his country, Portugal, in the Euros men competition, the soccer player removed Coca-Cola from his table during a press conference and opted for water instead. Coca-Cola is a non-alcoholic beverage manufacturer and seller that had significantly sponsored the European competition. The brand relies on celebrities and such global competitions to market its products.

Cristiano Ronaldo's gesture cost Coca Cola around $4 billion in share value immediately after the incident. Ronaldo's incident remained significantly powerful and harmful for the company as it influenced people to choose water over the aerated drinks. This video trended immediately on Twitter globally, and social media played significant roles in increasing the powers of the football celebrity. Thus, celebrities are opinion leaders who can either build a strong brand position or destroy it based on their large influence on their followers and fans.

Famous individuals and celebrities have always made the perfect salespeople because they resent a familiar face and provide companies with the easiest ways to create brand associations in their target customers' minds. All celebrities have a wide fan base comprising people who admire their lifestyle and those who look up to them for advice on different issues, including what to buy, wear, and eat. When a widely loved actor or famous individual in sports or entertainment is hired to endorse a product or service, their fans and followers search for the good on different platforms, giving it more credibility. Celebrity marketing is a tactic that entails working with a famous individual to endorse a product or service (Schauten et al. 260). The famous individual might be an actor, a footballer, a musician, an athlete, an ex-politician, or a cartoon character. Such individuals do not need to be international superstars but only have a decent following among the target market. For instance, a celebrity in a certain state in the U.S., such as California, might not have a large following in a different state in the same country, but they can create a thrill for a product or service by endorsing it in the state in which they have a following. Therefore, celebrities in different industries, including sports, entertainment, and politics, are employed by brands to create awareness around certain products and services because they influence their fan base.

Celebrity involvement in marketing can range from explicit to implicit endorsement of products and services. In some cases, celebrities endorse a product or service by informing their fans that they are using it personally and have a great experience using it. In other cases, celebrities are involved in a brand image, which mainly relies on a celebrity's reputation rather than their outright endorsement. There are different mediums through which celebrity marketing is employed, the most common being social media, Facebook, Twitter, and Instagram. The critical factor is to match the right celebrity with the right ad campaign or product. For instance, brands that sell sports apparel find it more effective to use celebrities in the sports industry to endorse their products and services. If this strategy is implemented effectively, a company can benefit significantly from an immediate change of its brand image among the target audience. Celebrities have to sway over their fans; thus, celebrities in the sports industry can contribute significantly to the growth of a sports apparel brand by endorsing their products and services to their loyal fans (Zhou et al. 13). Accordingly, celebrities can significantly promote a brand image either directly or indirectly by convincing their loyal fans to try companies that hire them to market the product or service.

2 Literature Review

Companies have continued to appreciate the important roles that celebrities play in promoting their brand positions in the market. The emergence of papers, cinema, and the internet has significantly changed firms' scope to implement celebrity marketing models and advertise their products towards maximum sales volumes and sales revenue. Several theories exist to justify why celebrity endorsements continue to succeed even though the celebrity has nothing to do with the company. Companies should acknowledge and apply the Product Match-Up Hypothesis while considering their products' online celebrity marketing model. Under this hypothesis, the firm should choose celebrities whose beliefs and brand position match a company's expected brand positions and vision. Accordingly, a matched celebrity leads to substantial success in the market, while mismatched celebrities can easily lead to huge losses to a firm. Thus, companies should consider existing theories to guide their choices of using online celebrity marketing models to advertise their products.

The Source Credibility Theory (SCT) displays the significance of companies using celebrities to pass information to consumers. Under the SCT, people believe information is passed from credible sources. Since celebrities are important people in society, they aim to remain relevant by only communicating credible information to maintain their image. Consequently, followers and fans believe that their loved celebrity cannot mislead them since such actions would adversely destroy their brand image in the community and affect their performances. Companies leverage the SCT to manipulate consumers' beliefs, opinions, attitudes, and behavior by using their favorite celebrities in their online marketing campaigns. Fans have established a strong link with their celebrities, which conforms to the social identity theory. Fans have higher chances of buying products and services endorsed by their celebrities since they trust the celebrities to have similar attitudes and value structures and expect incredible value from such products (Berger 174a). Thus, the online celebrity marketing model relies on the SCT to explain the companies' willingness to invest more in celebrities to endorse their products.

Source Attractiveness Theory (SAT) emphasizes that people have positive stereotypes about famous and successful individuals. Consequently, consumers emulate celebrities since they believe that following what they do and the advice they give will make them famous and successful at some point in their lives. Berger outlines that online posts form behavioral residue (154a). Companies understand this theory and create an online celebrity marketing model for their brands and products in the market. Under this notion, attractive communicators can easily change the consumers' beliefs towards a specific product in the market and make consumers have higher purchasing intentions. Thus, companies use the performer quotient to evaluate a celebrity's possibility of increasing sales revenue and new purchases when modeling the online celebrity marketing strategy.

The Meaning Transfer Theory (MTT) is a three-stage explanation of the use of celebrity endorsement by companies. The MTT starts with the formation of a celebrity's image that makes them important assets. Celebrities viewed as more

successful have extensive followers that make them very expensive for companies to endorse. These celebrities have distinct features and meanings that they communicate to the product. For instance, a fitness-enthusiast celebrity can transfer the meaning of a product being healthy and reliable. The third stage in this model is to transfer meaning from the product to consumers. In this case, the consumers change their perceptions of the product based on the celebrity's image and the meaning they associate with the product. Under this approach, online celebrity marketing must not focus more on the outcomes that the company expects. Still, it should consider the expectations of the targeted audience and channel the content towards addressing their interests to appeal to their emotional perspective of decision-making (Berger 183b). Thus, the MTT addresses emotional perception towards a product based on the celebrity's brand image in the market.

Marketers understand the costs and benefits of celebrity endorsement in online campaigns, hence opting for optimizing returns from such strategies. Celebrities often demand higher compensation for their use in the market caused by large competition from companies opting to use them as their brand ambassadors. Consequently, companies apply the psychological approaches associated with the MTT, SAT, and SCT to explain celebrity endorsement's impact on purchase motivation (Berger 183b). However, it is difficult to measure and observe celebrities' impacts on product purchasing decisions given that each theory has its fundamental differences. Specifically, the SCT emphasizes that customers change their minds and behaviors when they get information from people who share common features. SAT insists that a company should utilize more successful celebrities since they have higher rates of influencing purchasing intention and behaviors, while MTT insists on meaning being transferred between different individuals and objects. Therefore, companies should be more careful when developing online celebrity marketing models since these theories are too microcosmic to reach common and robust conclusions and do not reveal the indirect effects.

Celebrity endorsement is a significant type of non-priced competition that firms use to gain an advantage among consumers to enhance their sales volume and profitability. The industrial organization theory (IoT) argues that a company's behavior has strategic impacts that directly or indirectly influence its rivals' behaviors. Consequently, firms take significant time studying the industry behaviors to determine current trends that help them decide on the approach to take as they venture into celebrity online marketing strategies. Berger argues that the more a person learns about factors preventing someone from changing, the easier it becomes to help such individuals (183b). Firms should also adopt this strategy to learn their rivals and the market to identify gaps in the market and establish relevant online celebrity marketing strategies. For instance, the Thai Health Promotion Foundation overcame roadblocks to communicating to smokers the harm of smoking. The institution conducted research and realized that they would achieve more positive results by using smokers to convince other smokers (Berger b 36). Firms that combine the non-priced theories and the IoT in selecting their celebrity endorsers have higher chances of earning significant returns on investment measured by increased sales volume and profitability.

3 Analysis

3.1 Disadvantages of Online Celebrity Marketing Model

Companies must understand the associated shortfalls of online celebrity marketing campaigns. A firm ties its success to the success of a celebrity. Thus, a simple slip by the celebrity can cause huge losses to the company's overall image in the market. Berger insists that people get uncomfortable when attitude and behaviors conflict arise from celebrities' slight slips (37b). Before the disruptive impact of social media on marketing, companies had to pay a celebrity to star in an ad campaign or a television commercial. However, nowadays, a celebrity must utilize social media to maximize their value to a company since they have a large fan base on such platforms. Such a celebrity must align their image with the endorsed product or risk tainting the endorsement's effectiveness. A recent example of a celebrity who lost his brand ambassadorship is the Barcelona and France men's football star, Antoine Griezman. He was the brand ambassador of Japanese video game and entertainment company Konami. However, his endorsement deal ended abruptly after a video emerged from 2019 where Griezman and his Barcelona teammate Ousmane Dembele appeared to make anti-Asian remarks during their trip to Japan. Such actions by the celebrity adversely affected the Japanese company as it demonstrated their association with people who appear racist and do not respect the diversity of the world. It would easily translate to loss of share value and many customers choosing to play video games from rivals. Thus, a slight slip from celebrities significantly affects a company's performance and image in the market unless it takes swift action to salvage the situation.

There is a risk of companies using celebrities whose personality or image does not work well with the targeted audience. Companies must evaluate a celebrity's personality since the brand personality communicated in the market is directly proportional to customers' trust and brand loyalty. Selection is an important part of the brand endorsement process. A company that uses a celebrity with expertise in the product can successfully influence customers' opinions towards the brand (Berger 60b). However, an online marketing campaign that utilizes an endorser without sufficient knowledge of the product can lead to a significant targeted segment leaving the brand and preferring rivals due to a negative attitude towards the celebrity used in such marketing strategies. Therefore, companies must understand that they will earn higher financial returns if they hire top-ranked athletes or musicians to be brand ambassadors. These companies will earn higher financial returns and build long-term positive publicity that increases loyalty and brand position in the market. It is critical to building a relationship between the celebrity and the brand to attain long-term success. Encouraging such celebrities to be more involved in decision-making can result in optimum results that benefit both parties. It creates a sense of control and involvement towards the brand beyond the paycheck that a celebrity earns from such deals. Therefore, companies must remain vigilant to avoid the potential negative effects that arise from celebrity endorsement failures.

Additionally, there is a high risk that celebrities might overshadow a brand image, especially when consumers focus more on a celebrity rather than the product they are promoting. Most celebrities nowadays promote several products and services, especially because most brands have seen celebrity marketing as an effective strategy to increase awareness about their image. Thus, one celebrity might acquire more than one contract to endorse several brands at a time, which leads to overshadowing the brand, whereby fans focus more on a celebrity than the product or service they are meant to endorse (Lejie 116). This disadvantage has several consequences for both celebrities and brands. Brands might spend millions of dollars, especially when the expected results do not reach fruition. When fans focus more on a celebrity than the product or service they are trying to embrace, brands will not realize the expected results, thus losing millions. Secondly, celebrities might lose brand endorsement deals, especially when companies fail to realize their expected results. Hence, celebrity marketing is a risky venture because fans might decide to focus more on a celebrity than the products and services they are trying to endorse, thus losing both a celebrity and the companies that hired them.

3.2 Advantages of Celebrity Marketing

One of the main benefits of using celebrities to endorse a product or service is that brands can benefit greatly from influence consumer purchases. Fans have a certain affinity towards their favorite celebrities that brands can significantly increase their sales. For instance, fans might assume that if one of their favorite celebrities finds a product or service good enough for them, it will certainly be good enough for them. This main philosophy acts as the impetus behind adverts for different products, including makeup, hair products, and apparel. Consumers want to look as good as their favorite celebrities, and thus, are influenced to purchase the products that celebrities claim to use to look as good as them. Local consumers want to try soft drinks being endorsed by their favorite local baseball players. Hence, celebrity testimonials influence fans and the target market to purchase a product or service to have the same experience or look as good as their favorite celebrities.

Celebrities help build brand awareness more quickly compared to traditional marketing strategies. New companies find it difficult to increase awareness about their products or service to the target market, mainly because of competition from established brands. For instance, a new entrant in the fast-food industry might not compete with established brands like McDonald's and Burge King. In such cases, new entrants can use celebrities to endorse their fast-food products and services, thus creating awareness about their existence to the fan base. Such a situation allows them to compete with the established brands. New entrants might spend millions of dollars and waste several years trying to enhance their brand image to their target market, but using celebrity marketing is less expensive and will take a shorter time to create awareness. Thus, using celebrity marketing provides new entrants a chance to create cognizance about their product or service to a fan base.

3.3 Celebrities Generate Positive Press

The online celebrity marketing model relies on the fact that celebrities help companies generate more press and optimize the reach of the market base. Companies look for celebrities to improve their public relations and draw significant attention to their products. To succeed, an entity should consider celebrities to connect with the targeted audience and attract more media and other news outlets' attention. A company creates a significant background story that involves a celebrity and continuously involves the celebrity holding a press conference for progressive and continued media attention to the firm's brands (Berger 20a). If a celebrity continually holds a press conference, gets into interviews, and takes photos using a specific brand, their audience tends to emulate them by purchasing such products while the media keenly pays attention to the celebrity's loyalty towards such a brand. A celebrity who releases press content using a particular brand prompts discussion from fans, bloggers, and social media users, which generates a large potential customer base. As a result, a firm can increase its conversion rate to optimize sales revenue and returns on the marketing investment.

The online celebrity marketing model has also been successful to several entities through a co-branding strategy between companies and celebrities. In this strategy, firms combine a celebrity's brand and products to expand the customers' view of the primary brand. Celebrities bring the necessary star power to a company's brand to establish a strong position in the market and outdo potential rivals. Through co-branding, a company can reach a wider market base and those of their celebrity's fans. Using celebrities through co-branding depends on the remarkability of their image in the market. As Berger illustrates, people tend to share remarkable content widely among their circles of friends through social media (47a). Consequently, firms should choose celebrities able to display remarkable content that can widely reach a large audience. For instance, Kanye West and Adidas got into a co-branding partnership for the Yeezy brand. Kanye West is a controversial and unique musician well known for the brand that makes few want to mess with him in the music industry. He is famous globally and has large followers, whereby some love him, and others hate him. The musician partnered with Adidas to promote the streetwear segment. Given the current business environment that began with COVID-19, many companies continue to enter into co-branding partnerships with celebrities to benefit from the power and added value associated with such followers and fans of the celebrities. Therefore, co-branding is a key approach that companies use in their online celebrity marketing models to enhance the brand position and sales revenue.

4 Conclusion

The digital absorption rate globally has offered new ways that companies can utilize to reach a wide customer base. The use of online celebrity marketing has enabled

firms to increase their sales volume and profitability. Brand awareness and loyalty have also been possible through the use of online celebrity marketing techniques. These marketing strategies use the psychological approach to reach the targeted audience through celebrities. Efficient application of the MTT, SAT, SCT, and IOT help select the most appropriate celebrity that would help a firm reach its targeted audience and translate into financial and brand position benefits. Online celebrity marketing models help companies use opinion influencers to manipulate consumers' behaviors, perceptions, and purchasing decisions while attracting media attention to build awareness and brand loyalty. However, such a strategy has the main risk of inappropriate celebrity selection and celebrity slip that can translate to huge losses. Thus, the adoption of the internet in business practices has significantly contributed to the adoption of online celebrity marketing models that help organizations enhance their brand positions and competitiveness in the market.

References

Berger J (2016a) Contagious: why things catch on. Simon and Schuster

Berger J (2020b) The catalyst: how to change anyone's Mind. Simon and Schuster

Lejie Y (2021) Analysis of internet marketing from the perspective of "Internet Celebrity Economy." J Front Educ Res 1(3):115–119

Schouten AP, Janssen L, Verspaget M (2020) Celebrity versus influencer endorsements in advertising: the role of identification, credibility, and product-endorser fit. Int J Advert 39(2):258–281

Zhou M et al (2020) An accountability evaluation fot the responsible use of celebrity endorsement by the food and beverage industry to promote healthy food environments for young Americans: a narrative review to inform obesity prevention policy. Obes Rev 21(12):13–125

Analysis of China's Blind Box Economy—Taking POP MART as an Example

Xuemeng Wu

Abstract In recent years, the development of the Internet has promoted the continuous expansion of the art toy industry. The blind box, as a branch of the art toy industry, becomes more and more popular. Living in a fast-paced society with high pressure, an increasing number of people choose to purchase blind boxes to relieve pressure and escape from reality. Based on the research data and SWOT model, this paper analyzes China's blind box economy from the success of POP MART. After the research, it is found that POP MART's success is contributed by its correct marketing strategy such as abundant IPs, accurate targeting, various marketing channels, and consumer psychology like the gambler effect, hunger marketing, conformity and comparison psychology. The company still has internal and external problems to consider: single product portfolio, lack of IP content, the possibility of losing consumers and increasing competitors. According to existing problems, POP MART needs to enrich product categories, add stories for IPs, increase the rate of repeated consumption and create distinctive products.

Keywords Blind box economy · POP MART · SWOT · Consumer psychology

1 Introduction

Blind box is a kind of new fashion nowadays. Just like its name suggests, consumers do not know what's inside. Sometimes the boxes can surprise you and sometimes disappoint you. Blind boxes were first derived from Japanese 'lucky bags'. In China, from 2012, the blind box gradually developed in the Chinese market but most of them are imported from other countries Qi and Jie (2022). In 2016, the Chinese local blind box company POP MART, greatly expanded the mainland market and made it popular around China. The rapid development of the blind box and its hidden marketing theory have attracted the attention of relevant scholars and caused discussions on

X. Wu (✉)
The University of Toronto, Toronto, ON M1C 1A4, Canada
e-mail: vicky20041109@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_18

the topic of the blind box in academia, such as reasons why it can quickly spread, habits of its targeted consumer—Z Generation, marketing strategy used under the blind box economy, consumer behaviors and psychology used, and the developing statement and future. Based on those useful references and secondary resources, this essay analyzes China's blind box economy using a specific example, the leadership of the whole blind box market POP MART, and the success of POP MART using the SWOT model and psychological strategies. It also predicts the development of China's blind box economy and indicates problems and possible solutions. The result of this essay expands the research range of the blind box economy and excavates how the blind box economy applies customer psychology. After reading this essay, people will have a deep understanding of the future development of China's blind box economy and its problems and solutions.

2 The Background of POP MART

Wang Ning created POP MART in 2010. POP MART has so far developed a thorough platform that covers the entire chain of art toys and made significant contributions to the rapid growth of Chinese art toy culture. The development of POP MART can be divided into 3 periods. The first period(the exploration stage) is between 2010 and 2014. In this period, the business model of POP MART was defined as a grocery distributor selling trendy items, but it was faced with being replaced by others because of a lack of core competitiveness. The second period (growth stage) is between 2015 and 2016. Most of POP MART's revenue came from the agency of the art toy, Sonny Angel, and after getting the authorization of IP-Molly, POP MART quickly became popular. The third period (development stage) is from 2017 until now. POP MART continues cultivating their own IPs, signing excellent artists, obtaining authorization from well-known IPs, and creating an entire service chain for both online and offline shopping. The total assets of POP MART increased from 142 million yuan in 2017 to 8.32 billion yuan in 2021, which shows POP MART has achieved explosive growth over recent years Annual Report (2020). POP MART has already been officially listed on the Hong Kong Stock Exchange in 2020 and its earnings per share increased from 0.31 yuan in 2017 to 0.62 yuan in 2021. POP MART was chosen as an example because it is one of the most successful and representative companies in the Chinese art toy industry and blind box economy. By analyzing POP MART, the theoretical nature of China's blind box economy can be better analyzed.

3 SWOT Analysis of POP MART

SWOT analysis is a situational analysis that takes into account both internal and external competitive settings and conditions, as well as internal and external opportunities and threats that are relevant to the study object. This approach enables a

thorough and systematic examination of the research object's status, followed by the formulation of development strategies and plans that are appropriate given the findings of the study Helms and Nixon (2010).

3.1 S-Strength

Abundant and Strong IPs. Innovative IP images can highlight the differentiation of the brand and make it stand out from similar brands, so as to leave a deep impression on consumers' hearts. POP MART's propriety IPs don't have animation, film or television content to support, mostly from the original ideas of designers. Consumers can give their expectations of human design, and emotion to the commodity and make them more imaginative and emotional. Proprietary IPs, exclusive licensed IPs, and non-exclusive licensed IPs make up the majority of Pop Mart brand products. The most well-known and profitable IPs are those with a questionable reputation, such as Molly, SKULLPANDA, Dimoo, Bunny, and others. The proportion of revenue from propriety IPs shows a significant increase from 39% in 2020 to 57.6% in 2021 Annual Report (2020). In 2020, SKULLPANDA created 40 million RMB revenue in three months, and became the fifth head propriety IP of POP MART, verifying the strong IP of POP MART. Exclusive licensed IPs including The Monsters, PUCKY and others; Non-exclusive licensed IPs including cooperative brands with famous characters such as Sanrio, Line Friends and SpongeBob, etc. Chen (2021).

Accurate Targeting. Targeting means evaluating each segment's characteristic and selecting one or more segments to enter. The resource, manpower, material resources and capital of any enterprise are limited. Choosing the suitable target market, companies can concentrate on manpower, money, material and resources to strive for the advantages in the local market, and then occupy a share in the target market. POP MART divides its potential customers into several parts including the "Z" generation, artists, white-collars, parents and others. Z generation is people born between the 1990s and 2010s who are familiar with the internet and live in a relatively wealthy background Jiahui and Chen (2022). POP MART pays the most attention to this special group. Z generation is more willing to pay for their spirit satisfaction and can get great enjoyment and satisfaction from opening blind boxes. POP MART grabs the feature of blind boxes as the key to narrow the gap between young people, express their emotional demands and explore their values and the design of new IP always follows the taste of Z generation.

Various Marketing Channels. Marketing channels are ways to deliver goods or services from manufacturers to customers. The rapid development of the commodity economy makes the level of economic cooperation and professional division of labor constantly improve. In the face of numerous consumer groups, manufacturers should not only produce or provide products and services to meet the needs of the market, but also quickly deliver products and services to target consumers at an appropriate cost. POP MART has both online and offline marketing. Offline marketing for POP

MART has retail stores and roboshops. The retail stores are mainly located in the core business circles of first and second-tier cities. Retail stores aim to grab fans, experience new products, enhance the shopping experience and expand brand awareness. With an initially low investment cost and high operation efficiency, the roboshops have functions like a strong penetration of the second-tier cities and location mobility. Online marketing of Pop Mart includes Pop Draw (WeChat mini program), Tmall flagship store, JD.com flagship store, PAQU and other online channels. In particular, the popularity of Pop Draw increased by 92.6% from 2020 to 2021 Annual Report (2020). With the help of Pop Draw, the "selection-payment-unpacking" step can be restored online, shortening the user's purchase process. The PAQU app provides an online platform for blind box lovers, where people can get the latest information about blind boxes, communicate unpacking and changing experiences, and do second-hand selling.

3.2 W-Weakness

Single Product Portfolio. As the art toy market continues to increase, the blind box is more of a commercial model than a fixed product. Most revenue of POP MART comes from sales of blind boxes but blind boxes are not exclusive to POP MART. As the novelty of blind boxes wears off, the strength of blind box sales will also fade. Compared with the most successful IP company-Disney, the composition of its revenue includes film or TV entertainment, media networks, parks and consumer goods. Disney continues to establish the layout of the whole industry chain and to maximize it commercial value. Single product portfolio has the poor ability to resist risks and if the industry profits decline and competition deteriorates, it will cause a short period of capital chain rupture. The market cycle of products is unstable due to consumers' fatigue of using similar products. POP MART are becoming less competitive with the appearance of other blind box competitors like 52 Toys and MINISO.

Lack of IPs' Contents. The core competitiveness of POP MART is the IP training system. The threshold of blind box development is low but the incubation period is a long-term process. Most blind box companies just satisfy consumers' needs for facial attractiveness same as POP MART's popular IPs. Those characteristics lack the support of story and culture and are only image selling. The extension of the vitality of IP products needs the support of IP content, which can easily connect the relationship with customers and make them sympathize.

3.3 O-Opportunity

Developing Art Toys Market. The market scale of the global art toy industry is expanding day by day. Influenced by social and emotional needs, the popularity of Chinese art toys is rising. It can be predicted that the scale of China's fashion game market will continue to expand. According to the research, the proportion of Chinese art toy market in the global market scale increased from 11.18% in 2017 to 19.74% in 2020, and it is expected to reach 23.03% in 2023 Qi and Jie (2022). Blind box economy will take advantage of the art toy market and gradually develop into one of the core markets of global blind box consumption.

Potential Male Consumers. More than 60% of male consumers buy hand-made products, while only 37.4% buy blind boxes. It is expected that in the next five years, the blind box economy will gradually favour males, and the penetration rate of the male group will increase too, which will further promote the sustainable development of the blind box economy Qi and Jie (2022).

3.4 T-Threat

Risk of Losing Consumers. According to the data, more than 30% of Chinese netizen think the blind box is not practical and more than 20% of them think the price is unreasonable Qi and Jie (2022). Consumers' favour of IP is random with low brand loyalty. Once the market dividend subsides, there will be a risk of consumer loss. At the same time, the more customers buy, the greater the opportunity for customers to buy again, which means that in the whole collection process, the unpacking experience will be worse and worse.

Fierce Competition. China's blind box economy keeps rising, and blind box companies are also expanding, considerably but at present, the blind box industry and the market pattern are uncertain. The high-profit margin of blind boxes attracts more and more enterprises to enter the competition track. POP MART now has powerful competitors like 52 Toys, Dream, MedicomToy and MINISO Shi (2022). For instance, TOPTOY is an independent sub-brand of MINISO, the top retail company. Now it has launched TOPTOY mini-program, and later launch the platform mall and exhibitions in 2021. MINISO currently has 1, 697 overseas stores, covering more than 90 countries, which provides a great opportunity for TOPTOY's further expansion. The price of its blind boxes is relatively cheaper than others, so in the blind box industry, it has price advantages.

4 The Application of Consumer Psychology on the Blind Box Economy

4.1 Gambler Effect

Living in an era of material affluence, young consumers lack self-control, and the blind box economic model perfectly uses the mechanism of gambling to trigger young consumers' addictive psychology. Blind box consumption can be considered an act of gambling. The goal of purchasing blind boxes is to get the hidden style, but the probability of drawing the hidden one is only 0.69% Xinyue (2019). Consumers are over-confident and hope to turn a low probability event into a high one. Gamblers who lose money are more likely to invest more money in the casino than gamblers who win money. This is because people are willing to take risks have failed and they always want to win back what they lost, when they are failed and they always want to win what they lost but they just always lose more and form a negative investment. When blind box consumers have spent part of their time and money on blind boxes and the hidden style is not received, they will have a loss aversion. They think they have invested too much. If they stop, the previous investment will be meaningless. However, if they continue, the previous investment may be compensated Dongjian (2020).

4.2 Hunger Marketing

Hunger marketing refers to the marketing strategy that the supplier decreases the output to control the supply and demand relationship and then creates the "illusion" that demand exceeds supply Zhang (2021). Consumers always think rare things are worth more so the supplier can maintain the product image and high price. Hunger marketing is widely used in sales such as 'limited products', 'seckill', and 'long queues in front of stores', etc. The probability of getting the hidden style is almost zero so the scarcity causes the high value of it and at the same time the huge profit drives people to continue investing. For instance, POP MART published 3000 sets of MEGA collection series Space Molly × Spongebob co-branded by lottery sales, and more than 1 million people participated. Toys are sold out in a second and a toy with previous price-4999 yuan was fired to 80,000 yuan. When demand exceeds supply, the price flies and finally, the company can earn considerable profit.

4.3 Conformity and Comparison Psychology

Young consumers will take the popular products on the market as the optimal choice for their consumption, but their consumption standards may not be accurate. Therefore, they are easily influenced by information on social media, which leads to a great degree of conformity. The blind box companies put a large amount of information, and videos into various media channels so now the publicity of blind boxes is covered both online and offline. When young consumers see lots of people all recommending and sharing their unboxing experiences, they will be influenced by the conformity and begin to purchase Chenxue (2021). When consumers see someone around them have the hidden one, the comparison psychology will push them to buy for the inner sense of achievement. The comparison psychology makes the blind box a symbol of wealth, lifestyle and even luck, thus inducing more consumption.

5 Discussion

According to the SWOT analysis of POP MART and its application of consumer psychology, we can conclude that POP MART is still in a rapidly developing stage. Now, blind boxes are not just those toys but also food, stationary, pets, air tickets, and so on. With the development of the Internet, the blind box economy has to cooperate with the Internet to achieve sales goals and expand markets. Under the promotion of China's blind box industry, which successfully entered the peak of development, consumer groups also became stable. With the blind box economy hot, the phenomenon of brand-vicious competition gushed out. Faced with problems, major blind box brands need to adjust their strategy and fully consider their future development direction. Companies can promote the derivatives of blind boxes and IPs and make the structures of companies more stable and diverse or enrich the diversity of IP to gradually expand the blind box consumer group. Relative departments should strengthen the supervision of the blind box market and standardize the commercialization level of the blind box market. China's blind box industry will continue developing and account for a large portion of the global market.

6 Conclusion

The blind box economy is a popular topic in society and there are many mysteries about both marketing and consumer psychology under it. According to the development tendency, China's blind box(art toy) market still has a large space to develop. POP MART now has a completed service chain, a strong IP system and various selling channels including online programs, offline stores and roboshops but it still faces

problems like the lack of IP content, the risk of losing consumers and fierce competition. The fast growth of the blind box economy largely depends on consumers' irrational consumption. The application of the gambler effect, hunger marketing, conformity, comparison psychology plays an important role in the development. Even though the blind box economy is growing so fast in China, many problems have been revealed in recent years; the second-hand market of blind boxes is crazy; the quality of blind boxes is bad; blind boxes are not useful in daily life. If the blind box economy wants to be standardized, the government has to improve laws and regulations and intervene in the supervision. China's blind box economy will attribute a lot to both China and the global economy in the future. The major limitation of the present article is that the most analysis is based on existing literature and data, without the author's own survey. In the future, the author will combine specific market research and consumer surveys for more in-depth data analysis.

References

"Annual Report 2020." Popmart Global. https://global.popmart.com/blogs/result-and-reports/annual-report-2020

Chen X (2021) Research on blind boxes consumers—taking pop mart as an example. In: 2021 International conference on economic development and business culture (ICEDBC 2021). Atlantis Press, pp 21–26

Chenxue B (2021) Explore the young consumer psychology behind. "Blind Box Economy." Popular Psychol 9:2

Dongjian Y (2020) The application of addiction model in blind box marketing. Model. Economy Manage Digest

Helms MM, Nixon J (2010) Exploring SWOT analysis–where are we now? A review of academic research from the last decade. J Strategy Manage

Jiahui G, Chen R (2022) Understanding consumer behaviors of generation Z under China's blind box economy: case company: POP MART

Qi W, Jie L (2022) A brief analysis of the development prospect of China's blind box industry—from a case study of pop mart company. Mod Bus

Shi Y (2022) POP MART, who runs a "Mental Account." Manager

Xinyue H (2019) The mystery of blind box economy from the perspective of behavioural economics. Business Newsletter

Zhang Z (2021) Research on blind box and its marketing strategy. In: 2021 International conference on economic development and business culture (ICEDBC 2021). Atlantis Press pp 115–118

Analysis of How Investors Use Ratios to Pick Stocks Using Three Sample Stocks from the Financial Sector

Xinyu Wang

Abstract This research displays how investors should analyze and compare stocks using different investing strategies. Previous studies explained the theory behind some of the most popular investing strategies, such as value investing, growth investing, index investing, and momentum investing. Some key information that the studies mention include the P/E ratio, the P/B ratio, the PEG ratio, et cetera. This research uses the analysis of three sample stocks to create a more simple picture for investors on how to pick, evaluate, compare, and rank stocks. The results of the research show that UnitedHealth Group Incorporated has the least risk and is more profitable compared with Bank of America Corporation and JPMorgan Chase and Co. Value investors would be interested in Bank of America and JPMorgan Chase, while momentum investors would consider UnitedHealth Group. Moreover, growth investors and index investors might consider all the stocks, and so on. The research recommends to investors that stocks should only be compared if they come from the same sector, and stocks can be ranked differently based on different aspects.

Keywords Investing strategies · Financial ratios · Stock analysis

1 Introduction

1.1 Background

The stock market gained its popularity a long time ago, and it is still attracting more investors to join. As more and more people get familiar with the stock market, they start to realize the importance of having investing strategies instead of just picking random stocks. Even though different investors utilize different investing strategies and invest differently, they all have the same goal: to gain more returns. Data and

X. Wang (✉)
College of Arts and Sciences, Boston University, Boston, MA, USA
e-mail: wxy1113@bu.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_19

ratios about the companies are the most significant information that tells investors more about the stock. Therefore, knowing how to measure and analyze these data and ratios are important skills that investors, especially those that want to invest with purpose and to gain more returns, should be capable of. Stocks could be analyzed from different perspectives, for example, risks and profitabilities. These pieces of information also tell investors which stocks they should buy and which stocks they should sell.

1.2 Related Research

Moore highlights that P/E ratios (price-earnings ratios) and P/B ratios (price-to-book ratios) are significant in value investing strategy. Specifically, trailing-four-quarter P/E ratios are better at predicting stock return variations. The trading volume of stocks that have lower P/E ratios increases because they grab individual value investors' attention, and the investors are likely to ignore the other stocks. Value stocks with lower P/E ratios correlate with higher average returns (Moore 2020). Easton emphasizes that PEG ratios (P/E ratios divided by the current growth rate) are improved versions of P/E ratios. Easton also created a model that is able to make better predictions on the rate of return and rate of change for the long run. The model helps rank stocks using the PEG ratio because a higher PEG ratio indicates a lower return rate is expected. The model also is capable of providing information that stocks with PEG ratios equal to 1 are relatively priced (Easton 2004). Trombley is also trying to emphasize that PEG ratios are significant in stock analysis and selection. However, Trombley believes that when analyzing or ranking stocks, the PEG ratio works better when comparing stocks within the same industry. Because it is suggested that the growth rate should be approximately equal to the PE ratio, a standard PEG ratio should be 1.0. A relatively high PEG ratio suggests that the stock is overpriced, whereas a relatively low PEG ratio suggests that the stock is underpriced (Trombley 2008).

Kwag and Whi conclude that the foundation of value investing is to invest in stocks that are undervalued. Stock selection of value investing strategies is based on information like book-to-market ratios, earrings-to-price ratios, cash flow-to-price ratios, and dividend yields. Kwag and Whi point out that value investing strategy became one of the most favored and successful investing methods. There is strong evidence that value investing brings higher returns to the investors and is less risky than growth investing (Kwag and Whi 2006). Asness et al. demonstrate that value investing strategies have long histories, but they still confuse investors at the present time. Asness et al. also believe that the measurement of value is based on different information and different ratios. Profitability plays a significant role in identifying if the stock is underpriced and is expected to have higher future returns. Momentum can also be connected to value investing strategies, and sometimes it is more effective when combining the two (Asness et al. 2015). Damodaran highlights that investors following growth investing strategies focus on how the market values the company's

growth potential. Just like value investors, growth investors care about the value of the stock as well. One main difference between growth investors and value investors is that value investors try to find undervalued stocks and prefer to invest in mature companies that already have a significant amount of assets. In contrast, growth investors analyze the value of the growth and prefer to invest in growth stocks that are relatively cheaper (Damodaran 2012). Penman and Reggiani explain that value investing generates higher returns on average compared with growth investing, and it is considered to be less risky. However, a phenomenon called the "value trap" is a risk that underlies value investing. "Value trap" refers to the situation when stocks seem cheap and are expected to grow less but surprisingly have high growth potential and become risky (Penman and Reggiani 2018). Coles et al. state that the total amount of global capital committed to index investing strategies increased by approximately ten trillion dollars. They found out that index investing impacts the behaviors of investors and the activity of the stock price. The study shows that as the amount of index investing increases, the share turnovers of stocks increases, short interest increases, and the correlation with index price movement increases (Coles et al. 2022). Asness et al. explain that momentum is a phenomenon in which securities that have been performing well compared with other securities continue to perform well. In contrast, securities that have been performing relatively poorly continue to perform poorly. Asness et al. do not deny that momentum investing had several dark times in history. However, they also don't agree that momentum investing is too volatile and that returns are too small.

Viale et al. emphasize the difference between financial firms and non-financial firms and how they should be analyzed differently. For example, financial firms' equity returns and non-financial firms' equity returns cannot be compared together because financial firms usually have high leverage, which is typical for them but might have different meanings for non-financial firms. The writers also highlight some critical risk factors in analyzing financial firms. Qu did some research on the stock price of Bank of America. From 2007 to 2014, Bank of America had a relatively stable stock price. This is because Bank of America is large enough and important enough in people's daily lives. Using the Poisson distribution, Qu found out that Bank of America's daily trading volume is massive. After using the Heston model, Bank of America appears to be a good stock to invest. Liu highlights that factors like low-interest rates and higher risk on investment have resulted in changes in investment. Liu analyzed the performance of JPMorgan Chase and made a comparison with Monks and Witan. Data and ratios tell Liu that JPMorgan Chase has more minor fluctuations in average daily returns, which indicates it is less risky. However, unsystematic risk affects JPMorgan Chase the most. Overall, JPMorgan Chase is an ideal stock to invest.

1.3 Objective

In this research, different investing strategies will be introduced, and how these investing strategies work will be analyzed. The structure of the research is as follows. Firstly, some significant ratios and investors that utilize these ratios are defined. Then three sample stocks, all from the financial sector, are analyzed. Lastly, the research points out investors that will be interested in the three stocks. Overall, this research helps investors find a strategy that they prefer and methods of comparing and ranking stocks.

2 Ratios and Investors

In simple terms, value investing strategies is when investor buy stocks that are cheap and underpriced, then sell the stock when the price goes up; growth investing strategies is when investors buy stocks that are currently growing fast and are expected to grow more. Certainly, even though value investing strategies and growth investing strategies are some of the most popular investing strategies, there are some other investment strategies that will be mentioned in this research. Different ratios help investors rank and select stocks.

2.1 The P/E Ratio and Value Investors

P/E ratio, also known as the price-earning ratio, is computed by the market value price per share divided by the company's earnings per share. P/E ratio tells investors how cheap or how expensive the stock is. As Kwag and Whi concluded, the foundation of value investing strategies is to invest in stocks that are cheaper than their true value (Kwag and Whi 2006). This explains why Moore would say that the P/E ratio plays an important role in value investing strategies (Moore 2020). A lower P/E ratio indicates that the stock price is relatively low and possibly undervalued, attracting value investors to invest in these stocks. On the other hand, a higher P/E ratio indicates that the stock price is relatively high and possibly overvalued. Value investors should stay away from these stocks.

2.2 The PEG Ratio and Growth Investors

PEG ratio, calculated by dividing the price-earning ratio by the growth rate, as Easton mentioned in his research, is an improved version of the P/E ratio that provides more information (Easton 2004). Because growth rate is a component of the PEG ratio,

it makes the PEG ratio a significant ratio for growth investors in evaluating stocks. Growth investors like to invest in stocks that are growing at a relatively faster rate. If the PEG ratio is smaller than 1, it means that the stock's growth rate is higher enough for the growth investors to consider it. Otherwise, if the PEG ratio is greater than 1, it indicates that the stock is not growing fast enough, and growth investors will not consider the stock.

Subsequent paragraphs, however, are indented.

2.3 Other Ratios and Investors

Other than the P/E ratio and the PEG ratio, some ratios and information also help investors with different strategies. Index investing is a strategy in that investors try to match the market, not beat the market. Index investors barely buy individual stocks because they are betting on an entire country instead of betting on one company. Momentum investing is an investing strategy of buying stocks or securities that have had higher returns and outperformed other stocks over a short period of time and selling stocks that have had lower returns and underperformed other stocks.

3 Analysis on Sample Stocks

Viale et al.'s research emphasizes that it is important to compare stocks from the same category because all the stocks from the same category might have features that vary from stocks from different categories (Coles et al. 2022). Therefore, this paper picked three stocks that are all from the financial category: Bank of America Corporation, JPMorgan Chase & Co., and UnitedHealth Group Incorporated. The three stocks will be analyzed, compared, and ranked from different perspectives. All the information is captured from the newest data provided, which helps minimize the effect of Covid-19.

3.1 Brief Introduction

Bank of America Corporation and JPMorgan Chase & Co. both are financial institutions providing people products and services like banking, investing, and asset management. JPMorgan Chase & Co. is the largest bank in the United States, and Bank of America Corporation is the second-largest bank in the United States. UnitedHealth Group Incorporated provides health care products and insurance services, and it is the largest health insurance provider in the United States.

Table 1 Risk factors (2022.06.02)

	Bank of America	JPMorgan Chase	UnitedHealth Group
Market cap	$254.275B	$334.97B	$450.623B
Beta	1.39	1.11	0.83
Debt/equity ratio	1.138	1.227	0.6527

3.2 Risk

Table 1 presents data from the risk perspective. All three stocks have market caps that are large enough to be classified as large-cap stocks, so from a size perspective on risk, they are all the same. Beta measures the volatility of the stock. Bank of America has the highest beta, and UnitedHealth Group has the smaller beta. This shows that Bank of America is the riskiest in terms of stock market risk, and UnitedHealth Group is the least risky. The debt/equity ratio is computed by dividing the company's total liabilities by the company's total shareholder equity. This ratio is a measurement of the firm's financial leverage. JPMorgan Chase's highest debt to equity ratio suggests that a large amount of its potential growth is generated through borrowing, so JPMorgan Chase is the riskiest from a leverage perspective. On the contrary, UnitedHealth Group is the least risky. To sum up, UnitedHealth Group has the least risks.

3.3 Profitability

Table 2 presents data from the profitability perspective. Profit margin is a commonly used ratio that helps measure a company's profits relative to its revenue. Bank of America and JPMorgan Chase have higher profit margins than UnitedHealth Group. ROA (return on assets) is a ratio that tells investors how fast the company is growing its assets, and ROE (return on equity) is a ratio that tells investors how profitable a company is from a shareholders' viewpoint. UnitedHealth Group is the strongest from a ROA and ROE perspective, meaning that it's growing its assets the fastest, and it is more profitable from a shareholders' viewpoint compared with the banks. In summary, UnitedHealth Group is more profitable than Bank of America and JPMorgan Chase.

4 Investors that Would Invest in the Stocks

Table 3 presents data that shows how different investors will be interested in the stocks. Index investors would probably invest in all three stocks because they are

Table 2 Profitability factors (2022.03.31)

	Bank of America (%)	JPMorgan Chase (%)	UnitedHealth Group (%)
Profit margin	32.84	33.61	5.86
ROA	0.95	1.07	8.15
ROE	10.90	14.01	23.54

Table 3 Significant ratios and other data (2022.06.02)

	Bank of America	JPMorgan Chase	UnitedHealth Group
P/E	8.99	8.45	25.52
P/B	0.97	1.34	6.03
PEG	1.33	1.68	1.73
Momentum	No	No	Yes
Dividend yield (%)	2.66	3.47	1.35
Insider buyings	No	No	No
Stock buybacks	Yes	No	No

just buying the index, so they don't mind if the stock is underpriced or overpriced as long as the whole country or sector is doing well. The P/E ratios (price-earnings ratios) measure how much the companies are worth, and the P/B ratios (price-to-book ratios) measure the market's valuation of the companies relative to their book value. Value investors would consider Bank of America and JPMorgan Chase because their P/E ratios are smaller than 10, and their P/B ratios are under 2, meaning that the two stocks are cheap enough. The PEG ratios show how fast the stocks are growing. Conservative growth investors might invest in all three stocks because all the PEG ratios are fairly low.

For the "Momentum" row, a "Yes" means that the current stock price is higher than the 200-day moving average price, and a "No" means that the current stock price is smaller than the 200-day moving average price. Therefore, momentum investors would be interested in UnitedHealth Group because the stock is currently outperforming other stocks. Dividend yields display the percentage of the stocks' current price that is paired to shareholders. Dividend yield investors would be interested in JPMorgan Chase because its dividend yield is greater than 3 percent. These investors might also consider Bank of America since interest rates are very low around the world. The "Insider Buyings" row tells whether the companies experienced insider buyings within the past six months, and the "Stock Buybacks" row tells whether the amount of stock buybacks within the past six months is greater than 5 percent of the companies' worth. Investors who follow insider buyings and stock buybacks would invest in Bank of America.

5 Conclusion

In this research, some of the popular investing strategies are introduced, including value investing, growth investing and et cetera. The research also explains why some data and ratios, such as the P/B ratio and the PEG ratio, are significant for different investing strategies. Based on the analysis of Bank of America Corporation, JPMorgan Chase & Co., and UnitedHealth Group Incorporated, all three stocks can be favorable to investors with different investing strategies. This research recommends to investors that stocks can be analyzed, compared, and ranked based on different perspectives, and having an investing strategy is better than following the trends.

References

Asness C, Frazzini A, Israel R, Moskowitz T (2015) Fact, fiction, and value investing. The Journal of Portfolio Management 41(1):34–52. https://doi.org/10.3905/jpm.2015.42.1.034

Coles JL, Heath D, Ringgenberg MC (2022) On index investing. J Financ Econ 145(3):665–683. https://doi.org/10.1016/j.jfineco.2022.05.007

Damodaran A (2012) Growth investing: betting on the future?

Easton PD (2004) Expected rate of return on equity capital. Account Rev 79(1):73–95. https://doi.org/10.2308/accr.2004.79.1.73

Kwag S, Whi S (2006) Value investing and the business cycle. J Financ Planning-Denver 19(1):64

Moore J (2020) Glamour among value: P/E ratios and value investor attention. Financ Manage 49(3):673–706. https://doi.org/10.1111/fima.12281

Penman S, Reggiani F (2018) Fundamentals of value versus growth investing and an explanation for the value trap. Financ Anal J 74(4):103–119. https://doi.org/10.2469/faj.v74.n4.6

Trombley MA (2008) Understanding the PEG ratio. J Invest 17(1):22–25. https://doi.org/10.3905/joi.2008.701953

Analysis of Social Media Marketing Strategy: The Case Study of China and the US

Nuqian Tang

Abstract Different countries have distinct social media platforms to conduct marketing strategies. In the United States, there are mainly 4 ways of social media advertising: Facebook, Instagram, Twitter, and LinkedIn, to meet customers' demands in various fields. On the other hand, in China, Little Red Book (Xiaohongshu), TikTok (Douyin), WeChat, and Zhihu have served as leading advertising roles recently. Overall, both countries' social media marketing approaches are similar but with little difference. In general, firms use social media to perform business actions because they can increase brand awareness, grow revenue, and increase mentions in the press. Targeting the right audiences share personalized advertisements at the right time. Companies have the chance to develop further in the future.

Keywords Social media · Marketing strategies · China · United States

1 Introduction

In the world, there are 4.62 billion people who use social media. We cannot negate the effect of social media advertisements because there will indeed be many reaches. Companies' sales will steadily increase when attracting more customers on social media. China and the US have unique social media platforms to conduct marketing strategies to help companies to improve their brand awareness and product sales; however, their marketing methods will include their domestic businesses, but are not limited to these because all platforms help international businesses also.

Facebook uses seven marketing steps: setting goals, knowing the audience, engaging proactively, scheduling content, determining strategies, encouraging employees, and tracking & analyzing results. Companies on Instagram create a relevant and interesting range of their products, reach the target audience, interact with

N. Tang (✉)
College of Letters and Science, University of Wisconsin-Madison, Madison, WI 53703, USA
e-mail: ntang29@wisc.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_20

customers, and check progress regularly to ensure efficient advertising. Running audits, using hashtags, engaging with users, and finding voices are methods for Twitter marketing. In LinkedIn, the social media strategy will be sharing helpful information, perfecting company pages, interacting with users, and buying ads. Little Red books mainly have two marketing types: selling through official accounts and selling through Red Mall. Companies on TikTok create exciting videos and advertisements to reach their target audience. WeChat has 5 steps to help companies succeed in marketing their products: competitor analysis, target audience definition, WeChat official account type selection, WeChat marketing tools picking, and WeChat promotion & advertising. Zhihu not only works with Key Opinion Leaders (KOL) like other social media marketing strategies in China, but also uses pop-up advertisements, newsfeed advertisements, and display advertisements to increase sales (ByLorenzoBrizzo et al. 2022). Firms use social media to perform business actions because they can increase brand awareness, grow revenue, and increase mentions in the press (Lua 2021).

This research paper mainly uses data collection and an observational approach to study social media marketing strategies in China vs in the United States.

2 Social Media Marketing Strategies in the US

2.1 Facebook

Facebook is owned by Meta Platforms, an American company, which is an online social media and networking social service. Mark Zuckerberg, Eduardo Saverin, Andrew McCollum, Dustin Moskovitz, and Chris Hughes founded Facebook in 2004. They pick its name from the face book directories often given to American university students. Facebook users were limited to Harvard students at first; later in 2006, anyone over 13 years old was able to use it. In 2010, Facebook became the most downloaded mobile application. In 2020, Facebook had 2.8 billion monthly active users, ranking fourth in internet usage worldwide.

According to the enormous number of users, Facebook meets the requirements of being an excellent social media marketing place for multiple companies. There are seven marketing steps on Facebook: setting goals, knowing the audience, engaging proactively, scheduling content, determining strategies, encouraging employees, and tracking & analyzing results (Chen 2022). To start with, companies need to set specific goals of what they want to do. In the 2018 Sprout Social Index, 34% of people who use Facebook to advertise wished to increase their brand awareness; 21% wanted to increase community engagement; and 11% wanted to increase sales and lead generation. Secondly, knowing who is one company's target audience enables that company to determine which Facebook marketing methods it should conduct. Like other social media, the third step is communicating and networking with customers because Facebook serves well as a communication platform to increase engagement.

In addition, on Facebook, there are many content creation and curation options: from stories to status to group posts. From the 2018 Sprout Social Index, customers indicated the content types that they wanted brands to use, which were 30% linking to more information, 18% of graphics and images, 17% of produced video, 11% of text and conversations, and 7% of produced or edited photos.

Furthermore, advertising on Facebook is simple but not easy because companies need to pick the right advertisement strategies for themselves. Focusing on two points: cost effective and relevant is helpful for firms to select the accurate and creative content on Facebook ads campaigns. One thing to remember is always to keep Facebook ads fresh. The sixth step is to encourage employee advocacy because 72% of people reported feeling positive and connected with one brand when they were able to see the company's employees post something related to that brand on social media. With this element, one brand will succeed easily. The last step of Facebook marketing strategies is to keep an eye on the results: fan growth and how Facebook content is performing. Overall, Facebook is an efficient way of advertising products.

2.2 Instagram

Instagram is owned by Meta, which is a photo and video sharing social networking service founded in 2010 by Kevin Systrom and Mike Krieger. This application allows users to upload media that can be edited with filters and organized by hashtags and geographical tagging. In 2021, there were 1.21 billion active monthly users on Instagram.

To set up an advertising account on Instagram, people should switch to a business account and pick a photo or video for the ads. Like Facebook, people should find the target location, audience, budget and duration. When the advertisement is ready, via tapping "Create Promotion", people will be notified when your ad is approved and ready to run. More specifically, companies should create content that favors audiences such as exciting photos, videos, and customers' real feedback to increase their followers. In addition, a couple of posts with the right hashtags is also vital because this will help companies to send the correct information to their target audiences. Although the hashtag upper limit is 30, companies should follow the "less is more" rule.

Establishing brands' website links on Instagram, posting advertisements regularly at the right time, and interacting with customers is significant for succeeding and increasing sales on Instagram. According to the data from Sprout Social, the highest engagement time globally on Instagram is 5–6 a.m. on Thursday and Friday, around 11 a.m. on Thursday, around 3 p.m. on both Wednesday and Thursday, and about 4 p.m. on Thursday (Barnhart 2019). Thus, companies should post advertisements on Thursday because many people view Instagram on that day. Catching the chances and sharing stories is what companies need to learn. The last thing to mention is to show the latest and different products through posts at distinct periods, which helps

people to follow the news of one brand. Many customers like to comment on their ideas and questions under one position, and the brand needs to answer and appreciate the feedback.

2.3 Twitter

Twitter, Inc., founded on March 21, 2006 by Jack Dorsey, Biz Stone, Evan Williams, and Noah Glass, is an American communications company based in San Francisco, California, which operates the microblogging and social networking service Twitter; Vine short video app and Periscope live streaming service were their previous businesses. It has a website: twitter.com with 69.3 million active users in 2021.

There are 8 steps to creating marketing strategies for brands on Twitter. The first step is to run a Twitter audit to distinguish what is working and what is not working on the Twitter profile (Twitter Marketing: The Only Guide You Need to Succeed 2022). Through this check, companies can find out what posts the audience is most interested in, which helps the company decide on the content they will post in the future. The second step is to find a Twitter voice. Although unlike Facebook and LinkedIn, Twitter's posts can be more playful and casual, positions still need to be consistent and authentic with the brand voice. Thus, an engaging brand voice is vital to appeal to more customers. The third step is to use Twitter hashtags and trends because this will help the brand double the engagement. The fourth step is to utilize Twitter advertisements. Using paid ads will be more direct than non-paid ads because promoted tweets will expand and reach the audience quickly and do not need to wait for organic reach. The significant difference between paid and no-paid ads is that users will see the "paid ads" mark on the Tweets. In addition, like on Facebook and Instagram, finding the right time to tweet will increase the brands' popularity. According to the Sprout Social data, the highest engagement time on Twitter will be 9 am to 12 p.m. on Tuesday, from 9 a.m. to 3 p.m. on Wednesday, from 9 to 11 a.m. on Thursday, and 9 a.m. to 11 a.m. on Friday.

Furthermore, scheduling tweets ahead of time will make sure the maximum reach. The seventh step of Twitter's marketing strategy is to interact with the audience; like on Facebook and Instagram, encouraging customers to comment and message under the brand posts is vital because this action boosts engagement. The last step will be setting measurable goals to ensure everything about the advertisements is on track so companies can keep or change their marketing strategies efficiently.

2.4 LinkedIn

LinkedIn (functioning via both website and mobile application), an American business and employment-oriented online service, was founded in 2002 by Reid Hoffman, Konstantin Guericke, Eric Ly, Jean-Luc Vaillant, and Allen Blue in Mountain View,

CA. This professional networking and career development platform allow job seekers to post their educational and professional experiences and employers to post hiring opportunities. In 2021, it had 774.61 million active users. Although it might not have as much attention as Facebook and Instagram, as a favored network platform for business, it still serves a vital role for firms operating in the B2B sector. 40% of its members visit LinkedIn every day.

There are 9 steps to craft the perfect LinkedIn marketing strategy. The first step is to set the marketing goals which are expected to be specific, measurable, achievable, realistic, and timely such as increasing brand awareness, building leads, engaging with the target audience, and selling products (Geyser 2021). The second step is to know the audience through their taste, interests, and what they describe on their LinkedIn pages, ensuring that the company advertises to the target audience. Thirdly, perfecting the company page by telling positive stories attracts customers more. Fourthly, when the company gets the chance to promote a brand, it should take the chance because if more people become followers, it is easier for companies to sell products. In addition, creating and sharing helpful content enables people to remember one company. The sixth step is to use various forms in the content.

Furthermore, people must be active on LinkedIn to communicate with their target audience efficiently. Plus, buying ads is also an efficient advertising approach. Finally, like other social media, companies cannot neglect the importance of checking progress regularly because it ensures that everything is on track.

3 Social Media Marketing Strategies in China

3.1 Little Red Book/Xiaohongshu

Xiaohongshu (Little Red Book), founded in June 2013 by Charlwin Mao Wenchao and Miranda Qu Fang, is a social media and e-commerce platform described as "China's answer to Instagram." As of 2019, it had over 300 million registered users. In 2001, this company had over 100 million monthly active users. Plus, the female users reached 90.41% of total users in Little Red Book in 2021. Xiaohongshu serves as an online shopping guide by providing customers with real experiences, which helps people to choose the right products for themselves. Not only has Xiaohongshu local business in China, but also this platform creates Red Mall for selling international products and brands such as Gucci to customers.

To be specific about marketing strategies in Xiaohongshu, there are two types: selling through accounts and selling through Red Mall (AdChina.io.: A Brand's Guide to Selling on Xiaohongshu in China 2022). If companies want to sell through Red Mall, they need to register in Xiaohongshu enterprise's system and provide company information: financial status, company overview, and brand qualification. After submitting information, staff in Xiaohongshu will review the application and let companies sign contracts and complete professional training. After all these steps,

companies are authorized to sell products. On the other hand, companies want to sell through an official account. The first step is to open a brand account. Secondly, reaching out to KOL, Key Opinion Leaders, helps companies to increase their popularity. In addition, companies need to invest in Xiaohongshu advertising to reach more target audiences. Following all these steps, companies' sales will generally increase.

3.2 TikTok/Douyin

TikTok (Douyin in China), founded in September 2016, is a short-form video hosting service owned by Chinese company Byte Dance, which consists of a variety of short-form user videos such as pranks, stunts, tricks, jokes, dance, and entertaining content around 15 s to ten minutes. TikTok in 2021 had 1 billion users and is expected to have 1.8 billion users at the end of 2022.

Due to the large size of users, succeeding in marketing on TikTok will be helpful for the company's sales. The first step of advertising products is using accurate hashtags and following TikTok's current trend to produce videos viewers like to watch (Geyser 2021). Be careful on video length and clear description, people should essentially maximize the vital information about products included in one video. Setting hashtag challenges is also an effective way of getting more attention and fitting the advertisements under the right Effects tab, which are Trending, New, Interactive, Editing, Beauty, Funny, World, and Animal categories. Because TikTok has a personalized video selection, it is easy for the target audience to see the advertisements that companies want them to see through different types. In addition, incorporating TikTok influencers in campaigns and posting regularly and frequently attract more followers. When one company gets the customers' attention under one post, that company should encourage users to comment their opinions under the post so that everyone can see it. Increasing interaction between customers and one brand boosts the selling of products. The last thing to mention is blending in branded content. One company cannot always advertise their products and must keep producing interesting content to grab users' attention. With a certain amount of followers, they can post some advertisements regularly.

3.3 Zhihu

Zhihu, founded by Yuan Zhou, Shenshen Li, and Jixin Huang in Chengdu, Sichuan, Mainland China, is a question-and-answer website where questions are created, answered, edited and organized by the community of its users. On January 26, 2011, its website, zhihu.com, was created. According to the latest data, there are about 6.9 million monthly active users in Zhihu. It has over 120 million answers, forming the largest knowledge-sharing community in China. Previously to advertise on Zhihu,

forming a positive brand image is essential. By opening a Zhihu enterprise account, the company needs to answer actively, ask questions, and post articles & feeds.

Due to knowledge sharing purposes on Zhihu, the company should advertise its products and produce professional learning materials for users to acquire knowledge. Diving into advertising, marketing strategies on Zhihu are similar to other social media. Working with KOL is significant because this enables the company to increase its credibility and reach (Wan and Wan 2019). Knowing whether the selected KOLs will work for advertising or not, is indispensable for companies to focus on the KOLs' image, audience, expertise, engagement rates, and several followers. Furthermore, Zhihu has three advertising packages: pop-up advertisements, newsfeed advertisements, and display advertisements (AdChina.io. 2022). Adding a "click here" button on pop-up advertisements will grab users' attention and attract some users. Although this strategy hurts the western world, it is popular in China. Newsfeed advertisements provide detailed descriptions and are more accepted by users. Display advertisements are shown on the internal search pages, which boost the viewership efficiently. When advertising products, companies should choose the most suitable types for themselves.

3.4 WeChat

WeChat, founded in 2011 in China, is an instant messaging, social media, and mobile payment app developed by Tencent, which became the world's largest standalone mobile app in 2018. According to the latest data in 2022, WeChat has over 1.28 billion monthly active users. Plus, this application is available in 17 different languages. WeChat is essential for everyday business, especially in China, because around 80% of Chinese use this application. When users are unable to find companies' information and get their company related questions to be answered through Google or LinkedIn, they would love to search and understand some information through WeChat because many authorized companies will post their information through WeChat Official Accounts, and users know this information is accurate due to business licenses checking system in WeChat.

There are 5 steps to a successful company's market: competitor analysis, target audience definition, WeChat official account type selection, WeChat marketing tools picking, and WeChat promotion & advertising (DeGennaro and DeGennaro 2019). The first step is vital because a company can avoid competitors' mistakes through competitor analysis to develop a more profound and accurate marketing strategy. The second step looks easy, but the truth is that defining the target audience will be very difficult due to the large population; thus, some companies will work with market research or consulting firms to get a clear idea. The third step is to select an official account type between a service account or a subscription account. Most businesses will choose a service account because this enables companies to own many advanced tools; however, service accounts are only allowed to post 4 times per month, containing up to 6 pieces of content each post. Brands with the demand

for posting contents, running frequent sales, or unrequiring the advanced functions provided by service accounts choose to work with subscription accounts. The fourth step is to conduct the right marketing tools: WeChat Customer Relationship Management (CRMs), Social Media Listening (SML) and Social Media Monitoring, and The WeChat Index. Each serves vital functions for marketing. The last step will be the promotion part. KOL is the most efficient strategy to increase sales. In addition, WeChat group and WeMedia content syndication boost the engagement between customers and brands. Plus, WeChat advertising is also an effective marketing strategy. Still, it is not recommended for limited budgets and sensitive industries because these advertisements will only last from 12 h to 5 days, and it is costly, around 7463 dollars per ad.

4 Conclusion

In a nutshell, firms who use social media to perform business actions mainly because of increased brand awareness, growing revenue, and rising mentions in the press. By targeting the right audiences, the popularity and sales of brands will boost efficiency. No matter the social platforms in the US or China, they all serve similar functions that help companies succeed. In the future, with social media's help, many companies will perform well in selling products.

References

AdChina.io. (2022) A brand's guide to selling on xiaohongshu in China, https://www.adchina.io/selling-on-xiaohongshu-in-china/

AdChina.io. (2022) Your guide to marketing on Zhihu. https://www.adchina.io/zhihu-marketing-guide

Barnhart B (2019) 11 step instagram marketing strategy to drive sales. Power Rev

ByLorenzoBrizzo et al (2022) 5 Most popular platforms for social media marketing in China. Social Media and Influencer Marketing Speaker, Consultant & Author

Chen J (2022) 7 Steps to an effective facebook marketing strategy. Sprout Social

DeGennaro T, DeGennaro T (2019) 5 Steps for creating a successful wechat marketing strategy. Dragon Soc

Geyser W (2022) Tiktok marketing strategy-10 tips to master tiktok campaigns. https://influencermarketinghub.com/tiktok-marketing-strategy-tips/, Influencer Marketing Hub

Geyser W (2021) 9 Tips to craft the perfect linkedin marketing strategy. https://influencermarketinghub.com/linkedin-marketing-strategy/. Influencer Marketing Hub

Lua A (2021) Social Media marketing strategy: the complete guide for marketers. Buffer Library

Twitter Marketing (2022) The only guide you need to succeed. Sprout Social. https://sproutsocial.com/twitter-marketing/15/8/2022

Wan V, Wan V (2019) What is zhihu? a marketing guide to the largest Q&A platform in China. Dragon Soc

Analysis of Stocks in the Top Ten Weightings of the Nasdaq 100

Yiming Zhao

Abstract COVID-19 has had some impact on all aspects of life and has had a big impact on the world economy, and the stock market is usually the first to react. This article looks at the movements of the top ten weightings of the Nasdaq 100 in recent years in the light of COVID-19, and constructs a portfolio based on these. A comparison of returns and risks between these ten stocks was also conducted. There will also be a forecast of future returns for these ten stocks using SPSS. This work aims at how to get better returns in the stock market.

Keywords Nasdaq 100 · CAPM · Portfolio · Return · Forecast

1 Introduction

In 2020, a new pandemic caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV 2) hit us hard. As of 1 May 2020, it has affected more than 3.4 million people, while the death toll has reached 250,000 worldwide. The death toll is over 250,000 worldwide. The outbreak of the disease was declared a public health emergency of international concern by the World Health Organization (WHO). The World Health Organization (WHO) declared the outbreak a public health emergency of international concern on 30 January 2020. WHO names the disease COVID-19 on 11 February 2020 (Deb 2021). COVID-19 has also had a huge impact on the world economy. While the impact of COVID may have facilitated business formation and driven cross-generational adoption of technology, perhaps alleviating some of the demographic barriers to technology adoption. However, for a large proportion of the population, COVID will only mean disruption and despair (Hunter 2021).

The COVID-19 pandemic has had a widespread and severe impact on the global economy. The stock markets were the first to react, as usual, with a fall no less severe than that of the 2008 global financial crisis (Hassan and Riveros Gavilanes 2021).

Y. Zhao (✉)
Beijing-Dublin International College, Beijing University of Technology, Beijing, China
e-mail: 1311134930@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_21

The stock market in the United States has also seen a crisis. Until February 2020, the US stock market had experienced an 11-year boom since the 2008 financial crisis. The US stock market has experienced an 11-year boom since the 2008 financial crisis and the Wilshire 5000 Total Market Index, widely accepted as the benchmark for the entire US stock market As the benchmark for the entire US stock market, the Wilshire 5000 Total Market Index has risen significantly from 6,858.4 points on 9 March 2009 to 34.5 points, an increase of 403.5%. 6,858.4 points on 9 March 2009 to 34,533.9 points on 19 February 2020. However, from 20 February onwards, the US stock market regime suffered a sharp reversal from an uptrend to a downtrend from 20 February 2020.The COVID-19 has had a major impact on equity markets around the world and this paper picks the top ten weighted stocks in the Nasdaq 100 (as at 10 June 2022) to analyze. The ten stocks are AAPL (Apple Inc. Common Stock), MSFT (Microsoft Corporation Common Stock), AMZN (Amazon.com, Inc. Common Stock), TSLA (Tesla, Inc. Common Stock), GOOG (Alphabet Inc. Class C Capital Stock), GOOGL (Alpha-bet Inc. Class A Common Stock), META (Meta Platforms Inc. Common Stock), NVDA (NVIDIA Corporation Common Stock), AVGO (Broadcom Inc. Common Stock), PEP (PepsiCo, Inc. Common Stock). In total, these ten stocks account for 51.36% of the market capitalization in the NASDAQ 100 Index as of June 10, 2022. To some extent representative of the Nasdaq 100, the impact of COVID-19 on the stock market can be observed through the change in the returns of these ten stocks. In order to obtain the best possible returns from these ten stocks in the future, this work uses portfolio theory to construct optimal portfolios on the one hand, and SPSS to forecast their future returns on the other.

2 Methodology

First, the issue of portfolio selection involves finding an efficient portfolio, i.e. striking a balance between the expected return and risk of an investment. Obtaining a trade-off between expected return and investment risk (Calvo et al. 2012). Most portfolio selection models are based on the original Markowitz model and in many cases require the use of covariance matrix. Chen and Yang derive the optimal investment strategy and efficient frontier using the Markowitz model (Chen and Yang 2011).

In this paper the beta of the CAPM is obtained from the regression, similarly Caoetal estimate the CAPM regression using a valid market hypothesis and a j-test of the non-nested hypothesis to determine a reasonable choice of Covid-19 data (Cao et al. 2022).

SPSS is widely used for prediction of time series. Chaudhry et al. also used SPSS to make predictions of emergencies in Pakistan due to COVID-19 in their work (Chaudhry et al. 2020). This paper, on the other hand, also uses SPSS to predict the returns of ten stocks for the next six months.

3 Analysis

The correlation between the ten stocks was first calculated based on the returns of the ten stocks from August 2020 to June 2022.

Of these ten stocks, AAPL, MSFT, NVDA and AVGO are in the Information Technology industry, while GOOG, GOOGL and META are in the Communication Services industry. Table 1 shows the correlation between the stocks, with GOOG and GOOGL reaching a correlation of 0.994518, which is as expected as they are both part of Google. The correlation between AAPL and MSFT, MSFT and NVDA is also relatively high, reaching up to 0.725769 and 0.701695 respectively, but the correlations between other companies belonging to the same industry are below 0.55. This suggests that the industry sector is not the only factor that determines correlation, but also the complex relationship between individual companies, etc.

Assuming a risk-free rate of 1% per year, the return on the Nasdaq 100 over the same period is the market return. Table 2 shows for each stock the β calculated by regression.

β reflects the performance of an investment object relative to the broader market. The larger the absolute value, the greater the change in return relative to the broader market; the smaller the absolute value, the smaller the change relative to the broader market. If the value is negative, it shows that the direction of change is opposite to the direction of change of the general market; it falls when the general market rises, and rises when the general market falls. Notable among these are TSLA, NVDA and PEP, which have beta values of 2.401172, 1.78587 and 0.357518, respectively. The other seven stocks have beta values around 1. This means that TSLA and NVDA are high risk high return stocks while PEP is a low-risk low return stock. Next use the CAPM model to calculate the expected excess return and expected return for each stock. Table 3 shows the calculated results.

To get a better view of the ten stocks, their respective standard deviations were calculated to measure risk and plotted with the standard deviation as the x-axis and the expected excess return as the y-axis to obtain Fig. 1.

According to Fig. 1, TSLA has the highest standard deviation and expected excess return while PEP has the lowest standard deviation and expected excess return. Also, to some extent, it can be verified that there is a positive correlation between standard deviation and expected excess returns, i.e., higher risk tends to lead to higher expected excess returns. It can also be observed that META has a significantly higher standard deviation than AAPL, MSFT, AMZN, GOOG, GOOGL, AVGO with similar expected excess returns to these stocks, suggesting that META is not a good choice from an individual stock perspective.

To better observe the change in returns of these ten stocks over the two years, the following line chart is drawn. Figure 2 shows that TSLA's returns fluctuate most sharply, with monthly returns exceeding 40% on two occasions. META, on the other hand, and NVDA have not performed well recently, both showing monthly losses of around 30% in 2022.

Table 1 Correlation among ten stock

Correlation	AAPL	MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
AAPL	1.00000	0.72577	0.69706	0.67893	0.43915	0.44116	0.54960	0.54867	0.50878	0.51338
MSFT		1.00000	0.71023	0.74719	0.74111	0.73904	0.48139	0.70169	0.52802	0.40685
AMZN			1.00000	0.60488	0.70600	0.68957	0.38014	0.79141	0.43301	0.07592
TSLA				1.00000	0.43596	0.42990	0.26345	0.49886	0.48338	0.38428
GOOG					1.00000	0.99452	0.46460	0.52459	0.32488	0.11815
GOOGL						1.00000	0.45846	0.50754	0.34941	0.13885
META							1.00000	0.34764	0.30399	0.52630
NVDA								1.00000	0.45519	0.03704
AVGO									1.00000	0.38073
PEP										1.00000

Table 2 β for ten stocks

	AAPL		MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
β	1.021546		0.973867	1.075781	2.401172	1.007133	0.989816	1.019949	1.785870	0.932436	0.357518

Table 3 Expected excess returns and expected returns for ten stocks

	AAPL	MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
Expected return	0.014231739	0.014034231	0.014456406	0.019946819	0.014172033	0.014100298	0.014225125	0.017397942	0.013862603	0.011481014
Expected excess return	0.004231739	0.004034231	0.004456406	0.009946819	0.004172033	0.004100298	0.004225125	0.007397942	0.003862603	0.001481014

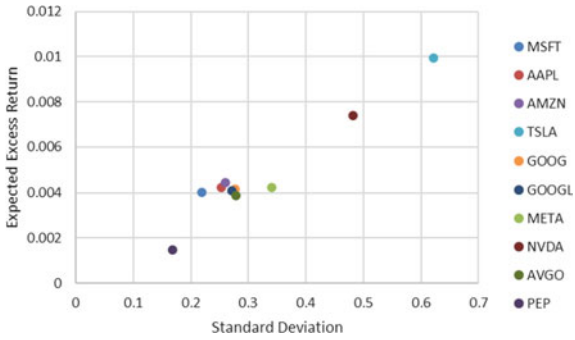


Fig. 1 Estimate of standard deviation and expected excess returns

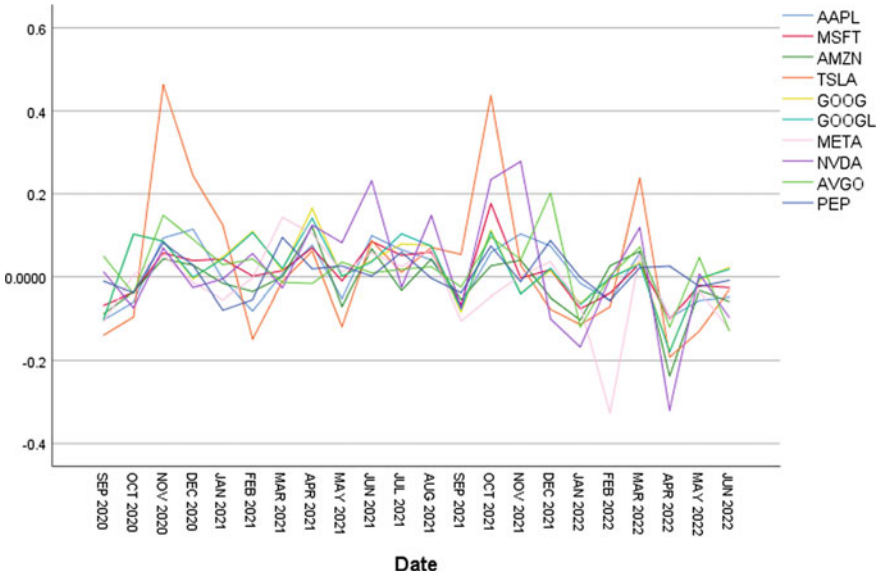


Fig. 2 Change in returns from September 2020 to June 2022

After analyzing the individual stocks, we choose to construct a portfolio in or-der to get a better choice. The first step is to calculate the covariance among the stocks as shown in Table 4.

Once the covariance between individual stocks is available, the optimal choice is obtained by constructing a covariance matrix to determine the weights of each stock when the Sharpe ratio is maximum as shown in Table 5.

The Sharpe Ratio represents how many points of excess reward an investor can get for each additional point of risk taken. A positive value means that the underlying reward is higher than the volatility risk, while a negative value means that the underlying operational risk is higher than the reward. It represents the ratio of investment return to risk, the higher the ratio, the better the portfolio. Sometimes some people

Table 4 Covariance among stocks

Covariance	AAPL	MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
AAPL	0.06091	0.03842	0.04364	0.10187	0.02927	0.02879	0.04522	0.06374	0.03412	0.02088
MSFT		0.04601	0.03864	0.09744	0.04293	0.04192	0.03443	0.07085	0.03077	0.01438
AMZN			0.06434	0.09328	0.04836	0.04626	0.03215	0.09449	0.02984	0.00317
TSLA				0.36964	0.07158	0.06912	0.05340	0.14276	0.07985	0.03849
GOOG					0.07293	0.07102	0.04183	0.06669	0.02384	0.00526
GOOGL						0.06993	0.04042	0.06318	0.02510	0.00605
META							0.11115	0.05456	0.02754	0.02891
NVDA								0.22157	0.05821	0.00287
AVGO									0.07382	0.01704
PEP										0.02715

Table 5 Optimal portfolio

Portfolio weight		0.09652	0.09626	0.15814	0.08769	0.00000	0.16415	0.10835	0.06227	0.16459	0.06203
		AAPL	MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
0.09652	AAPL	0.06091	0.03842	0.04364	0.10187	0.02927	0.02879	0.04522	0.06374	0.03412	0.02088
0.09626	MSFT	0.03842	0.04601	0.03864	0.09744	0.04293	0.04192	0.03443	0.07085	0.03077	0.01438
0.15814	AMZN	0.04364	0.03864	0.06434	0.09328	0.04836	0.04626	0.03215	0.09449	0.02984	0.00317
0.08769	TSLA	0.10187	0.09744	0.09328	0.36964	0.07158	0.06912	0.05340	0.14276	0.07985	0.03849
0.00000	GOOG	0.02927	0.04293	0.04836	0.07158	0.07293	0.07102	0.04183	0.06669	0.02384	0.00526
0.16415	GOOGL	0.02879	0.04192	0.04626	0.06912	0.07102	0.06993	0.04042	0.06318	0.02510	0.00605
0.10835	META	0.04522	0.03443	0.03215	0.05340	0.04183	0.04042	0.11115	0.05456	0.02754	0.02891
0.06227	NVDA	0.06374	0.07085	0.09449	0.14276	0.06669	0.06318	0.05456	0.22157	0.05821	0.00287
0.16459	AVGO	0.03412	0.03077	0.02984	0.0798 5	0.02384	0.02510	0.02754	0.05821	0.07382	0.01704
0.06203	PEP	0.02088	0.01438	0.00317	0.03849	0.00526	0.00605	0.02891	0.00287	0.01704	0.02715
1.00000		0.00443	0.00421	0.00765	0.00946	0.00000	0.00730	0.00497	0.00500	0.00690	0.00100
0.00469	Mean excess return										
0.01469	Mean return										
0.22566	Standard deviation										
0.02080	Sharpe ratio										

like to minimize risk and when the standard deviation is minimal, so Table 6 shows the weighting of each stock when the risk is minimal.

After obtaining the optimal and least risky portfolio weights, the weights of each portfolio are obtained according to a stepwise increase in expected return, and the efficient frontier is further drawn. Table 7 shows the data for each combination constructed to plot the efficient frontier, further visualizing the efficient frontier plotted in Fig. 3.

On the other hand, SPSS was used to build a time series model to predict the second half year returns of these ten stocks. The results obtained are as follows. Table 8 shows the model categories used for each of the ten stocks. According to Fig. 4, it can be observed that the predicted data shows largely negative returns for AAPL, AMZN, GOOG, GOOGL, and META. According to Fig. 4, it can be observed that the forecast data shows largely negative returns for AAPL, AMZN, GOOG, GOOGL and META. The overall returns for these ten stocks are still not good. As of June 10, 2022, the market capitalization of AAPL, MSFT, AMSF, TSLA, GOOG, GOOGL, META, NVDA, AVGO, PEP in the Nasdaq 100 is 12.37%, 10.57%, 6.30%, 3.99%, 3.65%, 3.64%, 3.41%, respectively. 3.39%, 2.06% and 1.98%. In total these ten stocks account for 51.36% of the market capitalization and are to some extent a snapshot of the Nasdaq 100. The future returns of the Nasdaq 100 are still not very good as judged by forecasting the returns of these ten stocks.

4 Conclusion

COVID-19 had a significant impact on the stock market, and the future earnings of the Nasdaq 100 are still not good, and the impact of COVID-19 on the stock market is still ongoing.

Among these ten stocks, TSLA has the best returns, while new energy vehicles have indeed been one of the best performing sectors in the stock market in recent years. The opposite is the PEP, which has the lowest return but also the lowest risk. The optimal portfolio is found by maximizing the Sharpe ratio of the portfolio when constructing the portfolio. At the same time, the point where the efficient frontier is tangent to CAL also represents the optimal portfolio.

The time series model constructed by SPSS predicts the movement of these ten stocks in the next six months, and the results obtained from the predictions show that the returns of these ten stocks are better than those of 2020 to 2021, but still not very good, and the impact of COVID-19 on the stock market is still ongoing.

Table 6 The least risky portfolio

Portfolio weight		0.00000	0.00000	0.21928	0.00000	0.00000	0.08266	0.00000	0.00000	0.00000	0.69806
		AAPL	MSFT	AMZN	TSLA	GOOG	GOOGL	META	NVDA	AVGO	PEP
0.00000	AAPL	0.06091	0.03842	0.04364	0.10187	0.02927	0.02879	0.04522	0.06374	0.03412	0.02088
0.00000	MSFT	0.03842	0.04601	0.03864	0.09744	0.04293	0.04192	0.03443	0.07085	0.03077	0.01438
0.21928	AMZN	0.04364	0.03864	0.06434	0.09328	0.04836	0.04626	0.03215	0.09449	0.02984	0.00317
0.00000	TSLA	0.10187	0.09744	0.09328	0.36964	0.07158	0.06912	0.05340	0.14276	0.07985	0.03849
0.00000	GOOG	0.02927	0.04293	0.04836	0.07158	0.07293	0.07102	0.04183	0.06669	0.02384	0.00526
0.08266	GOOGL	0.02879	0.04192	0.04626	0.06912	0.07102	0.06993	0.04042	0.06318	0.02510	0.00605
0.00000	META	0.04522	0.03443	0.03215	0.05340	0.04183	0.04042	0.11115	0.05456	0.02754	0.02891
0.00000	NVDA	0.06374	0.07085	0.09449	0.14276	0.06669	0.06318	0.05456	0.22157	0.05821	0.00287
0.00000	AVGO	0.03412	0.03077	0.02984	0.07985	0.02384	0.02510	0.02754	0.05821	0.07382	0.01704
0.69806	PEP	0.02088	0.01438	0.00317	0.03849	0.00526	0.00605	0.02891	0.00287	0.01704	0.02715
1.00000		0.00000	0.00000	0.00442	0.00000	0.00000	0.00167	0.00000	0.00000	0.00000	0.01406
0.00235	Mean excess return										
0.01235	Mean return										
0.14194	Standard deviation										
0.01656	Sharpe ratio										

Table 7 Data on the efficient frontier

	Min mean		Min SD				Optimum			
Mean excess return	0.00148	0.00185	0.00235	0.00285	0.00335	0.00385	0.00469	0.00519	0.00569	0.00619
Mean return	0.01148	0.01185	0.01235	0.01285	0.01335	0.01385	0.01469	0.01519	0.01569	0.01619
Standard deviation	0.16477	0.15630	0.14194	0.15626	0.17395	0.19062	0.22566	0.25856	0.29674	0.31767
Sharpe ratio	0.00899	0.01184	0.01656	0.01824	0.01926	0.02020	0.02080	0.02007	0.01917	0.01949
AAPL	0.00000	0.00146	0.00000	0.06433	0.06441	0.02912	0.09652	0.08217	0.00207	0.00207
MSFT	0.00000	0.13842	0.00000	0.07009	0.07017	0.02703	0.09626	0.08610	0.00000	0.00000
AMZN	0.00000	0.00000	0.21928	0.05851	0.05858	0.22079	0.15814	0.07785	0.00985	0.00986
TSLA	0.00000	0.00000	0.00000	0.00000	0.05887	0.08963	0.08769	0.23133	0.19994	0.28787
GOOG	0.00000	0.00000	0.00000	0.06600	0.06609	0.02849	0.00000	0.08334	0.67461	0.54744
GOOGL	0.00000	0.00000	0.08266	0.06809	0.06817	0.08285	0.16415	0.08477	0.00000	0.00000
META	0.00000	0.00137	0.00000	0.06451	0.06459	0.02905	0.10835	0.08230	0.00184	0.00184
NVDA	0.00000	0.00000	0.00000	0.02127	0.02129	0.06264	0.06227	0.03170	0.11169	0.12722
AVGO	0.00000	0.00327	0.00000	0.07563	0.07573	0.02521	0.16459	0.08961	0.00000	0.00250
PEP	1.00000	0.85548	0.69806	0.51156	0.45210	0.40517	0.06203	0.15084	0.00000	0.02121

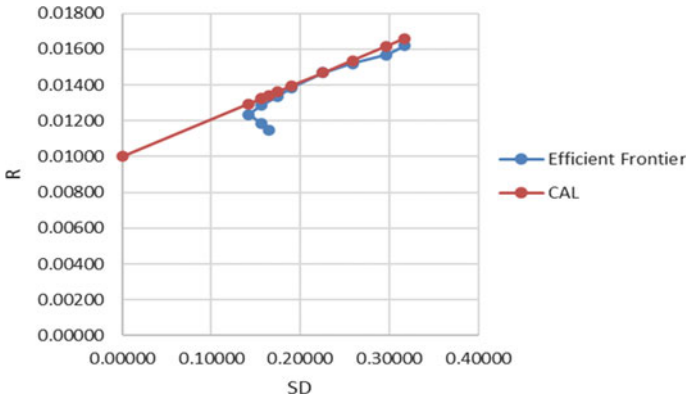


Fig. 3 The efficient frontier

Table 8 Time series forecasting model types

Model description			
			Model type
Model id	AAPL	Model_1	Winters' additive
	MSFT	Model_2	Simple seasonal
	AMZN	Model_3	Winters' additive
	TSLA	Model_4	Simple seasonal
	GOOG	Model_5	Winters' additive
	GOOGL	Model_6	Winters' additive
	META	Model_7	Winters' additive
	NVDA	Model_8	Simple seasonal
	AVGO	Model_9	Simple seasonal
	PEP	Model_10	Simple seasonal

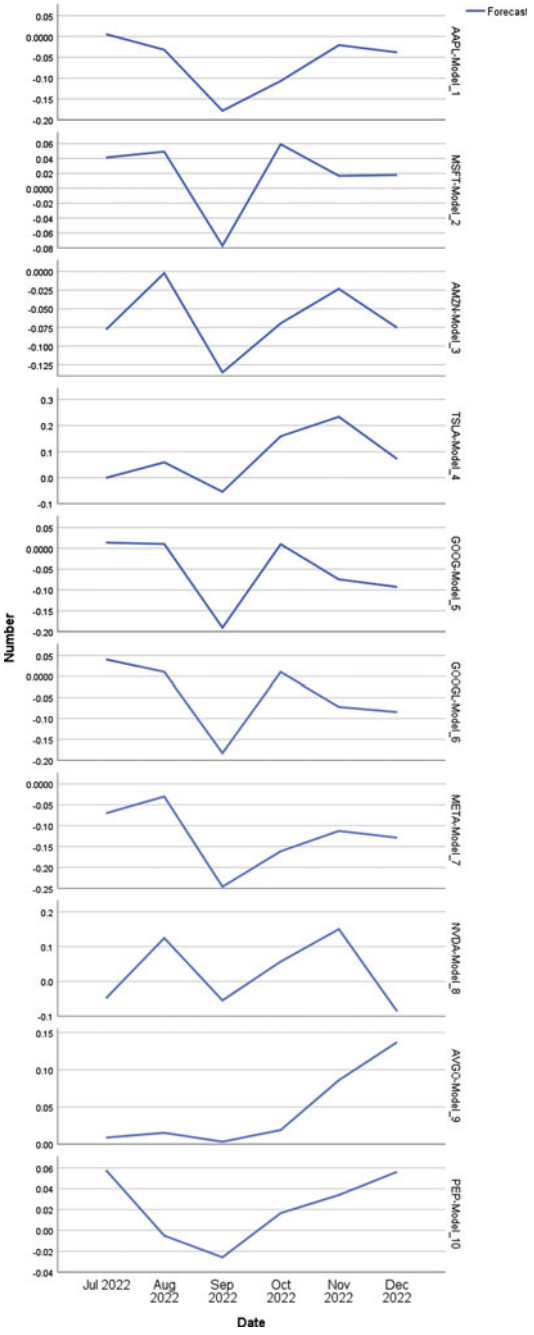


Fig. 4 Return forecast for the next six months

References

Calvo C, Ivorra C, Liern V (2012) On the computation of the efficient frontier of the portfolio selection problem. J Appl Math 2012:1–25. https://doi.org/10.1155/2012/105616

Cao KH, Woo C-K, Li Y, Liu Y (2022) Covid-19's effect on the alpha and beta of a US stock exchange traded fund. Appl Econ Lett 29(2):123–128. https://doi.org/10.1080/13504851.2020.1859447

Chaudhry RM, Hanif A, Chaudhary M, Minhas S, Mirza K, Asif T, Gilani SA, Kashif M (2020) Coronavirus disease 2019 (COVID-19): forecast of an emerging urgency in Pakistan. Cureus. https://doi.org/10.7759/cureus.8346

Chen P, Yang H (2011) Markowitz's mean-variance asset–liability management with regime switching: a multi-period model. Appl Math Finance 18(1):29–50. https://doi.org/10.1080/13504861003703633

Deb S (2021) Analyzing airlines stock price volatility during COVID-19 pandemic through internet search data. Int J Finance Econ, ijfe.2490. https://doi.org/10.1002/ijfe.2490

Hassan S, Riveros Gavilanes J (2021) First to react is the last to forgive: evidence from the stock market impact of covid 19. J Risk Financial Manage 14(1):26. https://doi.org/10.3390/jrfm14010026

Hunter CL (2021) Covid's economic reset: making the quixotic quotidian. Bus Econ 56(1):14–19. https://doi.org/10.1057/s11369-020-00200-5

Analysis of the Enterprise Supply Chain in This Modern Age—From Digital Transformation to Visualization and Sustainability

Chuhan Qin

Abstract With the development of the society, digital technology typified by big data dominates the development of this era. Digital transformation is the only way for enterprises to improve their competitiveness and develop in today's era. From the perspective of the enterprise supply chain, this paper analyzes the digital transformation of the supply chain to visualization as well as sustainability. Through literature review and case analysis, it aims to study how enterprises carry out the digital transformation of supply chains, and the relationship and impact of digital transformation and visualization of enterprise supply chains, and its impact on sustainability. The paper found that digital technology (especially big data) is the factor driving the digital transformation of enterprise supply chain, which in turn leads to the visualization of the supply chain, although there are still challenges behind the visualization. Regarding their impact on sustainability, this paper argues that the impact is positive, but remains controversial on social sustainability.

Keywords Digital transformation · Supply chain · Visualization · Sustainability · Big data

1 Introduction

With the development of current technology, big data has now occupied this era. It is becoming increasingly clear that in order for enterprises to increase their competitive advantage for growth, they must respond by improving their own competitiveness and responsiveness. At the same time, enterprises must rely on the innovation and development of their digital frameworks, from the management of raw materials and initial supply chain systems, to the satisfaction of diverse customer needs, to provide more personalized services, and to transform traditional business models through innovation. In the traditional network of enterprise supply chain, the lack

C. Qin (✉)
School of Economics and Management, Lund University, 22363 Lund, Sweden
e-mail: qinchuhan08@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_22

of efficient communication and coordination between individuals and organizations makes it impossible to respond to market changes in a timely manner. Meanwhile, information asymmetry will lead to resources wasting. Therefore, it is necessary to use new technologies like big data to achieve efficient communication and coordination capabilities and to promote the digital transformation of enterprise supply chains to visualize all aspects of the supply chain (Lu 2021). However, for an enterprise, whether it is at the micro level of the enterprise itself or at the macro-level of the country and society, sustainability cannot be ignored. For the existing research, scholars have already made corresponding understanding and achievements in the digital transformation and visualization of the enterprise supply chain. However, researches on the sustainability of the digital transformation and visualization of the enterprise supply chain is still relatively limited. After all, sustainability has always been an interesting and meaningful topic from a socioeconomic perspective. Therefore, this paper will use the literature review method and case analysis method to analyze the visualization and sustainability brought about by the digital transformation of the enterprise supply chain. Through this paper's study of the supply chain of enterprises, it is beneficial to provide ideas and inspiration for modern enterprises to carry out digital transformation and to improve their own competitive advantages, which is also beneficial to the development of enterprises in the future. At the macro level, the analysis of sustainability is conducive to promoting the sustainable development of society, and also provides ideas and case references for those who study related topics.

The rest of this paper will be divided into the following sections. Section 2 will conduct a literature review. Section 3 will introduce the digital transformation of the enterprise supply chain, including: Sect. 3.1 the definition and motivation of digital transformation of the enterprise supply chain and Sect. 3.2 the implementation of digital transformation of the enterprise supply chain. Section 4 will focus on the visualization of the digital transformation of the enterprise supply chain and the benefits of the visualization. Then there will be a discussion around the visualization. Section 5 will elaborate on sustainability from three dimensions: environment, economy and society. Finally, a conclusion will be drawn from this paper.

2 Literature Review

In 2018, global supply chain market flows over $14 billion, and it is expected that its revenue may exceed US$21 billion by 2022 (Alsharidah and Alazzawi 2020). Through business use of modern digital technologies, organizations can significantly increase their productivity, thereby cutting costs, while optimizing supplier relationships, increasing customer satisfaction, and achieving a more efficient and stable supply chain (Chang et al. 2011). Alsharidah and Alazzawi found through a study of some enterprises in Saudi Arabia that the digital transformation of the enterprise's supply chain showed the overall enhancement of the enterprise and cost savings of 30%. Lu proposed that in the current era with the development of the Internet,

the driver of the digitalization of enterprise supply chains is the application of big data. However, some scholars have not yet made a clear definition of big data. Wang et al. (2016) argue that big data is an overall approach to management, processing and analysis that improves value delivery through the 5Vs (volume, speed, variety, value and accuracy), the efficiency of performance measurement and enhances its own competitive advantage. Big data management and big data analysis are the main processes of big data application (Wamba et al. 2015). The digital transformation of the enterprise supply chain refers to promoting the digital transformation of the traditional supply chain by applying big data from the strategic and operational levels (Lu 2021). In other words, digital transformation is done through the implementation of various digital technologies (e.g. Big Data) to change the way companies connect and manipulate each process in the traditional supply chain to change the way they create value for customers (Cakic et al. 2021). Similarly, Junge and Straube also pointed out that in supply chain management, digital transformation is defined as enabling a better supply chain through the use of digital transformation technology (DTT), such as greater agility and productivity and greater customer centricity. To address today's more complex and uncertain supply chains and risk faced by businesses, digital transformation-led supply chain visibility can reduce risk and increase efficiency (Goh et al. 2013). Therefore, enterprises need to urgently realize end-to-end supply chain visualization to effectively control and manage risks in complex supply chains. Although at the micro-level, whether it is the digital transformation of the enterprise supply chain or the implementation of visualization, in order to ensure the deployment of technology as a sustainable resource, economic, environmental and social sustainability needs to be considered at the macro level (Junge and Straube 2020). Kayicki argued that the impact of digital transformation in supply chain management is expected to have a greater impact on the economic dimension than the social and environmental dimensions.

3 Digital Transformation of Enterprise Supply Chain

3.1 Definition and Motivation of Digital Transformation of Enterprise Supply Chain

In the traditional sense, the digital transformation of an enterprise refers to the comprehensive informatization of all operations, management and business of the enterprise. For the digitalization of modern enterprises, it is based on informatization, through the application of digital technologies such as big data, Internet of Things (IoT) and artificial intelligence in enterprise operation management and various businesses, so as to achieve a more efficient, comprehensive and agile operating model (Westerman et al. 2014). As for the traditional supply chain of enterprises, it is linear in nature, and the processes of design, planning, procurement, production and delivery are sequentially distributed. Based on the above literature review, the

digital transformation of the enterprise supply chain can be summarized as the use of digital technology (such as big data analysis) to monitor this process in real-time during the entire process from raw material production (supply terminal) to delivery. The motivation for the digital transformation of the enterprise supply chain can be summarized as: First, the enterprise can reduce production costs through the digitization of the supply chain, that is, use real-time sales and demand data to inform its strategy, can focus on selling a certain product, reduce or eliminate it. Production of low-demand products to reduce costs. Second, using a digitized supply chain enables a better understanding of customer needs and ensures that production capacity and raw material availability meet forecast demand, shortening lead times, and better control of the supply chain to increase efficiency. Finally, digitizing the supply chain can simplify operations. The development of the Internet is based on data, so data is becoming more and more available in operations, and through the digital supply chain, this data can be applied to advanced analysis opportunities. In addition, the use of data visualization capabilities will make it easier to apply data, avoid past mistakes, and improve execution.

Taking the wine supply chain as an example, "13. jul Plantaže", one of the biggest wine company in southern Europe, is applying this digital technology to the wine supply chain to achieve digital transformation. Each bottle of wine has a corresponding serial number that uses Optical Character Recognition (OCR) technology to track the location and life cycle of the wine. On this basis, the winemaker also sticks a unique QR code on each bottle of red wine, so that more specific information (such as production year, wine type, geographic location and weather data, etc.) of each bottle of red wine can be identified and stored in a centralized database, thereby reducing the cost of information collection throughout the process and improving the operational efficiency of the entire process. The whole process is shown in Fig. 1. It is worth mentioning that the QR code on each bottle of red wine is not only for the producer to scan, but also the consumer can scan to learn specific information about each bottle of red wine, which also helps to improve customer satisfaction (Cakic et al. 2021).

3.2 Implementation of Digital Transformation of Enterprise Supply Chain

The digital transformation of the enterprise supply chain is mainly implemented from two levels of strategy and operation through digital technology. At the strategic level, it starts with strategic sourcing. In order to avoid the uncertainty of suppliers, the application of big data can evaluate the current background of suppliers (such as economic conditions and risk factors), thereby helping enterprises to make correct strategic purchases. Secondly, compared with the traditional linear supply network design, big data technology analyzes, evaluates and optimizes every embedded point on the network of supply chain, thereby improving the elasticity of the supply chain

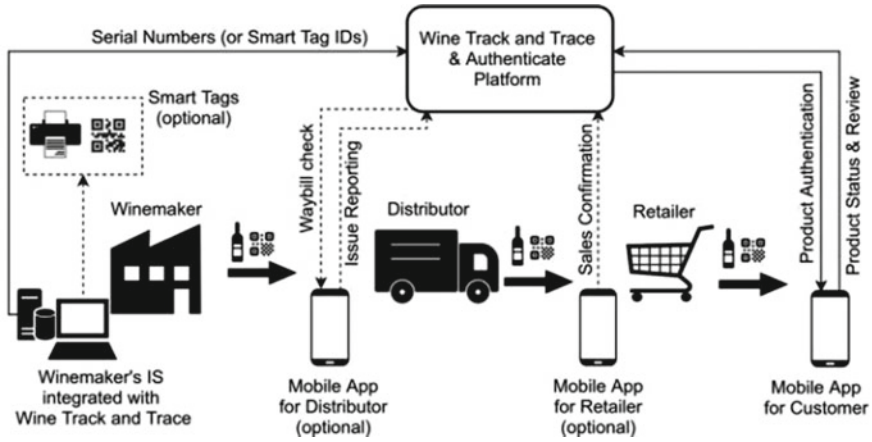


Fig. 1 Concept for the wine track and trace solution (Cakic et al. 2021)

network (Tiwari et al. 2018). Finally, in product design, big data technology will analyze consumer browsing history, purchasing behavior and other data, so as to grasp potential value points or information, and provide a reference for product design (Lu 2021).

At the operational level, from the perspective of purchasing, big data technology replaces people's subjective judgments, improves decision-making efficiency, shortens the purchasing process, improves the flexibility of purchasing quality, and improves the accuracy of purchase. Secondly, logistics, as one of the largest processes through the entire supply chain, can improve transportation efficiency and reduce logistics distribution costs through real-time monitoring of digital technology and intelligent route allocation. For production and manufacturing, digital technology can not only intelligently manufacture every production process, thereby improving product quality and efficiency, while big data technology can also optimize production planning through calculation. In addition, enterprises can make reasonable sales strategies through the prediction of market demand through the internal and external data of mobile phones through big data technology. Finally, for inventory management, big data technology can solve the problem of product backlog by forecasting, tracking and rotating inventory (Lu 2021).

4 Visualization of Enterprise Supply Chain

4.1 Digital Transformation Leads to Visualization

With the continuous growth of demand in the current era, the scale of enterprise supply chains continues to expand, and the entire supply chain network becomes

increasingly complex and often unpredictable. For enterprises, they will face high uncertainty and risks. Therefore, end-to-end visualization of the enterprise supply chain is very necessary. Generally speaking, visualization includes information graphics visualization and computer graphics visualization. Computer graphics visualization refers to the visualization of information or data by creating images, charts or animations, etc. Information graphic visualization is the visualization of information, data or graphics (Goh et al. 2013). The visualization of the enterprise supply chain can be understood as the collection, analysis and processing of logistics, inventory and other related information in the supply chain, and it is displayed graphically or in other forms according to demand. The realization of this model needs to rely entirely on digital technology, which means that the digital supply chain is the premise and driving factor for visualization. Just like the wine supply chain mentioned above, digital technology enables real-time tracking and information visualization of the entire supply chain from production to delivery.

Goh et al. proposed a visualization scheme of enterprise supply chain in their research and developed a supply chain visualization platform called "RiskVis". It features risk management and real-time monitoring for better supply chain risk management. RiskVis allows senior executives to have a clear overview of an enterprise's business. The platform can not only display the time, space and connection patterns of the supply chain but also enable real-time data collection and risk monitoring. This enables enterprises to better process the relevant information provided by the supply chain. Figure 2 shows the RiskVis framework. The implementation of the detailed functions of the system relies on the use of a variety of modern digital technologies such as the Internet, GIS, etc. These technologies are integrated to enable the system to dynamically display risks and other information needed to address issues in a timely manner (Goh et al. 2013).

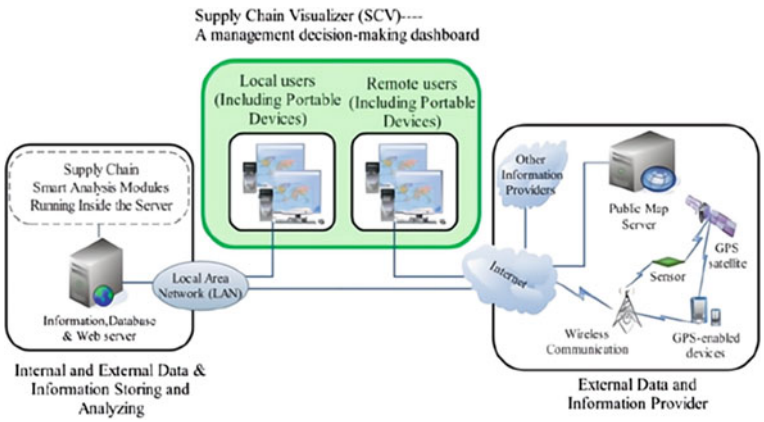


Fig. 2 RiskVis Framework (Goh et al. 2013)

4.2 Benefits Behind Visualization of Enterprise Supply Chain

It is obvious that the visualization of an enterprise supply chain can directly and effectively control and manage risks and uncertainties in complex supply chains (Goh et al. 2013). On the basis of this point of view, the visualization of the enterprise supply chain can also benefit enterprises from the following specific perspectives. First, transaction costs can be saved. Transaction costs at various points in the supply chain can be reduced by visualizing the integration of supply chain information. At the same time, in this way, the transaction time can be shortened. Second, procurement costs will also be reduced. Visualization makes it easier for suppliers to access inventory and procurement information, which makes the relevant procurement personnel more efficient and facilitates supplier management. Third, visualization helps reduce inventory. Suppliers can keep inventory information at any time through visualization, so manufacturing units and logistics companies can reasonably control the inventory amount through real-time inventory information, avoiding the situation of always high inventory. Finally, visualization shorten the cycle time. The use of automation systems in supply chain management can reduce errors in each link and improve accuracy, thereby shortening production time.

4.3 Discussion of the Challenges of Implementing Visualization

Although visualization brings many benefits to enterprise supply chain management, the challenges of implementing visualization still need to be discussed. It is because digital technology has made visualization that information security is one of the hidden dangers. When an enterprise shares enterprise information with other stakeholders in the supply chain, it is easy to cause information leakage or theft, thus affecting the development of the enterprise. In addition to this, system maintenance will also be a challenge. The supply chain management system is theoretically larger than all the systems in the enterprise, and its information volume and tasks are also larger than other systems in the enterprise, making the maintenance of the system more difficult and costly. If the system is not maintained or negligence occurs, once the information is wrong, it will bring a lot of losses to the enterprise.

5 The Impacts of Digital Transformation of Enterprise Supply Chain on Sustainability

Calatayud et al. (2018) propose that digital technologies can promote sustainability by creating transparency and flexibility to enhance relationships with consumers, thereby increasing resource efficiency and productivity, as well as reducing costs

and delivery times. Sustainability can be defined as a development that not only meets current needs but also does not harm future generations (UNESCO 2015). Sustainability is usually reflected in economic, environmental and social dimensions, which are also known as the three pillars of sustainability (Purvis et al. 2019). This section will discuss sustainability from the above three dimensions.

5.1 From Economic Dimension

The digital transformation of enterprise supply chains is significant for economic sustainability. Digital transformation can help enterprises manage their supply chains better. For example, big data analysis technology can analyze the necessary information of the enterprise supply chain to help the enterprise better understand the financial trend. In this way, enterprises can better understand and predict the market, and optimize their marketing strategies, so as to generate revenue more efficiently and reasonably and achieve economic sustainability. Not only that, digital technology can monitor and forecast every process in the supply chain in real-time, reducing risk and uncertainty in this way, thereby improving efficiency and reducing costs. In this way, business executives will be able to be provided with economic outcomes to achieve financial goals and achieve economic sustainability (Kayikci 2018).

5.2 From Environmental Dimension

Unlike sustainability in the economic dimension, the digitization of enterprise supply chains has an indirect impact on environmental sustainability. Sustainability in the environmental dimension is mainly reflected in carbon emissions. At present, the research on the direct impact of the digital transformation of the enterprise supply chain on environmental sustainability is relatively limited, because scholars have not found that digital technology can directly reduce carbon emissions in the enterprise supply chain. The IT technology that digital transformation brings to the enterprise supply chain can indirectly improve the environment. Stroumpoulis and Kopanaki pointed out that blockchain technology can reduce resource consumption and reduce greenhouse gas emissions by recalls at any time (Stroumpoulis and Kopanaki 2022). In addition, big data analysis technology and IoT technology can monitor the carbon emissions of each process in the supply chain in real-time at any time. In this way, companies can implement “green measures” on the corresponding carbon emissions in a timely manner, thereby having a positive impact on environmental sustainability (Kayikci 2018).

5.3 From Social Dimension

The sustainability of the social dimension of digital transformation remains controversial. Digital technologies can provide supply chain traceability to better safeguard human rights to achieve the social pillar of sustainability. In addition, technologies such as the IoT or big data analysis can provide information to stakeholders in the supply chain and society. Enhancing transparency within the supply chain through this digital technology reinforces the social sustainability dimension of the chain (Kayikci 2018). However, there is a contention that these digital technologies, such as artificial intelligence, may replace or eliminate some blue-collar workers, especially in automation-related manufacturing jobs. This increases the unemployment rate in society, which has a negative impact on social sustainability (Philbin et al. 2022). Therefore, in response to this situation, some scholars have suggested that when enterprises are in the stage of digital transformation, they should focus on training and re-education of employees to ensure the confidence and well-being of the workforce (Müller et al. 2018).

6 Conclusion

In the context of the current digital technology era, this paper analyzes the digital transformation and visualization of enterprise supply chains and the impact of this digital transformation on sustainability. Digital technologies such as big data, IoT, etc. greatly drives the digital transformation, and it is a necessary action to adapt to the development of enterprises in the current era, and it is also a prerequisite for supply chain visualization. Whether it's the digital transformation of the supply chain or visualization in particular, it's certain that it reduces costs and risks and increases efficiency for businesses. A supply chain visualization platform such as RiskVis, through digital technology, can monitor and predict the processes in the supply chain in real time, reduce the uncertainty and risks that enterprises may face, and optimize the management of the enterprise supply chain. It cannot be ignored that sustainability is an important indicator of social development, and digital transformation has a relatively positive impact on its economic, environmental and social dimensions. However, there is still controversy over social sustainability, and studies have found that digital transformation may also have a negative impact on social sustainability.

Nevertheless, this paper still has limitations. The analysis of the challenges faced by the digital transformation of enterprise supply chains is relatively lacking. In addition, the analysis of sustainability, especially the environmental sustainability with carbon emissions as an indicator, lacks specific data statistics and analysis, such as the comparison of carbon emissions data before and after the digital transformation of the supply chain. For future research trends, the challenges in realizing supply chain visualization and their solutions deserve to be discussed. The social sustainability

of digital transformation based on enterprise supply chains is still controversial and therefore deserves to be discussed in the future.

References

Alsharidah YMY, Alazzawi A (2020) Artificial intelligence and digital transformation in supply chain management a case study in Saudi companies. In: 2020 international conference on data analytics for business and industry: way towards a sustainable economy (ICDABI), Oct 2020. IEEE, pp. 1–6

Cakic S, Ismailisufi A, Popovic T, Krco S, Gligoric N, Kupresanin S, Maras V (2021) Digital transformation and transparency in wine supply chain using OCR and DLT. In: 2021 25th international conference on information technology (IT), Feb 2021. IEEE, pp 1–5

Calatayud A, Mangan J, Christopher M (2018) The self-thinking supply chain. Supply Chain Manage: Int J

Chang CS, Wang Z, Yang F, Tan WW (2011) Hierarchical fuzzy logic system for implementing maintenance schedules of offshore power systems. IEEE Trans Smart Grid 3(1):3–11

Goh RSM, Wang Z, Yin X, Fu X, Ponnambalam L, Lu S, Li X (2013) RiskVis: supply chain visualization with risk management and real-time monitoring. In: 2013 IEEE International conference on automation science and engineering (CASE), Aug 2013. IEEE, pp 207–212

Junge AL, Straube F (2020) Sustainable supply chains–digital transformation technologies' impact on the social and environmental dimension. Procedia Manuf 43:736–742

Kayikci Y (2018) Sustainability impact of digitization in logistics. Procedia Manuf 21:782–789

Lu Y (2021) Big data and supply chain digital transformation. In: 2021 2nd International conference on big data economy and information management (BDEIM), Dec 2021. IEEE, pp 242–245

Müller JM, Buliga O, Voigt KI (2018) Fortune favors the prepared: how SMEs approach business model innovations in Industry 4.0. Technol Forecast Soc Chang 132:2–17

Philbin S, Viswanathan R, Telukdarie A (2022) Understanding how digital transformation can enable SMEs to achieve sustainable development: a systematic literature review. Small Bus Int Rev 6(1):e473

Purvis B, Mao Y, Robinson D (2019) Three pillars of sustainability: in search of conceptual origins. Sustain Sci 14(3):681–695

Stroumpoulis A, Kopanaki E (2022) Theoretical perspectives on sustainable supply chain management and digital transformation: a literature review and a conceptual framework. Sustainability 14(8):4862

Tiwari S, Wee HM, Daryanto Y (2018) Big data analytics in supply chain management between 2010 and 2016: insights to industries. Comput Ind Eng 115:319–330

UNESCO (2015) Sustainable development. https://en.unesco.org/themes/education-sustainabledevelopment/what-is-esd/sd. Accessed 8 July 2022

Wamba SF, Akter S, Edwards A, Chopin G, Gnanzou D (2015) How 'big data' can make big impact: findings from a systematic review and a longitudinal case study. Int J Prod Econ 165:234–246

Wang G, Gunasekaran A, Ngai EW, Papadopoulos T (2016) Big data analytics in logistics and supply chain management: certain investigations for research and applications. Int J Prod Econ 176:98–110

Westerman G, Bonnet D, McAfee A (2014) Leading digital: turning technology into business transformation. Harvard Business Press

Analysis of the Impact of the Health Status of CDC Staff on Job Performance During COVID-19 Epidemic

Wen Zhan

Abstract The COVID-19 outbreak has seen a dramatic rise in the number of patients and an extreme shortage of medical supplies and specialized human resources. On this background, CDC staff, as the main force in the fight against COVID-19, are prone to physical and mental health problems, but the quality of their work is directly related to the efficiency of the fight against COVID-19. Therefore, while paying attention to the epidemic, we should also pay attention to the impact of the health status of CDC staff on job performance. By analyzing the working conditions and health status of CDC staff, this study constructed a relationship model between the physical and mental health of CDC staff and their work performance, and explored the impact of their occupational emotional exhaustion on the quality of their work, to find ways to maintain a good state of their physical and mental health and to plan the anti-epidemic work scientifically and rationally. This study aims to minimize the health risks of CDC staff involved in fighting COVID-19 and maximize the efficiency of epidemic treatment, and provide a reference for dealing with similar public health emergencies.

Keywords COVID-19 · Human resource management · CDC staff · Occupational emotional exhaustion · Job performance

1 Introduction

At the end of December 2019, China detected its first case of COVID-19 (Lin et al. 2020). Subsequently, the epidemic spread around the world and became the world's largest public emergency. At the height of the epidemic, people were not clear about the disease's pathogenesis and transmission route, however, the CDC (Center for Disease Control and Prevention) staff had to be in close contact with patients, so they were at inevitable risk, including a high risk of infection, fatigue from overwork,

W. Zhan (✉)
School of Management, Wuhan University of Technology, Hubei 430070, China
e-mail: zw2018575912@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_23

depression from discrimination, and loneliness due to lack of contact with family, etc. (Rao et al. 2020). These physical and mental health problems had reduced the enthusiasm and confidence of medical staff and had caused occupational emotional exhaustion, which had directly or indirectly affected the quality of medical staff's anti-epidemic work.

Yanli Cheng, Dong Chen, and other scholars conducted a study on the relationship between social support, anxiety, and depression among nurses fighting COVID-19 based on the structural equation model in April 2020, and confirmed that the social support of the nurses who fought against COVID-19 significantly associated with anxiety. Social support has a negative moderating effect on anxiety and anxiety has a positive moderating effect on depression. Hospital managers can improve the social support of nurses both internally and externally, thus reducing their anxiety at work and maintaining good health (Cheng et al. 2020). Chang Wang, Wenhao Li, and other scholars conducted a questionnaire survey among 1064 medical staff in a grade A general hospital in Changzhou from January to April 2020, using the 10-item Stress perception Questionnaire (PSS-10), Simplified coping style Questionnaire (SCSQ), Perceived Social Support Questionnaire (MSPSS) and 12-item general health questionnaire (GHQ-12), and concluded that the mental resilience score of front-line medical staff is lower than the average level, the stress response can negatively predict mental resilience, and social support can positively predict mental resilience (Wang et al. 2020).

As can be seen from the above studies, current scholars have mainly explained and studied the mental health status of medical staff during the epidemic through psychological theories. However, few scholars have explored the mechanism of the impact of physical and mental health on the work performance of CDC personnel, while the work quality of CDC personnel is of great significance to the efficiency of fighting the epidemic. Therefore, this study aims to explore the relationship between the physical and mental health status of CDC staff and their work performance, and then put forward the methods to maintain a good status of physical and mental health of CDC staff and improve the efficiency of epidemic prevention. This study also has important theoretical and practical significance for dealing with similar public health emergencies.

2 Working Status and Physical and Mental Health Status of CDC Personnel

In this study, 231 CDC personnel in central China were surveyed on their working status and the physical and mental status during COVID-19 from February to March 2020 using an online questionnaire tracking survey.

2.1 Basic Information of CDC Personnel Under Investigation

The survey included 84 men and 147 women. 36.2% were aged from 30 to 39, 42.4% had less than 10 years of working experience, 68.2% were married, 59.8% had a bachelor's degree, and 40.2% had junior titles.

2.2 Working Condition

CDC personnel wear many hats. Among the 231 CDC staff, 85 are responsible for the epidemiological investigation, 77 for data collation, 56 for science popularization, 51 for sampling and testing, 48 for supervision and inspection, 43 for management and coordination, 40 for virus elimination, 37 for epidemic surveillance, 37 for guidance and training. 30 people undertook emergency supplies support, 21 people undertook analysis and decision-making work. The average working hours of CDCS were (9.51 ± 3.40) h, and 23.1%, 35.2% and 41.7% of CDCS worked less than 8 h, 8–9.9 h, and $\geq$10 h, respectively. 30.0%, 41.2%, 53.1%, and 37.0% of workers need to contact confirmed COVID-19 patients, suspected COVID-19 cases, close contacts, and test specimens, respectively.

2.3 Physiological States

During the fight against the epidemic, disease control workers suffered from various physical conditions, including the inability to concentrate due to prolonged fatigue (23.9%), nausea and vomiting (33.5%), headache and fatigue (40.5%), hypoglycemia or even fainting (11.1%).

2.4 Psychological States

During the fight against COVID-19, health care workers experienced various psychological stresses, with fear of COVID-19 accounting for 42.6%; 54.8% were worried about being infected; The proportion of anxiety and tension due to overwork was 42.0%; Job burnout accounted for 52.2%; 37.6% felt lonely due to lack of contact with their families; The proportion of the blame for death was 26.2%.

3 The Influence Mechanism of Physical and Mental Health and Job Performance

3.1 Analysis of the Influence Mechanism

In late 2019, COVID-19 broke out and the number of cases rose dramatically. Worldwide, there is a sharp shortage of medical supplies and specialized human resources, resulting in a significant gap between the number of medical personnel and the number of patients (Wang et al. 2020), and a large gap in CDC personnel.

Under such circumstances, the working hours of CDC staff increased and the sleeping time decreased, which led to the increase of mental slack and job burnout index. Under the condition of physical and mental exhaustion, the probability of medical staff making work mistakes increased. Because patients require round-the-clock care, CDC staff often have to work in shifts, which can lead to irregular work lives and less contact with their families. Therefore, CDC personnel are prone to nausea and vomiting, headache and fatigue, even hypoglycemia and syncope physically, and these physiological conditions will aggravate the psychological state of anxiety and tension of medical staff, thus reducing the working behavior ability of medical staff. The COVID-19 pandemic, with its unprecedented infectivity and high fatality rate, and the lack of a vaccine or drug to contain the virus in the short term, has made the work of CDC staff more difficult. It is easy for medical staff to be excessively afraid of being infected, and to feel powerless and self-blame for the pain and death of patients, which reduces the work enthusiasm and confidence of CDC staff.

Error-prone work, reduced work efficiency, work enthusiasm are direct factors leading to the decline of work quality. When medical staff perceives that their work quality deteriorates, their negative psychology will intensify, leading to a series of physical and mental health problems, forming a vicious cycle of occupational emotional exhaustion.

3.2 The Influence Mechanism of the Health Status of CDC Staff on Job Performance

Based on the above analysis, we can build a mechanical model of the impact of CDC staff health status on job performance (see Fig. 1).

To improve the efficiency of epidemic control and promote the steady progress of anti-epidemic work, it is essential to solve the physical and mental health problems of medical staff.

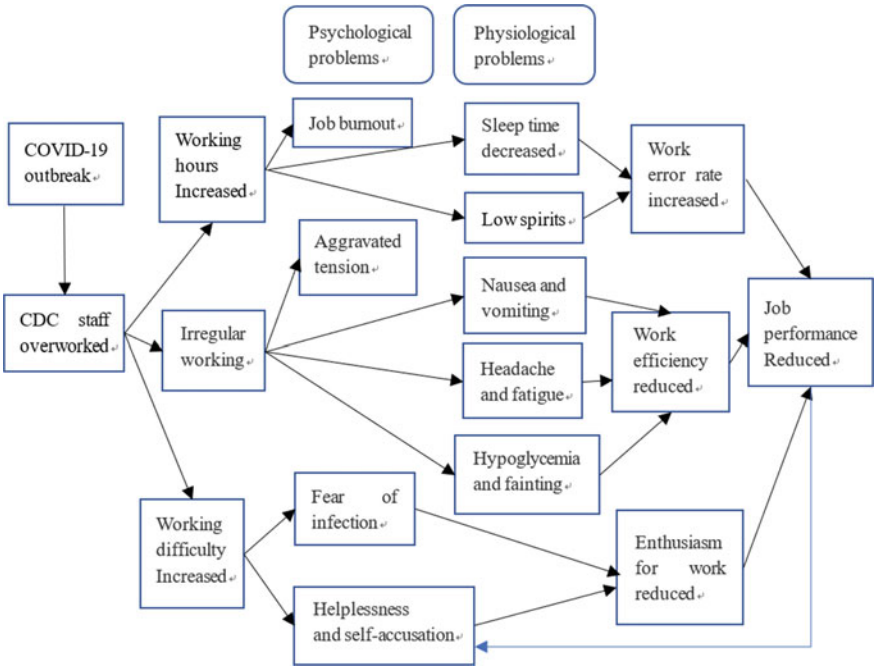


Fig. 1 Chart of the influence mechanism of the health status of CDC staff on job performance

4 Solutions and Advice

4.1 Recommendations to Hospitals

Establish a Talent Pool for CDC Staff. Hospitals can gather medical personnel together regularly for training and assessment of disaster relief. In addition, major public health events should be taken as the background to establish corresponding work and management processes, and relevant emergency plan drills should be organized regularly to ensure that everyone is equipped with the ability to deal with such events (Wang et al. 2020).

Carry out Psychological Training and Counseling for Medical Workers. Hospitals can help each medical worker establish a correct psychological defense mechanism and learn the right way to deal with psychological stress. In addition, hospitals can spread correct prevention and control methods and relevant knowledge points about diseases to medical staff through the Internet and new media.

Arrange Accommodation Properly for Medical Workers. Secluded accommodation should be arranged as close as possible to designated hospitals to ensure adequate rest time for medical workers.

4.2 Recommendations to Hospital Departments

Replenish Human Resources in Time. Hospital departments should optimize the scheduling structure, to shorten the working time of medical staff so that medical staff can get sufficient rest. For example, hospital departments can adopt the mode of "2 + 4", with 2 doctors in the department of infectious diseases and 4 nurses as a group, taking 3 shifts at night and taking shifts to reduce the night shift time of each group of medical workers. Moreover, dietary nutrition needs to follow up the need to provide medical personnel with nutritious meals to ensure their daily nutritional intake and energy expenditure.

Set up a Psychological Counseling Group. The department should also pay close attention to the mental health of medical staff. Professional psychological counseling experts provide psychological counseling for medical personnel, establish online and offline channels, and put forward personalized suggestions for their psychological problems. Provide one-to-one counseling for those with great psychological pressure, and apply for rest and recuperation from their superiors when necessary to adjust their psychological state (Chen et al. 2020).

4.3 Recommendations to CDC Staff and Other Medical Workers

Carry out Psychological Relaxation Exercises. Medical workers can use cognitive behavioral therapy, meditation relaxation therapy, MBSR therapy, respiratory regulation, relaxation training to relieve psychological pressure. Medical workers can also timely communicate with family members, friends, and colleagues to vent bad emotions and avoid an emotional backlog.

Set Alarm Clocks for Positive Information. Medical workers can set daily time for reading information and avoid being stimulated by negative events for a long time and actively choose an authoritative, reliable, objective, and true official information to read. Treat external information with a scientific and rigorous attitude, do not believe rumors, do not spread rumors. Medical workers can also learn related knowledge about death through media and lectures, and treat the occurrence and development of diseases and death of critically ill patients objectively and rationally, to reduce the sense of guilt and discomfort caused by this in their work (Xia et al. 2020).

Adjust the Pace of Life Reasonably. Medical workers should live regularly, and ensure adequate sleep time. For medical workers with poor sleep conditions, aromatherapy can be used to eliminate tension and relieve pressure to promote sleep. Medical workers should also control their diet and take in high-quality protein and various trace elements to ensure the diversity and richness of the food. Medical workers can do more indoor activities to strengthen their immunity. They can also

try traditional Chinese medicine methods such as Eight-dan Brocade and Taijiquan to strengthen their muscles and bones.

5 Conclusion

During the fight against the COVID-19 epidemic, CDC staff were overloaded with work and faced huge work pressure and infection risks. Their physiology and psychology were subjected to huge tests, and the detection rate of occupational emotional exhaustion was high, which not only seriously endangered the physical and mental health of medical staff, but also greatly reduce their work performance, affecting the smooth progress of epidemic prevention work.

Relevant departments of the hospital should give appropriate care and support, which can reduce the degree of occupational emotional exhaustion by improving staff's self-identification of their professional values and skills, organizational support, and reducing the psychological burden of fear of being infected. And the talent pool for the disease prevention and control system should be expanded, to reduce the work pressure of existing staff and improve the efficiency of anti-epidemic.

This study is an investigation of the relationship between the physical and mental health of medical staff and work performance during the period of the COVID-19 epidemic. Follow-up investigations on the physical and mental health and work quality of medical staff in other periods can be carried out, follow-up study can also conduct investigations on other factors which influence CDC staff's job performance.

References

Chen Y et al (2020) Epidemiological characteristics of COVID-19 patients in China. J Central South Univ (Med), 2020(06)

Cheng Y, Chen D et al (2020) Analysis of psychological and sleep status of general practitioners participating in COVID-19 prevention and control during COVID-19 outbreak. Chin Gen Pract, 2020(11)

Lin H, Ai H et al (2020) The impact of COVID-19 on occupational stress among frontline healthcare workers. J Wuhan Univ (Med Sci)

Rao M, Baoli Z et al (2020) Psychological status and coping strategies of medical staff in Wuhan under COVID-19. J Wuhan Univ (Med Sci)

Wang C, Li W et al (2020) Mental health status of medical staff during COVID-19 epidemic. Chin J Health Psychol

Xia L, Yan L et al (2020) Construction of a three-level intervention system for psychological crisis among first-line nurses in COVID-19 appointed hospitals. J Nurs Educ, 2020(11)

Analysis of the Internet Industry Based on SWOT Model and Porter's Five Forces Model—Taking Amazon as an Example

Mingyang Zhou

Abstract With the rapid development of technology, the modern consumer has many different means of consumption, and electronic consumption is one of the most popular in this era. Amazon.com, one of the largest e-commerce companies in the world today, has always operated in an unstable business environment. Various factors affect Amazon's operations, including but not limited to changes in consumer demand and fierce competition in the e-commerce market. Amazon has always wanted to maintain its leading position in the e-commerce business. In these efforts, it has had to deal with rival companies such as Wal-Mart. This paper analyses the strengths that Amazon holds in the e-commerce arena based on the SWOT model and Porter's Five Forces model and makes a list of its company's weaknesses, identified threats, unavoidable risks, etc. Finally, the analysis made by the two models gives certain conclusions and recommendations.

Keywords Amazon Company · E-commerce · Management policies · Strategic initiatives

1 Introduction

This paper uses Amazon as an example and analyses it through two models commonly used in management. The SWOT and Porter's Five Forces model. According to Sadq, Amazon has proven that in today's high-tech era, e-commerce is a major and indispensable business segment for every company, and Amazon.com, as one of the leading companies in this field, can leverage the power of technology to achieve better and more customer service (Sadq et al. 2018). This paper will analyze Amazon.com through two models and make a general strategic judgment and analysis of various aspects of Amazon.com through two business models. The paper is divided into

M. Zhou (✉)
University of Leicester School of Business, University of Leicester, Brookfield, London Road, Leicester LE2 1RQ, UK
e-mail: 531725416@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_24

five basic sections. The first section is the introduction, which explains the background information of Amazon.com, including the history of the company and the leading businesses it operates. The second part provides a general introduction to Amazon.com. The third part analyses Amazon.com based on the SWOT strategic model in management. The fourth section analyses Amazon.com based on Porter's Five Forces model. The final section summarises all the key messages of the article and presents Amazon's solutions. By analyzing these two models one will understand the issues that affect Amazon. Through the explanation and analysis of the above sections, certain constructive suggestions are made to help Amazon.com to implement more appropriate strategic deployment and decisions. The aim of this paper is to help Amazon.com address these challenges and provide the best way to do so: by introducing better management policies and strategic initiatives.

2 General Introduction to Amazon Company

Amazon, is one of the largest online e-commerce companies in the world and was one of the first companies to start operating in e-commerce. Amazon's founder, Jeff Bezos, founded Amazon.com in 1994 (Alshmrani 2021). Initially, Amazon.com was mainly in the business of selling books with the company's website, so it gradually made a name for itself in the field. Today Amazon.com has a wide range of products such as books, games, music, electronic devices, home and garden, toys and baby products. Amazon.com has become one of the world's largest online retailers in terms of the product range (Robischon 2017). Amazon Web Services also provides cloud-based services to many customers around the world, including universities and government agencies. Since the outbreak of covid-19, Amazon.com has established itself as a leading Internet company in the field of e-commerce and has become a model for other Internet companies (Sulaiman et al. 2020). Amazon's success can prove that through the Internet, companies can harness the power of technology to achieve better and greater customer service.

3 Analytical View of Amazon Inc.

3.1 SWOT Analysis

In today's age, one of the most commonly used strategic models, the SWOT analysis should be considered a well-known tool in strategic planning reports (Tigre 2019). There are four main components in a SWOT analysis, involving the analysis of a company's strengths, weaknesses, opportunities and threats. Thus, a SWOT analysis is actually a synthesis and summary of all aspects of a company's internal and external conditions, analyzing the strengths and weaknesses, opportunities and threats faced

by the organization. It is a method that helps a company make strategic decisions. A SWOT analysis helps a company focus its resources and actions on its strengths and greatest opportunities and helps the company make the most profitable strategic decision.

Strengths (S). The first advantage is that Amazon.com uses a "semi-integrated" logistics system, which allows for better control of logistics quality. Amazon.com has established global supplier relationships so that products can be delivered to customers in a short time when shopping through Amazon.com around the world (Santiago 2017).

The second point is that Amazon is the only Internet company that has its own IT team. According to incomplete statistics about 20% of Amazon's employees are involved in software development, from the search and purchase process for products to the payment process, private hobby recommendation and management, and electronic membership services, all of which are operated by Amazon's own IT team (Dumaine 2020).

The third point is that Amazon's brand digital assets lead in four areas: volume of digital content, goodwill, attention and engagement.

The fourth point is that Amazon has proven experience and technology in North America: website design, warehouse and logistics management systems, and core technologies such as AWS cloud services and Kindle (D'Agostino 2018).

Weaknesses (W). The first point is the number of customers and the ability of that group to pay for goods. According to incomplete statistics, Amazon has a large customer base of over 20 million, but 70% of these users are below the average income level, which makes the traditional online services not bring Amazon a satisfactory result in terms of profitable income, so this makes Amazon carry out a lot of after-sales service business or provide more other services to fill the income (Tigre 2019).

Secondly, thin margins. Although sales increased as a result of the additional service business, Amazon.com's actual revenue declined after deducting significant labour costs and high tax collections (Alshmrani 2021). Amazon.com faced increased competitive pressure due to its increased spending on online advertising campaigns, which caused its main competitors, Yahoo and Google, to significantly exceed the expectations of Amazon.com's analysts in their latest quarterly results. In addition, the CEO from the UK may have limited knowledge of the countries and is unable to grasp the needs, policies and regional characteristics of the countries' internet users. As a result, it is not possible to increase the actual revenue in a short period of time.

The third point is the long construction cycle of self-owned logistics. Amazon.com's advantage over its competitors in Tier 1 cities does not mean that it is still unsurpassed in Tier 2 and 3 cities (Assensoh-Kodua 2019). Therefore in a short period of time, Amazon.com cannot universally reach all consumers.

Opportunities (O). The first point is the rapid development of the Internet. With the development of technology, the Internet has become an indispensable part of people, and the fact that Amazon's main business is transacted through the Internet shows that

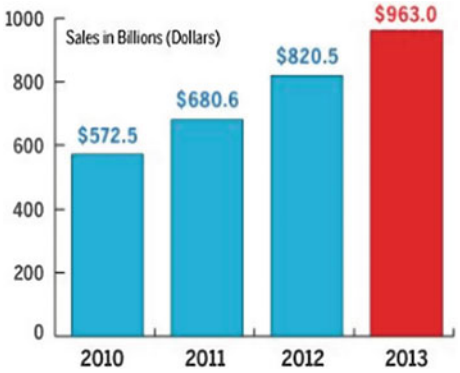


Fig. 1 The rapid growth of the Internet and e-commerce

its main business is inextricably linked to the Internet, so the rapid development of the Internet has been of great help to the development and progress of Amazon.com.

The second point is that the environment for the development of e-commerce is more favourable. The rapid development of the Internet has led most companies to develop e-commerce businesses. Therefore, most countries will provide a better policy and legal environment for e-commerce. This has led to the emergence of a new area of e-commerce that has attracted many investors and consumers. This has helped online retailers such as Amazon.com (Fig. 1).

This graph shows the growth in the early stages of global e-commerce development from 2010–2013. During these four years, the average growth rate reached 19.4% per year (Onyusheva and Seenalasataporn 2018).

The third point is the entry into new markets. The market size of e-commerce is still growing (Berg and Knights 2021). From its earliest days as an online book retailer, Amazon has grown to sell CDs, videos and DVDs, and now has a large online platform to sell software, appliances, toys, clothing, sporting goods, food, jewellery, beauty products, musical instruments and more. The new markets present new opportunities for Amazon.

The fourth point is to add more web-based online services. Although Amazon.com already has a more mature web-based online service system, the number of customers as well as the demand is also growing in different ways, for example, the mobile payment application has now become popular all over the world and the global demand for web-based online services is also increasing. Therefore, the number of customers will increase considerably by designing services that will satisfy them.

Threat (T). The first point is that Jingdong and Taobao (Assensoh-Kodua 2019) have captured the majority of e-tailing sales and other localized brands are on the rise, so competition in the e-commerce space will become very fierce.

The second point is that mobile payments also have very strong rivals in each country, for example in China with Ali's Alipay (Shehan 2018); in the US with Apple Pay (Shehan 2018).

Table 1 SWOT strategy improvement

SO Strategy 1. Enhance the shopping experience on the web and mobile terminals 2. Seize the opportunity to accelerate our international expansion	ST Strategy 1. Pay attention to the quality of third party sellers introduced 2. Play the advantage of scale
WO Strategy 1. Market segmentation and differentiated operation 2. Improve technology and ensure shopping safety 3. Use the brand advantage to increase the total number of customers and creditworthiness	WT Strategy 1. Cautious expansion 2. Undertake internal consolidation and aim to improve net profitability

Summary. Through Amazon's SWOT analysis, Amazon started to implement a membership system to promote its cross-border e-commerce business by giving gifts to consumers who have already applied for Amazon membership, adding free after-sales services and offering discounts for most of the products; and promoting consumers by cooperating with local creative brands and launching sales in other e-commerce platforms. The above actions show Amazon's determination to focus on the three main segments of cross-border e-commerce, digital reading and online cloud services. On the other hand, it also shows that Amazon has learned from the failure of its initial e-tailing business segment and started to improve the internal localization of Amazon.com's branches in each country, which can be a better way for Amazon.com's products to be closer to the psychology of consumers in different countries.

Table 1 shows some of the current situations of Amazon.com through the SWOT model.

3.2 Porter's Five Forces Analysis

Porter's Five Forces model was developed by Michael Porter in the early 1980s (Assensoh-Kodua 2019). It has a global and far-reaching impact on business strategy formulation, allows for effective analysis of the customer and competitive environment, and is part of the micro-environmental analysis of the external environment. The model states that there are five basic competitive forces that determine the intensity of competition in an industry, and that these forces combine to influence the attractiveness of the industry and the competitive strategy decisions of existing firms. These five forces are the ability of existing competitors to compete in the same industry, the ability of potential competitors to enter, the substitution power of substitutes, the bargaining power of suppliers, and the bargaining power of purchasers (Berg and Knights 2021).

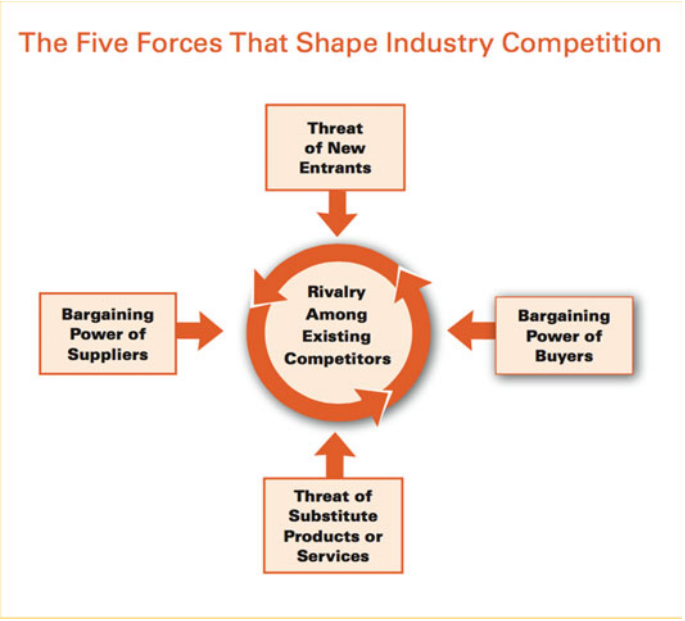


Fig. 2 An introductory diagram of the Porter's Five Forces model (Assensoh-Kodua 2019)

Competitive Rivalry

Number and Strength of Major Competitors. The e-tailing market is dominated by large retailers such as Walmart, Tesco and Amazon. The number of companies is large and they are large, but there are constant price wars between these giants in the retail sector. In comparison, the products offered by the giants are almost identical and product differentiation is low (Fig. 2).

Slowing Growth in Industry Sales. Consumer demand is gradually becoming saturated and the growth rate of e-commerce online channel transaction scale will slow down. As market industry sales gradually become saturated, competition for market share will become more intense.

Buyers' Bargaining Powers. The increase in the number of product websites available to consumers in online retailing, coupled with the use of the Internet, has reduced the cost of obtaining price information for customers. The reduced costs also ensure that consumers can easily move from Amazon to rival organizations, including Wal-Mart. These different alternatives have also given consumers the ability to move from one retailer to another. Unlike buying from an online platform, customers can easily move to Walmart's shops.

Suppliers' Bargaining Power. Amazon has a large number of suppliers, a low degree of centralization, few product differences between suppliers in the book business and low switching costs, as well as a wider sourcing market for clothing and electronic

products from other countries. As a result, suppliers do not have much bargaining power over Amazon.

Threats of Substitutes. The main substitute for e-tailing is physical retail shops. Due to their lower prices and better information services, as well as their wide variety of products, personalized service models and diverse payment channels, e-tailing has an advantage over the threat from physical retail shops.

Threats of New Entrants. The level of intense competition in each industry is caused by the many substitutes produced by each company's competitors and the high profits resulting from the low costs generated by their output. According to D'Agostino (2018), Amazon competes with organizations such as Wal-Mart, whose physical shops have replaced the online retail services offered by Amazon, and many of the large online sales rather than books have changed from separate online sales to large book shops. Since each consumer has a different level of consumption, without sufficient strengths such as the establishment of a supply chain, database maintenance, strong capital, technical support, etc. Based on this information, a strong competitive edge is a strategic priority for Amazon to maintain its long-term results.

In summary, Amazon.com needs to deal with competitor entry, substitution generation and consumer bargaining power. Through the above analysis, Amazon.com can face the different ways of competition from strong competitors by maintaining and strengthening its competitive advantage in the field and its e-commerce business. Secondly, Amazon.com needs to continue to improve its brand image, a good brand image has a great attraction for consumers. In addition, Amazon must address the different bargaining power of different consumers and their price needs by improving the quality of its online services. In addition, Amazon.com needs to improve and innovate new ways of offering its services in order to attract more consumers. Finally, Amazon needs to continue to improve the convenience of its website, the consumer experience and the security of each consumer's personal information.

4 Conclusion

Times are advancing and technology is constantly innovating, and these lead to a market where e-commerce is set to become very competitive. But in this highly competitive market, Amazon.com, the leader in the field, has a huge advantage and a strong competitive edge. Although the covid-19 epidemic is a major challenge for every industry and every business, it is a great opportunity for Amazon.com, as people will use the internet more frequently than ever before and the demand for online retailers is increasing (Sulaiman et al. 2020). As a result, most competent companies will now gradually enter the e-commerce market. If Amazon.com is to maintain its current position as a market leader it must accelerate innovation and change within the company. However, the needs of employees should be met at the same time as the company's reforms and innovations, as they are also an important

part of the company. This article identifies the main challenges facing Amazon and recommends some strategic initiatives that could help the organization become better. Once implemented correctly, Amazon will probably achieve better profitability and be on the right path to sustainability.

References

Alshmrani HM (2021) An analytical view of amazon success in the worldwide. Life Sci J 18(6)
Assensoh-Kodua A (2019) The resource-based view: a tool of key competency for competitive advantage. Probl Perspect Manag 17(3):143
Berg N, Knights M (2021) Amazon: how the world's most relentless retailer will continue to revolutionize commerce. Kogan Page Publishers
D'Agostino JL (2018) The impact of E-commerce on brands: an analysis of amazon and a plan for the future. Doctoral dissertation, University of Oregon
Dumaine B (2020) Bezonomics: how amazon is changing our lives and what the world's best companies are learning from it. Scribner
Lincoln IV, Andrew CE (2018) Porter analysis: a business strategy of amazon.com through a value chain and comparative advantage analysis of amazon's trademarks and intangibles. 27 Nov 2018. Practical Guide to US Transfer Pricing
Onyusheva I, Seenalasataporn T (2018) Strategic analysis of global e-commerce and diversification technology: the case of amazon.com inc. Euraseans: J Glob Socio-Econ Dyn 1(8):48–63
Robischon N (2017) Why amazon is the world's most innovative company of 2017. Fast Company Magazine, 2
Sadq ZM, Sabir HN, Saeed VSH (2018) Analyzing the amazon success strategies. J Process Manage. New Technologies, 6(4)
Santiago DR (2017) The role of FSC certification to maintain sustainability: the case of precious woods amazon company. REBRAE 10(1):8–35
Shehan AE (2018) Amazon's invincibility: the effect of defective third-party vendors' products on amazon. Ga L Rev 53:1215
Sulaiman MABA, Ahmed MN, Shabbir MS (2020) Covid-19 challenges and human resource management in organized retail operations. Utopia y Praxis Latinoamericana 25(12):81–92
Tigre MA (2019) Building a regional adaptation strategy for amazon countries. Int Environ Agreements: Polit Law Econ 19(4):411–427

Analysis of the Traditional Energy Revolution Under the Carbon Neutrality Target

Wang Han

Abstract In the global context of carbon neutrality, the development of traditional energy enterprises has brought unprecedented challenges. Facing the historical changes in the development of traditional energy, how should traditional energy enterprises develop? To answer the above questions, this paper analyzes the advantages and disadvantages faced by the traditional energy industry and the advantages and disadvantages faced by the new energy industry. On this basis, the paper puts forward the analysis of the transformation of the traditional energy industry.

Keywords Carbon neutrality · Traditional energy · Industrial transformation

1 Introduction

Under the background of excessive greenhouse gas emissions, the "carbon neutralization" and "carbon peak" are proposed to adopt the new energy structure of green energy with low pollution and small emissions. Human development cannot be separated from the development and application of new energy. Global economic development has an increasing demand for energy, especially for energy scarce countries. Green energy will gradually change the energy consumption structure and reduce the import and development of fossil energy, so as to better protect the ecological environment and promote the faster and better development of society. From the perspective of enterprises, traditional energy is still the main energy, which is difficult to replace in a short time. The development of new energy should be adapted to local conditions and cannot be comprehensively promoted. New energy and traditional energy are complementary and mutually beneficial, and the construction of a new energy system does not affect the overall development. The oppression of policies has led to a severe impact on the traditional energy industry. In order to continue

W. Han (✉)
Guangzhou Yaohua International School, Huadu District, Guangzhou, Guangdong Province, China
e-mail: 909353678@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_25

to continue and develop enterprises, consolidate the market position, and solidify the traditional energy industry, there is an urgent need for reform. New energy infrastructure investment has created new opportunities in saturated traditional infrastructure investment, provided new employment opportunities and prevented brain drain. At the same time, controlling global warming, protecting agricultural production and food security, and the development and application of technology in the field of "carbon neutrality" will effectively reduce the cost of electricity, making it possible for 5 g and maglev trains, which are more advanced but more energy consuming technologies, to be deployed.

2 Literature Review

Climate change is a global problem, the main cause of which is human activities. Its impact on human production and sustainable development is worsening, threatening the safety of air, food and water. The UK hosted the 26th UN Climate Change Conference of the Parties (COP26) in Glasgow, which proposed (Article 1 of the United Nations Framework Convention on Climate Change 2021) "Recognizing the importance of the best available science for effective climate action and decision-making" to formulate relatively stable adjustment policies to avoid other adverse effects according to the difficulty and national conditions of each country in reducing emissions (Article 15 of the United Nations Framework Convention on Climate Change 2021)." Calling on developed parties to develop and implement national adaptation plans and exchanges, as well as urgently and significantly increase the availability of climate financing, technology transfer, and capacity-building for adaptation in order to meet the needs of developing parties as part of global efforts.' As the major raw materials or processing agents of developed countries and the increasing demand of economic development contract parties, developing countries are increasingly difficult to reduce emissions, and do not have the relevant technological basis. Rashly reducing emissions and formulating environmental policies will inevitably seriously harm the interests of developing countries.

Emission reduction technologies and environmental policies need (Article 43 of the United Nations Framework Convention on Climate Change 2021) to "mobilize climate finance from all sources to the level needed to achieve the objectives of the Paris Agreement, including a significant increase in support to developing country contracting parties, exceeding US$ 100 billion per year." These funds will be used to support the rational transformation of high-emission enterprises, minimize losses in developing countries and avoid damaging the partnership between developing and developed countries (Paris Climate Agreement 2021).

According to article 15 of paragraph 4 of the Paris agreement: "taking into account the concerns of the contracting parties with the greatest economic response, in particular developing countries (Article 85 of the United Nations Framework Convention on Climate Change 2021)" also recognizes the need to ensure a fair transition towards sustainable development, poverty eradication, and the creation of decent

work and quality jobs, including by aligning financial flows with the means to achieve low greenhouse gas emissions and climate-adaptive development, including through deployment and technology transfer, and by providing support to developing country contracting parties. "As far as possible, the environmental response measures will be turned into a boost to the talents and economy of developing countries, so as to promote the coordinated development of developing countries in various aspects, avoid the failure to reach the agreed goals due to the opaque information generated by the response measures, and strengthen the confidence and credibility of both parties in cooperation and implementation of the agreement (Article 93 of the United Nations Framework Convention on Climate Change 2021).

"Emphasizes the important role of the cultures and knowledge of indigenous peoples and local communities in effective actions to address climate change, and urges contracting parties to actively involve indigenous peoples and local communities in the design and implementation of climate actions." We will formulate practical and efficient response methods based on local details, collect more information to help continuously improve the provisions of the Convention, and strive to complete the task of emission reduction in the shortest time, with the smallest loss and the largest gain (Carbon Neutrality Peak Carbon Dioxide Emissions 2022). In order to achieve "net zero-emission", the direct and indirect emissions of carbon dioxide from human activities in a specific area over a specific period of time must be absorbed through afforestation, energy conservation, and emission reduction, among other methods. This is what is meant by the term "carbon neutrality". Peak carbon dioxide emissions mean that at a certain point in time, carbon dioxide emissions will reach an all-time high and stay in the plateau. It will vary within a particular range and begin a gradual drop (Shanghai Environmental Energy Exchange Annual Report on Carbon Trading 2021)."

According to the "Shanghai Environmental Exchange Carbon Trading Report 2021", China's carbon trading is developing steadily, with the volume and tonnage of transactions increasing every quarter and more than half of the high-emission enterprises focused on entering the carbon trading market. Although the goal is clear and carbon trading is progressing in an orderly way, there are still great barriers to a low-carbon society in China (Tsinghua Climate Institute 2020). "First, China's manufacturing sector is still below the middle level in the global industrial value chain. It requires arduous economic restructuring and industrial upgrading activities in addition to high energy and material consumption. Secondly, coal takes over half of total consumption. The intensity of carbon dioxide emissions per unit of energy is almost 30% greater than the global average. It is difficult to optimize the energy structure. Third, being 2–3 times higher than developed nations and 1.5 times higher than the global average, China's energy consumption per unit of GDP makes it more difficult to build a sustainable and low-carbon economic system."

At present, the whole world is in the process of energy structure transformation and upgrading. Under the background of new energy replacing traditional energy, international pressure and other factors will lead to the unsustainable development of traditional energy industry. On the one hand, the exploitation of traditional energy continuously overdraws the natural environment on which the next generation depends for

survival, causing serious damage to the ecosystem. In order not to affect the sustainable development of mankind, carbon neutrality and peak carbon dioxide emissions are inevitable (Tsinghua Climate Institute 2020).

"Heading to the long-term goal of deep decarburization or carbon neutrality, technical breakthrough is still required in various fields. Demand-side management, energy efficiency, new and renewable energy power generation, and heat utilization all need to receive more attention, but strategic technologies that are still in their infancy but have the potential to be crucial in deep decarburization also require special attention. It is reported that large-scale energy storage, smart grid, distributed renewable energy networks, energy internet, and other technologies will all play a significant role in reducing emissions." So far, China has the ability to initially use carbon reduction technology, but there is still a gap between peak carbon dioxide emissions and western countries in commercializing it to achieve carbon neutrality. And our country's talents in this field are relatively inferior to those of western countries. In order to achieve the carbon-neutrality peak carbon dioxide emissions target, coal consumption and carbon intensity must be reduced. However, China's energy demand will continue to grow in the foreseeable future, and energy enterprises are in urgent need of reform (Xiang 2021).

"The central enterprises further optimize the industrial structure, vigorously develop strategic high-tech industries, reduce the production capacity of energy-intensive industries, and reduce total energy consumption through structural optimization. Promote advanced energy-saving technologies, promote industrial technology upgrading, reduce energy consumption intensity per unit of GDP, improve energy use efficiency, and realize technological energy conservation. We will continue the joint effort in production, consumption, and market of energy, change the energy pattern with coal, oil, and gas as the main components, create a clean, leading, electricity-centered, interconnected and new energy system, and open up a new path of green, low-carbon, and sustainable energy development."

Science and technology are the important foundation for the completion of the reform. Rational allocation of enterprise resources, active involvement in the deep development of decarburization technology and industrial innovation, transformation from product competition to product carbon index competition, accelerating the construction of intelligent power grid, and coordination among various regions to promote large-scale development of new energy. The implementation of the carbon neutrality target will inevitably bring greater survival challenges to the traditional energy industry. How the traditional energy industry should adapt to the new development environment has become an important issue. Based on this, this paper studies the advantages and disadvantages of the traditional energy industry under the background of carbon neutrality, and puts forward the countermeasures to achieve carbon neutrality in the traditional energy industry.

3 Thematic Analysis

The advantages of traditional energy industry are relatively high energy density; Secondly, it is convenient for mining, transportation and storage. Coal, oil, and natural gas are all easy to store and transport. Third, traditional energy has a large reserve and low cost. The disadvantage of traditional energy industry is that the world is currently in the process of energy structure transformation and upgrading. Under the background of new energy replacing traditional energy, international pressure and other factors will cause the traditional energy industry to be difficult to sustain development. On the one hand, the exploitation of traditional energy continuously overdraws the natural environment on which the next generation depends for survival, causing serious damage to the ecosystem. On the other hand, the technological route of new energy can be used in other industries, crowding out the remaining market of traditional energy.

There are many types of new energy sources, and different industries have different characteristics and advantages. New energy is the direct or indirect use of the sun or the earth's own resources, such as solar energy, wind energy, hydrogen energy, bioenergy, geothermal energy, nuclear energy, and water energy. Compared with traditional energy, new energy, including renewable energy and nuclear energy, has less pollution and more resources, which significantly guides solving the current serious environmental pollution and the depletion of traditional energy.

High cost is the first shortcoming of new energy, which is also the main cause of the difficulty in its early promotion. The price of different new energy sources has dramatically decreased since the growth of the electricity and photovoltaic industries. Instability is its second drawback, which is caused by the climate, such as light intensity and wind speed, rather than the unstable and immature power generation components or systems. Poor energy density is its third drawback.

In a rather long term, the new energy industry has been significantly developed in China. At present, the policy adopted by our country is that the government should guide its development, starting from the basic national conditions and based on theoretical basis and practical cases, to provide reference for the rapid development of new energy industry in our country. Compared with our country, the research and practice of the development of new energy industry in western developed countries is more referential. The experimental framework and guidelines of developed countries have shown a high degree of foresight and advancement.

The basic situation of China's energy is that coal reserves are abundant, but oil and natural gas are still difficult to meet domestic demand. For many years, coal has been the backbone of China's energy production and consumption. Coal accounts for two-thirds of China's energy consumption. The proportion of new energy is small and the growth is slow.

"Unlike traditional energy, the use of renewable energy must have better geographical conditions. However, the geographical conditions for the development of renewable energy in regions with rapid economic growth in China are often not superior. Therefore, energy supply regions and energy demand regions are often separated in

space. Taking China's electricity industry as an example, the eastern region is a region with rapid economic growth in China, and the electricity demand is correspondingly higher than that of the western region. Renewable energy electricity production is mainly concentrated in the western regions such as Sichuan, Guizhou and Inner Mongolia, resulting in the unbalanced spatial distribution of electricity demand and electricity output. Therefore, China has established a sound inter-provincial power grid system to strengthen the connection between regional power production and economic growth. Since the reform and opening up, the shortage of electric power has been the bottleneck of China's economic development. The country has also implemented the strategy of "economic development, electric power first" for a long time. However, in recent years, the growth of electricity demand in China has slowed down significantly during the period of economic transformation, which has led to a serious phenomenon of wind and water abandonment under the condition of centralized production of renewable electricity projects in some regions. The power investment of renewable energy and traditional energy must fully understand the dynamic relationship between power production and economic growth, so as to avoid the two extreme situations of power shortage and power surplus in the development of power industry and make power production match economic growth. At present, there is little research to measure the dynamic relationship between regional electricity production and economic growth" (Azhong 2021).

"In a fairly long period of time to come, the basic direction of the green and low-carbon transformation of global energy resources is clean traditional fossil energy resources and large-scale and effective renewable energy resources. At the same time, it is also necessary to emphasize the multi-energy complementarity between traditional energy resources and new energy resources, give full play to their respective endowment advantages, and integrate to form a safe, stable and reliable energy supply guarantee system. In particular, traditional energy sources should play a pivotal role in supporting the development of new energy sources" (Lv Jianzhong's 2022).

In recent years, China's continuous growth in total power generation has greatly slowed down the problem of insufficient power supply and limited economic growth. However, as a major economic center in eastern China, the demand for power is higher than that in the western region. However, the power supply is mainly concentrated in the environmental pollution of the traditional energy power production in the western region, forcing it to be more willing to put into production and build in the western region at a lower cost. Moreover, the geographical conditions of renewable energy in the western region are more advantageous. However, the power supply in economically developed regions depends on the neighboring regions, and the power demand is less dependent on the renewable energy in the western region. Under the condition of asymmetric supply and demand of electricity, the development of new energy in the western region depends on the demand for electricity from the local economic development, but also depends on the demand for electricity from the eastern economic growth.

The results of the impact of economic development on electricity production are not difficult to see: traditional energy has a positive and positive effect on the high-speed economic growth areas in the east. However, the production of new energy

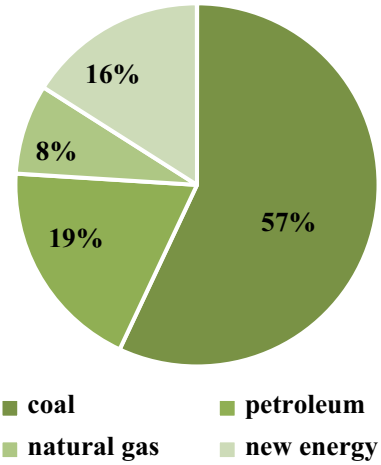


Fig. 1 Public data from National Bureau of Statistics of China (NBS)

has no significant impact on the high-speed economic growth area in the east in a short period of time. This situation has caused the construction of new energy power in the west to be put into operation but the power supply is surplus, thus giving up the construction of water conservancy projects and the construction of wind farms. While redeveloping new energy sources, our country focuses on guiding the demand for new energy and electricity in economically developed areas.

With the increasing industrialization and the increasing energy demand brought by economic development, the most important thing is whether the energy can be fully supplied. In a short period of time, traditional energy is still the main energy in our country, and it is difficult for new energy to form a large-scale and safe substitute for supply. China still needs to make good use of coal in an environmentally friendly and efficient way, increase oil and gas reserves, guarantee self-supply and build a new energy system driven by both traditional and new energy sources (in Fig. 1).

"According to China's "14th Five-Year Plan", great importance should be attached to increasing the development speed of non-fossil energy, vigorously promoting wind power and photovoltaic power generation, adhering to the principle of both centralized and distributed generation, both onshore and offshore generation, both local and external generation, both single-variety development and multi-variety complementation, both single and comprehensive scenarios, both power generation and non-power utilization, accelerating energy distribution in central and eastern regions, promoting organized development of offshore wind power, speeding up the establishment of hydropower bases in the southwest, promoting the construction of coastal nuclear power generation safely and steadily, and building a batch of clean energy bases with multiple complementary capabilities" (People's Daily 2035).

We should maintain the energy market reform: improve efficiency, reduce emissions, and actively develop new energy technologies such as photovoltaic, wind and hydro. Breaking the traditional energy monopoly on the energy market, allowing the energy market to circulate, safeguarding the environment for the growth of new

energy sources, and breaking the barriers to energy transactions, thus enabling new energy sources to spread out and completing the task of energy complementation. At the same time, renewable energy, especially wind power and solar energy, are subject to geographical restrictions and the need for land resources is likely to affect the economic development planning of the local area. China's implementation of large power grid layout, only China's power grid and China Southern Power Grid, rashly incorporating new energy into the power grid may cause a direct decrease in the stability and regulation capability of the power grid, which requires the central government to make unified planning and clearly define the positioning of new energy and traditional energy.

We should promote large-scale wind power and photovoltaic power generation bases mainly in the desert and Gobi, upgrade coal and electricity, clean up and transform them from major power stations to peak-shaving power stations. With the help of China's perennial trans-regional power transformation and transmission technology, the coordinated development of power generation, storage and load in various regions will be strengthened to achieve the complementation of new and traditional energy sources and improve the power control capability. China imports 50% of its crude oil to amuse itself in the Middle East region, and new energy cannot replace the strategic position of oil. Only oil security can guarantee energy security.

4 Conclusion

Peak carbon dioxide emissions are a quantitative change and carbon neutrality is a qualitative change. Only through the quantitative change in peak carbon dioxide emissions can the qualitative change of carbon neutrality not be achieved. Carbon neutrality can not be achieved without energy revolution, systematic social transformation of the economy and society and a green revolution. The overall transformation of the energy system is particularly important. The path of energy revolution requires scientific design and decision-making deployment based on technologies, markets and policies.

References

Article 1 of the United Nations framework convention on climate change. 13 Nov 2021
Article 15 of the United Nations framework convention on climate change. 13 Nov 2021
Article 43 of the United Nations framework convention on climate change. 13 Nov 2021
Article 85 of the United Nations framework convention on climate change. 13 Nov 2021
Article 93 of the United Nations framework convention on climate change. 13 Nov 2021
Azhong CCY (2021) Traditional energy, renewable energy, power production and economic growth—an empirical analysis based on semi-parametric structure global vector autoregression model. J South China Univ Technol (Soc Sci). 12 Jan 2021
Carbon neutrality peak carbon dioxide emissions. Eng Geophys, 30 Mar 2022

Lv Jianzhong's' to ensure energy security needs to do a good job of traditional energy and new energy strategy coordination'. The world's oil industry. 28 Apr 2022
Paris climate agreement, paragraph 4, article 15. 13 Nov 2021
People's daily, outline of the 14th five-year plan for national economic and social development of the people's republic of China and long-term objectives in 2035. 13 Mar 2021
Shanghai environmental energy exchange annual report on carbon trading (2021)
Tsinghua Climate Institute (2020) The task of carbon dioxide emission reduction in 2050 is arduous and technical support is indispensable. China Energy News 2020
Xiang Z (2021) "How to realize" peak carbon dioxide emissions. Energy Central Enterprises. State Grid. 5 Mar 2021

Analysis and Optimization of Queuing Problem in Barbershop

Bingyu Feng

Abstract Queuing is a phenomenon often encountered in daily life. In a service system, long queue time and low service efficiency will lead to a decrease in customer satisfaction. Many barbershops also face serious queuing problems that affect their customer satisfaction and competitiveness. This paper aimed to analyze the queuing problem of barbershops based on Queuing Theory. Taking Barbershop A as an example, this paper established a model based on Queuing Theory to analyze its queuing problem and aims to propose an optimization strategy for its service system and reduce customer waiting time. A sample of 1344 ($8 \times 12 \times 14$) arrivals in a period of 14 days were selected in barbershop A with eight barbers was selected to determine the arrival rate and service rate. Then, based on the data, the queuing system was modeled and tested with a new working schedule after adding one assistant to explore the efficacy of the proposed solution. As a result, the average waiting time for a customer in queues and the average number of customers in queues could be reduced by adding one assistant, who is responsible for messaging, cleaning, and checking out, using queuing theory. In addition, the profits per day also increased. Through the analysis of the barber shop queuing problem, this paper can provide a certain solution to the queuing problem of similar service systems.

Keywords Queuing theory · Barbershop · Average waiting time

1 Introduction

As the living standard increases, the need for improving one's appearance also increases. Consequently, the competitiveness within the barbershop industry increases. There are several factors that affect the overall competitiveness of one barbershop, and the average waiting time plays an important role in evaluating

B. Feng (✉)
Dornsife College of Letters, Arts and Sciences, University of Southern California, Los Angeles 91755, USA
e-mail: bingyufe@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_26

one's competitiveness. To increase the competitiveness and customer satisfaction rate, barbershops need to decrease the average waiting time.

There are some indicators that determine service efficiency and customer satisfaction. First, the average waiting time for customers is important since it plays an important role in determining customer satisfaction even before customers receive the actual service. In Eilers's article, it is concluded that waiting times are a significant component of patient satisfaction, which also applies to other service industries in which waiting occurs (Eilers 2004). Second, there are various components that determine the average waiting time. The components include the service rate, the arrival rate, the discipline of queuing, the number of available employees providing services, and the idle time between each service. Based on the queuing theory, when the service rate from the employees is less than the arrival rate from the customers, a queue appears. In the case of barbershops, queuing theory can be used to optimize the business management and service process via mathematical models and actual measurements.

In this paper, we tend to analyze the problem of barbershop A, which has a high average waiting time resulting in a low customer satisfaction rate and a low online review score. To improve customer satisfaction and decrease the average waiting time, barbershops need to optimize their business management and service process. This paper aims to apply queuing theory in barbershop A to model its service process and carry out a new strategy to improve service rate thus reducing the average waiting time.

2 Literature Review

Queuing theory is the mathematical and scientific approach to analyzing queues. There are three elements in a queuing system: the customer, who waits for service, the server, which provides the service, and the queue, which is the group of customers waiting to be served (Hall 1991). Based on the queuing theory, a model can be constructed to show the arrival rate, waiting time, service time, and departure rate. The available channels of entering a queuing system are determined by the number of available servers. If all servers are occupied, customers shall be queued to get services based on different service disciplines, which include first in first out, last in first out, priority, and shortest job first. The arrival process includes regular arrivals, which have the same amount of time between each interval, and random arrivals, which have the Poisson characteristics that exponentially distribute customer arrivals and all arrivals are independent. In addition, the service time for a server is independent for another server and the service process is also independent of the arrival process (Masek et al. 2015). Hensley and Sulek find that the only wait satisfaction that affected customer perceptions of service quality was related to the waiting time of service-entry (Hensley and Sulek 2007).

A large quantity of research has been published to show the effectiveness of queuing theory in solving real-world problems. De Bruin et al. determine the optimal

bed allocation when a maximum number of refused rates is given (Bruin et al. 2007). They construct a structural model which clearly depicts the emergency cardiac inpatient flow and analyzes data that show the impact of fluctuations in arrivals and variation. They conclude that the length of stay of patients is highly variable and merging departments can improve operational efficiency. McManus reviews the model based on the queuing theory to determine the optimal allocation of ICUs when a random demand is given (McManus et al. 2004). In his results, the rejection rate of ICU as a function of utilization is consistent with predictions from queuing theory, which concludes that high utilization of units must increasingly reject new admissions. Masek et al. provides an insight into an application optimizing warehouse store management, in which two e-points are favored due to their improvement on loading efficiency and reduction of operational cost (Masek et al. 2015). Al-Sharif et al. present the exploration of a macroscopic view of the performance of an elevator traffic system under certain conditions. They construct a system loading diagram, a Poisson model, and Simevents simulation to illustrate the concept of a workspace, which assumes finite running time and transient conditions that allow the designer to subject the elevator system's loading values to an excess of 100% (Al-Sharif et al. 2014). Koh et al. find that McDonald's service quality could be improved significantly if the food preparation time can be reduced, particularly during peak period so that the customer waiting time could be greatly reduced, which affects the customer satisfaction greatly (Koh et al. 2014). Hettiarachchi conducts the research of queuing theory to solve banking queue management problems and finds that having one line and many counters (One line) is effective than having many lines (Hettiarachchi 2016).

In the previous findings regarding the queuing model in the field of hospitals, the servers are nurses and doctors who are responsible for allocating beds and prescribing medications. Specifically, one of the solutions to decrease the average waiting time of patients who queued for getting medications is that the hospital should hire more assistants to help nurses manage documents, which are not directly involved in the service process, thus increasing the efficiency of nurses when distributing prescription medication. Based on the observation of Barbershop A's service process, between each service period, there is an idle period for servers to take a rest and do personal things including messaging other clients, checking out, and cleaning service areas. The logic of hiring assistants to reduce the burden of unnecessary work that is not directly involved in the service process can also be applied to the situation of barbershops, whose servers were found to have the burden of unnecessary work after providing each service. Based on the situation, this paper proposes a hypothesis that Barbershop A should hire an assistant who is only responsible for checking out, messaging clients, and cleaning service areas to reduce the idle period of servers between each service and thus possibly reducing the waiting time.

3 Methodology

This paper assumes that the average service rate of servers is stable and will remain unchanged since the skills of barbers are mature and stable in a short period of time.

A sample of 1344 ($8 \times 12 \times 14$) arrivals in a period of 14 days were selected in barbershop A with eight barbers. The data include the arrival rates, service rates, and average waiting times. Based on the Poisson distribution model, we assume that arrivals of customers are random and independent. We also assume that all barbers have the same level of skills and independent service processes. The queuing model follows the discipline of first-in-first-out.

Based on the findings of previous works, this paper models the queuing system of barbershop A based on the Poisson distribution because the arrival of each customer is independent and random. Each barber represents an individual server, whose service process is independent of the arrival process of each customer and whose service rate is independent of that of other servers. If all servers are occupied, upcoming customers will be queued and be subject to the queuing discipline of first-in-first-out.

The formula of the queuing model is shown below:

Average number of clients receiving services $r = \lambda/\mu$.

Average number of clients in queue $L = Lq + r$.

Average waiting time in queues $Wq = Lq/\lambda$.

Average total time spent in the barbershop $W = Wq + 30/\mu$.

Average server utilization $\rho = \lambda/s\mu$.

4 Results and Discussions

The business process of barbershop A services consists of three stages.

First, walk-in clients come and choose barbers they prefer. Then, barbers provide services. Meanwhile, barbers who are on rest may receive calls from potential clients to make an inquiry about the service and queuing time. If clients are inclined to come and get service, barbers will reserve a spot for them in the queue. Second, when working barbers finish their services, barbers check their clients out and may answer calls or messages from potential clients. Third, after providing one service, barbers may have a 10 min break before providing the next service. During this 10 min break, barbers need to clean their service areas to prepare for the next clients.

On average, within the 14 days, barbershop A, consisting of 8 barbers, has provided 96 services per day. These services are exponentially distributed. Based on the 8 h working hours, from 10 am to 6 pm, each barber on average provides 12 services, which means one service cycle costs 40 min. Specifically, one service cycle contains an average service time of 30 min and a 10 min break.

The arrival rate, λ, was the number of customers who entered to Barbershop during a period of 1 h. The service rate, μ was the number of services delivered from one barber to customers during a period of 1 h.

Table 1 Changes due to the scenario of hiring one assistant

μ	λ	Average server utilization	The average number of customers in line for service	The average number of customers in the system	The average waiting time for a customer in queues	The average time a customer spends in the system
1.50	4.00	2.67	4.27	6.93	1.07	1.73
2.00	4.00	2.00	4.00	6.00	1.00	1.5

Since in an 8 h work shift, a total of 8 barbers can deliver a total number of 96 services in an 8 h working schedule, the service rate $\mu = 1.5$.

Based on the documented data, the arrival rate $\lambda = 4$.

After adding one assistant, each barber's working period was reduced to 30 min from 40 min, for 10 min of chatting, cleaning, and checking out are now done by the assistant. Consequently, a barber can provide a maximum of 16 services per day in an 8 h working schedule, and the service rate is increased to 2 since $\mu = 16/8 = 2$. As a result, the average number of customers in line for service is reduced from 4.27 to 4.00, the average number of customers in the system is reduced from 6.93 to 6.00, the average waiting time for a customer in queues is reduced from 1.07 to 1.00, and the average time a customer spends in the system is reduced from 1.73 to 1.50 (Table 1).

Based on the analysis above we can confirm that the addition of one assistant can increase working efficiency and decrease the waiting time. However, if the additional cost is higher than the potential increase in revenue, the proposed solution is not practical for small businesses. Next, we will evaluate the economic effect of the proposed solution on the overall profits.

After adding one assistant, the 10-min break would be eliminated, since the assistant would deal with all works that do not directly relate to customer services. As a result, based on the 8 h working hours and an average service time of 30 min, a barber can provide a maximum number of services of 16, which increases 4 services from 12 services. So, the total services provided per day for 8 barbers would be 128 services. The average salary for a barber is $20/h and the average salary for an assistant is $14/h. The number of total services provided per day will increase from 96 to 128, which increases profits by $1600. Besides, the cost of hiring 1 assistant per day is $112.

Based on the calculation above, after adding one assistant, the profits increase from $3480 to $4968 per day. As a result, the addition of one assistant would not only lead to an increase of $1488 in profits, but also reduce the average waiting time and the average number of customers in queues.

5 Conclusion

This paper proposed a solution for barbershop A to decrease the waiting time and increase the customer satisfaction rate, thus increasing the overall profits as well. The average waiting time for a customer in queues and the average number of customers in queues could be reduced by adding one assistant, who is responsible for messaging, cleaning, and checking out, using queuing theory. In addition, the profits also increase. However, this analysis still has limitations. For instance, this paper used the sample data from a barbershop, which has a relatively standardized service process for each male customer. As a result, the standardization of services simplified the calculation process, which might be not suitable for other business entities, whose services are more random and flexible in terms of time and working process. Besides, appointments were also excluded in this paper since it would disrupt the queuing disciplines of first-in-first-out and be difficult to calculate mathematically. In the future, I shall add more flexible procedures into this model, including appointments and cancellations, which might provide more solutions to same kind of small businesses.

References

Al-Sharif L, Abu Alqumsan AM, Ghanem W, Tayeh I, Jarrar A (2014) Modelling of elevator traffic systems using queuing theory. In: 4th symposium on lift and escalator technologies, vol 4, pp 9–18

De Bruin AM, Van Rossum AC, Visser MC, Koole GM (2007) Modeling the emergency cardiac in-patient flow: an application of queuing theory. Health Care Manag Sci 10(2):125–137

Eilers GM (2004) Improving patient satisfaction with waiting time. J Am Coll Health 53(1):41–48

Hall RW (1991) Queueing methods: for services and manufacturing. Pearson College Division

Hensley RL, Sulek J (2007) Customer satisfaction with waits in multi-stage services. Managing Serv Qual: Int J

Hettiarachchi AT (2016) Application of queuing theory to enhance the operational efficiency of the bank. Doctoral dissertation

Koh HL, Teh SY, Wong CK, Lim HK, Migin MW (2014) Improving queuing service at McDonald's. In: AIP conference proceedings, vol 1605, no 1, pp 1073–1078. American Institute of Physics

Masek J, Camaj J, Nedeliakova E (2015) Application the queuing theory in the warehouse optimization. Int J Ind Manuf Eng 9(11):3744–3748

McManus ML, Long MC, Cooper A, Litvak E (2004) Queuing theory accurately models the need for critical care resources. J Am Soc Anesthesiologists 100(5):1271–1276

Analysis of the Impact of Crossover Brand Co-branding on Consumer Purchasing Behavior

Mengtong Wang

Abstract Cross-border co-branding is one of the very popular marketing methods nowadays, consumer is benefitting a lot from that. Moreover, the co-branded products of Dior and Air Jordan have gained a very big buzz worldwide in 2020. This article was mainly based on the cross-border co-branding case of Air Jordan and Air Jordan to explore how consumers' purchasing behavior is influenced. This paper uses the theory of planned behavior to investigate how various influencing factors affect consumers' buying behavior. Later the research made a qualitative analysis by SWOT analysis on Dior with various influencing factors as variables. The conclusion of this study was that various influencing factors act externally and internally, respectively, to influence consumers' purchasing behavior by affecting their attitudes and subjective norms. Therefore, in the next cross-border co-branding marketing, brands should pay more attention to consumers' real needs in order to influence consumers and promote their purchasing behaviors.

Keywords Air Jordan · SWOT · Cross-border brand · Co-branding

1 Introduction

1.1 Research Background

With the gradual development of the market, more and more brands have started to choose cross-border co-branding as a marketing method. With one successful case after another, cross-border co-branding has now become a popular marketing strategy. More and more brands are starting to collaborate with brands/IPs from different sectors to launch new products together to attract the attention of consumers

M. Wang (✉)
Guangdong University of Foreign Studies, Guangzhou, Guangdong Province, People's Republic of China
e-mail: 20180602147@gdufs.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_27

and thus drive their buying behavior. These collaborations also bring a lot of benefits to both partners, not only in terms of profits from product sales, but also for brand image enhancement. A good example of this is the launch in 2020 of the Air Jordan 1, a joint project between the luxury brand Dior and the sports brand Air Jordan (Nike's Dior 2022). A cross-border collaboration between a luxury brand and a sports brand, Dior and Air Jordan's co-branding has created a huge buzz around the world. Basically, it is one of the most successful joint collaborations between a luxury brand and a sports brand since Chanel and Reebok launched co-branding shoes in 2002. The most expensive Air Jordan shoe ever made, the Air Jordan 1 OG Dior High is priced at 18,000 RMB and 16,000 RMB for the Air Jordan 1 OG Dior Low (Nike's Dior 2022). Only 13,000 pairs of the sneaker were produced worldwide, 5000 of which were supplied to Dior's VIC, with only the remaining 8000 pairs available in a worldwide lottery (Dior x Air Jordan 1 co-branded shoe 2022). Despite this, the number of participants in the lottery reached 5 million, with a winning rate of just 0.16% (Dior x Air Jordan 1 co-branded shoe 2022).

1.2 Research Gap

Although cross-border co-branding is very popular, there is not much research on cross-border marketing. Li and Wang used the trendy brand supreme as the subject of their study and conducted a qualitative study of customers to analyze the impact of co-branding on Supreme's brand image. In the Chinese market, Zhao and Sun used the SOR theoretical model, SEM methods and questionnaires to analyze what factors have an impact on consumer acceptance of cross-border co-branding in the case of cross-border marketing. Nowadays, as more and more brands use cross-border co-branding as a marketing tool, there are many failures that are gradually showing up. Not all cases of cross-border co-branding are as successful as the case of Dior and Air Jordan. The recent Adidas and Gucci co-branded collection, for example, was criticized on Chinese social media. This is because the Adidas and Gucci co-branded umbrella is priced at 11,000 RMB, but on the details page it shows that this umbrella is not waterproof. The hashtag #SaleRMB11,100 co-branded umbrella is not waterproof has also made its way onto the top search lists on Weibo, Douyin and other platforms. In the face of all the criticism on the internet, Gucci and Adidas have responded by saying that "this umbrella is highly collectible and is not recommended for everyday use" (Adidas and Gucci Cross-Border Co-Branding Why the Waterloo 2022).

The co-branding of a leading luxury brand and a leading sports brand, adidas and Gucci, has received a very different response in the Chinese market than the co-branding of Dior and Air Jordan. In these two cases, what factors influenced consumers' buying behavior, resulting in different final outcomes? This paper looks at the case of Dior and Air Jordan to find out how each of these factors influenced consumer behavior in the cross-border co-branding. This paper hopes to explore the factors influencing consumer buying behavior, so as to understand how crossover

co-branding works in influencing consumers, and to provide some help as well as new ideas for the next crossover co-branding marketing plan.

1.3 Fill the Gap

This paper will review the definition of cross-border co-branding and the TPB model and related literature and use the TPB model as a tool to find information and data to conduct a SWOT analysis of the successful case of cross-border co-branding between Dior and Air Jordan. Based on the results of the analysis it will be explored to what extent and from which perspective the factors influencing consumer buying behavior in cross-border co-branding marketing will each have an impact on consumer buying behavior. Finally, the findings will be discussed, and recommendations made in the context of the current state of cross-border co-branding.

2 Literature Review

2.1 Co-branding

Co-branding is a marketing strategy that utilizes multiple brand names on a good or service as part of a strategic alliance (Co-branding 2022). Co-branding, sometimes referred to as a brand partnership, is a form of collaboration between two or more well-recognized companies that retains the names of all participants. It often has a medium- to long-term lifespan, and its ability to create net value is insufficient to warrant the establishment of a new brand or formal joint venture (Blackett and Boad 1999). With the use of distinctive logos, brand identifiers, and color palettes, each brand participating in such a strategic partnership contributes to the collaborated brand while maintaining its own identity (Co-branding 2022).

Co-branding is to combine the market presence, name recognition, favorable associations, and cachet of two or more brands in order to persuade consumers to pay more for them. Additionally, it can reduce a product's susceptibility to private-label competitive imitation. (Besharat and Langan 2014). Over the past two decades, the number of brand partnerships has increased significantly as awareness of the growth opportunities presented by this strategy has grown.

2.2 Important Results

For many firms looking to grow their client bases, profitability, market share, customer loyalty, brand image, perceived value, and cost savings, co-branding is a

useful strategy. Co-branding is a strategy used by many different sorts of companies to build synergies based on the distinctive qualities of each brand, including merchants, eateries, automotive manufacturers, and electronics producers (Co-branding 2022). Co-branding may lessen the need for expensive investments in pursuing new markets or be a strategy for overcoming non-financial entry barriers, increasing brand exposure, lowering risk, accelerating the payback of investments, facilitating price profit maximization, or offering a fresh method of reaching the market (Besharat 2010).

Two (or more) parties consciously deciding to collaborate on a specialized product can spark co-branding. It can also occur because of a company merger or acquisition in order to transfer a brand associated with a well-known manufacturer or service provider to a more well-known company and brand (Co-branding 2022). The positive perception of co-branding among consumers is influenced by several things (Ajzen 1991). The brand attitude of the partner brands, perceived brand quality, brand equity, brand familiarity, fit between the brands, brand involvement, variety seeking, need for uniqueness, and consumer brand consciousness are some of the success factors that have received attention in the co-branding literature.

2.3 Theory of Planned Behavior

The theory of planned behavior was proposed by Icke Ajzen in 1985. It is an extension of the Theory of Reasoned Action (TRA) jointly proposed by Ajzen and Fishbein. The individual purpose to carry out a specific conduct is a key component of the idea of planned behavior, just as it was in the original theory of reasoned action. The motivating elements that drive an action are thought to be captured by intentions, which are signs of how much effort someone is prepared to put forth to carry out the conduct (Theory and of Planned Behavior 2022). The TPB is comprised of six constructs that collectively represent a person's actual control over the behavior (Ajzen 2011). The degree to which a person has a favorable or unfavorable opinion of the behavior of interest is referred to as their attitude. It requires taking into account how the conduct will affect the results. Behavioral intention is a set of motivational elements that affect a certain activity; the stronger the intention, the more probable it is that the behavior will be carried out. And subjective norms are the notion of whether the majority of individuals find the behavior to be acceptable or unacceptable. It has to do with a person's opinions about whether peers and significant others believe the individual should indulge in the behavior. Social norms are the accepted standards of conduct within a community, a population, or a broader cultural setting. The term "perceived power" describes the perception of elements that may help or hinder the accomplishment of a behavior. Each of those factors is thought to be under a person's behavioral control to some extent depending on perceived power. The perceived ease or difficulty of carrying out the desired activity is known as perceived behavioral control. People perceive behavioral control differently based on the situation and their actions, which causes views of behavioral control to fluctuate (Ajzen 2011).

2.4 Important Results

The performance of a behaviorism is a joint function of intentions and perceived behavioral control, claims the theory of planned behavior. Several requirements must be met for a prediction to be correct. First, the behavior that is to be predicted must match or be compatible with Ajzen the measures of intention and perceived behavioral control. Meaning, the described context must be the same as the setting in which the action is to occur, and intents and perceptions of control must be evaluated in respect to the specific activity of interest (Theory and of Planned Behavior 2022). Intentions and perceived behavioral control must be constant between the time of their evaluation and the behavior's observation is the second requirement for accurate behavioral prediction. The precision of perceived behavioral control is the third prerequisite for predictive validity (Theory and of Planned Behavior 2022).

According to the idea of planned action, there are three fundamentally distinct factors that influence intention. The first factor is a person's attitude toward the activity, which describes how positively or negatively they see the behavior in issue. The second predictor is a social variable known as subjective norm, which refers to the felt social pressure to engage in the conduct or refrain from doing so. The third antecedent of intention is the level of perceived behavioral control, which, as this paper saw earlier, refers to how easy or difficult the behavior is thought to be to carry out. It is supposed that this antecedent reflects prior experience as well as anticipated obstructions and hurdles.

Generally speaking, the stronger an individual's intention to engage in the action under consideration should be, the more positive the attitude and subjective norm with respect to a conduct, and the larger the perceived behavioral control (Ajzen 2011).

2.5 Summary

However, today, the theory of planned behavior is more often used in studies on health and less often in studies on marketing. As one of the most frequently cited and influential models for predicting human social behavior, the Theory of Planned Behavior may have good results if used in marketing research (Sarsby 2016). Therefore, this paper wants to investigate how the theory of planned behavior is used in the marketing direction to predict consumers' buying behavior.

For cross-border brand co-branding, it is not only the product-level characteristics that have an impact on consumers, but also the brand-level characteristics are very important. The synergistic effect of combining two brands is very significant for consumers. Brand attitude, perceived brand quality, brand equity, brand familiarity, brand fit, brand engagement, diversity seeking, need for uniqueness, and consumer brand awareness play a key role in influencing consumer buying behavior for co-branded marketing. These factors influence the consumer's intention to purchase. The

more the product satisfies the factors influencing the consumer's purchase behavior, the stronger the consumer's purchase intention will be. If the synergistic effect of the two brands matches the local social customs of the consumers, the stronger the purchase intention of the consumers will be, while on the contrary, the consumers will have a negative attitude towards the products, which will affect the purchase behavior.

3 Method

3.1 Research Design

A variety of method are used to assess the important factors of co-branding, each has its advantages and disadvantages. Most of the paper used the method of quantitative research, by collecting data through questionnaire for target consumers. However, because there is a paucity of qualitative studies in the literature on co-branding, in order to fill this gap, this paper is going to using qualitative research method. This paper will mainly use SWOT analysis to summarize and analyze the various factors that may influence the consumer's purchasing behavior in the case of Dior and Air Jordan's co-branding. It will also analyze the reasons for the success of the Dior and Air Jordan co-branding by combining internal and external conditions.

SWOT analysis is a 4-box strategy analysis and strategy development framework, which is derived from Strengths, Weakness, Opportunities and Threats (Theory and of Planned Behavior 2022). The primary objective of a SWOT analysis is to help organizations develop a full awareness of all the factors involved in making a business decision (Dior Company's Market Analysis in the UK 2022). The Strengths (S) and Weakness (W) refer to the internal factors, while Opportunities (O) and Threats (T) refer to the external factors. A SWOT analysis of the case will help us to understand the strengths and weaknesses that distinguish it from other cases, and combined with an analysis of the external market environment, will allow us to understand the future opportunities as well as threats.

Some literature has conducted quantitative analysis of Air Jordan and Dior consumers, i.e., using questionnaires to obtain data and generalize conclusions. For example, Luo and others market research report on Air Jordan in China concluded that consumers attach the most importance to the appearance of the product, while price, performance, and popularity are in the second tier of consumer concerns. But the reason behind such a conclusion is very curious. Qualitative analysis is a very effective way of exploring how these factors influence consumer purchasing behavior, and Study corgi's analysis of the Dior market in the UK uses qualitative analysis to analyze the current state of the Dior market in the UK and provide recommendations for the current state (Consumption Patterns Are Changing with Younger Generations 2022). This paper combines TPB theory to analyze from what perspective various factors influence consumers, so as to deeply explore the decision-making process of

consumers' purchasing behavior and uncover the reasons behind certain influencing factors that consumers value. Based on the results of the analysis, this paper then proposes recommendations for the future development of co-branded marketing. The main purpose of this paper is to provide some theoretical help and suggestions for the next co-branding cases. So, in order to achieve this purpose, it is necessary to conduct a SWOT analysis.

3.2 Ari Jordan

Air Jordan, a brand of the American company Nike, started out as a sneaker for basketball superstar Michael Jordan. The first air Jordan was released in 1985 and it has been almost forty years since then. As one of the most influential sports brands, Air Jordan is very popular all over the world. Air Jordan's main line has been launched to the Air Jordan XXXVI (36) series. In addition to the main line of products, Air Jordan also contains some secondary lines of sneakers, but the most popular is the main line series. Dior x Air Jordan 1, the subject of this article, is a joint launch of Dior and Air Jordan, a co-branded sneaker based on Air Jordan's first series of sneakers, Air Jordan 1. Dior is a French luxury Dior is a French luxury house, founded in 1946 by French designer Christian Dior. Now Dior belongs to LVMH, the world's largest luxury group. The Dior x Air Jordan 1 is one of the products of Dior's rejuvenation strategy. The Dior x Air Jordan 1 was launched in 2020, and as the most expensive Air Jordan shoe ever released, it has caused intense debate around the world, as well as gaining high popularity (Nike's Dior 2022).

Also, as millennials grow older, they are gradually becoming the mainstream consumers of today, so the consumers in this paper are mainly discussed based on millennials as a consumer group (Millennial Marketing Statistics 2022). Millennials, defined as those born between 1981 and 1996, are also referred to as Generation Y or Gen Y. Most of the millennials are highly educated, and as one of the beneficiaries of the development of the Internet, most of them are proficient in various social software and their consumption behaviors are heavily influenced by social media. According to survey data, 93% of millennials own smartphones and 90.4% of millennials are active on social networks (5 Core Characteristics and of Millennials and How to Market Based on Each One 2022). Millennial consumers are more likely to get information about products they need from social media and are more likely to get recommendations from their social networks accordingly (SWOT Analysis of Dior 2022).

3.3 SWOT Analysis

Strength. Air Jordan is based on Michael Jordan, a great basketball player who has a huge fan base all over the world. As one of the most popular sports brands in the world, Air Jordan has a very large consumer base, and they all have relatively strong spending power. Also, this is the first time that the head luxury brand Dior is co-branded with a sports brand. Dior as a 34-year-old fashion house, now belongs to the world's largest luxury group LVMH. It is indisputable that Dior also has a very large and loyal customer base. Dior's customers are people between the ages of 15–40 who have a tendency towards fashionable clothing and accessories. Dior's customers come from upper-middle and high-income social groups (Has the Sports Brand "Gone Bad" by Associating with Luxury Goods 2022).

Combined with millennials' preference for social media, this large group of consumers has a strong influence on social media, and their loyalty and love for the brand makes them willing to share their purchases and thus recommend others to buy the brand. This factor influences the "subjective norm" part of the theory of planned behavior. With the influence of brand loyalists, the purchase of Dior or Air Jordan is perceived by most people as receiving positive feedback and support from their peers or similar people, thus positively influencing the purchase behavior of these consumers.

In recent years, Dior has focused on its youthful strategy and collaborated with many popular celebrities around the world, such as Jisoo from Blackpink, Rihanna, Bella Hadid and so on. With the success of celebrity marketing, Dior's popularity has skyrocketed in the minds of millennials and Generation Z who rely on social networks. Also due to the addition of Michael Jordan, the legendary ball player, Air Jordan has been a symbol of sentiment in the hearts of many consumers, especially millennial male consumers. For many consumers, being a fan of Michael Jordan, they will always keep a good impression of Air Jordan because of the addition of their idol.

Brand image affects consumers' attitude towards the brand's goods. For example, in 2018 Dolce & Gabbana produced a promotional video related to Chinese culture in order to enter China, but the brand's lack of understanding of Chinese culture resulted in a finished product that was very offensive to Chinese people. Under such circumstances, Dolce & Gabbana's brand image fell to the ground in China, and Chinese consumers' attitude towards Dolce & Gabbana tended to be negative and refused to buy Dolce & Gabbana's products as a result. Therefore, a good brand image can make consumers' attitude towards brand products tend to be positive. Dior's brand image has always been high-class, gorgeous and elegant, so in the eyes of consumers, Dior's products represent high quality in line with Dior's brand image, and consumers will be happy to buy Dior's products. Through the celebrity effect, this will make consumers trust Air Jordan's products. According to the theory of planned behavior, consumers' good attitude towards the goods will give positive feedback to their behavioral perception control, which will promote consumers' purchasing behavior.

The Dior and Air Jordan co-branded sneaker is a limited edition, with only 8000 pairs available worldwide. This scarcity effect, combined with its status as Dior's first co-branded product with a sports brand, greatly increases the collector's value of this co-branded sneaker, making consumers more eager for the shoe and more likely to be impulsive to buy for the sneaker.

The limited-edition strategy collectively influences consumers' attitudes and subjective norms about the item. The limited quantity strategy makes consumers feel that the item is scarce, which increases their desire for the sneaker. This influences the consumer's attitude towards the product. Then when many people express their desire for the sneaker on social media at the same time, it creates an atmosphere on social media that drives people to buy the sneaker. Consumers will think that there are so many people who want to buy these sneakers as much as they do, then the act of buying these sneakers is supported, which affects the subjective norm part. Under the influence of both, the consumer's perception of the purchase behavior will tend to be stronger, thus promoting their purchase behavior.

Weakness. This joint sneaker is very expensive. the Dior and Air Jordan joint sneaker is priced at 18,000 RMB for the high-top model and 16,000 RMB for the low-top model. The Dior x Air Jordan 1 is ten times more expensive than an ordinary pair of Air Jordan 1, which costs around 1000–1500 RMB. This is actually beyond the purchasing power of the vast majority of Air Jordan consumers. This factor affected the consumers' attitude towards Dior x Air Jordan 1, as the lack of money made their attitude towards the sneaker more negative, thus discouraging them from buying it.

Opportunities. Dior and Air Jordan's collaboration was forward-thinking, and at the beginning of 2022, luxury brands and sports brands went into "blowout mode" [19]. Another luxury brand, Miu Miu, also announced a collaboration with New Balance, Loewe chose to launch a joint model with the new sports brand On, and the French designer brand Ami decided to collaborate with Puma. In addition, Supreme and Burberry's joint collection was officially launched on March 12, a week after the news that the former will collaborate with Louis Vuitton again. Dior, which chose to collaborate with Air Jordan in 2020, is certainly forward-looking. In the period between 2017, after the important success of Supreme's collaboration with Louis Vuitton, and 2022, before luxury brands are heavily co-branded with sports brands, co-branding between luxury brands and sports brands is rare and can draw the attention of consumers, thus prompting them to get to know them.

Threats. With the explosion of Dior and Air Jordan co-branded Air Jordan 1, the price of Dior Air Jordan 1 in the secondary market remains high, but at the same time, there are many fake shoes in the secondary market. In the absence of supervision, consumers buy imitated products at too high a price, which will make consumers' impression of the brand worse and reduce the brand's goodwill in consumers' minds.

At the same time these imitations, if they are too ubiquitous, will also directly affect the consumer's attitude towards the co-branded sneakers. For example, if consumers find that many people buy Dior x Air Jordan 1 imitations, and at the same time the imitations are very widespread, this will make consumers have an idea that it is

not worth spending the original price or higher price to buy the genuine product, or consumers think that there are too many imitations, and wearing the genuine product will also give a feeling of wearing imitations, for example, 2010s supreme in the Chinese market is flooded with imitations This situation, which leads to consumers' attitude towards Dior x Air Jordan 1 tends to be negative and will reduce their willingness to buy.

In 2020, the New Crown epidemic broke out all over the world, and because of the lockdown, many businesses were unable to operate and many people lost their jobs, people put more money into daily consumption and chose more cost-effective objects, and their desire for luxury consumption was greatly reduced. So due to the poor economic situation, people may be less likely to buy for the massive premiums brought by brand co-branding compared to before the epidemic.

In the post-epidemic era, many people's income is greatly reduced or even lost. People's attitude towards expensive goods will tend to be negative in order to make a living, because buying expensive goods adds an unnecessary expense and brings more pressure to their lives. So, in this situation people will choose not to buy expensive goods such as Dior x Air Jordan 1, but to look at goods such as ordinary Air Jordan which are relatively more cost-effective.

4 Results

So, in the case of the Dior and Air Jordan co-branding, the main factors that influence consumers' purchasing behavior are the uniqueness of the product, brand fit and brand loyalty. As the first product launched by the head luxury brand Dior Sports in association with a sports brand, the uniqueness of Dior x Air Jordan 1 is undeniable. At the same time Dior and Air Jordan have also adopted a hunger marketing strategy by launching a limited-edition model, making the product uniqueness a step up. Such a gimmick of limited-edition collaboration between two head brands in different fields affects consumers' attitudes. According to the theory of planned behavior, the more positive the attitude, the greater the support from others, and the greater the perceived behavioral control, the greater the behavioral intention. Millennials are more willing to get support from social networks, and with a host of celebrities having already put their feet on the co-branded shoe beforehand and posting it on social networks, it will create a subjective norm that most people are in favor of buying the co-branded shoe. Although the price of the shoe is expensive for the average consumer, and at this point may make many consumers perceive that performing the act of purchase is difficult and will deter many average Air Jordan consumers, for many Dior consumers, the shoe is affordable, so with the addition of positive attitudes and positive subjective norms, they will be motivated to perform the act of purchase.

At the same time, Dior has been implementing marketing strategies to rejuvenate its brand image in recent years, including but not limited to collaborating with popular celebrities around the world, using celebrity marketing to impress young

consumers, and being present in various social media where young people are active to communicate with millennials and young consumers of the Z generation. With the support of these strategies, Dior's brand image has begun to rejuvenate. Under such circumstances, Dior's cooperation with Air Jordan, a sports brand with a high affinity for young people, is undoubtedly a good fit. This kind of co-branding that fits the brand image of both sides will give consumers the impression that the co-branding carried out by both sides is sincere and not casual. To a greater extent, it strengthens the positive attitude of consumers towards the co-branding, which will prompt them to make a purchase. In addition, the huge loyal consumer base accumulated by both parties through emotional marketing will also encourage these consumers to buy the joint shoes.

5 Discussion

Thus, if a new co-branding marketing is to be done, how to get better results? First of all, we need to understand what kind of people are the target consumers of the product. For example, the main consumers of a large proportion of goods are now millennials and Generation Z. To motivate these consumers to buy, brands need to understand their characteristics, such as reliance on social media, focus on value for money, focus on social responsibility, and so on. By using the product's selling points to market and promote on social media, the main forum for these consumers, it creates the idea that their purchases are favored and wise, reinforcing their subjective norms. It also takes advantage of their desire for uniqueness and value for money to influence their attitude toward the product.

One example of failure can be cited here. Not too long ago, Gucci and Adidas co-branded merchandise created a huge buzz on Chinese social media, while the vast majority of these discussions were negative. The main reason was that the co-branded umbrella from Adidas and Gucci was not waterproof and was also very expensive, at around 11,000 RMB. This touches on the price sensitivity of millennials and Gen Z. They are not going to spend 11,000 RMB for an umbrella that is not waterproof. This has a direct impact on the attitude of many consumers towards this co-branded product, making their attitude towards Adidas and Gucci co-branded products more negative than that of Air Jordan and Dior co-branded products. And Gen Z likes to express their opinions on social media. After the negative opinions about Adidas and Gucci co-branded merchandise become more frequent on social media, consumers' subjective norms will be affected, making them think they are disapproved of buying this product, even though they may have the attitude of wanting to buy it. This is a very important reason why Adidas and Gucci's co-branded merchandise failed in the Chinese market.

Therefore, to a large extent, it is necessary for brands to conduct research on consumers to understand their real needs, so as to choose the right partners to cater to their preferences, and to carry out targeted marketing promotion through the characteristics of the main target consumers, using the characteristics of the products to

make consumers have a positive attitude towards co-branded products, and at the same time make them feel that their purchase behavior is supported, acceptable and reasonable, so as to predict consumers' purchase behavior.

6 Conclusion

In the current context of cross-border co-branding, especially the spurt of cross-border co-branding between luxury brands and sports brands, this paper examines the successful case of co-branding between luxury brands and sports brands, Dior and Air Jordan. This paper conducts a SWOT analysis for the case of Dior and Air Jordan combined with the theory of planned behavior and explores how consumers' purchasing behavior is influenced by different influencing factors. According to the Theory of Planned Behavior, when influencing factors positively affect consumers' attitudes towards purchasing behavior, it will have a catalytic effect on consumers' purchasing behavior. At the same time, brands need to pay attention to and guide the trend of social media to influence consumers' purchasing behavior from the perspective of subjective norms. By intervening positively on attitudes and subjective norms, it influences consumers' perceived behavioral control and ultimately strengthens consumers' willingness to buy.

Therefore, for the brands that are or will be carrying out cross-border co-branding, they need to consider the needs of consumers, so as to choose the right objects to carry out cross-border co-branding and launch products that meet the needs of consumers. And they need to control external factors to influence consumers' purchasing behavior from both internal and external aspects.

This paper provides a new research angle to study the purchasing behavior of consumers in cross-border co-branding, but the authors believe that it would be fuller if there were some large volumes of data to support the article. The authors also found that not many studies have been conducted in the area of this paper, so in future studies, subsequent researchers can use this paper as a basis for more quantitative analysis or by analyzing other cases to provide stronger support for this conclusion.

References

5 Core characteristics of Millennials and how to market based on each one. https://adespresso.com/blog/marketing-to-millennials/. Last accessed 06 July 2022

5 million people apply for Dior x Air Jordan 1 co-branded shoe, price speculated to $10,000. https://www.yicai.com/news/100697591.html. Last accessed 17 June 2022

Adidas and Gucci cross-border co-branding why the waterloo? https://www.163.com/dy/article/H7TLN5QQ0529CQD6.html. Last accessed 02 July 2022

Ajzen (1991) The theory of planned behavior. Organ Behav Human Decis Process (50):179–211

Ajzen (2011) The theory of planned behavior: reactions and reflections. Psychol. Health 9(26):1113–1127
Besharat A (2010) How co-branding versus brand extensions drive consumers' evaluations of new products: a brand equity approach. Ind Mark Manage 8(39):1240–1249
Besharat A, Langan R (2014) Towards the formation of consensus in the domain of co-branding: current findings and future priorities. J Brand Manag 2(21):112–132
Blackett T, Boad B (1999) Co-branding the science of alliance, 1st edn. Macmillan Press Ltd, The United Kingdom
Co-branding. https://www.investopedia.com/terms/c/cobranding.asp. Last accessed 02 July 2022
Consumption patterns are changing with younger generations. https://www.group.pictet/wealth-management/consumption-patterns-are-changing-younger-generations. Last accessed 05 July 2022
Dior Company's market analysis in the UK. https://studycorgi.com/dior-companys-market-analysis-in-the-uk/. Last accessed 05 July 2022
Has the sports brand "Gone Bad" by associating with luxury goods? https://www.bjnews.com.cn/detail/1648202434168721.html. Last accessed 06 July 2022
Millennial marketing statistics. https://truelist.co/blog/millennial-marketing-statistics/. Last accessed 06 July 2022
Nike's Dior co-branded sneakers are hyped at $130,000, what are the concerns behind the "gold rush"? https://www.zgswcn.com/article/202007/202007111121261029.html. Last accessed 17 June 2022
Sarsby A (2016) SWOT analysis: a guide to SWOT for business studies students. Leadership Library, The United Kingdom
SWOT analysis of Dior. https://www.marketing91.com/swot-analysis-dior/. Last accessed 06 July 2022
SWOT analysis: what it is and when to use it. https://www.businessnewsdaily.com/4245-swot-analysis.html. Last accessed 02 July 2022
The theory of planned behavior. https://sphweb.bumc.bu.edu/otlt/mph-modules/sb/behavioralchangetheories/BehavioralChangeTheories3.html. Last accessed 02 July 2022

Analyze the Business Value of Niche Products Based on Long-Tail Market Theory

Dongni Liu

Abstract Niche market is the inevitable development of market competition, "long tail theory" with its unique perspective for the niche market provides a wealth of marketing value, has important practical significance for China's small business marketing. However, there is a lack of systematic classification and research on the rich commercial value of such niche toys. This paper will collect and analyze search data for goods in Google Trends, classifying and summarizing such products that conform to the long tail theory. The study found that outdoor sports categories such as fishing gear and water equipment are most in demand in summer; Niche toys such as patchwork and pet dogs are widely sought after by people during the epidemic; Nail polish glue and false eyelashes, which belong to beauty products, are also very popular. It is recommended to promote seller sales from the three dimensions of user demand, encouraging the introduction of goods, and improving marketing and category construction.

Keywords Long-tail market · Niche products · Niche markets · Internet economy

1 Introduction

1.1 Research Background

According to the "2020–2021 Annual Development Report on China's Cross-border Export B2C E-commerce" released by i-Research, the niche categories of the Red Sea and the long tail effect of the blue ocean will contain a large number of opportunities in the future (Plunkett 2021). The "long tail theory" was first proposed in 2004 by Wired magazine editor-in-chief Chris Anderson (Markwood 2010). In the traditional

D. Liu (✉)
The Sino-British College, University of Shanghai for Science and Technology, Shanghai 20000, China
e-mail: SBC-20-0002@sbc.usst.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_28

commodity market, guided by the Pareto rule of two eights (the rule of 80/20), companies try to seize the 20% market share that is very important to them, and this part of the market share brings 80% of the profit to the enterprise (Yu 2020). However, with the continuous development and expansion of the Internet economy, the market formed by the market share gathered by small value creation can still create huge economic value for enterprises, and the theoretical key of "long tail marketing" lies in this. In the long-tail marketing theory, products in niche markets with low demand or poor sales prospects still have a large profit margin as long as the cost of storing and distributing those products is not high. Ideally, the long tail theory includes niche markets for mass goods, affluent economies, and large markets formed through the aggregation of many small markets. To put it simply, the theory of "long tail marketing" in the Internet economy breaks the 82 rule of the traditional business operation model. Through some network technologies, the market demand that lives in the traditional market that is neglected and undervalued can be valued by applying the theory of 'long tail marketing'. In the era of the Internet economy, niche product companies are paying more and more attention to how to win more market space, so enterprises pay more attention to market segmentation, through market segmentation, constantly looking for more market opportunities, to find a target market suitable for the company itself. Therefore, more and more enterprises, especially small and medium-sized enterprises, have begun to pay attention to and apply the "long tail marketing" theory, and take the long tail marketing theory as one of the marketing theories of enterprises.

1.2 Research Significance

The long tail theory believes that because of the influence of cost and efficiency, people have paid more attention to key people or things in the past, and if these people or things are represented by a normal distribution curve, the "head" of the curve is usually the focus of people's attention, and the "tail" curve is not highly concerned (Ciurel 2013). In the network and the post-epidemic era, with the reduction of communication and communication costs, the "tail" of the curve has also begun to receive people's attention, although people only spend a very low cost, but pay attention to the overall benefits generated by the "tail", and even the phenomenon of exceeding the benefits produced by the "head". If the space channel for storing and circulating goods is wide enough, the cost of producing goods will drop significantly, and individuals can produce goods, such as computer programs, and at the same time, the cost of selling goods is greatly reduced. In the past, products that were not highly sought, as long as someone sold them, some people would buy them. The market share of these low-demand, low-volume products can be compared with the market share of mainstream products, that is, many small markets converge into one kind of market energy, which is enough to compete with the mainstream large market. With consumers faced with endless choices, what they really want and the channels they

want to access have changed, and a new set of merchandise marketing models has emerged.

1.3 Paper Organization

The framework of this article is as follows, and the first part is an introduction, including the background and significance of the research. The second part is a literature review, combing through the literature from niche toys, beauty products, and outdoor sports products. The third part is the conclusion, based on existing research, it is found that all three categories are high-potential goods that fit the long tail theory, but this study is largely based on the power of the internet, ignoring the reality of how clothing, retail distribution, and brand proliferation have evolved. In order to better promote the integration of online and offline, enterprises can start from three perspectives, namely, the future needs of users, encourage the introduction of preferential policies such as brand parties, implement precision marketing, and improve category construction.

2 Literature Review

2.1 Niche Toys

Patchwork Toys. In recent years, educational toys have become more and more popular in the global market, which can not only meet the collecting psychology and sense of accomplishment of adults, but also improve children's structural thinking and hands-on ability to alleviate stress (Zhiying and Goldman 2019). As shown in the chart below, taking Lego as an example, according to Google Trends, Lego's search trends have risen steadily over the past year (2021–2022), especially on Thanksgiving last year. During the holiday shopping tide such as Christmas, major e-commerce platforms have done their best to collectively launch holiday preferential policies to push the popularity of the toy market to the peak (Fig. 1).

From the perspective of the market, its market capacity is much larger than 17 million US dollars, the hot search area is the European market, and there is room for growth in other markets other than the mature market in the United States. On the Amazon platform, Top hot sales mainly include: Lego+ big IP products, such as lego technics for adults; There are also IP images created by other brands such as Playmobil and COBI. AliExpress Top hot sale is mainly a patchwork toy. In addition, Chinese trend toys represented by blind boxes are becoming popular overseas. According to the "2020 Cross-border Export Consumption Trend Report" released by CBNData, the online consumption of blind boxes has shown explosive growth, with consumption growth rate of more than 400% (Lili 2021).

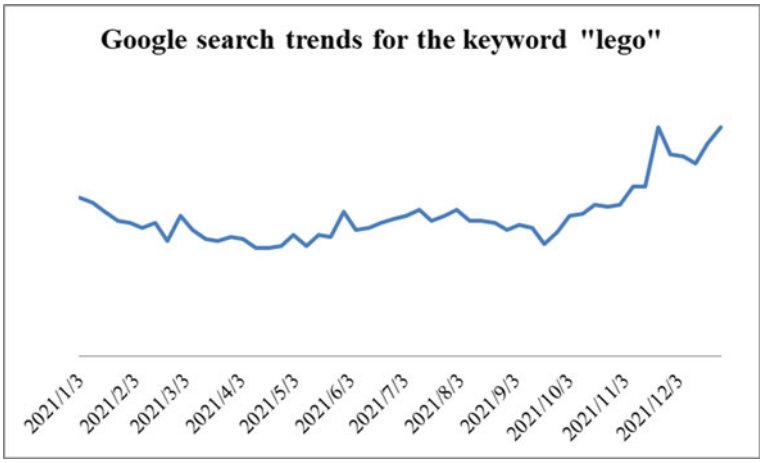


Fig. 1 Search trends for the term 'lego' from 2021 to 2022 (*Source* Google Trends data search)

The outbreak of the new crown pneumonia epidemic in 2020 has also stimulated the consumption of the global market for educational toys. According to the latest statistics from the General Administration of Customs of China, in January and February this year, China's toy exports totaled US$5.02 billion, an increase of 96.8% over the same period last year and an increase of 41.2% over the same period in 2019 (Lili 2021). In order to add fun to their children's "home epidemic prevention" life, parents have begun to increase the purchase of indoor educational toys through e-commerce channels; In addition, the outbreak caused urban lockdowns, and disposable income shifted from other types of entertainment such as movie theaters, amusement parks and restaurants to toys. According to the study, 94% of consumers believe that the educational value of toys is very important, which makes it one of the three major factors influencing Chinese consumers to buy toys (Yina 2014).

Pet Dog Toys. According to a report released last year by the American Pet Products Association, the number of households owning pets in the United States reached 84.6 million, and the penetration rate of household pets rose to 68%, of which 75% of them mainly own dogs (Anonymous 2009). Due to the impact of the new crown pneumonia epidemic, the number of pets purchased and adopted by U.S. families has ushered in a significant increase, and the corresponding pet toys have also been pampered, such as chewing toys and sounding toys.

As shown in Fig. 2, the overall search trend for pet toys is steadily increasing from Google Shopping Trends in 2021, especially after December.

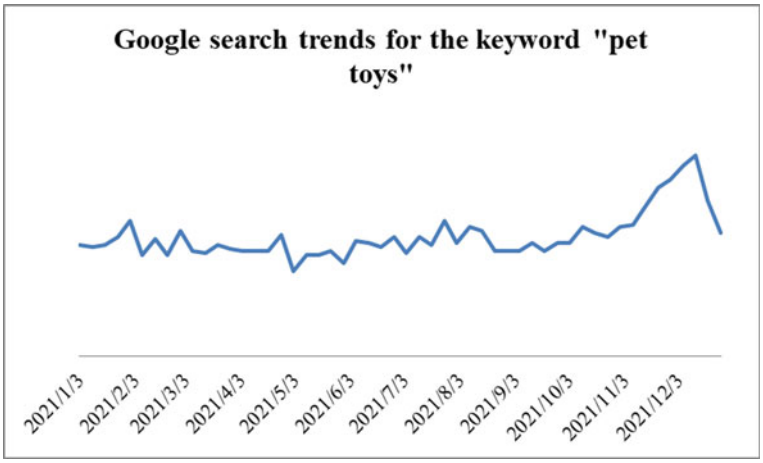


Fig. 2 Search trends for the term 'pet toys' from 2021 (*Source* Google Trends data search)

2.2 Beauty Products

Nail Polish Glue. Nail art is one of the most popular makeup items at the moment, solid color glue, sequin glue, luminous glue, bubble gum, crack glue All kinds of nail glue oil with different shapes, the effect is ever-changing, and the hearts of thousands of girls are captured.

According to the statistics of "Global Nail Care Market Analysis: 2018–2024" (Global Nail Care Market Analysis 2018) released by ReportByuer, an industry information decision-making company in London, the average annual growth rate of the nail care market is expected to remain at about 5.3% from 2018 to 2024 In 2024, the global nail market will reach $13 billion (Fig. 3).

Judging from the Google search trend, the search trend of nail glue oil in the past three years is relatively stable, with 2 peaks every year: that is, June to July and December. The United States topped the list, with the United Kingdom, Canada, Australia and Ireland being the top 5 countries in terms of search volume.

From the perspective of hot selling categories on different platforms, Amazon is mainly based on nail gel sets, and the hot selling prices are concentrated in 5–15 US dollars, and the foreign brand market accounts for more than 50%; AliExpress is mainly a domestic cross-border network brand, and the hot selling price of a single piece is about 1.5 US dollars; DHgate is mainly small and medium-sized wholesale, the price of a single bottle of products is about 2 US dollars, the brand is similar to AliExpress, and the online product volume is greater than 8000.

False Eyelashes. The wearing of false eyelashes can make women's eyes look more attractive and attractive. At present, there are two main types on the market: grafting eyelashes and wearing pair eyelashes directly. Compared to mascara, false eyelashes are well-defined and the effect of applying makeup is more pronounced. According

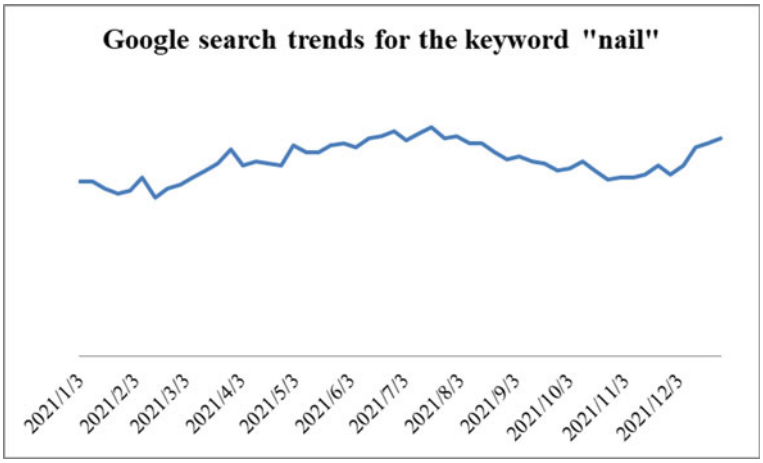


Fig. 3 Search trends for the term 'nail' from 2021 (*Source* Google Trends data search)

to Grand View Research, Inc. According to a new report, the global false eyelashes market size is expected to reach $1.6 billion by 2025, with a CAGR of 5.4% during the forecast period, when the Asia–Pacific region will remain one of the most lucrative markets, with the highest CAGR from 2019 to 2025 at 6.6% (Grand View Research Inc 2019) (Fig. 4).

According to google search trends, false eyelashes have tended to be stable in the past 3 years, with no obvious seasonal impact. The top 5 countries by search volume are: United Kingdom, Ireland, United States, Australia and New Zealand. According to market feedback, female consumers in Europe and the United States

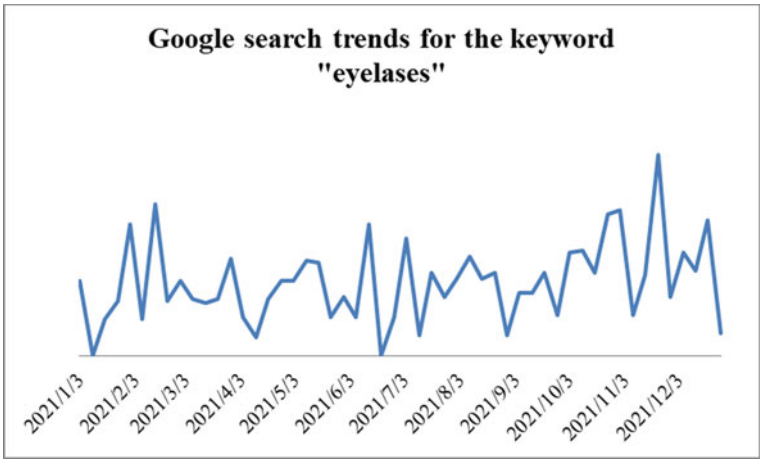


Fig. 4 Search trends for the term 'eyelashes' from 2021 (*Source* Google Trends data search)

prefer thick, slender false eyelashes, such as 25 mm false eyelashes, which are biased towards mink in material. At present, the main hot products of Dunhuang.com are single pairs of false eyelashes with low unit price, and eyelash peripheral products, such as tweezers, eyelash cleaning tools, eyelashes exquisite storage boxes and other products are also favored.

2.3 Outdoor Sports Products

The global outdoor goods industry is in full swing. According to the survey, the revenue scale of the global outdoor products industry reached nearly 160 billion US dollars in 2020, an increase of 28.33% year-on-year (Zhiyi 2019). The growth trend is overwhelming, and it is expected to exceed $230 billion by 2025. At the same time, the consumer group of outdoor products continues to expand, and more than 1.3 billion people are expected to fall in love with outdoor sports as a healthy lifestyle in 2023.

Fishing Gear. The fishing period, which begins in spring for more than half a year, is the peak season for overseas consumers to "show their skills". According to the search trend of Google Trends in the past 5 years, April to October is the peak season for the demand for fishing gear products every year, and February and March is the best time to stock and put on the shelves of fishing gear products (Fig. 5).

According to Google Trends data, the search volume of fishing gear type products in 2020 increased by more than 33% year-on-year. From the perspective of platform data, taking DHgate.com as an example, as shown in Fig. 6, fishing tackle products have been in a stable state of orders in the past three years, and there is still a lot

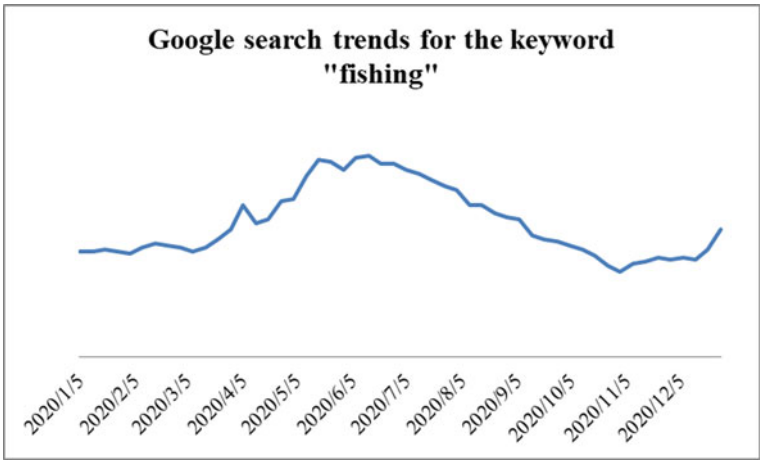


Fig. 5 Search trends for the term 'fishing' from 2020 to 2021 (*Source* Google Trends data search)

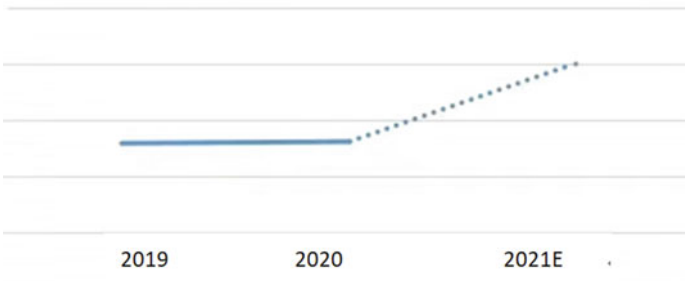


Fig. 6 DHgate Net's fishing tackle list in the past two years and the expected trend in 2021 (*Source* DHgate's 2019–2021 data comparison analysis)

of room for development in this category compared to the growing buyer demand market.

It is understood that the hot selling tools on the Dunhuang net platform are mainly bait and fish hooks. At present, the focus is on recruitment: bait, fishing hooks, fishing rods, fishing reels and other products. In response to the demand of buyers, in 2021, the fishing tackle industry will use means such as creating explosive models, branding, and small batches of high-frequency overseas warehouses for hot products to greatly assist in increasing the growth of category GMV.

Water Sports Equipment. In the past few years, the overseas market for water sports equipment has continued to grow, and all kinds of water sports have been played with tricks, coupled with global warming, rising temperatures, and longer and longer summers, and cooling off through water activities has become a daily routine for people around the world, which has made the market demand for water sports-related products reach a new height (Fig. 7).

It can be seen from the Google Trends trend in the chart above, consumer search trends for water sports are increasing every year, with the highest demand in July–August. Therefore, starting in March is also a good time for water sports equipment to rise.

3 Conclusion

3.1 Main Findings

The three categories mentioned above may have great development potential and commercial value. At this stage, for sellers, how to grasp the opportunities of these categories is the top priority.

Taking the sub-category of toys under the category of toys—pet dog toys as an example, overseas, especially in the United States, middle-aged and elderly people

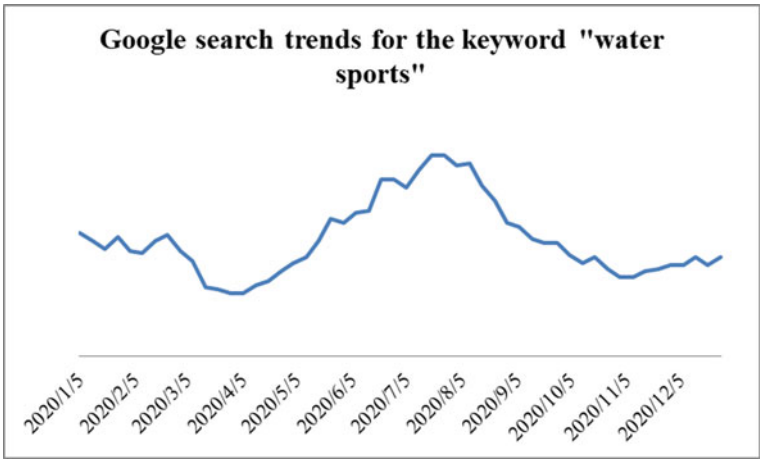


Fig. 7 Search trends for the term 'water sports' 2020 to 2021 (*Source* Google Trends 2019–2020 Water Sports Search Trends)

live alone for a long time, and the loyal companionship of pets can alleviate some loneliness. Since the dog itself is a creature evolved from the wolf, it is born to hunt and prey, and the sound and chewing can make the dog psychologically extremely satisfied, especially the toys that imitate the prey, such as bones and stuffed animals. Therefore, the market development potential of dog toy supplies such as chewing toys and sounding toys is considerable.

Regarding how the seller enters the market, for small and medium-sized sellers such as agents, company can choose the potential explosion such as making a sound or chewing part of the product to try to explode, through the explosion around the pet line to do products and upgrades, such as increasing cleaning and beauty, collar traction and other lines to meet the various needs of buyers; For the brand side, you can take advantage of the number of models, styles, and prices, and occupy the user's mind through the rich variety of toys.

3.2 Future Studies

The product platform can also promote seller sales from the three dimensions of "user demand, brand introduction, and precision marketing". First of all, take pet toys as an example, the buyer's demand is the dog's demand. Sellers can comprehensively judge the current and future needs of users by purchasing different toys (puppy rubber, plush toys, adult dog leash toys), collar traction size, etc. Secondly, as far as commodities are concerned, the introduction of brand parties, trade and agents is actively encouraged. Finally, for precision marketing, channels and scene activities to accurately push users is worth a try; Categories can also be actively built, for

example, around the dog family life scene and tourism, through clothing, beauty cleaning, toys and other popular products.

References

Anonymous (2009) Research and markets: according to the American pet product association (APPA), Americans will spend $45.5 billion on pets in 2009. M2 Presswire

Ciurel D (2013) The long tail principle in online marketing. Anale.Seria Stiinte Econ XIX(19):126–128

Global nail care market analysis (2018–2024) ID: 4620916 Report August 2018 Region: Global, 201 Pages, Marqual IT Solutions Pvt. Ltd (KBV Research)

Grand View Research, Inc (2019) False eyelashes market size worth $1.6 billion by 2025 | CAGR: 5.4%. https://www.prnewswire.com/news-releases/false-eyelashes-market-size-worth-1-6-billion-by-2025--cagr-5-4-grand-view-research-inc-300929474.html

Lili W (2021) China's toy exports soared, educational toys "favored" . China Foreign Trade (04):50–51

Markwood PS (2010) The long tail: why the future of business is selling less of more. Learned Publishing 23(3):268–269

Plunkett JW (2021) Plunkett's transportation, supply chain & logistics industry almanac 2021: transportation, supply chain & logistics industry market research, statistics, trends and leading companies. Plunkett Research, Ltd.

Yina L (2014) Trends: science, technology and engineering and other educational toys are popular. Toy World 11:29–31

Yu F (2020) Research on "Long Tail Marketing" theory and its application strategy in the era of internet economy. Mark Circles (20):108–109

Zhenyu C (2016) "Case" :D Y Outdoor Products Co., Ltd.—Development strategy research. Master's Thesis, Jinan University

Zhiyi W (2019) Research on the motivation, risk and performance of diversified mergers and acquisitions of outdoor products enterprises. Master's Thesis, Southwestern University of Finance and Economics

Zhiying Z, Goldman KM (2019) The popularity of American-inspired educational toys is high. Chin Foreign Toy Manuf (09):52+11

Asymmetric Information Analysis on Supply Chain Finance's Profit Model: Based on E-Commerce Platform JingDong

Xinqing Fang

Abstract The concept of Supply Chain Finance has become popular since the development of e-commerce platform and online finance, but few papers have discussed the deep functions of it. What will happen when Supply Chain Finance is applied to bilateral e-commerce platforms? The financing constraints of small enterprises using the e-commerce platforms is also a big problem in nowadays society. Therefore, this paper has discussed the asymmetric information factors on the market that has led to the financing problems, and how the application of Supply Chain Finance has effectively moderated the problem. The paper has focused on the asymmetric information on the market by targeting the e-commerce platform JingDong, using S-W model to present the adverse selection problem, and Supply Chain Finance's solution to it by increasing information transparency. Ultimately, it has also increased the network effects of large e-commerce platform JingDong.

Keywords Asymmetry information · Network effects · Supply chain finance · MMEs

1 Introduction

There was a very interesting business circle: in order to produce more products, sellers on the platform need to use the money they got from consumers to be the fund. Especially for medium and micro enterprises, they do not have much initial capital, so they are more relying on the money from consumers. However, for online e-commerce platforms, most of them have a very long approval time to give the receivables to sellers. For example, on a famous Chinese e-commerce platform Taobao, it requires 10–20 days of waiting for money from consumers. There is a gap between the receivables and the time needed for production. Hence, a gap on the working capital has been generated. Financing constraints therefore happens. For small enterprises,

X. Fang (✉)
Beijing City International School (BCIS), Beijing 100022, China
e-mail: christinefang060809@outlook.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_29

they often got rejected when applying loans from banks because they lack proper mortgages.

So, how can they get financed and develop in the long-term? There were many research papers on Supply Chain Finance, indicating that it is a tool to increase information transparency, and played a vital role to provide guarantee to enterprises. How does the use of Supply Chain Finance solved the problem? What about to combine SCF with e-commerce platforms? Thus, this paper takes JingDong as the e-commerce platform that is using the SCF, also as a case to research the function of SCF on the market.

2 MMEs Financing Constraints: Asymmetric Information

2.1 The Theory of Asymmetric Information

The theory of asymmetric information was first proposed by George Akerlof in 1970, he believed that the information is distributed unevenly on the market, and the parties with less information are in a more vulnerable position. Parties with more information have better power on manipulating the market and price adjustments. Same situation has applied to the financial institutions and borrowing enterprises. When enterprises are applying the loan, the financial institutions only receive the materials that the enterprise provide to them. All the information is directly given by the borrowing enterprise. This result in severe information asymmetry and put the financial institution into a vulnerable position.

When talking about asymmetric information, two relative concepts are needed to be mentioned: Credit rationing and Adverse selection. Credit rationing is the concept where a bank encounters surplus capital demand while it must operate under a fixed interest rate. Because banks are unable to raise interest rates, they must implement some non-interest rate lending conditions in order to force capital demanders to withdraw their requirements, therefore eliminating excess demand and drive the market back to the equilibrium. Common credit rationing methods involve checking the credit of each enterprise, so banks will prefer more successful and big enterprises. Secondly, before the appliance of credit rationing, a phenomenon called adverse selection shall happen. Before credit rationing, banks tend to increase the interest rate in order to avoid small enterprises from borrowing, but that would result in a situation where only the enterprises with high risks shall borrow loans from the bank. Because they are the one that have nothing to lose and willing to take the risk. Borrowers with lower risk are reluctant to pay higher interest rate because their projects are also less profitable. This is when adverse selection happens. As a result, the borrowers who are most likely to sign a loan contract are those with the least likelihood of repayment. Then, financial institutions will use credit rationing to avoid adverse selection. Due to the need to manage the risks, traditional financial institutions are more willing to provide financing for large enterprises. It is not worthy

for they to finance small enterprises because the risks are high. Ultimately, the victim is those medium and micro enterprises.

2.2 Research Model

A famous model of asymmetric information is the S-W model brought up by Stiglitz and Weiss in 1981, which has illustrated how credit rationing is one of the equilibria of the market.

π: expected return, P: possibility of repayment, a: fixed operation costs, c ($c > 0$): Non-interest variable parameters for loans, L: number of loans, b: deposit ratio, so bL = deposit amount, and r^L: Revenue return per loan, r^D (deposit revenue. The final function is proposed as: $\pi = P \cdot \left(L \cdot r^L\right) - a - bLr^D - (c/2)L^2 a$. The optimal interest rate can be gotten by second derivative: $RL = (p/c)(1 + ep)$. On the S-W curve, when L^E is smaller than E, the curve is normal, where higher interest rate equals higher loan volume. Sooner After $L^E = E$, the curve has shifted its direction and become a negative relationship. On the point (L^E, r^E), the loans expected return has been maximized, and LE became the optimal loan volume. The S-W Model is the base of asymmetric information, and it is the most direct way to show the theoretical situation of credit rationing.

2.3 Unwillingness of Financial Institutions to Lend Loans to MMEs

For MMEs (Medium and Micro Enterprises), the unwillingness of financial institutions to provide loans is more common. Firstly, MMEs are defined as the enterprises that "the annual taxable income should not exceed 300,000 RMB; MMEs shall not have more than 100 employees for industrial department, and other departments shall not have more than 80 employees." They are usually more small-scaled, more information opaque, and more risks when borrowing. Simply put, they have higher risks of default. Stiglitz and Weiss (1988) pointed out that MMEs financing constraints were directly caused by information asymmetric. The incomplete exposure of information has led to the existence of uncertainty in the market, further caused uncontrollable risks. Therefore, even if these enterprises are willing to pay high interest rate, they would still be unable to get loans from banks due to the asymmetric information. In conclusion, there are three main reasons that hinders those MMEs from getting financed: Financial institutions lack the full comprehend of the MMEs; MMEs usually lack of proper mortgage and pledge to get financed; MMEs are small scaled, thus not being able to overcome large economic shock and harder to survive in the long-term.

2.4 Current Market for MMEs

At the end of 2018, there are more than 30 million MMEs and 70 million self-employed businessmen in China. They've contributed over 50% of the tax, 80% of the workforce, and 60% of the GDP. However, their loan only counts for 19% of the whole loan being lent. The average approval period of MMEs' loans has increased from 76 days in 2017 to 86 days in 2018. It has worsened the situation where sellers need to wait longer to get paid. 62.9% of the enterprises has encountered overdue payment, 40% of them has overdue over 3 months. 33% of the medium enterprises, 38% of the small enterprises, and 41% of the micro enterprises all found it hard to get financed. Without the money to keep produce products, small enterprises face the problem of lacking working capital. Therefore, if they fail to get financed by financial institutions, they would probably bankrupt.

The comparison of the state-owned business loans proportion and the private business loans proportion is also facing huge inequality: (Wan 2020) (Fig. 1).

However, here comes a solution. The development of Supply Chain Finance can solve the financing problem of MME sellers. The mechanism of supply chain finance to reduce the financing constraints of sellers is to reduce the degree of information asymmetry. By letting the information be more transparent, financial institutions and platforms can have better understanding on the sellers, therefore raise the reliability of it.

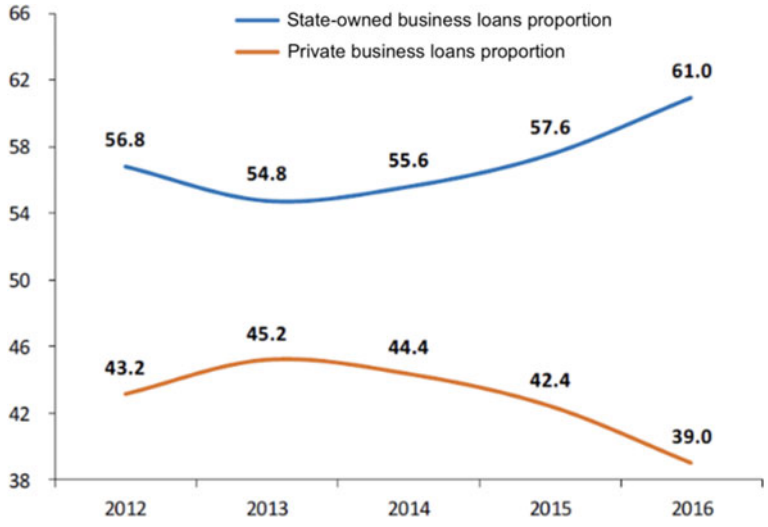


Fig. 1 Comparison of loans proportion

3 Topic Background: The Concept of Supply Chain Finance

3.1 International Literature Review

Timme in 2000 have brought up the idea of supply chain finance: "Supply chain finance is a combination of financial institutions such as commercial banks and all participants in the supply chain, in order to achieve the goal of mutualization by integrating logistics, information flow, capital flow and the operation status of all participants." Hofmann in 2003 have further extended the idea on Timme's, stating that "Supply chain is essentially a kind of financial service, which consists of multiple parties including enterprises in the supply chain and external financial service providers (Timme and Williamstimme 2000). It makes funds flow among all participants and achieve the goal of jointly creating value." Lastly, in 2007, William have brought up a conclusion of the function of Supply Chain Finance (Hofmann 2003). "Supply chain is a combination of multiple participants. This combination can improve financing efficiency, transparency of financing process, utilization rate of funds and reduce the use cost of transactions" (Atkinson 2007).

3.2 China Literature Review

"Supply chain finance is a new finance model, with a core enterprise surrounded by financial institutions. Those financial institutions also took the job of integrating the upstream and downstream enterprises of the core enterprise, helping both enterprises to develop." Followed by Hua Song in 2016, he stated the differences between financial institutions and the use of Supply Chain Finance (Yang 2005). "Different from original banks' loans, supply chain finance is the supply chain of production, aiming at helping the upstream and downstream enterprises who participate in this financial activity" (Song and Chen 2016).

4 How Online Finance Has Solved the Problem—JingDong SCF

4.1 JingDong Finance Introduction

JingDong, the largest B2C (Business to Customer) platform in China, was officially stepped into the e-commerce field in 2004. In 2014, JingDong became the first e-commerce company that was appear on the market from the Nasdaq Stock Exchange. After 6 years, JingDong has appear on the market again from the Stock exchange of

Hong Kong. The funds gained from this was mainly used in the development of supply chain finance. In 2020, JingDong was the 13th among China's top 500 enterprises (Li and Dong 2021). Among all the sellers on the platform, 80% of the sellers are MME enterprises. JingDong is one of the most famous online e-commerce platforms in China, where its development is the fastest, and most classic one. JingDong Supply Chain Finance is an ecosystem with a number of participants. Its participants are mainly its departments and the upstreaming and downstream suppliers. JingDong itself includes JD shopping mall, JD technology, and JD logistics. To be more specific, JD shopping mall is in charge of collecting transaction data, whereas JD technology is in charge of screening the data, process the data, and create a risk management system for each seller. Then, it would be able to provide specific loans and insurance for each seller. Lastly, JD logistics is in charge of the transport of the products and storage of pledge. JD logistics can also provide guarantees for its upstream and downstream sellers, helping them to get loans from banks (Li and Dong 2021). In 2019, there are more than 300,000 enterprises using JingDong Supply Chain Finance, and the amount of loan being lent was nearly 600 billion RMB. JingDong Supply Chain Finance's scale is keep increasing with a positive trend. Beside this, the annual revenue of JingDong Supply Chain Finance is also increasing. It has increased from 250 million RMB in 2015 to 2.25 billion RMB in 2019. JingDong Supply Chain Finance's efficiency is 10 times more efficient than normal financial institutions, and the cost is 70% lower.

4.2 Main Services of JingDong Supply Chain Finance

There are three financing services under the JingDong Supply Chain Finance, they are: Jing Bao Bei, Jing Xiao Dai, and Chattel Financing. Jing Bao Bei is a financing tool of JD focusing on the self-operated supplier, the ones who stock their products in JD's warehouse. The default rate of Jing Bao Bei is lower than 5/10,000, way lower than the default rate in normal financial institutions (Fang and Tian 2018). Jing Xiao Dai is another financing tool of JD focusing on all the sellers on the JD shopping platform. It mainly provides credit loans for its sellers and helping them to get loans quicker. Chattel financing is a financing tool for sellers outside of JingDong's platform. They could use their inventory as a pledge, to acquire loans from JingDong.

4.3 How JingDong Eliminates Asymmetric Information, and JingDong's Risk Management

JingDong has its own system to manage and eliminate the risks. The method of JingDong to remove risks is the use of Big Data. JingDong gets its Big Data by four

sources: (1) The transaction data in JingDong shopping mall; (2) The transaction data in JingDong SCF; (3) The public data on the internet; (4) The credit data collected by the third party. Based on these four sources, JingDong has come up with its own system called "Super Brain" for risk management. 4 models have been set up: (1)"Skynet": Used to analysis the potential risks transactions. (2) "Sky Machine": Used to to real-time dynamic analysis, further identify potential risks under the transactions. Further calculation based on the "Skynet" system. (3) "Sky Shield": Used to detect anti-fraud → monitor the borrowers' behavior in real-time. Being able to detect whether the borrowers are using the loans to do right things or not. If not, it shall report it and take back money. (4) "Sky Strategy": Used to make decisions when sellers default. Either punish the sellers by taking back money or do further restrictions on the selling market. JingDong would conduct deep research on the enterprise before they provide their loan, and they would monitor the enterprise all the time when the money has been lent. If the enterprise has default, then JingDong would automatically deduct money from the sellers to pay back loans and add the enterprise into the blacklist.

5 How Does JingDong Used Supply Chain Finance to Increase Its Network Effects

5.1 Network Effects Definition

Network effect is a concept which states that consumers' utility from using a good or a service positively depends on the overall number of consumers using. This concept was originated in 1908, where AT&T chairman Theodore Vail noticed that the value of a phone depends on its connections to other phones, and the increase in the number of connections. After 72 years, the Father of the Ethernet Robert Metcalfe has further developed this concept. He proposed that the value of the network is proportional to the square of the number of connected users (N2). In 2001, the computer science professor believed that the real value of the network increases exponentially (2 N) with the number of people connected to it.

E-commerce platform such as JingDong can be defined as a bilateral network. One side is suppliers' side, and another side is consumers' side, also defined as demand side. They join the network for different reasons and provide complementary value to each other.

Increase in the demand side can increase in the supply side. Vice versa. This is just the main point of network effects. More sellers will lead to more buyers, and more buyers also stimulus more sellers joining the platform, create a virtuous circle.

The function of the network effect is set up as: a_i: sensitivity to network effects; v_i: match value; p: price; n: number of users. Therefore: $u_i = v_i - p + a_i n$.

5.2 How Does the Application of SCF on JingDong Increase the Network Effects

The mechanism of JingDong's network effects is: Provide credit loans to its sellers → easier to get financed, sellers could get financial help → sellers can better survive and develop in the long term by using platform JD → more sellers are willing to join JD → if there are more sellers, then more buyers are willing to purchase on JD → overall profit increase and increase in network effects.

6 Conclusion

In this paper, the MMEs financing constrains due to asymmetric information, and how the apply of Supply Chain Finance to solve the information asymmetry have been analyzed. The possible conclusion is that JingDong has used its Supply Chain Finance to solve the information asymmetry in the market and help MMEs to get financed and develop in the long-term. JingDong has also gained more network effects with Supply Chain Finance, which is a win–win action.

References

Atkinson W (2007) Supply chain finance: applying finance theory to supply chain management to enhance finance in supply chains. Int J Log Res Appl 6:43–51

Fang R, Tian J (2018) Research on JingDong supply chain finance models with the corresponding products. May 2018

Hofmann E (2003) The flow of financial resources in the supply chain: creating shareholder value through collaborative cash flow management

Li S, Dong S (2021) Research of supply chain financing profit model based on the e-commerce enterprises—a case study of JD. 26 May 2021

Song H, Chen S (2016) Supply chain finance and internet supply chain finance: a theoretical outlime. J Renmin Univ China 30(5):95–104

Timme S, Williamstimme C (2000) The financial-SCM connection

Wan M (2020) Research on the development strategy of Z supply chain finance department business transformation. Ming Wan, Beijing, April 2020

Yang SH (2005) The supply chain finance problem with a bank perspective. Logistic Technol 2005(10):179–182

A Review of Riders' Job Satisfaction in Takeaway

Sha Sijia

Abstract Improving job satisfaction is helpful to improve employees' work enthusiasm. As a new labor group, it is of great significance for takeaway riders to improve their job satisfaction. Based on literature research and applying ERG theory, the author classifies the dimensions of job satisfaction of takeaway riders in China, analyzes them one by one and puts forward relevant suggestions, aiming at improving the job satisfaction of takeaway riders and promoting the standardized development of the industry.

Keywords Job satisfaction · Takeaway rider · ERG theory

1 Introduction

In recent years, the rapid development of Internet economy has spawned various new industries. At present, take-out industry has become an important part of platform economy, and take-out riders have entered people's field of vision as a new professional group. This occupation presents diversified and flexible employment characteristics and employment structure. The employment forms include the following four types: crowdsourcing, special delivery, outsourcing and seller's self-delivery. Crowdsourcing refers to a part-time take-out person who grabs orders through the platform and independently delivers orders in scattered ways. Delivery refers to a full-time delivery person who has a formal labour relation with the platform and accepts system delivery orders. Outsourcing refers to riders hired by third-party companies organized by the platform. Sellers' self-delivery refers to full-time food delivery personnel employed by sellers. With the rapid expansion of take-out industry, the group of take-out riders also presents the characteristics of scale, and the work quality and satisfaction of take-out riders have also attracted the attention of academic circles.

S. Sijia (✉)
Wuhan University of Technology, Nanhu New Campus,, Wuhan University of Technology, No.122, Luoshi Road, Hongshan Street, Hongshan District, Wuhan City, Hubei Province, China
e-mail: 1720558829@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_30

2 Definition of Job Satisfaction

Job satisfaction can affect the enthusiasm and quality of employees, and then affect the operation and management of enterprises. The concept of job satisfaction was first put forward by Hoppock in 1935. He thought that job satisfaction is the psychological and physiological satisfaction of employees to environmental factors, that is, the subjective reflection of workers to work situations. When studying job satisfaction, due to the different theoretical framework adopted by research objects and scholars, job satisfaction is determined to be different. Taiwan Province scholar Xu Guang summarized the concept of job satisfaction into the following three categories (Guangzhong 1977).

Comprehensive definition: The definition of job satisfaction is single. It is an attitude or viewpoint towards the job itself, the factors affecting the job or the working environment, and an overall emotional response to the job. It does not involve the object, cause and process of job satisfaction.

Definition of the nature of gap: It refers to the decision of job satisfaction as the remuneration that an individual thinks must be paid to himself and the remuneration actually obtained. That is what they want less what they actually get. The gap level is inversely proportional to the satisfaction level, and the definition of insufficient demand is another explanation of this definition.

Reference framework definition: This definition holds that people's attitude and interpretation of these target features are the most important factors affecting people's attitude and behavior, and this attitude and perception are influenced by personal self-reference framework.

3 Research on Job Satisfaction

Domestic research on employee satisfaction in traditional service industry began in the early 1990s, focusing on the current situation, influencing factors, utility and countermeasures of employee satisfaction in traditional service industry. The factors that affect the job satisfaction of service employees mainly include demographic variables, job returns, job itself, corporate culture, etc. The job returns include salary, promotion opportunities, training and development, etc. Enterprise culture includes management style, interpersonal relationship, organizational fairness, organizational authorization and so on. Generally speaking, their influence on job satisfaction of service employees is in the following order: corporate atmosphere, job return, fairness, overall corporate identity, personal promotion and job adaptability (Qiu et al. 2009) (Table 1).

At present, under the background of Internet, take-out distribution, as a new industry, is quite different from traditional industries. According to factors such as industry characteristics and working conditions, employee satisfaction of takeaway riders can be considered from the dimensions of material return, growth and

Table 1 Dimensions of work satisfaction of takeaway delivery

Delivery job satisfaction dimension	First-order dimension	Secondary dimension
	Material return	(1) Wage income (2) Social insurance
	Growth and development	(1) Future planning (2) Skills training (3) Education level
	Reward and punishment management	(1) Material or monetary rewards (2) Fine
	Enterprise management	(1) User complaints (2) System construction
	Work schedule	(1) Working hours (2) Frequency of rest
	Working pressure	(1) Degree of family support (2) Social image

development, reward and punishment management, enterprise management, work and rest system, and work pressure (Jiachun 2020).

4 ERG Theoretical Analysis of Low Satisfaction of Takeaway Riders

ERG theory is a new humanistic needs theory put forward by American scholar Alderfer on the basis of Maslow's hierarchy of needs theory. He believes that people have three core needs, namely, the need for existence, relatedness and growth.

4.1 The Need for Existence

Survival needs meet the first two requirements in Maslow's theory-survival and safety, and are related to people's basic material survival needs. This study will analyze whether the company provides competitive remuneration, labor rights protection and job safety.

Salary Issue. At present, there are many drawbacks in the salary system of take-out industry in China, such as low salary level and imperfect salary design.

At present, the overall basic salary level of takeaway riders is low. For most riders, the calculation method of salary is 'piecework'. The income is calculated by a single order, that is, 'delivery quantity x unit price'. The calculation standard is single, which

makes it impossible to achieve a balanced income with other members of society and lacks competitiveness. Zheng Guanghuai's team from School of Social Sciences, Central China Normal University, after a long-term investigation of the labor process of take-out workers in Wuhan, found that 'the income of take-out workers exceeds 10,000 yuan' is only a 'special existence' in the initial stage of the platform. With the end of platform subsidies and the participation of more and more riders, 'earning over 10,000 yuan' is becoming an illusory dream. The research report released by the team shows that only 2.15% of take-away riders earn more than 10,000 yuan per month, while 53.18% of the respondents report that the current income cannot meet the family expenses.

There are some problems in the salary design of take-out platform, such as imperfect assessment methods, one-sided salary management mode and unreasonable reward and punishment mechanism (Zifan 2018). There is a hierarchy of take-away riders in China, which is divided into take-away captains, take-away trainers, take-away knights and take-away riders. Because it is difficult to leapfrog, most of the staff are take-away riders. However, at present, there are few allowance steps in the salary management of take-away riders in China. The gradient is large, which leads to the rider's work enthusiasm not increasing but decreasing. In addition, some scholars believe that the platform punishes riders relatively harshly, and the punishment caused by user complaints is too great (Yaorui et al. 2021). In fact, the platform is more inclined to consumers, and it is difficult to safeguard the interests of riders, which also reflects the drawbacks of the current pay system of take-out platform.

Security Issues. Data show that about 75 takeaway riders are injured or killed in traffic accidents every day in China. Takeaway riders run red lights, go backwards, take motor vehicle lanes and other phenomena emerge one after another, and traffic accidents occur frequently. Take-out brings convenience to people, but its traffic safety hazards can not be ignored.

It is pointed out that take-away riders generally have low educational background, and lack of education in traffic safety leads to poor understanding of traffic laws and regulations and weak safety awareness (Yuchao et al. 2020). Besides the rider's personal factors, the high-intensity working pressure caused by platform design mode is also an important inducement of traffic accidents.

Salary Calculation Method. Takeaway riders mainly have two modes of service, special delivery and crowdsourcing. Unlike special delivery, which is directly employed by the take-out platform and has fixed working hours, crowdsourcing riders do not have an employment relationship with the platform. They need to grab orders through the platform and independently deliver them in scattered ways. At present, the platform adopts a piecework-based salary calculation method. For most riders, more work means more income, and speed means income. In order to meet performance and high income, riders have to race against time.

User Evaluation Mechanism. The research shows that the user evaluation mechanism of the current platform is not perfect. Once the user complains or gives a bad review for overtime, the rider may face not only fines, but even lose his job in serious cases.

The article Takeaway Rider, Trapped in the System points out that the punishment rules of the platform are not very reasonable, the complaint channels are not smooth enough, and the rider suffers.

Distribution Mechanism. At present, the traditional delivery mechanism has some defects. The platform has certain restrictions on the rider's delivery time. If the delivery is overtime, the rider will be deducted from his salary and even affect the site rating. In addition, although the artificial intelligence algorithm naturally has the logical discourse of 'technically correct', in the actual delivery process, the back-end algorithm time prediction has certain defects. Riders need to walk when entering the community, and they need to wait for the elevator when entering the office building, which will compress the delivery time of take-away riders. However, the platform often ignores these physical factors that will lead to timeout (Ping 2019).

Based on these pressures, take-away riders who suffer from both income and spirit have to improve their pace, and being forced to hurry will undoubtedly increase their traffic risks.

Protection of Labor Rights and Interests. At present, riders are not satisfied with the various welfare insurance measures offered by the company. The lack of rights and interests protection is a universal problem of rights and interests protection for take-away riders and even the whole network contract workers, including lack of institutional constraints on labor remuneration, passive dissolution of labor relations, high work intensity, lack of guarantee of rest and vacation rights, and lack of basic medical insurance and basic social system protection. In the absence of legal protection for the fast-growing food distribution industry in China, informal workers are struggling to make a living (Chan 2021).

The fundamental reason for the lack of rights and interests of take-away riders is that the system is not perfect and the standardized labor relations are not established. Takeaway rider is a new occupation, and there are still many irregularities in the relevant rules and regulations, which lack effective supervision and management mechanism (Shuang 2018). The employment mode of sharing economy is flexible, and most platform enterprises have not established standardized labor relations with network contract workers. There are outstanding problems in the social insurance of network contract workers under the background of sharing economy. At present, as a flexible worker in a new format, the legal relationship between take-away riders and employers is qualitatively blurred. Special delivery riders are generally full-time employees of third-party companies cooperating with take-away platforms. They have fixed working hours, and have labor relations with third-party companies. Crowdsourcing riders are part-time and can decide whether to take orders or not. There are disputes in judicial practice about what kind of employment relationship the crowdsourcing rider belongs to and whether it constitutes a labor relationship.

4.2 The Need for Relatedness

This refers to the need of developing interpersonal relationship, which is equivalent to the emotional need and a part of the need of respect in Maslow's theory.

At present, the position of takeaway rider has low social identity, relatively low status in society, insufficient respect from society and discrimination. At present, the society generally thinks that the rider is not decent (Yaorui et al. 2021), which affects the professional identity of the employees in this industry to a certain extent. In addition, unlike the traditional work, the deliveryman has no fixed schedule and work place, and almost all interactions between the company and the deliveryman are conducted through the Internet. Usually, unless they are willing, they have no contact with other people at work (Chen 2020).

4.3 The Need for Growth

This is the need of personal self-development and self-improvement, which is equivalent to the need of self-realization in Maslow's theory. In China, the most important thing to show the growth space and development opportunities is the possibility of job promotion.

The research found that the current take-away rider's career development prospect is not good, and the employees generally have low professional identity and low work commitment (Sheng et al. 2019). Most riders only take delivery as a short-term job, and will not consider expanding their career development space or planning future career development goals in the delivery industry, and show low interest in vocational skills training related to rider's work.

The reasons for the above phenomenon are roughly as follows:

The Threshold for Employment is Low. With the rise of take-out industry, a large number of jobs have been brought. However, the professional threshold of take-away distribution is low. At present, the rider's general education is not high, the employees are mainly migrant workers, and the occupation lacks technical demand. The employees think that the work is 'fragile' and highly replaceable, which indirectly leads to the low self-identity of the employees (Yan 2021).

Single Post and Lack of Hierarchy. The delivery industry only has a single post, and its employees have no career prospects. Different from other positions, the take-away distribution industry has no job hierarchy, and riders have no room for promotion. Data show that most riders only use distribution as a springboard. The lack of opportunities for further development of employees has become an important reason for the poor career prospects of the take-away industry.

To sum up, the author classifies the status quo of job satisfaction of takeaway riders through ERG theory, and finds that there is much room for improvement in rider's job satisfaction. The sustainable development of the take-away industry cannot be

separated from the support of the platform, relevant departments and the public. Some suggestions will be put forward below for reference.

5 Conclusion and Suggestion

5.1 Platform

Improve the Entry Threshold and Vocational Training. There are some requirements for the safety awareness and the concept of rule of law of foreign sellers. Regular training and education on safety knowledge for riders are needed. It is also necessary to have a certain supervision and punishment mechanism for unruly takeovers.

Improve the Algorithm. From the user evaluation mechanism, various aspects of improvement on time prediction, distribution route planning are needed. The companied should establish a better positioning system, real-time monitoring of take-away food delivery staff routes and conditions. They should give the best route planning (Fischetti et al. 1993). Physical and spatial obstacles should be taken into account in the setting of the delivery time for foreign riders. Optimize the mode of receiving orders and dispatching orders, and enrich the service quality. Scholars pointed out that the robot can relieve the pressure of artificial food distribution, and try the business model of cooperation between robot and human (Zhang et al. 2021).

Optimize the Salary System and Improve the Post Division System. Set the minimum working standard, and standardize the wage standard of the sharing economy industry. According to Zhou Zifan, there is a certain blind spot in the salary system of take-out industry in China, which can only be advanced through exploration, and can be improved from the following points: providing differentiated guarantee, improving user evaluation index, restricting the punishment right of enterprises, setting reasonable delivery time, and reforming piece-rate salary (Zifan 2018). Scholar Xu Ting thinks that the platform can be reformed from the following aspects: adjusting the basic salary mechanism, adjusting the salary structure, qualitative and directional two-way management, and optimizing the structure setting (Ting 2018).

5.2 Relevant Departments

Improve laws and regulations and standardize industry systems. Every untested new market will go through a chaotic stage, and this challenging revolution in China's catering industry will develop in a good direction as long as there are sufficient supporting policies and strict market supervision (Maimaiti et al. 2018). Safeguarding

the rights and interests of network contract workers according to law is the focus of building harmonious labor relations. It is necessary to strengthen the construction of labor legal system in sharing economy, restrict enterprises from strictly controlling delivery time at the expense of workers' safety, standardize the whole industry, and make competition rational and orderly. Optimize road design and strengthen supervision. Intensify publicity and appeal to the public to understand more about selling riders to the outside world.

References

Chan J (2021) Hunger for profit: how food delivery platforms manage couriers in China. Sociologias 23:58–82

Chen SH (2020) The qualitative study of job satisfaction and commitment of delivery men in online food industry in Bangkok

Fischetti M, Laporte G, Martello S (1993) The delivery man problem and cumulative matroids. Oper Res 41(6):1055–1064

Guangzhong X (1977) Discussion on job satisfaction of factory workers and its related factors. J Inst Ethnol Acad Sinica, 43

Hoppock R (1935) Job satisfaction

Jiachun L (2020) Investigation on the occupational survival status of Guangzhou takeaway food delivery staff. South China University of Technology

Maimaiti M, Zhao X, Jia M et al (2018) How we eat determines what we become: opportunities and challenges brought by food delivery industry in a changing world in China. Eur J Clin Nutr 72(9):1282–1286

Ping S (2019) Digital labor under 'Algorithm Logic': a study on delivery workers under platform economy. Ideological Front 45(06):50–57

Qiu W, Yi X, Xinggui Z (2009) Review of the research on job satisfaction of employees in traditional service industry at home and abroad [J]. J Guangdong Vocat Coll Finance Econ 8(06):24–28

Sheng L, Xiaoxuan W, Yang H, Jiageng X (2019) Expression and dissolution of interest demands: an investigation on the labor process of 'takeaway brother'. J China Inst Labor Relat 33(02):99–108

Shuang W (2018) Study on the countermeasures of protecting labor rights and interests of online delivery workers in Dalian. Dalian University of Technology

Ting X (2018) Study on the salary management mode of takeaway riders in takeaway industry. W Leather 40(06):37

Yuchao X, Mengxia W, Ze B, Yuhua W, Menghua Z (2020) Investigation and research on the phenomenon of takeaway riders violating traffic rules in Xi'an. Think Tank Times, (07):133–134

Yan C (2021) Study on the employment vulnerability of takeaway riders from the perspective of employment quality. Shandong Soc Sci 05:93–99

Yaorui L, Lei S, Chang W (2021) Investigation and analysis on the professional satisfaction of take-away riders-taking Fuzhou as an example. Econ Res Guide (14):115–118

Zhang Y, Deng X, Wang M (2021) Analysis of food delivery market in China: a case study of Meituan

Zifan Z (2018) A study on the pay of takeaway riders in internet plus era. J China Inst Labor Relat 32(03):96–104

Can NFT Refresh the Field of Digital Copyright Protection? The Positive Role and Potential Risks of NFT in Digital Copyright Protection

Yining Li

Abstract Digital works refer to works created by means of digital technology and disseminated to the public through the Internet. With the vigorous development of digits, the copyright protection of digital publishing has attracted much attention. Therefore, it is very important to improve the ability of digital copyright protection. The non-fungible token (NFT) may bring a new opportunity for digital copyright protection by virtue of its traceability and non tamperability based on blockchain. In this article, we first discuss how NFT protects copyright and the risks implied therein. Then it gives its application prospect, its application in copyright traceability, and the problem of right confirmation in the future meta universe. Finally, it points out that creators need to pay attention to and generate NFT works as soon as possible to protect their NFT copyright. Platform supervision should formulate appropriate operation rules, and NFT holders should clarify their rights to avoid infringement. NFT is an emerging technology with many uncertainties. In future applications, we should make proper use of NFT technology to make it have a positive impact on our lives.

Keywords NFT · Digital copyright infringement · Copyright protection

1 Introduction

The continuous development of modern information network technology promotes the creation and dissemination of works, and the digital publishing industry is booming. At the same time, digital publishing copyright protection is also facing severe challenges. Compared with traditional publications, digital publications are more prone to copyright infringement. The cost of digital publication infringement

Y. Li (✉)
Shandong Agricultural University, Shanggao Street, Taishan District, Taian 271000, Shandong, China
e-mail: 572699986@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_31

is low and the means of infringement is simple. Therefore, network infringement is common.

NFT, fully known as non-fungible tokens, refers to non-homogeneous digital assets based on blockchain technology. Each NFT is unique and indivisible because it maps to a unique serial number on a specific blockchain. Every NFT transaction will be recorded in the decentralized blockchain ledger, which has the characteristics of tradable, verifiable, tamperable, and traceable (Zhang and Ye 2021). Confirmation of rights is a major problem in intellectual property protection. Due to the virtuality of cyberspace, network infringement is hidden, the infringement cost is low, and it is extremely difficult to protect rights. Therefore, digital publishing infringement is prohibited repeatedly (Zhang 2021). The NFT described in this article can use blockchain and encryption technology to make virtual products certified. By discussing the role and limitations of NFT in the copyright protection of digital works, this paper finds out the value of NFT in the copyright protection of digital works, predicts the application prospect of NFT, and realizes better copyright protection of digital works.

This paper is divided into five parts. The second part is a brief literature review. The third part of the article focuses on the intellectual property issues involved in NFT. The fourth part discusses and analyzes the issues that creators, holders, and trading platforms should pay attention to in maintaining copyright and the application scenario of NFT. Finally, the fifth part summarizes the article.

2 Research on Copyright of Digital Works

Digital publishing is a new publishing method based on digital technology and Internet technology, which stores and disseminates the contents of works in the form of data through editing and processing (Zeng and Huo 2015). With the rapid development of Internet technology, digital publishing has become an important publishing method. At the same time, the copyright protection of digital publishing is becoming more and more serious. Digital copyright is also a kind of copyright, which is protected by Chinese law (Jia 2020). In recent years, the state has also successively issued many laws to protect digital works. However, though digital publishing is a legal concept, the definition of its connotation and extension has not reached an accurate, clear, and unified conclusion so far. The formulation of industry norms or national standards lags behind the needs of the rapid development of China's digital publishing industry (Zhang 2021). At present, the copyright protection of digital publishing in China mainly includes the following problems: weak social awareness of digital copyright protection, imperfect digital copyright interest distribution system, insufficient legal protection of digital copyright, and lack of advanced technology (Zhang 2021). These factors have brought great challenges to the copyright protection of digital works.

Compared with traditional paper publishing, digital publishing has a fast circulation speed and low reproduction cost. These characteristics make it more vulnerable to infringement. Due to the great difference between digital publishing and paper publishing, the traditional way applied to the copyright protection of paper publishing has been unable to meet the requirements of digital publishing copyright protection (Zeng and Huo 2015). The suggestions put forward by the existing literature on strengthening the copyright protection of digital works include the following aspects: improving China's digital publishing copyright legal system, improving the copyright collective organization and management mode, strengthening supervision, publicity, and education, and so on.

The emergence of NFT technology is expected to further strengthen the copyright protection of digital works. NFT assigns a hash value to digital works by coining coins on the blockchain to keep them permanently on the blockchain. Based on the non-tamperability of blockchain, digital works are truly unique and their ownership has been confirmed (Shen 2021). Each NFT work corresponds to metadata that is permanently saved and cannot be changed. The content of metadata records makes each work different. NFT is the digital certificate of works, which cannot be forged. If NFT is applied to the field of copyright confirmation, it can help to confirm the rights of digital works.

3 NFT and Digital Copyright Protection

3.1 NFT and Intellectual Property

NFT has a positive impact on copyright protection and more and more contemporary art comes from digital creation. In the future, NFT will play a very important role in solving the copyright problem of digital works.

We have always faced challenges in distinguishing between original and plagiarized digital works. In the world of digital art, it is very easy to copy digital media such as painting, photography, and music. By copying and pasting, network users can regard other people's digital works as their own possessions. This also makes it difficult to distinguish whether works are legally obtained or pirated in the network environment.

NFT can effectively solve the problem of copyright traceability of digital works. As we all know, blockchain is a distributed, decentralized, and tamper-proof accounting method. Works can be recorded on the blockchain through some technical means to achieve tamper-proof capability. NFT issues smart contracts through the platform, turning them into a series of unique numbers, casting them into a code, a pass, and unique virtual asset ownership. Based on blockchain technology, we can clearly understand the origin and transaction of NFT and even trace it back to the source. Its creators and holders will be clearly recorded on the blockchain. The digital works certified by NFT are the original, and other copies are pirated. Authors

of digital works can confirm the rights of their digital works by generating their own works into NFT and using blockchain technology to let computers around the world act as account books. Even if digital works may be pirated, NFT's data certificate cannot be copied and forged. Fakes have no chance of survival at this time.

In the field of NFT, the owner only holds the ownership of NFT. It should be noted here that neither the NFT owner nor other users can copy NFT works, because the person who owns the copyright of NFT works is the creator of the works, who may be the publisher of NFT or the start-up company of NFT. Copying NFT works without the authorization of the copyright owner is illegal and is copyright infringement.

In the process of selling, NFT automatically completes the NFT transaction of works in the form of a smart contract, which only means that the ownership of NFT works has been transferred, and the copyright of works has not been transferred. In other words, the buyer can only obtain the right to collect works and cannot copy and use the purchased NFT works. If the seller is the copyright owner and both parties reach an agreement on the copyright transaction, the copyright can be transferred only if both parties reach an agreement on the written contract.

3.2 Infringement Risks of NFT

Although NFT will provide new ideas on intellectual property protection of digital works, the technology will have shortcomings, and NFT may also cause some infringement risks.

The first is that the work is cast into NFT without the authorization of the creator. Blockchain can only record technology and doesn't know what happens in the real world. NFT cannot be tampered with, but it can only prove that the content of rights after the works are cast into NFT has not changed, and the legitimacy of the source of rights before casting cannot be guaranteed (Zhang and Cheng 2021). Since the copyright owner of NFT works does not need to be the same person as the owner of NFT, it is easy for the creator to find that his works have been stolen and cast into NFT for sale without permission. This undoubtedly infringes the copyright of the original work.

Second, copyright owners may run off many copies of digital works and cast each into the NFT and release these NFTs on different platforms for sale. Although NFT is unique, it only represents the uniqueness of specific NFT works. Therefore, piracy may continue because of the behavior of the copyright owner.

Third, if the owner of NFT has multiple ID accounts, he may conduct NFT transactions back and forth in multiple accounts and raise its price. The essence of blockchain decentralization and anonymity is to be unknown to buyers. Its own rights and interests may be infringed.

Fourth, buyers and investors face copyright risks. All NFT platforms generally formulate special agreements to restrict the rights of NFT holders and buyers. Before purchasing NFT, each NFT buyer shall specify the relevant rights that can be obtained

by its purchase under the relevant provisions of the NFT trading platform to avoid the risk of infringement.

4 Results and Discussions

4.1 Application Prospect of NFT

First of all, as mentioned above, NFT can help solve the problem of digital copyright traceability, protect the copyright of digital works by providing unique digital certificates, and enable the public to directly identify pirated works.

NFT should be the most widely used technology in the digital art market. NFT can mark the ownership of original digital assets to prove their uniqueness. Therefore, those assets have scarcity and collection value. NFT can provide digital certificates for digital works of art. If the copyright of works of art is guaranteed, it has collection value. The circulation of works of art in the network environment is more convenient, with unparalleled liquidity and premium of traditional works of art. Moreover, some NFT platforms stipulate that the original author of each transaction of NFT works can obtain a certain proportion of tax, which brings benefits to the originator.

The meta universe, a recent hot topic, is a virtual world parallel to the real world, which is built through digital technology and users can interact with others in real time. Users can make digital creations in the meta universe. With the continuous maturity of NFT technology, NFT will inevitably be introduced in the establishment of metauniverse in the future. NFT can solve the problem of right confirmation in the meta universe. Users in the virtual world will build a variety of products. If the copyright of these products is not certified, it is easy to be copied indefinitely, so it is difficult to protect the rights and interests of users in the meta universe. Meta universe is based on blockchain and has the characteristics of decentralization. The works created by users cannot be certified by authoritative institutions. NFT can effectively authenticate the assets in the virtual world and realize the ownership confirmation of users' virtual assets.

NFT can also be integrated into real-life scenarios. For example, NFT is used to mark assets and provide stronger protection for assets.

4.2 How Do Creators Protect Their NFT Copyright?

Creators themselves should have copyright awareness. If authors are not aware of the protection of rights on the Internet, they do not pay full attention to the theft of works at the initial stage. Only when the infringement reaches a certain degree, the influenced creators will fight for rights, but they often miss the best opportunity of

rights protection (Jia 2020). If the author uses the NFT platform to sell the stolen works, he must submit a statement to the NFT platform as soon as possible.

In addition, blockchain technology is largely unregulated. The anonymous nature of wallets makes it difficult to track the real identity of buyers, and the NFT trading platform lacks administrative jurisdiction. At present, if your works are cast into NFT and released to the platform without authorization, it is difficult to protect your rights. Therefore, NFT creators need not only to improve their copyright awareness to protect their rights. Casting their works into NFT as soon as possible may be an important way for creators to protect their rights. At this time, we can provide evidence through our own casting time to get pirated works off the shelves.

4.3 How Does the NFT Platform Help Protect the Copyright of NFT Works?

With more and more things created on the digital platform and having greater value, we must strengthen supervision to ensure the sound development of the industry.

NFT will greatly promote the development of digital assets, but there are no relevant regulations specifically for NFT. In view of the lagging characteristics of the law, we should first start with the control of the platform itself. At the beginning of the development of digital publishing, many traditional publishing houses began to revise the publishing contract when digital publishing was in full swing and agreed on the right of network communication, which delayed the authorization of a large number of book authors and objectively caused the loss of the economic value of digital copyright (Xu 2013). Therefore, in order to protect the rights of all participants in NFT circle, each NFT trading platform should timely formulate corresponding terms and rules, link the platform rules with data security and copyright protection, and form a set of adaptive normative mechanisms to ensure the rational use of NFT. For the trading platform, a system should be established in advance to protect the author's copyright, including advanced audit, afterwards right protection, etc. When the publisher casts NFT works, a certain range of audits can be carried out, which is conducive to avoiding the theft of works and maintaining the reputation of the platform.

4.4 Problems that NFT Holders Should Pay Attention to When Participating in NFT Works Trading

When the Internet was just emerging, there were a large number of copyright infringement problems. Firstly, for consumers, in order to save money, they often download and copy digital publishing works that do not need to be purchased through the Internet and take their actions for granted, unaware that their actions are infringing

the copyright of digital publishers (Zhang 2016). In other words, they are not aware of their rights at all. Moreover, in order to increase the number of views, the publishing platform has not effectively curbed this situation. By analogy with the above situation, it is extremely important for the holders of works to clarify their rights in the transaction of the NFT market.

NFT cannot grant the holder intellectual property rights to the works. It can only prove that the works owned by the holder are genuine works and do not provide copyright transfer. The holder cannot exercise the rights given by the author or NFT trading platform for the NFT he owns, nor can he copy it privately or use it economically. Otherwise, these unreasonable uses will lead to infringement.

Participants in the NFT trading market should invest carefully, pay close attention to the system of trading platforms, clarify their rights, and avoid infringement.

5 Conclusion

To sum up, this paper aims to discuss the positive role of NFT in copyright protection by studying its technical characteristics. The uniqueness and non-tamperability of NFT are of great significance to the copyright protection of digital works. This paper first discusses the difficulty of digital copyright protection, and then explains the positive role of NFT in the application here, as well as the infringement risks of NFT. Finally, this paper provides the application prospect of NFT and how creators, holders, and trading platforms protect the copyright of NFT works. Understanding these problems can provide strong theoretical support for the copyright protection application of NFT.

This research also has limitations, which may lead and give suggestions to further research. Whether the original author can be required to prohibit the circulation of real-world works after casting them into NFT is an important question. If NFT buyers want to "return goods", whether they need a secondary transaction and how to deal with the taxes and fees that may be involved remain to be explored and studied.

In the development of new things, there will always be problems. NFT has both positive value and negative risks. NFT is bound to bring great changes to our lives and challenges at the same time. If NFT technology wants to play its role in intellectual property rights, it needs to be based on public consensus. When NFT is widely spread among the public and people see its long-term effect, various problems at this stage may be solved.

References

Jia Y (2020) Research on the problems and countermeasures of digital publishing copyright protection. Journalists Obs (30):48–49

Shen Q (2021) Can the hot NFT solve the pain of digital works copyright. Wen Wei Po, 009

Xu X (2013) Digital copyright protection from the perspective of digital publishing: current situation, problems and countermeasures. J Baoding Univ 04:116–119
Zeng W, Huo S (2015) Research on the problems and Countermeasures of digital publishing copyright protection. The Press, issue 03, pp 50–53+57
Zhang H (2016) Problems and countermeasures of digital publishing copyright protection. Commun Copyright (10):182–183+186
Zhang B (2021) Research on the problems and countermeasures of digital publishing copyright protection. Publ Ref 06:46–48
Zhang Y, Cheng N (2021) The development of NFT in the field of copyright protection needs to break through its own limitations. China Press and Publication Radio and Television News, 005
Zhang Y, Ye D (2021) What can NFT bring to copyright protection. China Press and Publication Radio and Television News, 005

The Importance of Content Marketing in Media

Xinyuan Huo

Abstract Content marketing is evolving and becoming an impressive marketing tool in this data-driven, and digital world, especially with the advent of social media. The research method of this paper is qualitative because the aim is to provide an extensive overview, explanation, and discussion on content marketing in media. To investigate the issue of content marketing, 32 peer-reviewed literature and academic references were selected in Google Scholar for this study. This literature was published from 2012 to 2022. This paper argues that the future of marketing requires brands to center on engagement and interaction between the brand and consumers through content marketing. And a brand can conduct content marketing for its enterprises by four practical steps: setting a mission, goals, and performance indicators for the content marketing campaign, knowing its audience, creating a plan for content creation, and utilizing keywords and promoting its content.

Keywords Content marketing · Social media · Online content

1 Introduction

Content marketing is the industry standard as it is more effective than traditional marketing (Baltes 2015). Content marketing is an approach that utilizes podcasts, videos, relevant articles, and other media to engage, attract and retain an audience (Kee 2015). Content marketing provides valuable and relevant information for consumers instead of solely focusing on selling approaches.

A brand's audience wants it to produce quality and valuable content, which needs to be natural, engaging, and entertaining. Content may be in videos, images, and text, among others, and may be informative, entertaining, or problem-solving. Audiences require brands to create content that is authentic, relevant, and tells a story (Rancati 2014). Content marketing is essential for brands that want to build their

X. Huo (✉)
The University of California, Irvine, CA 92617, USA
e-mail: xinyuah2@uci.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_32

presence online successfully. Content marketing objectives are for a brand to reach its audience, increase conversions, and increase brand awareness and customer loyalty while learning about customer needs or interests through engagement (Baltes 2015; Rancati 2014). Therefore, brands should not only focus on increasing sales but also on building customer relationships and educating the target audience about the products or services that each brand offers. Content marketing also requires brands to devise effective content marketing strategies and new methods to produce and share content with the target audiences (Baltes 2015). The content marketing strategy should highlight a brand's goals, content channels, types of content, and content marketing budget. A content marketing strategy enables a brand to deliver valuable content and invest in multimedia without going out of budget (Kee 2015; Bala 2018). Brands not using effective content marketing strategies are lagging in the industry.

This study addresses two main questions: what is content marketing and the importance of content marketing in media. This research is significant in ensuring readers understand the importance of content marketing in media. It provides in-depth knowledge on content marketing and how brands can implement content marketing to drive the business forward and nurture customer relationships.

This paper has three sections; the first is 3.1, which discusses the content marketing concept. The second is 3.2, which analyzes marketing components, while the third is 3.3, which discusses content marketing implementation. The conclusion summarizes the whole paper, the theoretical and practical significance of the research, and its limitations.

2 Method

This paper utilizes 32 carefully selected works of literature ranging from articles, journals, and some academic reference books. Most of the literature used in this research paper is peer-viewed articles and academic reference books from Google Scholar. Some of the sources are articles from various websites on Google. These pieces of literature have varying publication years, and their time ranges from the year 2012 to 2022. The authors of this literature are perceived as experts within their respective fields, which strengthens the trustworthiness and reliability of this literature. The articles are reliable, relevant, and trustworthy as they focus on business and the marketing field. They cite older articles that also focus on content marketing and are acknowledged as exceptional sources. The purpose of these articles is to explain and provide in-depth knowledge on the concept of content marketing and its role in media. The literature meets this purpose as they provide different perspectives on content marketing and its importance in media from different experts.

3 Discussion

3.1 Definitions

Definition and Terminology of Content Marketing. In marketing, content is anything a brand or individual develops for consumption. Examples of content include blog posts, infographics, Slideshare, videos, and photographs. Content marketing is the approach that makes these examples of consumable content work for a brand cohesively (Odden 2012). Content marketing is a form of attraction strategy which involves being available when customers need compelling, engaging, relevant, educational, and entertaining information. Thus, the brand's content should be purposeful and align the consumer needs with business objectives and goals. Content marketing is a critical growth strategy for developing a brand's presence and increasing sales and audience engagement (Plessis 2017). Content marketing works with social media since social media is essential in creating brand presence, extending a brand's content, and increasing audience engagement. Social media refers to applications and websites that allow users to participate in social networking or interact, create and share ideas, information, or other content (Seyyedamiri 2019). Social media acts as the medium via which content reaches the audience because social media encourages direct interactions and communication between businesses and the audience. Social media transforms communication between brands and their audience from monologues to dialogue (Guoan 2019). Thus, brands use social media presence for content marketing for their content to reach their target audience and attract potential consumers.

Content Marketing and How it Plays a Role in Marketing. Content marketing is developing and distributing beneficial and applicable content to an audience via social media posts, white papers, blogs, videos, newsletters, emails, and other media (Holliman 2014). Content marketing promotes brand awareness and business expertise. When a brand consistently uses content marketing, it creates an impression on its audience, who form a relationship with the business (Jutkowitz 2014). Eventually, as the brand disseminates relevant information, the target audience is more likely to buy from the brand.

Content plays various roles in marketing, including informing the target audience, creating a sense of community, and entertaining to pitch an 'idea' or 'product'. Firstly, content tells the target audience about things they want or need to know. Content marketing uses blogs and white papers to practically provide knowledge of the subject matter, showing the audience that a brand has researched the subject matter (Holliman 2014). Well-written and well-presented content tells the target audience about a brand and sells a product's merits in the process, thus attracting buyers.

In addition, content marketing creates a sense of community through social media engagement. Customers value the sense of belonging to a community, especially on social media (Jutkowitz 2014). Content marketing utilizes social media by sharing resources, interests, and information, enabling the audience to connect to more than

the product or brand (Plessis 2017). Finally, content marketing entertains the audience while pitching an 'idea' or 'product'. Content comprises elements consumers want to return to when the content is entertaining and communicates the business personality (Lieb 2012). The content's element enhances brand recognition and can give it prowess and a competitive advantage in the brand's field.

3.2 The Components of Content Marketing

User Generated Content (UGC). User Generated Content (UGC) is a dominant media in content marketing. UGC is any form of content, for example, images, infographics and videos developed by individuals instead of brands (https://www.dotcentric.co.uk/news-and-insight/ugc-customer-experience/). UGC is usually original, customer-centric, and brand-specific; people create and publish this content on social media or other channels. UGC is a vital component of content marketing in this era where consumers can rave over a brand on social media.

A. Takes authenticity to the next level. UGC is essential in taking authenticity to the next level. The current digital world requires brands to maintain a consistent online presence since there is high competition for audience attention (https://blog.hootsuite.com/user-generated-content-ugc/). Due to this, consumers are more selective about what content to consume and brands to interact with or purchase. Thus, both consumers and marketers are passionate about quality and authentic content. It is easy for audiences to identify fake user-generated campaigns quickly (Agarwal 2020). Therefore, brands should ensure that their UGC originates from their customers, employees, or brand loyalists.
B. Helps establish brand loyalty and grow the community. In addition, UGC helps establish brand loyalty and grow the community on social media. UGC provides consumers with unique opportunities to participate in the growth process of a brand (Sebastian 2019). UGC allows consumers to be part of something greater and will enable them to grow as part of the brand's community (https://www.dotcentric.co.uk/news-and-insight/ugc-customer-experience/). Consumers are no longer spectators in a brand's growth which influences brand loyalty since people love the sense of being part of something great.
C. Increase conversions and influence purchasing decisions. UGC also increases conversions and influences purchasing decisions. UGC affects the final stages of a buyer's process, primarily when a brand focuses on converting its audience and influencing them into purchasing products (https://blog.hootsuite.com/user-generated-content-ugc/). UGC is the authentic component of content marketing that proves the worthiness of buying a brand's product. Approximately 70% of consumers consider a brand's UGC ratings or reviews before making a purchase decision (Agarwal 2020). Thus, UGC reviews are vital in increasing conversions and influencing the audience's purchasing decisions.

Position Target Audience. Position Target audience is another component of content marketing that involves a brand defining its audience to create content useful to the audience. A brand cannot create content if it does not know whom it's making the content for, which is why it is crucial to identify the audience the brand wants to target with its content. Brands position their target audience in multiple ways, including surveying existing customers, researching industry trends, and analyzing competitors' target audiences. This process involves analyzing the brand's current customer base by checking its demographics, including gender, age group, and location, among others (Hawlk 2017). This process gives the brand in-depth knowledge on the characteristics and consumer behavior of an audience that is interested in its products. A brand needs to identify its competitors and target audience; this helps the brand determine any consumer groups it may have missed in targeting (https://www.semrush.com/blog/content-marketing-strategy-guide/). These collective insights ensure a brand builds a strong definition of the characteristics and values of the target audience. By clearly positioning its target audience, a brand can make an exemplary reputation and experience for its audience through the content that they create and share.

Building the Content Marketing Strategy. Content marketing also comprises building the content marketing strategy; this strategy is a plan which maps out the execution and distribution of a brand's content for marketing purposes (Bala 2018; Savar 2013). Building a content marketing strategy involves developing a content marketing mission statement and value proposition. A brand produces this mission statement by summarizing why it is creating content, whom it benefits, and why it is beneficial (https://www.semrush.com/blog/content-marketing-strategy-guide/). Provision of value is also vital in building the content marketing strategy. Brands develop value propositions by determining the unique value they can provide to the audience with their content, what makes the brand outstanding from other content creators, and why people should follow the brand's content channels. A successful content marketing strategy attracts a brand's target audience at each marketing campaign stage and maintains customer engagement even after they make purchases (https://blog.hubspot.com/marketing/content-marketing-plan). Therefore, building the content marketing strategy also involves aligning the content strategy with business goals.

Marketing Tactics. Marketing tactics are another powerful component of content marketing. Content marketing tactics include building targeted landing pages, segmenting the audience to increase engagement, knowing the target audience, and giving them what they want. Brands market their content by building more targeted landing pages by creating advanced guides for Search Engine Optimization (SEO) and other marketable topics on the internet (Chaffey 2019). Each advanced guide has its separate landing page, optimized for the suitable keywords the audience uses in the search for content. By creating targeted landing pages, brands offer user-generated content that suits their stage in the customer journey. The second content marketing tactic is segmenting the audience to increase engagement. Innovative brands recognize that they have to segment their audience based on their needs because individuals

are at different stages of the buying journey (Plessis 2017). Segmenting consumers based on their personas enables a brand to create relevant and specific content for each segment. The final content marketing tactic is knowing the target audience and giving them what they want. A brand has to know its audience very well before creating content which it can do by performing keyword research to identify what the target audience wants (Chaffey 2019). The brand can obtain an overview of the keywords searched by its target audience and use them when creating content. Then a brand can base its content creation on the audience and implement a successful content marketing strategy.

3.3 Content Marketing Implementation

Create Engaging and Valuable Content. Content marketing requires a brand to create engaging and valuable content that involves a lot of thinking, research, and hard work. The brand's responsibility is to create quality content and make it worthy enough for the audience to engage (https://www.digitalmarketing.org/blog/how-to-create-engaging-content). Several effective ways to create engaging and valuable content include knowing your audience. Brands have to interact with their audience at a direct level to understand their interests better. Social media enables brands to know their audience since a brand can use social media platforms to post content and reply to consumer comments (Kaufmann 2016). This practice increases engagement and enables a brand to identify audience interests. Another effective way to create engaging and valuable content is by telling a story. Brands best connect with potential customers when they share stories and content that are real and authentic (Pulizzi 2012). Therefore, brands have to share real experiences with their audience and make these stories appear personal for the audience to relate and connect to and increase their liking for the brand.

In addition, brands can create content with purpose/ intent to ensure it is engaging and valuable. A brand should have clear intentions and goals before starting content to make quality and appealing content (https://www.digitalmarketing.org/blog/how-to-create-engaging-content). By determining the content creation purpose and goals, brands can make engaging content that interests and attracts the target audience. Finally, leaning on strengths ensures the creation of engaging and valuable content. A brand that wants to increase its engagement creates valuable content by adding value to its advertising product or service (Pulizzi 2012). A brand should create content that advances knowledge and adds meaning to the audience's lives. For instance, brands can utilize videos, infographics, or images to add value to content.

Invest in Multimedia. Effective content marketing requires brands to invest in multimedia. Multimedia is the use of more than one type of medium of communication, and some types of multimedia include videos, podcasts, images, animations, or text. People have different preferences because each individual

learns differently (https://www.socialmediatoday.com/marketing/why-multimedia-content-so-important-infographic). For example, some consumers prefer reading a 15 min blog post while others prefer watching a five-minute video on the same subject. Therefore, brands should not be limited to producing content in only one form because multimedia content is vital to today's content marketing strategies. Multimedia content boosts conversion rates and changes how consumers interact with a brand's content (Tadeus 2020). Competing for people's attention is difficult since human beings process visual data quicker than text information (https://www.socialmediatoday.com/marketing/why-multimedia-content-so-important-infographic). Thus, investing in multimedia is a great way for brands to attract ideal customers. Some brands claim that multimedia content is expensive and therefore focus on blog posts because they are more affordable than creating videos and infographics. Brands do not have to overspend on multimedia content and can save costs by setting budgets for creating quality content (https://www.scripted.com/content-marketing/multimedia-content-roi). Even simple short videos are excellent multimedia content worth investing in and highly beneficial for businesses. Infographics and videos are famous in content marketing as they help increase post traffic. Brands that use infographics can quickly grow their traffic and increase sales (https://www.scripted.com/content-marketing/multimedia-content-roi). Thus, a brand should use the right tools to invest in multimedia to attract customers and gain a competitive advantage.

Channels. Merely creating and publishing content is not enough in content marketing; brands need to generate content for as many channels as possible. In content marketing, a channel refers to a place or site where an individual or brand posts its content (Watson 2015). There are three categories of content marketing channels: paid, owned, and earned. Paid channels are places where brands pay to distribute their content to interested parties (Savar 2013). A 'Pay per click' ad is an example of a paid channel where a brand only gets charged for their content marketing campaigns when the audience engages with their content (Kapoor 2016). Social media platforms like Facebook and Instagram have paid ad campaigns that brands use to market content (Lieb 2012). Brands also utilize the paid channel of sponsoring content or sending goods to influencers on social media platforms to share information or post reviews.

While owned channels are sites that a brand has direct control over and distributes content without requiring the brand to pay for anything (Savar 2013; Thornhill 2017). Social media pages, YouTube channels, podcasts, websites, and email lists are owned channels, and brands can use them to post any content. Finally, earned channels are sites where a third party shares a brand's content for free. Examples of earned channels include individuals sharing a brand's social media content to their friend groups or bloggers and journalists sharing a brand's content on their platforms (Savar 2013). Earned channels are a form of digital "word of mouth" and thus very valuable in content marketing.

4 Conclusion

In conclusion, the future of marketing requires brands to center on engagement and interaction between the brand and consumers through content marketing. This research is significant in providing in-depth knowledge and extensive discussion on content marketing in media. An audience values a business that informs, educates, and answers their questions through content. Consumers want content that keeps them informed and more knowledgeable. Content marketing helps a brand answer the audience's questions, develop relationships, build trust, generate leads, and improve conversions. The roles of content marketing are entertaining an audience to merit sales, informing the target audience, and creating a sense of community. In content marketing, brands build content marketing strategies, position target audiences, and use UGC across all stages of the customer's journey to nurture relationships and increase engagement and conversions. Social media also proves to be successful in improving brand presence when a brand incorporates it with content marketing.

Brands can conduct content marketing for their enterprises by following practical steps. The first is setting a mission, goals, and performance indicator for the content marketing campaign. This step enables a brand to define business goals and a way to measure success and align these with content marketing. The second is for the brand to know its audience, which helps a brand in targeting its content appropriately. Content marketing works when brands recognize consumer behavior and characteristics as it ensures the production of relevant content. Thirdly, a brand should create a plan for content creation. The plan should comprise information on content production, distribution and management team, and schedule. The fourth step is for a brand to share and audit its existing content. If a brand has the content, it should share it with the audience and assess whether existing content is effective to find any content gaps.

Finally, a brand can utilize keywords and promote its content across various channels over the internet. Using keywords helps the audience to find the brand's content easily. Lastly, there were various limitations in conducting this research. For instance, Google Scholar had several search limits, thus would limit the articles one sees in the search results. Thus, it was essential to spend quality time looking at the search pages to get relevant literature. The most common limits that Google Scholar and Google had were the full-text limit, as it would only present full-text literature in the search results. Therefore, the use of keywords like "content marketing in media" and refining search options were necessary to get the desired literature in search results.

References

Agarwal M (2020) Importance of user generated content as a part of social media marketing that drives customer's brand awareness and purchase intentions. Int J Anal Experimental Modal Analysis 12(2):3071

Bala M (2018) A critical review of digital marketing. Int J Manage IT Eng 8(10):321–339

Baltes P (2015) Content marketing-the fundamental tool of digital marketing. Bull Transilvania Univ Brasov Econ Sci Ser V8(2):111
Chaffey D (2019) Digital marketing: strategy, implementation & practice. Pearson, UK
Guoan Z (2019) Precision retail marketing strategy based on digital marketing model. Sci J Bus Manage 7(1):33–37
Hawlk K (2017) Need marketing ideas? Ask your target audience. J Financ Plan 30(11):28–29
Holliman G (2014) Business to business digital content marketing: marketers' perceptions of best practice. J Res Interactive Mark
How to develop a content strategy in 7 steps: a start-to-finish guide (2022) Blog.Hubspot.Com. https://blog.hubspot.com/marketing/content-marketing-plan
How to create engaging content (2022)https://www.digitalmarketing.org/blog/how-to-create-engaging-content
How much do images, videos and infographics boost content marketing ROI? (2017) https://www.scripted.com/content-marketing/multimedia-content-roi
Jutkowitz A (2014) The content marketing revolution. Harvard Bus Rev
Kapoor K (2016) Pay-per-click advertising: a literature review. Mark Rev 16(2):183–202
Kaufmann H (2016) The content challenge: engaging consumers in a world of me-formation. In: The impact of the digital world on management and marketing, pp 271–285
Kee Y (2015) The review of content marketing as a new trend in marketing practices. Int J Manage Accounting Econ 2(9):1055–1064
Lieb R (2012) Content marketing: think like a publisher—how to use content to market online and in social media. Que Publishing
Odden L (2012) How to attract and engage more customers by integrating SEO, social media, and content marketing. Wiley, New York
Plessis C (2017) The role of content marketing in social media content communities. S Afr J Inf Manage 19(1):1–7
Pulizzi J (2012) The rise of storytelling as the new marketing. Publ Res Quarterly 28(2):116–123
Rancati E (2014) Content marketing metrics: theoretical aspects and empirical evidence. Eur Sci J 10(34)
Savar A (2013) Content to commerce: engaging consumers across paid, owned and earned channels. Wiley, New York
Sebastian O (2019) User-generated content and consumer brand engagement. In: Leveraging computer-mediated marketing environments. IGI Global, pp 193–220
Seyyedamiri N (2019) Social content marketing, social media and product development process effectiveness in high-tech companies. Int J Emerging Markets
Social Media Marketing & Management Dashboard (2022) https://blog.hootsuite.com/user-generated-content-ugc/
Tadeus U (2020) Current trends in consumption of multimedia content using online streaming platforms: a user-centric survey. Comput Sci Rev 37:100268
The Importance of User Generated Content (UGC) on Customer Experience—A Dotcentric Blog Post (2021) Dotcentric.Co.Uk. https://www.dotcentric.co.uk/news-and-insight/ugc-customer-experience/
The Ultimate Guide To Content Marketing Strategy (2022) Semrush Blog. https://www.semrush.com/blog/content-marketing-strategy-guide/
Thornhill M (2017) Social media advertising in a competitive market: effects of earned and owned exposures on brand purchase. J Hospitality Tourism Technol
Watson G (2015) The evolution of marketing channels: trends and research directions. J Retail 91(4):546–568
Why multimedia content is so important, Social media today (2016) https://www.socialmediatoday.com/marketing/why-multimedia-content-so-important-infographic

Communication Problems Between Parent–Child

Yanan Wang

Abstract This article explores differences in parent and child growth environments, communication needs, and points of mutual exclusivity when opposing views. Identify the reasons for disagreement by looking for differences. Conflicts are resolved by exploring communication needs. Learn about contradictory rendezvous points by exploring mutually exclusive attributes. Analyze failed communication cases to explore the misunderstandings, wrong opinions, and immoral actions parents and children are prone to make when communicating. Analyzing successful communication cases can help parents and children learn the correct way of delivering information. For family relationships that already have broken down, a third party can be used to mediate. Exploring the third party's existence, meaning, and important role is necessary. Analyzing the preconditions of being a third party who can intervene in the parent–child relationship can help explore the basic conditions for establishing the relationship between the two parties during communication. In future research, the research will continue to investigate whether the intervention of a third party in a broken parent–child connection may help them repair the relationship gap and guide them to appropriate communication methods to establish a good communication relationship.

Keywords Parent–child relationship · Third-party mediation · Education negotiation

1 Introduction

All children will have an adult education before being fully developed and independent. These educations often come from family, school, and society. Family education is one of the keys to determining a child's life. The initial teaching of parents lays the foundation for the child's behavior and character development. Currently, there

Y. Wang (✉)
University of Central Florida, Orlando, FL 32816, USA
e-mail: Yanan.Wang506@knights.ucf.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_33

is increasing emphasis on the role of parents and children's mutual perception and understanding of each other's character and intentions as determinants of their influence on each other. One aspect of parental skills related to child well-being that has emerged in several recent studies is a family organization. Another involves the ability of some parents to develop common forms of interaction with their children, which include shared positive emotions and mutual responses (Maccoby 2000). The interaction mode between parents and children shows the parent–child relationship well and can better reflect the communication problems and contradictions between parents and children.

The way parents and children interact, communicate and educate in each family is different according to the history, culture, education, experience, and growing environment. As society develops, many ways of socializing and educating also need to evolve. Long-term unchanged and undeveloped education methods will make children unable to receive correct education, making it difficult for them to communicate with their parents. Also, parents cannot effectively educate their children, or the children's behaviors go against the parents' expected development direction. When a child cannot communicate well with the original educator, it will affect the child's future social communication and interpersonal relationships.

Many failed educations show a lack of communication or effective communication between parents and children. Lack of communication can lead to inability and unclear communication of ideas, leading to misunderstandings among children, broken family relationships, and even hostility between children and their parents. The lack of effective communication will cause children not fully understand their parents' meanings. Thus misunderstanding, wrong execution, leading to the wrong path, and the final result will lead to some children forming character defects. Excessive guidance will also make educational significance develop in the opposite direction.

Some memorable little social moments occur when the parent–child is coordinated. For example, the child may encounter new fun things that haven't happened, make new unintentional mistakes, or some Things that may cause children to think and ask questions. At times like these, parents may do or say impressive things and have a lasting impact. Conversely, not caring, ignoring a child's feelings, breaking a promise, or revealing a deception may disrupt the trusting relationship between parent and child, thereby changing the nature of the effects that may arise between them (Maccoby 2000). For families that have already developed a rift, whether the intervention of a third party can effectively regulate the relationship between parents and children. To find whether it is possible to successfully communicate or share complete thoughts and feelings by speaking, writing, transmitting, or using different media to convey or exchange information.

2 Standpoints, Opposing Points, and Mutually Exclusive Points

For nearly 30 years, society and education have undergone various reforms and development, which has led to a certain difference in the growth environment of contemporary parents, the educational level of their parents, and the level of social development of today's teenagers. From the 1960s to 2010s, the average age difference between parents and children was about 26–30 years (https://www.ssb.no/260132/average-age-of-parents-at-childs-birth-sy-72). Due to the rapid development of society, technology, etc., the growth environment of parents and the education methods they receive is completely different from what today's teenagers are exposed to. Different backgrounds and experiences will create completely different values and shape different positions and viewpoints for the educated. This part will analyze how parents' and children's educational environment, communication needs, the opposing points in the communication process, and mutual exclusion points will impact the relationship between Parents-Child, and the educational outcomes, which help to understand the basic reasons for failure better. It is a better start to change the communication between parents and children, help establish a good communication environment, and reverse what is about to be formed or has caused adverse effects.

2.1 Educational Environmental Impact

From Parents Perspective. Twenty years ago, education was based on books and lectures; students sat in classrooms, teachers explained knowledge to children, and students were asked to sit down and memorize factual information on subjects (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). Students at the time must passively accept knowledge from teachers and conduct research using existing knowledge. Regardless of new perspectives, and academic development, students' acquisition channels are slow through newspapers, books, and teachers. For some necessary materials, students must spend hours in the library flipping through books for projects or research (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). Therefore, efficiency is slow and passive. This kind of environment will cause the students at that time to become accustomed to receiving information from their predecessors and thinking through the data. In the past, students would be beaten with a ruler for misbehavior (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). Physical punishment was the most effective way to prevent students or children from continuing to make mistakes. Because physical pain makes most students work harder to avoid being hurt or punished or choose to obey to avoid conflict with the punisher.

Contemporary Youth. For today's teenagers, the developed Internet and electronic devices enable teenagers to access social and academic information very quickly. With the huge advantage of having the Internet at our fingertips, people

can reduce the time they spend browsing a book to 30 s (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). Due to the speed of information dissemination, many teenagers will be exposed to new information in advance. Since children are naturally curious and explore new things, they are very interested in exploration and development. Education reform has also changed from passively receiving knowledge from teachers and parents to active teenagers. Curriculum reforms in schools now allow students to compare, contrast and discuss these topics in a small group to increase their knowledge and improve their communication skills, which will be more helpful to them in the future rather than factual (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). The current education pays more attention to the overall development of students, communication skills, abilities, and other skills that can help them integrate into society smoothly in the future. Instead of unilaterally improving their knowledge reserves, they have transformed from independent to united writing. Because the world has changed to where they need more people to work together, schools are joining groups more and offering a program to find different options (https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/). With the development of the times, the reform of education, and the development of the Internet, contemporary children will be more mature than their parents at the same age, so their needs will be more advanced than their parents. Psychologically, adolescents have increased self-awareness and the requirement for independent thinking. They are impulsive, easily influenced by others, and long for independence and recognition from adults and society. They pursue esteem and self-actualization needs (http://www.simplypsychology.org/maslow.html). Children will pay more attention to equal communication and communication and seek the needs of both parties rather than passive indoctrination and command. On the other hand, every child wants their ideas to be approved by their parents, which is their psychological need.

2.2 Communication Needs

From Parents Perspective. Teenagers' initial way of learning is to explore the unknown through imitation, so many behaviors and concepts are almost copied from their parents. The path of educating children is no exception. The basic needs of people vary according to society. According to Maslow's Hierarchy of Needs, people's most basic needs are physiological needs, including food and clothing, safety needs, job security, love and belonging, friendship, esteem, and self-actualization needs (http://www.simplypsychology.org/maslow.html). In society, 20 to 30 years ago, most people still sought food and clothing to accomplish their physiological needs. When they could not limit fertility through reasonable means, the growth environment of their children would change to a certain extent. Satisfying food and heating and having a job to maintain the family was the status quo of most families during that period, so that family education would be relatively lacking. Parents

would not have time to consider higher-level demand education or communication education.

Contemporary Youth. With the development of the times, the reform of education, and the development of the Internet, contemporary children will be more mature than their parents at the same age, so their needs will be more advanced than their parents. Psychologically, adolescents have increased self-awareness and the requirement for independent thinking. They are impulsive, easily influenced by others, and long for independence and recognition from adults and society. They pursue esteem and self-actualization needs (http://www.simplypsychology.org/maslow.html). Therefore, children are eager to exchange information with their parents and have further communication with parents, not limited to any form of communication. Children will expect more companionship and interaction from their parents to complete the needs pyramid of the Maslow's theory gradually. Children will pay more attention to equal communication and communication and seek the needs of both parties rather than passive indoctrination and command. On the other hand, every child wants their ideas to be approved by their parents, which is their psychological need.

2.3 Opposing and Mutually Exclusive Points

Adolescents seek independence because they are in a position of being educated and protected. They have high expectations for their children and want them to be obedient and promising. Due to the lack of parents' own educational experience, they will blindly wish to prevent their children from suffering the same experience as themselves. At the same time, as parents, they have to undertake certain social responsibilities, and they need to fulfill the obligations of raising and educating their children. Therefore, parents will interfere more and guide their children's lives. Their demands are easily ignored, especially the doting of their parents is often viewed by them as shackles.

Because they are not deeply involved in the world, young people often take a romantic attitude towards things, are easily depressed when encountering setbacks, and are easily influenced by others. Parents will use their own experience as a reference, apply it to their children's education, and give more education they think is good. They do not provide sufficient reasons to help their children solve their doubts but instead bind them to a group of them. Incomprehensible behavior can make them more reluctant to communicate with their parents. In addition, ignoring, ignoring, or even not paying attention to the changes in children, simply thinking that time can help children understand themselves, will also intensify the conflict between children and parents. However, because the educational acceptance of contemporary children is not limited to parents and teachers but also on the Internet, they will have more new ideas and communication methods, coupled with susceptible thinking. Unequal communication methods will lead to inefficient communication and even intensify conflicts. Every child wants their ideas to be approved by their parents, which is

their psychological need. However, from a practical point of view, the simple needs of children are often not met, which is one of the important factors causing the generation gap between parents and children.

2.4 Failure Communication

In the communication between children and parents, there are serious problems such as self-centeredness, "what you want to say" and "what you want to hear" are always out of sync, resulting in a "pseudo communication" that lacks real communication (https://m.sohu.com/n/355719685/?v=3). Parents and children focus on different priorities. When parents pay more attention to efficiency and children pay more attention to feelings, there will be differences in the previous communication between parents and children. When both parties completely refuse or cannot think from the other party's perspective, ineffective communication and failed communication occur. Egocentric communication occurs largely unintentionally because both parties of the communicator see the same thing from their perspective and try to persuade the other party to accept their point of view without considering whether the other party's point of view is acceptable or not. Taken by oneself, or whether the other person can understand their point of view. The parents' starting point tends to be more realistic for parents and children. Years of social experience will cause them to lose or forget part of their children's thoughts and thinking, so they cannot understand their children's ideas. At the same time, it is believed that children's thirst for knowledge is only for pure happiness while ignoring the thirst for knowledge itself is for better growth. As a child, exploring the unknown is based on fun and satisfying curiosity, and sharing is based on feeling valued after receiving a positive response. These are the basics to help children grow. However, when parents with enough experience cannot correctly distinguish their children's play behavior, they will unilaterally deny their children's views. In addition, due to the "empirical theory," parents will also think they know the truth and refuse to accept the child's explanation. Low-level, intractable conflicts between parents—arguing, standing by, rolling eyes—seem irrelevant. After all, it's not physical violence. But it is characteristic of many homes. This behavior may help explain many of the long-standing mental health problems in children, including depression, anxiety, poor sleep, and aggressive behavior (https://childandfamilyblog.com/parental-conflict-effect-on-children/). In addition to how parents communicate with their children can affect the parent–child relationship, the relationship between parents can also affect the child's growth. Inactive problem-solving and conflict-solving methods can harm children, and they can also cause them to follow suit. Treat parents, or other people, in the same way when faced with the same problems and conflicts. This is a manifestation of refusal to communicate. Parents' refusal to communicate will cause children to be unable to actively or passively solve problems, which will trouble their lives for a long time, cause pressure on their minds, and distort their characters.

Unilateral control is also a common communication method in many families. It refers to a communication method unilaterally manipulated by parents and does not allow children to refute. Its fundamental core is that parents want to forcibly shape their children to become the ideal, ideal individual based on their own experiences and ideas. A parent does not necessarily use a unilateral command to achieve this. In the name of love, PUA family education constantly denies and suppresses children "for your good." The ostensible purpose is to avoid the child's pride and keep the child always awake, but the actual goal is to make the child obedient and even control the child (https://min.news/en/baby/1709fc9e633b0e3792997f9e852ad98b.html). Or it is inherently unfair to compare a child's shortcomings with other people's children's strengths (https://min.news/en/baby/1709fc9e633b0e3792997f9e852ad98b.html). Although parents' original intention is to set goals and examples for their children, in comparison, they often suppress their children's self-confidence and make them feel inferior to others. Adults should understand their sacrifices, losses, and gains and should not regret or complain when they choose. Affectionate education puts pressure on children from the side and forces them to be obedient. Getting up early to make breakfast for your child is a matter of happiness and love. However, many parents will habitually tell their children about their efforts to spur them to work hard in the direction they expect. From the perspective of suffering, children cannot fully appreciate it. With this love, the child feels heavy and moves forward (https://min.news/en/baby/1709fc9e633b0e3792997f9e852ad98b.html).

2.5 Positive Communication

Establish mutual interaction, dialogue, and exchange of information. Conflict is inevitable in the family, but how to communicate and resolve it is the key to education. Active listening is a way of listening to others and letting them know that you are trying to understand the message they are sending (https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/comunications-skills-your-family/). Active listening shows respect for both parties and conveys the equal status of parents and children in this communication. Communication means not only "informing" but also asking questions. The purpose of communication is to allow both parties to understand each other and reach a consensus rather than unilateral notification. Therefore, explaining, interacting, transmitting information, and explaining needs are the main contents of the communication.

In the study, disagreements were commonplace when the typical conflicts children communicated with their parents revolved around schoolwork, family activities, and responsibilities. Given the conflict resolution process, these adolescents try to prevent conflict, but when conflict occurs, they use emotion, aggression, calmness, surrender, or some sharing of responsibility as conflict resolution strategies (Riesch et al. 2003). First, explicit expectations are referring to parents making rules, consequences of actions, and planning for situations. These rules, effects, and plans are effective,

predetermined, fair, and known to children. Second, power is referring to the use of pull rank by parents to achieve compliance without having to address the underlying problem. Third, Negotiation is about finding common ground with children to make decisions and build systems of family functioning. This dialogue includes thoughts and opinions shared by parents and children. Fourth, Calm down is to involves parents and children taking time to reflect, reassess the situation, and move on to the discussion and the last is feedback, it is the use of "I" statements to reiterate what the other person has said, acknowledge the seriousness of the problem, and provide timely comments in a constructive manner (Riesch et al. 2003).

2.6 Third Parties to Intervene in Parent–Child Communication

When the parent–child relationship in the family is too tense and cannot communicate normally but has to maintain communication, a third-party mediation will be a good choice. Mediation is a voluntary dispute resolution method in which a neutral third party assists conflicting individuals in settling. Specific preventive goals of parent–child mediation are to enhance family functioning, maintain family integrity, and improve adolescent outcomes (Tucker et al. 2017). Not only does it look at resolving or managing specific family disputes, but it also promotes greater parent–child communication. It provides families with negotiating tools they can take home and use to resolve future disputes themselves. In the case of parent–child mediation, the goal is to fundamentally change family dynamics and provide family members with specific skills that can have a lasting positive impact on family functioning and adolescent problem behaviors over time (Tucker et al. 2017). Usually, asking a third party for mediation is to help both parties keep calm when stating problems and conditions and better explain their demands. And transmit information. As a third party, one needs to be sensitive to power imbalances between parents and adolescents while gathering and analyzing data, transforming output, maintaining flexibility in meeting with all parties where the parent and child are located, and building trust and confidence throughout the process. Confidentiality is maintained (Tucker et al. 2017). Evidence shows that most parents and adolescents involved in parent–child mediation believe it positively impacts how they get along, considers it a success, and recommend it to friends without reservation (Tucker et al. 2017).

For children, facing a third party will be somewhat restrained. Instead of fully revealing their shortcomings, they will show their strengths. The purpose is to win the other party's favor to help them better communicate their needs. The third-party person often needs to meet the characteristics of being familiar with the child, being recognized by the child, resonating with the child's emotions, and understanding the child's feelings to be competent for this role.

For parents, facing a non-family member or an inadvertently intimate family member will be more rational. And conversations between adults are a more familiar

pattern to them. Parents will give enough respect to listen to the third party's transmission and will not appear impatient because the third party is equal to the parent in terms of role or authority. Not everyone can become a third party to intervene in parent–child communication to meet the above conditions. But it's possible for teachers, grandparents, relatives, pastors, police officers, lawyers, or someone with a status entrusted with an equal mission.

3 Conclusion

In conclusion, it is necessary to specify educational methods according to individual differences to adapt to the changes of the times. however, to find specific educational ways according to individual differences, it is necessary to complete the information transmission process through communication to better understand individual characteristics, by exploring whether communication and negotiation can be used to achieve parents' educational goals for their children. By analyzing positive cases, the research team found that listening is the best way to receive information, and active listening helps balance the position of parents and both parties when communicating. Questioning is the best way to analyze and understand data. Both parties' questioning and answering are to establish mutual interaction, dialogue, and information exchange, to understand each other better, explore the needs of both parties, make appropriate concessions and reach a consensus at the end. People can find the basic problems between parents and children by analyzing failed cases. this can better help them find solutions to the issues and avoid the same or similar mistakes from happening again. Analyze the problems and solutions between parents and children by analyzing and trying the means of third-party intervention and communication. Gradually gaining the trust of both parties in order to seek a deeper understanding is the most important task of the third-party during mediation. In future research, it will be tested whether the transition of parents and children in failed cases to parent–child relationship in successful cases can be gradually guided by mediation coordination. Because long-term third-party intervention to mediate conflicts between parents and children is not a sustainable way, however, when a third party intervenes in mediation and guides parents and children to develop and communicate independently, it is possible to ensure family harmony and the meaning and independence of children's education.

References

CLPCCCMHP. https://childandfamilyblog.com/parental-conflict-effect-on-children/. 17 July 2022
CSFYF. https://www.udel.edu/academics/colleges/canr/cooperative-extension/fact-sheets/comunications-skills-your-family/. Last accessed 17 July 2022

ENV20YA. https://tafttoday.com/3032/columns/education-now-vs-20-years-ago/. Last accessed 17 July 2022

How much pressure and impact the Chinese family PUA has caused to children will be seen in a few years. https://min.news/en/baby/1709fc9e633b0e3792997f9e852ad98b.html. Last accessed 17 July 2022

Maccoby E (2000) Parenting and its effects on children: on reading and misreading behavior genetics. Annu Rev Psychol 51(1):1–27

MHN. http://www.simplypsychology.org/maslow.html. Last accessed 17 July 2022

Riesch SK, Gray J, Hoeffs M, Keenan T, Ertl T, Mathison K (2003) Conflict and conflict resolution: parent and young teen perceptions. J Pediatr Health Care 17(1):22–31

SSCFEFPCCC. https://m.sohu.com/n/355719685/?v=3. Last accessed 17 July 2022

SSSN. https://www.ssb.no/260132/average-age-of-parents-at-childs-birth-sy-72. Last accessed 17 July 2022

Tucker JS, Edelen M, Huang W (2017) Effectiveness of parent–child mediation in improving family functioning and reducing adolescent problem behavior: results from a pilot randomized controlled trial. J Youth Adolesc 46(2):505–515

Commuting Mode Choices in Small Cities of China: A Case Study of Qianshan

Tianran Chu

Abstract As the size of cities grows with socio-economic development, the corresponding commuting patterns become more and more abundant. However, as there is a wide gap between large and small cities, inverting their commuting patterns also makes a big difference. However, there are few studies on commuting patterns in small cities. In this article, we focus on the commuting patterns in Qianshan, a small city, and analyse whether environmental awareness affects people's choice of commuting patterns from a low-carbon perspective. It is found that e-bikes are popular in this small city, and that low carbon is an important factor, in addition to the fact that people tend to use e-bikes due to the urban planning of the small city. The results of this study will allow for the formulation of urban planning policies suitable for small cities as well as recommendations for the development of transport in small cities.

Keywords Commuting mode choices · Small cities · Low-carbon

1 Introduction

Nowadays, the rapid economic development has led to the expansion of cities and the increasing variety of commuting modes, making commuting trips and the factors influencing them more and more concerned by various parties. The study of this series of issues will not only explore the characteristics of people's commuting patterns, but also contribute to the development of local policies and urban planning.

There are various factors that influence the commuting mode choices, and there are many studies done by scholars on large cities (Engelfrie and Koomen 2018). However, the commuting modes of smaller cities are often overlooked, due to the differing rates of economic growth, the commuting modes of China's small and medium-sized towns and major cities can frequently differ substantially. According

T. Chu (✉)
Hubei University, Wuhan, Hubei 430000, China
e-mail: chutianran@stu.hubu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_34

to the Travel Mode Choices In Small Cities Of China: A Case Study Of Changting, the study of commuting modes in small cities can improve the lifestyles of their inhabitants due to the economic underdevelopment that leads to poor urban planning and transport planning in small cities.

In general, at this stage there is little research into commuting mode choice in small cities and we know very little about the transport problems that exist in small cities. Understanding the choice of commuting patterns in small cities and the factors that influence them can guide policymaking and urban planning.

Two research questions are addressed in this paper: (1) What are the peculiarities of commuting patterns in China's small cities? (2) What variables impact residents' commuting mode patterns in small cities, and to what extent do these factors influence residents' commuting mode patterns? A small Chinese city, Qianshan, is used as a case study to examine this set of issues, which is located in Anhui Province. Using data collected through an online questionnaire and a multiple logistic regression model was used to analyse the influence of socio-economic characteristics, trip characteristics and low-carbon factors on commuting mode choice.

Following a brief review of past research on factors influencing commute mode choices, the study area, questionnaire design, and descriptive statistics are introduced. Then, results and discussion of the multinomial logistic regression are interpreted. Finally, some of the findings and the limitations of this study are the last part of this paper.

2 Literature Review

2.1 Factors Affecting Travel Mode Choice

There are various factors that influence commuting modes, including both objective and subjective factors. From the perspective of objective factors, the factors that influence people's choice of commuting modes include socio-economic characteristics, such as whether they can afford to buy a car or not, etc. In addition, there are also trip characteristics, such as commuting distance and commuting time, etc. From the perspective of subjective factors, in this study, we mainly investigate the influence of low-carbon factors on the choice of commuting mode.

Socio-Economic Factors. Gender, age, education level, employment, and income are socioeconomic factors, and some academic research implies that socioeconomic traits impact people's transport mode choices (Li et al. 2018). For instance, Women are more likely to use the car less for travel and choose public transport instead (Matthies et al. 2002).

Trip Characteristics. Trip characteristics can often directly influence people's commuting modes, with people usually walking to their destination within 1 km, cycling between 1 and 6 km, and driving over 6 km to their destination (Zumkeller and Nakott 1988). And commuting distances vary with the size of the city, with large

cities tending to have greater commuting distances than small and medium-sized cities (Ling et al. 2015; Li et al. 2021).

Low-Carbon Factors. Low-carbon awareness, low-carbon knowledge, and low-carbon behaviors are three elements to consider (Jia et al. 2018). People discovered that low-carbon knowledge had a small but considerable impact on travel intention (Liu et al. 2017). For environmental reasons, women are more inclined to travel by public transportation than by private automobile, resulting in lower carbon dioxide emissions (Matthies et al. 2002).

The commuter's ecological worldview may be characterized as low-carbon awareness, with those who value the environment above all else exhibiting high levels of environmental awareness. carbon consciousness (Liu et al. 2017). People's knowledge of carbon emissions reflects their low-carbon knowledge, which is a positive sign for people and will influence their choice of commuting mode (Kaplowitz et al. 2012). A very low individual carbon footprint is often accompanied by low-carbon habits (Barros et al. 2018). Unlike low-carbon awareness and knowledge, low-carbon habits can directly influence the choice of commuting patterns.

In general, this study will examine the impact on commuting mode choice in terms of the above three factors, namely socio-economic factors, trip characteristics and low-carbon factors. In this paper, data will be collected by means of an online questionnaire, and first descriptive statistics will be conducted to summarize the socio-economic characteristics, trip characteristics and attitudes toward low-carbon of local residents in Qianshan. The data will then be analyzed by multiple regression models through SPSS to investigate the factors that have a significant impact on the choice of commuting mode choice.

3 Data and Methodology

3.1 Study Area

Qianshan is a small mountainous city located in the southwest of Anhui Province, China. It was an important site for human activity as far back as 5000 years ago. As of the end of 2018, the city had a population of around 600,000 people, most of whom live in rural areas. The total land area of Qianshan is 1686.03 km^2, accounting for 1.21% of the province's total land area. Located in the Dabie Mountains, Qianshan has an undulating terrain. Most streets and roads are narrow and congested, which makes electric bicycles very popular among residents.

Qianshan has grown very rapidly over the years and the population is growing very fast, but the roads and streets have not improved along with the economic development. However, it is these narrow roads and congested streets that have led the vast majority of Qianshan residents to choose to commute by e-bike. Although the public transport system has been developed in Qianshan over the years, the only form of public transport is the bus, and compared to the big cities, the timeliness of

buses in Qianshan is not guaranteed, and the bus routes are not designed to go in all directions and are often limited to prosperous areas. So hardly anyone chooses to use the bus as their mode of commuting.

3.2 Questionnaire Design

In order to study the factors that influence the commute mode choice of residents in Qianshan, I conducted a survey of local residents by distributing an online questionnaire in October 2020. The questionnaire is divided into three main sections, (1) the socio-economic characteristics of the respondents, (2) the travel characteristics of residents, (3) factors related to low-carbon perspectives (Jia et al. 2018). The first part of the questionnaire focused on the residents' gender, age, annual income, occupation and vehicle ownership. In the second section, residents are asked about their commute trips made on their typical workday, origin and destination districts of each trip, travel mode, starting and ending time of each trip. When studying the influencing factors from an environmental perspective, this section is divided into three parts, (1) low-carbon knowledge, (2) low-carbon awareness and (3) low-carbon habits (Jia et al. 2018). All items are graded on a five-point Likert scale that ranges from "strongly disagree (=1)" to "strongly agree (=5)." Respondents can check one of five choices to indicate which option best represents their viewpoint. I used three questions to measure low-carbon knowledge: one is linked to general low-carbon knowledge (i.e. knowing how to minimize carbon emissions), and the other two are connected to knowledge about carbon emissions during transportation (i.e. I know that one of the most important causes of environmental pollution is automobile emissions). Low-carbon awareness is tested using two measures that inquire about the respondent's own environmental concerns (i.e. To protect the environment, we must conserve energy and reduce emissions). The part about low-carbon behavior is measured by two items one of which related to transportation (i.e. I will carpool with someone when I take a taxi). The other item is related to how the respondent handles disposable goods.

Based on the data collected about the residents' travel characteristics, I can calculate the commuting distance from the starting and ending points of the trip, and the commuting time based on the time of departure and the time of arrival at the workplace.

There were seven travel modes identified in our survey: walk, bicycle, e-bike, bus, car, and others. Nearly half of the people choose to travel by e-bike and one-third choose to travel by private car, which is very different from the commuting patterns of residents in big cities, so the study mainly focuses on electric cars and private cars in commuting patterns.

3.3 Data Collection and Descriptive Statistics

Between May and July 2021, I distributed online questionnaires using a website commonly used in China called Wenjuan Star, a platform used by many academics to collect data in China. In the end, I collected 221 questionnaires, and after an initial screening, 167 valid data were retained.

Social-economic characteristics. Table 1 shows the socio-economic characteristics of respondents. In general, a higher proportion of the respondents were female than male, and almost half of the respondents were aged 41–50 years old (43.4%). Their education level is evenly distributed between Senior high school or less, junior college and college, and only a very small number of respondents have a master's degree or above. Nearly half of the respondents earn more than 70,000 yuan a year, and their occupations are mainly government workers.

Table 1 Social-economic of respondents on weekdays

Variable		Total (N = 166)
Gender (%)	Female	62
	Male	38
Age (%)	≤30 Years old	7.8
	31–40 Years old	29.5
	41–50 Years old	43.4
	≥51 Years old	19.3
Education level (%)	Senior high school or less	27.7
	Junior college	34.3
	College	34.9
	Masters or above	3.0
Income (%)	≤25 k	12
	40 k	18.7
	55 k	19.9
	≥70 k	49.4
Occupational category (%)	Personnel of party and government organs and institutions	38.0
	Business, company personnel	13.9
	Professional, technical, scientific, educational, cultural and health personnel	12.7
	Self-employed, freelance	11.4
	Commercial, service staff	7.2
	Manufacturing production company workers	3.0
	Rural migrant workers	2.4
	Others	11.4

Table 2 Trip characteristics of respondents on weekdays

Variable		Total (N = 166)
Bicycle ownership (%)	0	42.2
	1	46.4
	≥2	11.4
E-bike ownership (%)	0	7.2
	1	48.2
	≥2	44.6
Car ownership (%)	0	8.4
	1	64.5
	≥2	27.1
Commuting time (%)	<20 min	56.6
	20–29 min	18.1
	30–39 min	6.0
	40–60 min	6.0
	>60 min	1.2
Commuting distance (%)	<1 km	9.0
	1–3 km	40.4
	3–5 km	28.3
	5–10 km	7.8
	≥10 km	14.5

Trip Characteristics and Mode Choices. Tables 2 and 3 show the trip characteristics and mode choices. The majority of respondents' commute is concentrated in less than half an hour (74.7%), with only a very small proportion commuting for more than an hour (1.2%).

Taking commuting distances into account, the vast majority of commuting distances are concentrated between 1 and 5 km, but 14.5% of people commute more than 10 km. Compared to large cities, the commuting distance for residents of Qianshan is much shorter, Xiamen, China, for example, the average commuting distance for residents of Xiamen is about 6 km (Li et al. 2021).

Table 3 Commuting choices of respondents on weekdays

Variable		Total (N = 166)
Commuting modes (%)	Walk	9.6
	Bicycle	0.6
	e-bike	50.6
	Bus	7.8
	Car	31.3
	Taxi	0

In terms of ownership, the proportion of households with at least one bicycle is about the same as the proportion of households without a bicycle (46.4% and 42.2% respectively). Almost every household owns at least one e-bike and almost half of the households own more than two e-bikes. 64.5% of households own a car and 27.1% own more than two cars. The results of ownership are a direct consequence of the commuting patterns of the respondents (Ling et al. 2015).

Table 3 shows that more than half of the people commute by e-bike, 31.3% by car and the other modes of commuting are walking, cycling, bus and taxi, which together account for no more than 20% of the total. This result is interesting and differs significantly from the commuting patterns of people living in large cities. However, in medium-sized cities this has led to the popularity of e-bikes due to travel habits, safety and mode shift considerations (Ling et al.).

Low-Carbon Factors. In this study, the choice of commuting mode is considered in terms of three low-carbon factors: low-carbon awareness, low-carbon knowledge and low-carbon habits and several perspectives were set for each area.

1. Low-carbon knowledge

   - I know some ways to reduce carbon dioxide emissions;
   - I know that sudden acceleration, low speed or high speed will increase the fuel consumption of the car;
   - I know that one of the most important causes of environmental pollution is car emissions.

The final average of these three points is 4.29, 4.56 and 4.40 respectively; the first score is relatively low but the overall score indicates that Qianshan residents are more aware of the relevant carbon emission methods.

2. Low-carbon awareness

   - To protect the environment, we must conserve energy and reduce emissions;
   - In order to reduce carbon emissions, I would love to make a contribution to saving energy every day.

The final averages for these two points were 4.65 and 4.66 respectively, very high scores reflecting the high level of environmental awareness among residents of Qianshan, which is due to the development of modern society and the improvement of education levels.

3. Low-carbon habits

   - I don't use disposable items and I recycle renewable resources;
   - I will sacrifice my personal comfort to reduce my carbon footprint, such as taking the stairs instead of the lift, carpooling with others when taking a taxi, etc.

Unlike low carbon awareness and low carbon knowledge, people's choices tend to be self-serving when it comes to real self-interest. The mean scores for these two views are 4.11 and 4.08 respectively, which is not a very low score, but much lower than the previous two, suggesting that people's ideas are often not fully acted upon.

4 Results and Discussion

4.1 Econometric Modelling

For this investigation, I utilized the multinomial logistic regression model (MNL), which has been frequently used to explore mode choice (Hu et al. 2018). MNL is a statistical approach for investigating the connection between one dependent nominal variable (with more than two options) and a number of independent variables. Our dependent variable is mode selection, which has three options: others, e-bike, and automobile.

$$\text{logit}(y=1) = \log\left(\frac{P(y=1)}{1-(P(y=1))}\right) = \beta_0 + \beta_1 S + \beta_2 T + \beta_3 L \quad (1)$$

$$\text{logit}(y=k-1) = \log\left(\frac{P(y=k-1)}{1-(P(y=k-1))}\right) = \beta_0 + \beta_1 S + \beta_2 T + \beta_3 L \quad (2)$$

where k is the dependent variable's number of possibilities, S is a vector of socioeconomic factors, and T is a vector of trip variables The collection of regression coefficients associated with each explanatory variable is L, which is a vector of low-carbon components.

4.2 MNL Regression Results

Tables 4 and 5 show the MNL regression findings for respondents' e-bike and car. The dependent variable's baseline mode is walk/bus/bike in both models. E-bikes and cars are two more ways of transportation. For one unit increase in the value of the independent variable, the Exp(B) quantifies the ratio of the chance that individuals will pick an alternative travel mode to the probability that they will choose the baseline mode. The findings for all significant are shown in Tables 4 and 5.

Age, income, occupational category, e-bike and car ownership are all connected with mode choice in the socioeconomic group. We may deduce that persons between the ages of 31 and 40 prefer e-bike and car to walk/bicycle/bus, and individuals between the ages of 41 and 50 prefer vehicle to walk/bicycle/bus since EXP(B) uses walk/bicycle/bus as the reference mode. Low income is linked to a reduced likelihood of driving to work. The higher the ownership of e-bike, the more people tend to ride them to work, and car ownership shows this pattern. It is worth noting that the effect of car ownership on people's choice to drive to work is highly significant and has a large Exp(B) value. When car ownership is one, the EXP(B) value is as high as 82,901,042.7, while when car ownership is two or more, the EXP(B) value will reach 140,890,935. Results for high Exp(B) are rarely found in other studies. For example,

Table 4 Multinomial logistic regression of commuting mode choices (e-bike)

Variable	E-bike	
	Exp(B)	Sig
Socia-economic		
Age (base level: ≥51 years old)		
31–40 Years old	4.243	0.022
Occupational category (base level: others)		
Professional, technical, scientific, educational, cultural and health personnel	0.208	0.076
E-bike ownership (base level: 0)		
1	8.357	0.015
≥2	12.900	0.004
Car ownership (base level: 0)		
1	5.6	0.005
TRIP		
Commuting time (base level: >60 min)		
<20 min	363,214,271	0.000
20–29 min	633,296,678	0.000
30–39 min	223,516,474	0.000
40–60 min	111,758,247	//
Commuting distance (base level: >10 km)		
1–3 km	4.750	0.026
3–5 km	24.500	0.001
5–10 km	10.500	0.060

in another study in Changting, a small city, the Odds Ratio for choosing to travel by car when people own a car was only 72.394.

Among the trip characteristic variables, commuting time are also extremely significant in influencing people's choice of commuting patterns. The longer the commute, the more people prefer to travel by electric vehicle, whereas for short commutes such as 1–3 km, people do not prefer to drive to work. The EXP(B) value for commuting time is also very large, which is hardly found in other studies.

5 Conclusions and Limitation

In this paper, the commuting mode selection of residents in a small city—Qianshan is studied, and the factors that affect residents' travel mode selection in a small city are analyzed. Questionnaires were designed to collect residents' socio-economic

Table 5 Multinomial logistic regression of commuting mode choices (car)

Variable	Car	
	Exp(B)	Sig.
Socia-economic		
Age (base level: ≥51 years old)		
31–40 Years old	5.343	0.017
41–50 Years old	2.780	0.086
Income (base level: ≥ 70 k)		
<25 k	0.078	0.024
Car ownership (base level: 0)		
1	82,901,042.7	–
2	140,890,935	0.000
TRIP		
Commuting time (base level: >60 min)		
<20 min	293,365,413	0.000
20–29 min	601,775,206	0.000
30–39 min	361,065,123	0.000
40–60 min	240,710,082	–
Commuting distance (base level: >10 km)		
1–3 km	0.90	0.041
5–10 km	4.577	0.085

characteristics, trip characteristics and attitude of low-carbon. The main findings are lister as follows.

- The most popular mode of commuting in Qianshan is the e-bike, followed by the. private car, due to the lack of public transport and the congested roads, while no one chooses to commute by taxi, which is very interesting and very different from the commuting mode favoured by residents of large cities. As a result, almost every household in Qianshan has at least one e-bike, and many have more than two.
- Because of the small size of the city and the proximity of the various activity areas, many people are able to commute in less than twenty minutes.
- Low-carbon factors did not show a strongly direct impact on the intention of. commuting mode choice. Knowledge and awareness of low-carbon only showed significance on travel by car. But almost everyone showed a high level of behavior, awareness and knowledge of low-carbon.
- The findings reported in this research can assist local officials in developing policies. Firstly, the road should be widened and a special lane for e-bikes should be built, otherwise it is likely to cause congestion and accidents when e-bikes and cars mix on a road, especially when many people choose to commute by e-bike. Secondly, the public transport system should be strengthened. The main reasons

why few people choose to commute by bus are the lack of timeliness of buses and the small size of the public transport system. Finally, the government should strengthen the residents' awareness of environmental protection. As a result, low-carbon awareness and low-carbon knowledge will lead to less use of cars for commuting, both of which should be considered for inclusion in the education programs of residents.

There are various limitations to this study that need to be investigated further. Many residents' commuting chains often contain both complex and simple commuting chains, but the results of this questionnaire do not allow for a more detailed analysis of complex commuting chains in isolation. In addition, the impact of the building environment on the commuting characteristics and commuting patterns of residents was not considered in the course of this study.

References

Barros MV, da Silva BPA, Piekarski CM, da Luz LM, Yoshino RT (2018) Tesser, DP https://onlinelibrary.wiley.com/doi/10.1002/tqem.21578. Carbon footprint of transportation habits in a Brazilian university. Environ Qual Manage 28(1):139–148

Engelfriet L, Koomen E (2018) The impact of urban form on commuting in large Chinese cities. Transportation 45:1269–1295

Hu H, Xu JG, Shen Q, Shi F, Chen YJ (2018) Travel mode choices in small cities of China: a case study of Changting. Transp Res Part D: Transport Environ 59:361–374

Jia N, Li LY, Ling S, Ma SF, Yao W (2018) Influence of attitudinal and low-carbon factors on behavioral intention of commuting mode choice—a cross-city study in China. Transp Res Part A: Policy Pract 111:108–118

Ling Z, Cherry CR, Yang H, Jones LR (2015) From e-bike to car: a study on factors influencing motorization of e-bike users across China. Transp Res Part D: Transp Environ 41:50–63

Liu DY, Du HB, Southworth F, Ma SF (2017) The influence of social-psychological factors on the intention to choose low-carbon travel modes in Tianjin, China. Transp Res Part A: Policy Pract 105:42–53

Scheiner J (2010) Interrelations between travel mode choice and trip distance: trends in Germany 1976–2002 18(1):0–84

Weinert JX, Ma C, Yang X, Cherry CR (2007) Electric two-wheelers in China: effect on travel behavior, mode shift, and user safety perceptions in a medium-sized city. Transp Res Rec 2038(1):62–68

Consumer Rights and Business Ethics in E-Retail Business-Study of China's E-market

Haoqin Yin

Abstract This paper studies business ethics involved in e-retail in China with the main purpose to explore how to protect consumer rights effectively. When consumers make purchase from online shopping websites or social media platforms, they make judgement merely based on cyber images and descriptions. Asymmetric information and unfavorable business terms have been putting consumers in disadvantageous positions and arouse increasing complaints. China being the largest market with the fastest development of e-retail business, offers ample cases for examining how entrepreneurs and organizations bear social responsibilities to protect consumer's rights. The paper focuses on studies of both traditional e-retailers and novel business forms such as live commerce to reveal problems consumers meet in e-purchase and discuss solutions. The paper makes analysis based on statistical data published by Chinese government and conducts surveys to collect consumers' feedback through questionnaire. Personal observation is also included in the methodology of the research as the author traces price changes of sample products to spot pricing fraud issues.

Keywords Consumer rights in E-retail · Business ethic problems · Solutions to improve consumer experience

1 Introduction

Contemporary consumers' behavior is shaped by new forms of business, among which cyber retail stores have become a major channel for people to obtain merchandises and services from all over the world. According to Forbes News, global e-commerce sales will "hit $4.2 trillion as online surge continues" (Verdon 2021). While E-business offers unparalleled convenience to consumers and allows human

H. Yin (✉)
Oaks Christian High School, Westlake Village, CA 91362, USA
e-mail: yhqmax@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_35

beings to go beyond the physical limit of spaces, it also lowers the threshold for players and therefore incur more swindling and violation of trading justice.

1.1 Purpose of the Study

In the context of cyber trading, business ethics of an organization or an individual seller directly decides to which extent consumer rights are protected. Both governments and entrepreneurs have been exploring effective measures to protect consumers. For instance, in 2017, Chinese's National Administration Bureau of Industry and Commerce issued the "Interim Measures for Unconditional Return within Seven Days of Purchase for Online Transactions" stipulating that online seller must accept return and refund unconditionally within seven days of purchase (http://www.gov.cn/zhengce/zhengceku/2020-11/03/content_5557118.htm). However, it is still commonly seen that an ordinary consumer encounter problems of injustice and fraudulence during the cyber trading process. Poor after service and difficulties in obtaining refund greatly reduce confidence of consumers and therefore inhibit demand. In e-business, it is pivotal to maintain consumer loyalty as the sunken cost of getting a customer is very high. Therefore, to study how to help consumers to achieve pleasant shopping experience not only protects the consumer's rights, but also plays a critical role in advocating e-business to sustain healthy development. In addition, revealing the dilemma that consumers face will offer a reference for government and leading enterprises to amend existing rules and acts, so as to protect consumer rights more effectively.

1.2 Defining the Scope of E-commerce in This Paper

E-commerce takes multi forms. In this paper, the scope of study is narrowed down to B2C transactions and live commerce on social media.

B2C, also known as Business to Consumers, is the type of digital business when products and services are sold by a company to end consumers. In the process of a B2C deal, consumers directly deal with a seller through a digital platform.

Live commerce is a business form combining live shows to introduce featured merchandise with real-time chat between sellers and the audience. When seller promote merchandise through various media platforms with a live show atmosphere, they can easily create a sense of urgency among the potential clients and lead to impulse buying.

1.3 Research Methodology

To study the general conditions of consumer rights conditions in China's e-business, data of consumer complaint's type, frequency and major areas is collected from government official websites and annual reports from retail companies.

Primary resources are achieved through design of survey and analysis of first-hand feedback from end consumers. Independent survey was conducted through social media platforms, with Wechat as the main source.

2 Market Size of China's E-Commerce and Major Issues of Consumer Complaints

2.1 Market Size of China's E-commerce

The scale of e-business has been developing at an unprecedented pace in China. According to the statistics of China's Ministry of Commerce, from 2016 to 2020, the national e-trading revenue increased from RMB 26.1 trillion to RMB 37.21 trillion. With a giant digital buying population at 780 million, online shopping accounted for 25% of the country's retail business (Jian et al. 2021). In 2021, China's e-commerce scale reached RMB 42.3 trillion contributing to more than half of the world's e-commerce retail sales.

2.2 E-Commerce Cases Rank No. 1 Among National Consumer Complaints

In the transaction of digital business, consumers are facing high risks of receiving defective merchandises, fake goods and poor service. China Consumer Association published an analysis based on the consumer complaints received in 2021. The report indicated that 63,730 cases were reported to arise from e-commerce, a 6.77% increase compared to that of 2020 at 59,688, sending e-commerce category to the top of the list (https://cca.org.cn/tsdh/detail/30346.html).

Consumer loyalty is tested which directly affect the performance of the e-business. Chinese government issued regulations to protect consumer rights such as unconditional return and refund policy within seven days of purchase. Meanwhile, major e-business runners offer lenient return and refund policies to maintain client viscosity. However, neither the government protection or organizational initiatives serve to eliminate the issues that consumers have when shopping online.

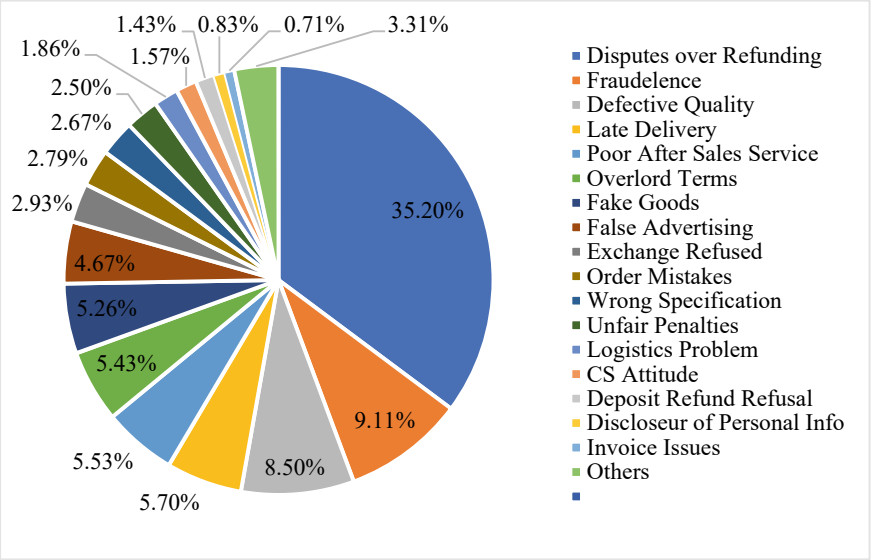


Fig. 1 "*Digital retail arouses complaints*" China Comnews, Mar 16, 2022

2.3 Major Issues that Arouse Customer Complaints

Figure 1 shows that among all the complaints filed against the 413 mainstream e-commerce dealers in 2021, disputes over refunding, fraudulence and defective quality count for 52.81% of the total cases, while issues such as late delivery, poor after sales service, unfair trading terms and fake goods respectively account for over 5% of the total cases (Liu 2022).

3 Business Ethics Problems Occur in E-Retail

3.1 Asymmetric Information and Misleading Messages

In B2C business, a consumer heavily relies on the detailed specifications and description of a merchandise to decide whether the product is of good quality. While a consumer believes that what he or she reads tells the facts about a product, sellers make use of asymmetric information to mislead the consumers.

A typical example is that processed food suppliers may reveal the ingredients with esoteric terms, which are difficult to understand by ordinary consumers. A watch seller may offer model numbers as the specification, while consumers won't be able to judge from a series of numbers the quality of a watch. Such phenomena also happen in real-life deals. However, when a consumer cannot actually touch the

merchandise, the seller can easily highlight the points that would attract the attention of consumers and distract them away from noticing possible problems.

Another commonly seen problem is fake reviews when sellers hire people to write positive comments and users' recommendation. According to a survey conducted by China Youth News with 2036 participants in March, 2021, 87.1% of the consumers referred to other people's reviews before making purchase decision, while 87% of the participants reported that they had been misled by fake reviews (Wang et al. 2021).

3.2 Price Cheating and Obfuscating Promotions

Pricing is a tricky tool that brand owners and sellers use to confuse consumers. At an earlier stage, in 2016, the Chinese Consumer Association published a report claiming that 16.7% of the retailers in the famous Double 11 Promotion inflated the retail price and offered a huge discount to make believe that the deals were a good bargain (Zhao 2016). Such problems still exist after five years. In 2021, the famous LukFook Jewelry was found to inflate their retail price in online flagship store in JingDong platform during the 6.18 promotion and offered a seemingly attractive price (Liu and Lu 2021).

In more cases, as consumers have learned to be alerted and resort to the convenience of internet search to quickly make a price comparison, the retailers changed their strategies to plot obfuscating promotions schemes. With all the complicated stimulating plans, consumers end up finding that "free" gifts are of poor quality; final price after 50% off is higher than the price paid in previous purchase; not to mention that in order to get coupons, consumers have to buy a lot of surpluses. In the "2021 Double 11 Festival Consumer Complaints Report" issued by Black Cat Survey, 27% people among the 1.5 million consumers who filed a complaint expressed their discontent in the misleading promotions (https://n2.sinaimg.cn/tech/a153944b/20211125/2021xftssjbg.pdf).

3.3 Return and Refund Barriers

As early as 2016, the Chinese government issued regulations stipulating consumers are entitled to return products unconditionally within seven days of purchase. This greatly encouraged people to make purchase online eliminating the risks of getting an unwanted product. However, after the protection span, it will be very difficult for a consumer to claim a return if some hidden problems are identified. Even when a product is found to have quality issues, retailers will find excuses to delay the refunding or to simply deny the return request.

Chinese Youth News interviewed 1531 consumers in March 2022. 60% of them experienced difficulties in return and refund in online purchase (Sun and Xu 2022). The reasons that sellers used include: the return application was made after 7 days

of purchase (51%); the merchandise was bought under promotional terms together with another product and therefore cannot be accepted to return alone (46.1%); the buyer had to provide a third-party inspection report to prove the product has quality issues, otherwise the return is not approved (36.6%). These are typical examples of the barriers that consumers encounter in claiming a return.

3.4 New E-retail Forms Create More Problems

Despite of all the problems consumers keep complaining about, the development of e-retailer is unstoppable. While online shops in various giant platforms have become a norm in people's life, new forms of retailing emerge quickly. Live Streaming on social media platforms and group purchase swiftly spread taking more shares of the e-market. In the new channels or platforms, consumers found themselves subject to more possibilities of fraud and cheating.

Live Commerce is the worst-hit channel where sellers manipulate the buying decisions through creating "cannot-miss" impression. It is a usual practice of the show presenter to use an accelerated converse speed to heat up the atmosphere. Then by highlighting or even exaggerating the positive features of a product, the sellers always offer coupons to push for instant purchase. Unlike the traditional e-retail stores who are supervised by commerce administrators, such new channels are expanding at such a savage speed that legislators are slow to issue detailed rules to regulate the behaviors. As a result, the complaints of Live Sales skyrocketed in 2020 as much as 357.75% over that of the previous year (Zhao 2022).

4 Why Is It So Difficult to Protect Consumer Rights

The importance of protecting consumer rights is indisputable in maintaining brand loyalty and sustainability of a business. However, in a market as huge as China, sellers have inexhaustible resources of new consumers. The price they pay for dishonest behavior is insignificant compared to the benefit it brings. Meanwhile, regulatory authorities are prudent and tolerant of grey-area practices by new forms of e-retail which slacks supervision.

4.1 Huge Benefit Versus Lenient Penalties

The scale of live streaming business is incredibly huge. Taking the top live streaming player Weiya for example—her annual sales revenue is near to RMB 10 billion. On the Double 11 Festival 2021, her sales reached RMB 1.95 billion within one single day. Comparing to such a revenue, the penalties she paid for giving misleading messages

in her show was negligible. In a show in August 2021, a bread Weiya sold in her live show was found to have 40% more Caroli than what she described in the ingredients. She was also blamed to sell a fake brand shoes previously (Shan and Ye 2021). Ironically, in April of the very same year, Weiya was appointed by Hangzhou Public Security Bureau as the Ambassador of Anti-Fraud. Although Weiya was punished severely later with a fine amount as spectacular as RMB 1.3 billion, this penalty was imposed due to tax evasion, while the penalties because of her dishonest behavior was never revealed to the public with a clear amount.

4.2 Laws and Regulations Are Stagnant and Confusing

E-commerce has already prevailed for more than two decades in China, while legislations are always lagging behind the swiftly changing market. The Chinese Consumer Rights Protection Law was issued in 1993 and went through two amendments in 2009 and 2013 respectively (https://gkml.samr.gov.cn/nsjg/fgs/201906/t20190625_302783.html). According to article 56, Chap. 7 of the law, in case of providing misleading information to the consumers, the business player may face punishment including "the illegal income will be confiscated; a penalty of less than 500,000 yuan may be imposed; business license will be suspended." By comparison, the China E-Commerce Regulations issued in 2019, stipulates more details to regulate the market that has been booming with e-business. However, regarding the misleading information problems, Article 85 under Chap. 6, the legal liabilities stipulates that " … in case of unfair competition such as false or misleading commercial promotions…, penalties will be imposed according to relevant law." (https://gkml.samr.gov.cn/nsjg/fgs/201908/t20190820_306141.html), which gives vague standards and therefore leaking holes of execution.

In May 2021, State Administration for Market Regulations issued a new law "Regulations for the Supervision and Administration of Online Transactions". In Article 14 of Chap. 2, which defines the general liabilities of online business, there listed situations of illegal conducts such as:

(1) fabricate transactions and consumer reviews;
(2) purposedly mislead consumers by displaying positive reviews in more obvious places;
(3) take orders without real stock, make false reservations, or fake tips records;
(4) fake traffic data such as clicks, attention, and transaction interactions (https://gkml.samr.gov.cn/nsjg/fgs/202103/t20210315_326936.html).

Punishment for such misconduct, however is stipulated to be executed under the frame of China Anti-Unfair Competition Law (Article 43), which apparently does not focus on protection of consumers' rights. Such complicated and stagnant laws deprived market admin is trators power to control the situation effectively.

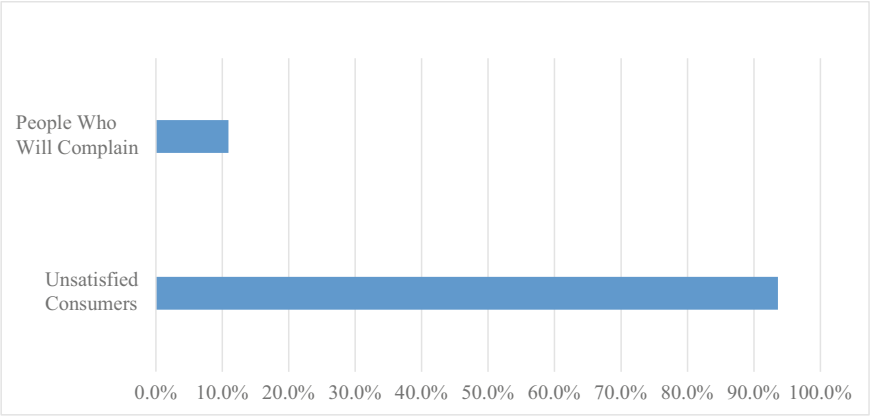


Fig. 2 Consumer tolerance of price gauging

4.3 Consumer Ignorance and Tolerance

Unlike traditional retail channels, e-commerce offers a leeway for the sellers to hide somewhere unreachable by both the consumers and the administrators. A consumer has to spend a lot of time and energy to defend himself in case of purposedly fraud or unfair trading. In addition, Chinese traditional culture has given its people a tolerant attitude towards "insignificant damages". In a survey to study consumer response to price gauging during the pandemic lockdown, an online questionnaire was sent to 1975 people and received 302 effective responses. As shown in Fig. 2 which is drawn based on the independent survey conducted in May 2022, about 93.7% of the participants expressed discontent about the high price of necessities during the lockdown. However, only 10.9% of them expressed the willingness to bring the issues to relevant authorities for arbitration.

The main reasons of such low involvement include: it is not worth the effort to bother for such a temporary problem; it is time-consuming to file an official complaint; chances are slim to get back the overpaid money; I don't know where to get relevant administrators' help.

Low rate of complaints by consumers is also a main reason that the e-retailers act recklessly to infringe consumers rights.

5 Conclusion

Among all the markets in the world, no doubt that China is by far the most advanced in digital business development. By the end of 2021, the online consumers reached 782 million, accounting for over 55% of China's overall population. Such a huge consumer body is swiftly adapting to all kind of digital e-retail forms. Meanwhile,

people go through all sorts of unprecedented problems that occur in the cyber trading process. Studying the cases in China offers a meaningful reference to global business administrator and entrepreneurs who emphasize on the importance of maintaining a healthy and sustainable business environment in the cyber world.

Improvement will be achieved through joint effort of government, business runners and end consumers. For government, it is essential to amend relevant laws and regulations timely so that administrative officers have detailed guidelines to regulate the market. Honest business runners can use propaganda tools to educate the consumers to make informed judgement on qualities and values. Meanwhile, the general consumers should be encouraged to defend their own rights more proactively. In this way, more people will be able to embrace the development of e-business without reservation and enjoy the unparalleled convenience.

References

Black Cat Consumer Survey (2021) Double 11 festival consumer complaints report. Sina Data Center. https://n2.sinaimg.cn/tech/a153944b/20211125/2021xftssjbg.pdf

Jian FL, Cai YD et al (2021) China Ministry of E-Commerce and Information, Ecommerce in China 2020. http://images.mofcom.gov.cn/dzsws/202109/20210915160142367.pdf

Liu XY (2022) Digital retail remains a hot area of complaints. Comnnews. https://www.comnews.cn/content/2022-03/16/content_3961.html

Liu XY, Lu XW (2021) E-commerce companies accused of false propaganda in double 11 festival. The Paper Consumer Complaints Weely.https://m.thepaper.cn/newsDetail_forward_15385654

National Administration Bureau of Market Regulation (2021) Measures for the supervision and administration of online transactions. https://gkml.samr.gov.cn/nsjg/fgs/202103/t20210315_326936.html

PRC National People's Congress (2013) PRC law on the protection of consumer rights and interests. State Administration for Market. https://gkml.samr.gov.cn/nsjg/fgs/201906/t20190625_302783.html

PRC National People's Congress (2018) People's Republic of China Law of E-commerce. State Administration for Market Regulations. https://gkml.samr.gov.cn/nsjg/fgs/201908/t20190820_306141.html

Report by China Consumer Association (2022) 2021 report on national consumer complaints. https://cca.org.cn/tsdh/detail/30346.html

Shan SH, Ye Q (2021) The low-fat whole-wheat European buns sold by Weiya contain 40% more energy than advertised. Sina Finance News. https://finance.sina.com.cn/chanjing/gsnews/2021-08-30/doc-iktzscyx1319336.shtml

Sun S, Xu X (2022) Mar 15 consumer rights survey: 60% of respondents have encountered obstacles in returning goods. China Youth Online. https://finance.sina.com.cn/chanjing/gsnews/2021-08-30/doc-iktzscyx1319336.shtml

The State Council of The PRC (2017) Interim measures for unconditional return within seven days of purchase for online transactions. http://www.gov.cn/zhengce/zhengceku/2020-11/03/content_5557118.htm

Verdon J (2021) Global E-commerce sales to hit $4.2 trillion as online surge continues, Adobe Reports, Forbes. https://www.forbes.com/sites/joanverdon/2021/04/27/global-ecommerce-sales-to-hit-42-trillion-as-online-surge-continues-adobe-reports/?sh=677fff1750fd

Wang PZ, Huang C, Wang ZW (2021) 84.7% of respondents believe false product reviews greatly affect the credibility of the platforms. China Youth Daily. http://society.people.com.cn/n1/2021/0318/c1008-32054372.html

Zhao WJ (2016) China consumers association: double 11 festival saw 16.7% of players offering false promotions. Xinhua News Agency. http://www.gov.cn/xinwen/2016-12/12/content_5146949.htm

Zhao W (2022) 12315 consumer rights platform received nationwide complaints about live commerce, a record high increase of 357.74% compared to the previous year. Xinhua News. http://www.xinhuanet.com/2021-03/15/c_1127212568.htm

Covid-19 and Internet Medical Platforms: Opportunities and Challenges

Ye Liu, Yufei Chen, Jiale Zhou, Shaoxuan Zheng, and Yixuan Jiang

Abstract Today, the COVID-19 pandemic facilitates the rapid development of internet medical platforms. This dissertation is aiming to discuss the cur-rent situation regarding the pandemic and the platforms concerning the opportunities and challenges for different groups. This paper takes a qualitative design approach where the investigation was done through the case studies derived from primary research and secondary data. Consequently, the investigation shows that the pandemic has brought many merits. Except for increasing user groups and higher revenues, for doctors, there are growth opportunities, higher communication efficiency, and better customer management. For patients, it reduces the risk of infection. Nonetheless, challenges attaching to long-term development do exist. The findings indicate the platforms has professional talents issue, the lack of sound laws, sufficient law enforcement, and perfect supervision systems. For patients, their privacy and rights cannot be well ensured, and people may have difficulties in the use of digital technology. The value is to understand how and why some companies have thrived under these circumstances while seeking solutions to counter some challenges.

Keywords COVID-19 · Internet medical platforms · Internet healthcare platforms

Y. Liu
Arts Faculty, The University of British Columbia, Vancouver, BC V6T1Z4, Canada

Y. Chen
School of Finance, Southwestern University of Finance and Economics, Chengdu 611100, China

J. Zhou
Hangzhou Foreign Languages School Cal Center, Hangzhou 310023, China

S. Zheng
DarlaMoore School of Business, University of South Carolina, Columbia 29208, USA

Y. Jiang (✉)
Adam Smith Business School, University of Glasgow, Glasgow G12 8QQ, UK
e-mail: jyx18698732988@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_36

1 Introduction

When people hear "Epidemic," they associate it with "disaster," "stagnancy," and some other negative words. The COVID-19 pandemic indeed brought devastating blows to many industries–airlines, hotels, manufacturing, and so on. With the pandemic spreading worldwide, many enterprises shut down or failed, but some other sectors benefited. However, even in the industry that is being better in the pandemic, not everything is a great opportunity. This paper wants to explore those industries that benefited from the pandemic to understand why and how. And for this purpose, we are going to look at the Internet healthcare platforms. However, we would also argue that there are always challenges even when a business benefits from its opportunities.

During this period, the government urged citizens to stay home; meanwhile, the healthcare facilities would give COVID-19 infected people or suspected infected ones priority treatment, which made typical medical consultation turn to online plat-forms, and then the Internet healthcare explode. "Internet hospital," "remote consultation service "and" online drug purchase" have become hot topics in mainland China. Around 170 new Internet healthcare platforms were built (EY, China 2021). The number of existing platform registrants grew fast; for example, as of December 31, 2020, PING AN Good doctor's users totalled 372.8 million, up 57.6 million (18.3%) from the previous year's end (PING AN 2020). At the same time, the National Health Commission of the People's Republic of China (NHC) released statements several times to encourage Internet healthcare companies to build online platforms and even connect their online goods and services to the national healthcare system.

In the seemingly positive situation, those Internet healthcare companies in China face unprecedented challenges. Are those doctors online professionals or not? And how can these Internet healthcare platforms led by enterprises compete with public hospitals' media? Facing these challenges, what do they do to get long-term development?

To investigate the opportunities created by Covid and the challenges associated with the possibilities, we employed two case studies. In this paper, we use case methodology, and this is based on both secondary data and primary re-search (expert interviews).

2 Opportunities

2.1 Technology

The Coronavirus pandemic improved the business for Chinese start-ups that deal with online medicine delivery and health consultations. The Chinese government made concerted efforts to support this industry, while at the same time, the sector attracted many investors. For instance, PING AN Good Doctor reports an average

year-on-year growth of 26.7% in online consultations per day, reaching 83l,000 in the first six months of 2020. The revenues it generated from online medical ser-vices also doubled to 694.9 million Yuan, while its registered users increased by more than 56 million during the same period (Cheng 2020).

With more players involved in this new venture, Internet efficiency has improved, making it more accessible to the people. Tech companies have also developed some of these online healthcare platforms, which is a significant contribution to the efficiency of the Internet. Consequently, the government released a guideline that included internet-based medical services and treatments under insurance cover (Xiaoyang 2020). This directive has helped with improving the credibility of these platforms across the country to its consumers.

Covid-19 was a big blow to the everyday life known by humans, which encouraged businesses to find ways to sustain their businesses. Since the pandemic led to global lockdown, the Internet has been one of the better ways to do business since it is efficient (Kotler and Caslione 2009). This lockdown and contact restrictions is arguably one of the main reasons why these Internet healthcare platforms thrived during this time. Nonetheless, these Internet hospitals are a way of encouraging people to use the Internet more. Initially, none of this would have been possible, but covid-19 necessitated it, and now most things can and are done online (Simon 2009). Technology has created an environment where most basic tasks or errands, which are always done face to face, can now be done online, which cultivates the culture of operating online.

2.2 Encouraged Polices

In the case of the new coronavirus, the state has promulgated a series of policies and tried them to make people's lives more convenient.

In February 2020, "Notice on Strengthening information Support for the Prevention and control of pneumonia in novel Coronavirus Cases" mentioned that it is pivotal to make full use of Internet hospitals and Internet diagnosis and treatment (China National Health Commission 2020). All the medical institutions are supported to launch online medical consultations and expand the range of services. Therefore, the pressure of offline outpatient departments could be relieved. In the case of PING AN Good Doctor, the platform started to co-operate with Grade III Level A hospitals, created online to offline, integrated, and one-step services. At the beginning of 2020, The Affiliated Shunde Hospital of Jinan University utilized PING AN Good Doctor's medical platform to establish an inter-net hospital (China.com 2021).

In March 2020, with the release of "Guidelines on promoting "Internet Plus" medical insurance services," the internet healthcare institutions that satisfy all requirements obtained the rights to do follow-up visits for common insured disease and chronic disease patients. Furthermore, these institutions can issue electronic prescriptions for insured patients to access medical insurance payments (China National Health Commission 2020; National Health Insurance Administration 2020).

In April of the same year, Shandong Province was the first province that allowed online medical insurance settlement. Currently, the whole procedure could be done online, and all the expenses can be made following the existing treatment policies of offline medical insurance (Haibao news 2021). Up to 31 March 2021, the Shandong Healthcare Security had provided online consultation to over 4,000,000 people, appointment registration to over 840,000 people, drug delivery to over 70,000 people, and 7,000,000 insured Shan-dong citizens in total (www.ce.cn 2021).

2.3 Benefits for Medical Workers

Identity Authentication. For doctors, the first advantage is identity authentication. The internet medical plat-forms could help doctors set up their consulting rooms and create personal intellectual property. With the Internet, all medical practitioners acquire the opportunity to provide services by utilizing their professional knowledge to earn living expenses as their full-time or part- time jobs. According to Ling Xu, the COO of 'The Future Doctor,' the person we interviewed, their signed-up doctors are passionate because they gain more chances to contact people who need help.

Increased Loyalty with Decreased Expenses. Second, customer loyalty could be strengthened, and the cost for doctors would be reduced. The space limitation could be removed; patients no longer need to travel from place to place to get consultations, which means doctors can access more patients. Also, the costs for establishing a studio or private clinic can be reduced, such as rent and utilities for water, electricity, gas, and so on. Eventually, it enhances the stickiness of patients at the same time (Wen and Wei 2015).

Efficient Management. The third benefit is that the higher efficiency of communication and patient management could be achieved. In past years, it has been difficult for hospitals and doctors to keep track of patients' recovery process after leaving the hospital, which created barriers for disease control. Especially nowadays, many people tend to go to hospitals with higher reputations, and these hospitals are generally concentrated in relatively developed areas. To be more specific, there is a large number of patients in Beijing Cancer Hospital are taking medical services and regular subsequent visits. It is common to see that they come from different provinces in China to this hospital for better treatment, said Dr. Wang Lize (who works at the Breast Cancer Prevention center). Doctors benefit from online platforms by having more opportunities to keep abreast of their patient's situations if there are difficulties for some of them to come to the offline hospital (Thepaper.Cn 2021). Thereby, mastering patient information and controlling diseases could be achieved much easier, online consultations and online prescriptions are enough. When changes happen to patients, such as exacerbation of diseases, then offline outpatient is needed at that time.

Young Doctors. The last point is that there will be more opportunities open to young medical workers to acquire further development. The Internet medical platforms provide the possibility for those who do not gain a reputation and status yet since they escape from the traditional hospital management system. These doctors

could offer help to wider groups of people by using the Internet, to accumulate more personal experiences and seek a sense of satisfaction and achievement (Wen and Wei 2015).

2.4 Benefits for Patients

Communicate Anytime and Anywhere. The benefits for the patient are even more pronounced. The first is to communicate anytime and anywhere. Figure 1 shows that 10 am, 3 pm, and 9 pm are the most frequently used periods for Ping, An Good Doctor. People in these three time periods are mostly busy, and they don't have enough time to go to the hospital. The online medical platform saves this part of the time. When people feel unwell, they can communicate with online doctors as soon as possible to get the most timely treatment. It can also be found from the Figure that the communication between doctors and patients is usually no more than 10 times, which means that most conditions can be effectively treated without going to the hospital.

Health-consciousness. The second is health-consciousness. Online medical platforms also pay attention to people's health conscious. Figure 2 shows that obstetrics and gynecology, dermatology, and pediatrics are the top three popular departments. Obstetrics and gynecology is a good example. As a parturient, people need to pay attention to their body changes and communicate with doctors at all times. It is not easy for pregnant women to go to the hospital alone, especially with a prolonged pregnancy cycle. Online medical platforms communicate with doctors about their health-conscious, and it is essential to consult with them about diet formulas that are more beneficial to babies.

Reduce the Risk of Infection. The last one is to reduce the risk of infection. Before the new coronavirus, the number of daily visits to Ping, An Good Doctor was 74,893.92, and this number reached 114,898.50 after the epidemic (Jiang et al. 2021).

This work will find that people's demand for online medical treatment is increasing, and people will start to avoid going to the hospital when the disease does not need to go to the hospital for treatment. Figure 3 shows that the number of people who usually consult during the new coronavirus has increased significantly.

Surprisingly, after the end of the new coronavirus, the number of general consultations has increased more significantly. The new crown virus has left people with indelible worries. Even if the new crown epidemic is over, people still do not want to go to the hospital for treatment, and they do not want to be infected by other diseases during therapy in the hospital. At this time, the safety of the online medical treatment is reflected; people can use the online medical plat-form to conduct medical consultations at home safely.

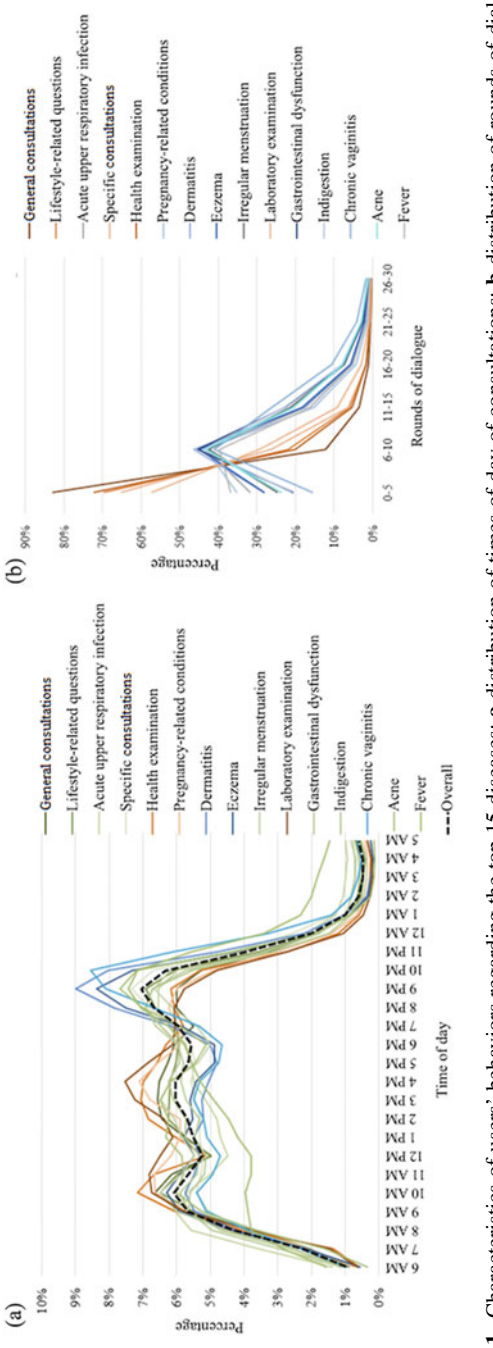


Fig. 1 Characteristics of users' behaviors regarding the top 15 diseases: **a** distribution of times of day of consultations; **b** distribution of rounds of dialogue between users and physicians Health-conscious (Jiang et al. 2021)

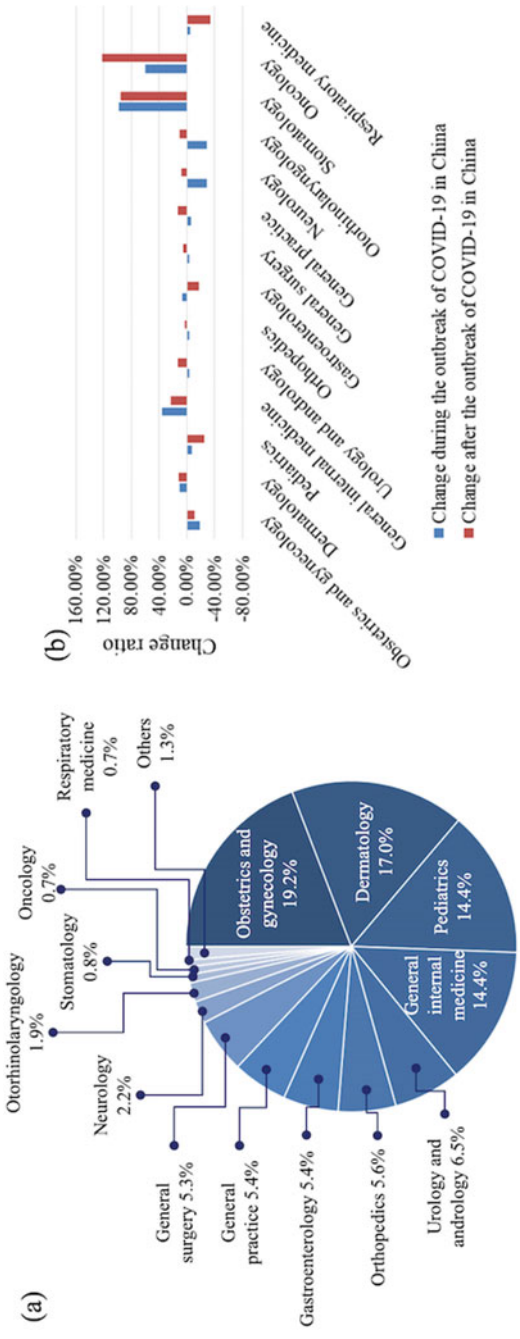


Fig. 2 Departments represented in the consultations and inquisitions: **a** distribution of the departments; **b** change ratios of the distribution of the top 14 departments during and after the outbreak of COVID-19 in China. Reduce the Risk of Infection (Jiang et al. 2021)

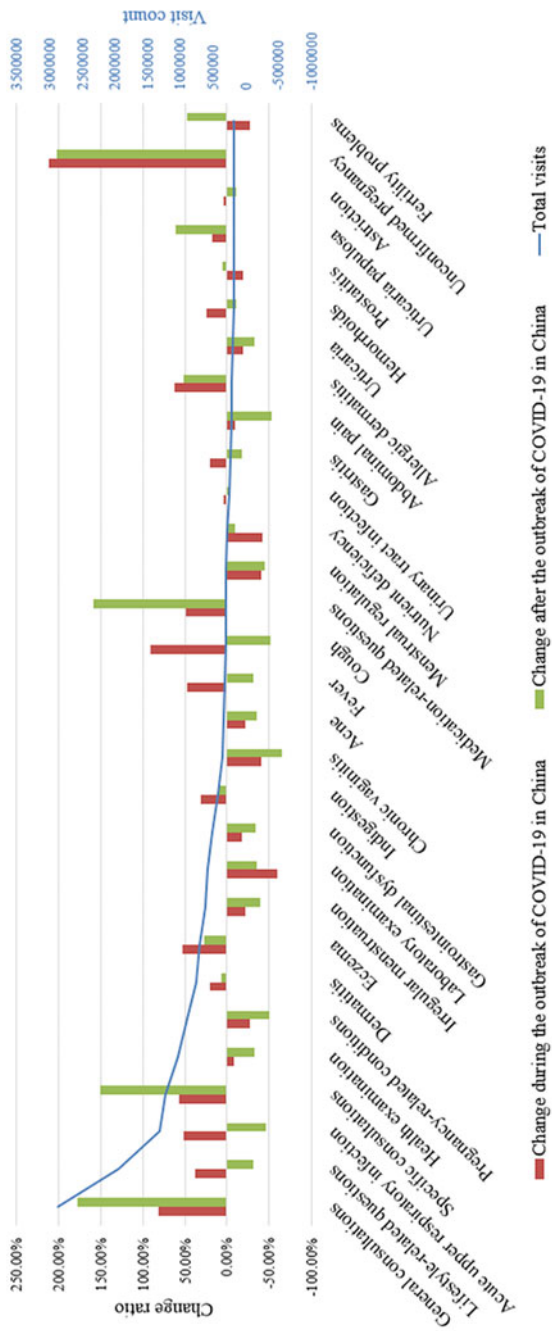


Fig. 3 Distribution of the top 30 diseases represented in the yearly visits to Ping An Good Doctor; change ratios of the distribution of diseases during and after the outbreak of COVID-19 in China are also shown (Jiang et al. 2021)

3 Challenges

However, behind the industry's explosive growth, there are many challenges. During the COVID-19 crisis, people show great concern about safety and health management, leading to complete changes in consumer preferences and purchasing pat-terns. The rapid growth of online healthcare has paid dividends for many companies seeking opportunities in the blank online medical market. Still, we cannot ignore that these companies will face many difficulties transitioning from explosive growth to long-term stable development. The rest of this part will identify and discuss the challenges these companies may face using both supply and demand perspectives.

3.1 Platforms

The first perspective is the supply side. About the platforms themselves, the most essential 'pain point' is the lack of professional talents. Most online doctors are still working in offline medical institutions, and sharing online means losing offline. Excellent doctors in public hospitals rarely cooperate with Internet platforms; they are busy with everyday work and fear that working on Internet platforms will make offline patients trust them less. Also, some nonstandard Internet healthcare platforms push unmatched doc-tors or services to patients. We found a comment on the IOS APP Store about PING AN Good Doctor, and it said, "I have an urgent question, and I'm an adult it (the platform) gave me a pediatrician". At the same time, it must not be overlooked that the cost of virtualization. The price is very high in the early stages of platform development unless a specific size is reached.

3.2 Weakness of Policy

About the weaknesses of policy, as Internet medical is now an emerging industry, there are still unsound laws and regulations, insufficient law enforcement, and imperfect supervision mechanism. From the analysis of the model, we can see that although the state has proposed many policies to protect it, it still faces many problems in the actual implementation process (Hanisch et al. 2021). For example, data security issues, legal policy regulation issues, and health insurance payment issues.

3.3 Patient Medication Safety and Private Protection

The second perspective is the demand side. The first dimension is patient medication safety and privacy protection. Under the traditional medical model, cases and

prescription orders issued by doctors are reviewed at various levels, and hospitals have a strict patient privacy confidentiality system. However, in Internet health care, especially in corporate-led Internet health care platforms without the backing of a physical hospital, many patients who seek medical treatment online receive electronic prescriptions that have not undergone an audit process, making it challenging to ensure the safety of patients' medication. In addition to this, these prescription lists can easily be leaked on the Internet, violating patients' privacy (Shuai 2021).

3.4 Lack of Consumer Advocacy and Litigation Capacity

The second dimension is the lack of consumer advocacy and litigation capacity. The main reason for the high incidence of infringement in recent years, especially in online medical shopping, is the lack of awareness of the rights of pharmaceutical consumers, who either actively ignore their rights because of the small amount or passively give up their rights because of their lack of legal awareness and lack of tools to defend their rights (Hongjing et al 2021). For individual consumers, their litigation capacity and knowledge are at a disadvantage. The asymmetry of pharmaceutical information and the lack of professional pharmaceutical knowledge put online pharmaceutical consumers in a difficult position.

3.5 The Difficulty for Elderly People

The third dimension is the older adults. Older people are usually more likely to get sick, and they may need more medical advice. But online healthcare plat-forms are hard to use for this group. "Health Anhui," a blogger in Anhui province, said, "Official of the province Healthcare Commission said that the fast-growing 'smart healthcare' makes elderly patients feel uncomfortable." According to the Knoema website, in 2015, the elderly literacy rate for China was 81.3%, which means 18.7% of the older adults (65+) could not under-stand, read, or write a short, simple statement on their everyday life, and the number of elderly illiterate population in China was 24,600,260 (Knoema 2021). Therefore, making Internet healthcare platforms friendlier to illiterate older adults is a serious problem (ANHUI Health 2021).

4 Conclusion

At a broader level, this dissertation was motivated by the observation that although most industries suffered from the Covid-19 pandemic, some industries benefited from it. To assess the influence of the epidemic on the Internet healthcare companies, this dissertation uses two platforms as examples, PING AN good doctor and Future

Doctor. Further study shows that under a good premise, there are also challenges. Our research focuses only on what is the opportunities and challenges. Future research should further explore the joint efforts of making functional innovation strategies to make online medical platforms better, such as financial management, privacy management, policy works, with marketing strategies to guide media in surviving any crisis in the future.

References

ANHUI Health (2021) How to solve the elderly "medical difficulty". ps:m.sou.coma439087067100189947pv=0001153wahtt//h//_/?id__

Cheng E (2020) China's digital health care start-ups get a boost from the coronavirus, Beijing, and investors (Online). Viewed 26 Oct 2021. Available from: https://www.cnbc.com/2020/09/1l/chinas-digital-health-care-start-ups-get-a-boost-from-the-coronavirus-Beijing-and-investors.html

China National Health Commission (2020) Notice on strengthening information support for the prevention and control of pneumonia in novel coronavirus cases

China.com (2021) In response to national policies, Ping an Hao Doctor continues to build an Internet hospital. psea.cna.comarce202109290920218879 24.mhtt//hhi/til//_htl

EY, China (2021). https://www.djyanbao.com/report/detail?id=2692316&from=search_list

Haibao news (2021) Home Internet medical treatment: can ease the difficulty of medical treatment and achieve the effect of offline diagnosis and treatment?. ps:aaao.au.coms=169673152412005083 1wr=speror=pchtt//bijihbid/?id&fid&f

Hanisch S, Arias-Cabarcos P, Parra-Arnau J, Strufe T (2021) Privacy-protecting techniques for behavioral data: a survey. arXiv preprint arXiv:2109.04120

Hongjing W et al (2021) Derivative rights of online shopping consumers in the internet plus medicine field. Med Soc 34(10):123–128

Jiang X, Xie H, Tang R, Du Y, Li T, Gao J, Xu X, Jiang S, Zhao T, Zhao W, Sun X (2021) Characteristics of online health care services from China's largest online medical platform: cross-sectional survey study. J Med Internet Res 23(4):e25817

Knoema website. ps:noema.comaasCnaopcsEucaonLeracyEeryhtt//k/tl/hi/ti/dti/it/ldl-literacy-rate

Kotler P, Caslione JA (2009) How marketers can respond to recession and turbulence. J Cust Behav 8(2):187–191

National Health Insurance Administration (2020) Guidelines on promoting "Internet Plus" medical insurance services

PING AN (2020). http://www.pingan.cn/ir/financial-report.shtml

Shuai L (2021) Analysis on the influencing factors of users' privacy anxiety of online medical platform based on grounded theory. Office Informatization 26(10):6–8

Simon H (2009) Hidden champions of the twenty-first century: the success strategies of unknown world market leaders. Springer Science & Business Media

Thepaper.Cn (2021) Advantages and limitations of Internet medical treatment, listentothedoctor-showtosay. ps:m.epaper.cnaaao12377904htt//th/bijih_

Wen D, Wei S (2015) Internet + Healthcare: healthcare revolution in the mobile Internet era. Economic Press China

www.ce.cn (2021) "Internet Plus" medical services will be included in medical insurance policies. www.ce.cncyscyyy20201118202011836020422.smhtt/////hdt///t_htl

Xiaoyang L (2020) China's Internet-based healthcare platforms gain further growth. China.org. (Online). Viewed 19 Oct 2021. Available from: www.cna.org.cnusness2020htt//hi/bi/-12/08/content_76991151.htm

COVID-19 Influence on the Environment and the Travel Industry

Wenkai Duan

Abstract 2020 is an unusual year with the COVID-19 pandemic had spread all over the world. As the negative effect of pandemics suffers the society, the potential positive effect may also benefit certain fields. For example, some researchers believe that COVID-19 has positive effects on the environment. Since the environment is closely connected with the development of the travel industry, it is significant to explore the relationship between COVID-19 and the sustainability of the travel industry. This article identifies the short-term negative impacts and the long-term positive impacts on the travel industry. In the following parts, I will explain the effects by examining and exploring the existing article to illustrate the logical relationship between them. The article will also use the data as evidence to prove the thesis statement. Several suggestions will be proposed including educating the tourists to make them have sustainable manners and having the local government make the policies to avoid over-tourism.

Keywords COVID-19 · Sustainability · Travel industry · Over-tourism

1 Introduction

At the beginning of 2020, COVID-19 outbreaks begin all around the world. It causes drastic effects on the global economy, global health, and so on. Construction, domestic services, and hospitality, which are more contact-intensive and less teleworkable, suffered significant job losses and hours reductions as a result of the pandemic (Masri et al. 2021). Medical systems around the world are under extreme pressure. However, it seems like there are some positive effects on the natural environment. As a great number of countries shut down, the industrial activities shut down globally as well. In terms of air quality, the planet as a whole experienced a

W. Duan (✉)
Boston University, Boston, MA 02215, USA
e-mail: weduan22@bu.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_37

drop in air pollution, especially NO_2. For example during the first month of lockdowns, China produced 200 million fewer metric tons of carbon dioxide than in the same period in 2019 (Muhammad et al. 2020). Water also gets cleared and experiences more water flow due to less settling of sediment that is disturbed by boat traffic (Yunus et al. 2020). Despite the environmental benefits from COVID-19, the pandemic crashed the travel industry. Lockdown the borders was a common precautionary measure in almost all the countries in the world. International travel was not even an option for a long time. Countries that highly depend on profit from the travel industry were in an economic depression. An abundance of airlines shut down and went into bankruptcy. Domestic travel was also strictly restricted in a lot of countries. Nevertheless, with the vaccines and COVID cases dropping, the travel industry seems to start to recover. Since the benefits that lockdown brought to the environment, I hypothesized that the tourist sites are more sustainable than pre-pandemic. The environmental measures closely connect to the tourist sites. For example, some of the tourist sites' environments were affected by the high amount of tourists. In this case, the profit for the travel industry will drop dramatically as the environment is continuously destroyed. Therefore, the travel industry's economic measures depend on the sustainability of the attractions In these circumstances, I focus on the travel industry to determine whether there is a positive effect of COVID-19 had on the industry. I demonstrate that COVID-19 makes the environment more sustainable, which will positively impact the travel industry in the long term.

2 Literature Review

As the COVID-19 spread all over the world, the pandemic harshly impact society. From the economic perspective, many factories and businesses have closed around the world, and some will never return. It results in a higher rate of unemployment and poverty. In order to avoid bankruptcy, many businesses had to terminate their staff. The demand for oil was reduced dramatically as a result of the closure of factories and the reduction of travel rates (Rezaei 2021). Although the COVID-19 is extremely detrimental to society, some studies suggest it may positively influence the environment. Sulaman Muhammad et al. discuss the air quality before and after the pandemic. The author believes that the overall air quality on the planet will be cleaner than before because of the pandemic, although some countries may experience worse air quality after they back to normal. He took countries like China to prove his point. In addition to the air quality, there are researchers that focus on other environmental factors. Yunus, Ali P., et al. focus on the water quality before and after the lockdown period. It gives convincing evidence on how the pandemic influences water quality. The study takes place at Vembanad Lake, India. Although the Lake is mainly polluted by the industrial element, this Lake is a tour site where millions of tourists come here for sightseeing each year. This place is locked down after the end of the march which made this place a perfect place to do the study. Suspended particulate matter (SPM) is one of the most important indicators of water quality.

The study divides the lake into 20 zones and it illustrates that 18 out of 20 zones have lower SPM during the lockdown period than the pre-lockdown period. The study shows that tourism and industry have a severe impact on the lake water quality and it is a good example of how the covid-19 pandemic influences the water quality. The lockdown causes much less pollution from industry and tourists go into the water so that the quality of water has been improved since the pandemic started. Except for the water and air quality, some researchers also examines COVID-19's impact on forest (Earth.Org 2020). According to the literature above, the sustainability of the environment improved during the pandemic. These works make a great contribution to my own research in that they provide sufficient evidence that COVID-19 does have some positive effect on the overall environment. The topic environment and sustainability are popular topics in the travel industry. Some researchers discuss that tourists are responsible for the sustainability of Coastal tourist sites (Sultan et al. 2020). Environmental sustainability and conservation, according to research, are critical issues for the long-term success of coastal tourism. Marine ecosystems that have been preserved and sea beaches that have been developed give open areas and recreational opportunities. As a result, beaches are the most essential assets of coastal tourism, which must be properly conserved in order to contribute to the industry's long-term economic development. As a result, it is now more vital than ever for beach management authorities to evaluate the primary variables that impact tourists' responsible attitudes toward coastal destinations. Since sustainable behavior is more and more important for the development of the travel industry, other researchers notice the necessity for such a sustainable development strategy to implicate. The researcher indicates that the coherence difficulties between heritage protection and tourism development necessitate the adoption of a clear, shared vision and strategy that adheres to sustainable development principles, as well as the use of appropriate planning and management techniques (Coşkun 2020). The author explains that because of the importance of tourism development in regional and national strategies across the Mediterranean, as well as the objective attractiveness of Mediterranean regions, particularly coastal destinations areas, for mass tourist markets, the possibility of having a sustainable tourism development strategy is important not only for heritage conservation but also for local tourism regions' competitiveness, as heritage is assumed to provide. The previous researches have a comprehensive explanation of the relationship between sustainability and the development of the travel industry. Nevertheless, there is limited information provided that could prove there is a direct relationship between COVID-19 and the positive effects on the travel industry in a long term. Based on the information above, I hypothesize that the COVID-19 may make the travel industry better off in the long term since the environment of the tour sites is more sustainable than before.

3 Sustainable Development for Tourist Destinations During COVID-19

3.1 Overtourism During the Pre-pandemic Period

In recent years, global tourism has increased dramatically. According to recent data from the World Travel and Tourism Council (WTTC), the tourism industry accounts for 10.4% of global GDP, making it one of the world's most important economic sectors (https://www.wttc.org/). Although the tourism industry brings enormous economic benefits to society, overtourism is instrumental for the sustainability of the destination. Overtourism is a term used to describe places where hosts or guests, residents or visitors, believe there are too many tourists and that the quality of life or the experience has degraded significantly (Dodds and Butler 2019; Goodwin 2017). In a 2017 survey of 26,000 European people, over two-fifths agreed that overtourism poses a serious threat to the preservation of cultural heritage sites. They believe that tourists do not contribute enough to their economy since they frequently buy counterfeit goods or underpay for food and drinks in local restaurants and coffee shops (Adie et al. 2019). This situation causes the cultural heritage sites to become commercial sites. The visitors and the residents are both satisfied with the situation. Visitors come to these sites because they want to feel the atmosphere of history and human culture. Ironically, with overtourism, the historical site is not historical anymore. Rather, it is a place full of fake products and restaurants. For the residents, they believe the visitors are intentionally buying the fake product which is harmful to the cultural heritage sites. Despite this, Overtourism, according to some residents, has disturbed daily activities and the cultural identities of their towns due to the rapid growth of tourist accommodations in neighborhoods, noise pollution from visitors, intoxicated conduct in public spaces, and security concerns (Gurran and Phibbs 2017). In other words, the number of tourists may exceed the local residents. For example, Barcelona estimates that 30 million overnight guests visited the city in 2017, despite a permanent population of 1,625,137 (Milano et al. 2018). The unreasonable number of tourists caused big trouble inside of Barcelona and lead to the dissatisfaction of the Barcelona residents (Leadbeater 2017). In another famous tourist site, Rome, overtourism has harmed the quality of life in many areas of the city by increasing traffic congestion and air pollution, despite the Italian government's efforts to address these issues (https://skift.com/2018/11/15/rome-tour-bus-restriction-stirs-europes-latest-overtourism-controversy/?utm_campaign=EarlyTimeZone-SkiftDailyNewsletter&utm_source=hs_email&utm_medium=email&utm_content=67552492&_hsenc=p2ANqtz-8pzUFCOFl7pKcMSDULH-nGQ9LE7). Overtourism decreases the satisfaction rate for the visitors and the residents. It is important to regulate some of the tourists' behavior in order to make a place pleasurable both for the visitors and residents. There are some researchers who create some useful ways such as control of tourist accommodation, mobile analytic, doors open day, etc. to avoid overtourism (Luca et al. 2020). Compare with these management toolkits, the COVID-19 pandemic is more like a natural regulation that leads to the recovery period of those overtourism sites.

3.2 The Decline of Tourists Due to COVID-19

The pandemic of COVID-19 in 2019 lead the world to stagnate. In order to prevent the spread of the disease, most of the countries make the strictest travel restrictions in history. Some of the countries even do not allow their own citizens to enter the border if they have, they do not have the negative test result. The number of international flights dropped dramatically. For example, China made a policy called "five one's" which means the same airline can only have one flight between one Chinese destination and one foreign destination per week. In other words, during pandemics, tourism has become the main topic of biosecurity efforts by the government and others (Hall 2011; Seyfi et al. 2020). The tourism industry experienced an unprecedented disaster during 2020. According to World Tourism Organization, international tourist arrivals dropped by 65% during the first half of the year as a result of the pandemic, governments all over the world closed their borders and imposed travel restrictions, resulting in an unparalleled drop.

3.3 The Sustainable Development During COVID-19 for Travel Industry

Nevertheless, the reduction of the number of international tourists offers a recovery period for the tourist sites. As the paper mentioned above, overtourism became the major problem among the travel industry which cause dissatisfaction for both tourists and the residents. The lock-down of the border means there are no international travelers for the majority of the time in 2020. Moreover, because most of the countries have domestic travel restrictions and less willingness for travel during pandemics, the number of domestic travelers was also extremely limited. With nearly no tourists, the tourist sites will hugely benefit from the following aspects. Firstly, the overall environment of the sites became much better. In urban tourist sites, with a limited number of tourists, there would be much fewer cars on the road which will reduce air pollution and lighter traffic jam. The fewer activities for tourists in a coastal area will lead to better water quality and cleaner beaches. In short, fewer tourists result in a more sustainable environment in tourist sites and cities. The damage from overtourism will be recovered from this period. More importantly, the satisfaction rate of tourists and residents will increase. Although it is obvious that residents will be benefited from having fewer tourists in town, tourists' attitude toward the pandemic is questionable. The tourists will not be satisfied that they cannot travel to anywhere they want at the beginning of the pandemic, but they will be surprised by the beauty and natural view of the tourist sites after the recovery. Although there are not sufficient data or evidence to support the claim, it is clear to see that all people love to see the original view of a tourist site instead of a commercial site. Therefore, the recovery of the environment will provide a more pleasurable place for both the visitors and the residents in the future.

4 Discussion

In order to have a deeper understanding of the importance of sustainability for tourist sites, I investigate the previous work regarding the responsibility of tourists for sustainability. The study examines the relationship between social media UGC and travelers' behaviors. Based on the research model and data, the researcher promotes the idea that most travelers do not have sustainable behaviors. According to the researcher, to help visitors comprehend the relevance and value of environmental protection, destination marketing organizations should strengthen environmental awareness, initiatives, and promotions via social media. Furthermore, location management could create advertising pieces or documentaries with slogans and visual narratives that encourage tourists to reflect on the serious harm caused by uncivilized behavior (Sultan et al. 2021). This research demonstrates the importance of the sustainability of the tourist site and points out the unethical behavior of tourists is one of the most important factors that harm the environment. In order to make a more concise conclusion, the researcher must take this factor into consideration. Overtourist is a problem because unethical behaviors will more likely happen when there are more tourists. For example, if there are 40 tourists with 10% of unethical tourists with bad behavior toward the environment, there will be only 4 unethical tourists. If there are 4000 tourists with 10% of them unethical ones, the 400 unethical tourists will be much more harmful to tourists' sites than 4 unethical tourists. Therefore, although the environment of the tourist sites has improved due to the lack of tourists, education for tourists is essential for maintaining a sustainable tourist site. In addition to this, the local government should have appropriate regulation policies to maintain a sustainable environment for both the visitors and the residents. Numerous popular tourist sites were experiencing overtourism which was condemned by the local residents. The places such as Boracay adopted several policies that intended to solve the overtourism issue. The main problem of Boracay is pollution, mainly due to the lack of modern sewage infrastructure. The water at some beaches, for example, has fecal coliform levels 47 times higher than the permissible levels. This posed major health dangers to both residents and visitors (https://www.ehl.edu/). The government closed Boracay for tourism in February 2018 for the environment to recover. Although its intention was good, it harshly impacted the locals who were highly dependent on tourism. The government soon revised its policy to a more progressive one. One of the rules in the policy was forbidding smoking and drinking behavior on the beach. It connects to my previous idea that the tourists' unethical behavior needed to be forbidden in order to have a long-term sustainable environment. The policies in Boracay made a great contribution to the long-term sustainable environment for Boracay. For other places like Boracay, it is important for the government to find an appropriate policy for local sustainability.

5 Conclusion

This is the study to examine the relationship between COVID-19 and its impact on the travel industry. The paper uses sustainability as an important measure to explore the research and conclude that COVID-19 has positive outcomes for the travel industry in the long term because the overtourism problem was diminished and the environment could have a recovery period. This paper offers a novel view on COVID-19 potential positive effect to extend the existing literature. Consequently, the research still has other things to explore in order to make a more comprehensive result especially for collecting more data. Because COVID-19 is the new pandemic that occurred in late of 2019, there is limited data and resources available to mathematically prove the paper's main argument. For future research, they must address the data on the travel industry during the post-pandemic period in order to complement the paper. At the present state of information and knowledge, however, there are lessons people could take from the paper. The most important one is that everything is two-sided. Even the pandemic may bring a potentially positive outcome for society. It enlightens future researchers to explore other positive outcomes that COVID-19 could benefit society.

References

Adie BA, Falk M, Savioli M (2019) Overtourism as a perceived threat to cultural heritage in Europe. Curr Issues Tour 1–5

Coşkun IO (2020) Travel and tourism: sustainability, economics, and management issues. In: Aslam M, Lew AA (eds). Springer, Heidelberg

De Luca G, Shirvani Dastgerdi A, Francini C, Liberatore G (2020) Sustainable cultural heritage planning and management of overtourism in art cities: lessons from atlas world heritage. Sustainability (basel, Switzerland) 12(9):3929. https://doi.org/10.3390/su12093929

Deforestation Surges in Amazon as Brazil Fights COVID-19: Earth.Org—Past: Present: Future, 21 Aug 2020

Dodds R, Butler R (2019) The phenomena of overtourism: a review. Int J Tour Cities 5:519–528

Goodwin H (2017) The challenge of overtourism; Responsible Tourism Partnership, Hough, UK

Gurran N, Phibbs P (2017) When tourists move in: how should urban planners respond to Airbnb? J Am Plan Assoc 83:80–92

Hall CM (2011) Biosecurity, tourism and mobility: institutional arrangements for managing tourism-related biological invasions. J Policy Res Tour Leis Events 3:256–280. https://doi.org/10.1080/19407963.2011.576868

Leadbeater C (2017) Anti-tourism protesters in Barcelona slash tyres on sightseeing buses and rental bikes. Available online: https://www.telegraph.co.uk/travel/news/bus-attack-in-barcelona-adds-to-fears-as-tourism-protests-grow/

Masri DA, Flamini V, Toscani F (2021) The short-term impact of COVID-19 on labor markets, poverty and inequality in Brazil. International Monetary Fund

Milano C, Cheer JM, Novelli M (2018) Overtourism: a growing global problem. In: Conversation 2018, vol 18. Available online: https://theconversation.com/overtourism-a-growing-global-problem-100029

Muhammad S et al (2020) COVID-19 Pandemic and environmental pollution: a blessing in disguise? In: Science of the total environment, Elsevier, 20 Apr 2020

Rezaei N (2021) Coronavirus disease—COVID-19, 1st edn. Springer International Publishing: Imprint: Springer

Seyfi S, Hall CM, Shabani B (2020) COVID-19 and international travel restrictions: the geopolitics of health and tourism. Tour Geogr. https://doi.org/10.1080/14616688.2020.1833972

Skift DP. Rome tour bus restriction stirs Europe's latest overtourism controversy. Available online: https://skift.com/2018/11/15/rome-tour-bus-restriction-stirs-europes-latest-overtourism-controversy/?utm_campaign=EarlyTimeZone-SkiftDailyNewsletter&utm_source=hs_email&utm_medium=email&utm_content=67552492&_hsenc=p2ANqtz-8pzUFCOFl7pKcMSDULH-nGQ9LE7

Solution to Overtourism: Lessons from Boracay Island, The Philippines (ehl.edu)

Sultan MT, Sharmin F, Badulescu A, Stiubea E, Xue K (2021) Travelers' responsible environmental behavior towards sustainable coastal tourism: an empirical investigation on social media user-generated content. Sustainability (basel, Switzerland) 13(56):56. https://doi.org/10.3390/su13010056

Sultan MT, Sharmin F, Badulescu A, Stiubea E, Xue K (2020) Travelers' responsible environmental behavior towards sustainable coastal tourism: an empirical investigation on social media user-generated content. Sustainability 13(1):56

The World Travel & Tourism CouncilWorld Travel & Tourism Council. Available online: https://www.wttc.org/. Accessed on 2 Mar 2020

Yunus AP et al (2020) COVID-19 and surface water quality: improved lake water quality during the lockdown. In: Science of the total environment, Elsevier, 27 Apr 2020. www.sciencedirect.com/science/article/pii/S0048969720325298

Current Situation and Digital Development Trend of E-Commerce Live Streaming in China

Shuting Yang

Abstract With the continuous progress of the network and the arrival of the era of big data, e-commerce live streaming gradually becomes an optimal choice of consumers' daily shopping. Since the emergence of e-commerce live streaming in 2016, the potential of e-commerce live streaming gradually expands, and there has been a trend of diversification. The specific division of labor of the industrial chain has become increasingly obvious. By sorting out the development history and evolution trend of e-commerce live streaming, this paper summarizes its development status and characteristics. However, in its evolutionary process and possible future development trend, there are possible or existing problems that need to be solved and arranged in advance. Therefore, this paper summarizes the industry supervision, low-price promotion, younger consumer groups and the efficiency of the whole industry chain to analyze and propose solutions. In this way, we hope that e-commerce live streaming can give play to more advantages in the current trend and achieve a healthier and sustainable development.

Keywords E-Commerce · Live streaming · China

1 Introduction

1.1 Background

With the popularity of Internet and intelligent terminals, e-commerce shopping has gradually become the choice of many Chinese consumers. Compared with traditional shopping, it is more preferred by most customers (Lu and Siegfried 2021). According to the 49th Statistical Report on China's Internet Development, by December 2021, the number of online shopping users in China reaches 842 million, accounting

S. Yang (✉)
SILC, Shanghai University, Shanghai 201800, China
e-mail: shutingyang@poers.edu.pl

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_38

for 81.6% of the country's total Internet users, which. Online retail sales achieved 13.1 trillion RMB in 2021, increasing by 14.1% YoY (CNNIC 2022). Since 2016, traditional e-commerce has begun to evolve to e-commerce live streaming. In the process of development, the potential energy of e-commerce live streaming gradually expands and presents a rising trend. According to the Statistics of the National Bureau of Statistics, in April 2022, when China was affected by the epidemic, the total retail sales of consumer goods decreased by 11.1% YoY, while the retail sales of e-commerce consumption increased by 5.2% YoY (https://finance.sina.com.cn/jjxw/2022-06-17/doc-imizirau8985028.shtml?cref=cj). As a result, consumers are investing more into e-commerce and the industry is changing.

1.2 Research Significance

At present, many scholars have sorted out the development process of e-commerce live streaming as well as summarized the development status, existing or possible problems and solutions. Many brand businesses have expanded from traditional e-commerce to e-commerce live streaming. E-commerce live delivery has become an indispensable part of online shopping for consumers. In order to maintain its power, enterprises' live streaming needs to be carried out purposefully and strategically. However, there is less sorting out in terms of future development trend, which needs to be filled in. Through the evolution of E-commerce live streaming, there are various trends. At present, live tape is growing continuously, showing a larger volume. The content categories of live streaming goods are increasingly diversified from agricultural products to cars. It shows a trend of subject diversification, and the situation dominated by the head anchor evolves into the coexistence of diversified subjects. Data shows that among the nearly 100 million live streaming rooms on Taobao, the number of merchant live rooms accounts for more than 55%, higher than the number of star live rooms. Kuaishou in the second quarter of 2021, the vast majority of e-commerce transactions are selfish domain traffic (https://baijiahao.baidu.com/s?id=1699187523005358264&wfr=spider&for=pc). E-commerce live streaming has its own characteristics, breaking through time–space limitations and efficient transmission. Good products and positive interactions enhance user engagement. The combination of product page and live explanation reduces user churn rate and improves conversion rate. Product quality and interactivity have become the focus of consumers. Consumer purchase intentions are positive and indirect affected by perceived product quality, perceived interactivity (Chen et al. 2020). The whole industry chain presents specialization. Enterprise executives and mainstream media are also vigorously bringing goods live in front of the camera. In 2020, the government and mainstream media will bring goods live to help farmers and poverty alleviation (Lingqi and Yongquan 2021). E-commerce live streaming is developing in a variety of directions, but there are also many problems to be solved in the process of vigorous development. There are several types of existing problems in e-commerce. Firstly,

many scholars have mentioned the lack of supervision in the industry, and the problems of false publicity and falsification of data (Qingxin 2021). This requires supervision from more live streaming platforms and consumers. Secondly, to improve the professionalism of anchors, they need to be familiar with commodities, learn communication knowledge and understand e-commerce knowledge for rechecking (Weiwei 2021). Professional live streaming teams need to be cultivated, and it takes a long time to try and practice. Thirdly, due to serious homogeneity and repetition, it is necessary to cultivate users' viewing habits by creating IP that is personalized and consistent with the image of brand products and solve copyright problems by combining UGC and OGC (Lu and Siegfried 2021; Xiaotong 2020). E-commerce live streaming is developing rapidly, but it will also encounter problems. Most scholars conduct macro analysis from the perspective of industry, but seldom mention the pain points of enterprises' failure to grasp the future trend in the development process and how to make planning from enterprises and the whole industrial chain.

1.3 Research Approach

This paper aims to study the current situation and existing problems of Chinese e-commerce live streaming and how brands can cater to the future trend and achieve better development. In the part of literature review, firstly, this paper will sort out the definition and essence of e-commerce live streaming, so as to have a clearer understanding of the essence of it. Then, the paper will summarize the development history and technical basis of e-commerce live streaming, paving the way for the following analysis. Thirdly, the paper will explore the possible or existing problems of e-commerce live streaming and the possible future development trend of the industry. Therefore, the paper needs to put forward solutions and enterprises and brands in order to meet the general direction of development to formulate future development strategies.

2 Literature Review

2.1 Definition and Essence of E-Commerce Live Streaming

E-commerce live streaming is a way to display products, answer questions and guide shopping with the help of network platform and live streaming technology. Stores can set up live rooms and professional anchors to make centralized recommendation (Zhi et al. 2021). The current e-commerce live streaming is the live streaming of goods in data-based marketing mode. Starting from the needs of consumers, the demand and purchasing power can be obtained by virtue of experience, and various marketing strategies can be adopted to carry out business activities in a

planned way. The essence of e-commerce live streaming is content plus e-commerce. Compared with e-commerce itself, there are several changes in e-commerce live streaming. E-commerce live streaming has upgraded the way of selling goods and increased the participation of anchors and MCN company in the industrial chain (Ying 2021). Compared with the graphic introduction of traditional e-commerce, the use of commodities and vivid explanation of e-commerce live streaming have more impact and can feel commodities more intuitively. In terms of sales logic, different from traditional e-commerce looking for goods, e-commerce live streaming is looking for goods (Lingqi and Yongquan 2021). The direction of interaction is changed from one-way to two-way, which increases the subjectivity of interaction. But essentially what has not changed is that, just like traditional e-commerce, e-commerce live streaming still relies on high-quality goods and good service to win customers and achieve transformation (Dong et al. 2021). To some extent, it is still tough for consumer to know product quality, despite E-commerce displays product details such as descriptions and reviews (Cai and Wohn 2019).

2.2 Development History and Foundation

In 2016, Mogujie, Taobao and JINGdong began to conduct live streaming. Platform gene is search plus e-commerce, began to build live streaming ecology. In 2017, Taobao clarified the mode of live streaming and accelerated the realization of content. In 2018, Douyin and Kuaishou started large-scale short-sighted band products, and the platform was upgraded to use social + algorithm plus content. The e-commerce department will be established formally with brand-name commodities of daily necessities, beauty makeup and clothing to cultivate the benchmark of the head and encourage talented people to participate. In 2019, e-commerce live streaming officially broke out and became an important marketing mode and increment source for multiple platforms, including Pindoduo, Xiaohongshu and Weibo. In 2020–2021, due to the impact of the epidemic, e-commerce live streaming will grow twice, penetrate into multiple industries and combine with offline business scenes to become the main battlefield of the e-commerce Festival. The rapid development of e-commerce live streaming is based on a certain foundation. In addition to the support of digital technologies such as 5G technology and big data, the strong interactivity of network live streaming meets users' participation needs and gradually increases user stickiness, thus increasing traffic and conversion rate. Anchors use the way of answering questions with high frequency, so that consumers can feel the interaction in real time. The real-time explanation and feedback between anchors and customers vividly bring the products into life (Fengju 2020). Through the red envelope distribution, the first to buy can have the distribution of gifts, stimulate consumers to buy desire. Then it realizes consumer retention, purchase conversion, repurchase frequency, sharing fission and improve the sales of live room.

2.3 Current Situation and Characteristics of E-Commerce Live Streaming

The Epidemic Has Made The Consumption Scene Online, and the Development of E-Commerce Live Streaming Has Also Increased. The epidemic has made people unable to go out, increasing the proportion of online work, study and recreational activities, and forming a new consumption habit. Live stream plus is established when it penetrated into fields, such as games, education, sports etc. (Lu and Siegfried 2021). At the same time, the original offline consumption gradually moves online. People lockdown depend on live stream to acquire new message and purchase (Jenny 2020). Therefore, e-commerce live streaming has been developed to support people's needs. According to the 2021 annual data report of live streaming e-commerce, the transaction scale of Douyin and Kuaishou live streaming e-commerce continues to increase in 2021, and the transaction scale of live streaming e-commerce is close to one trillion market (GUOJI PRO 2021). In 2021, Douyin and Kuaishou live streaming exceeded 75 million, with a YoY growth of 100% and the number of links of live streaming goods exceeded 390 million, with a year-on-year growth of 308% (GUOJI PRO 2021). According to Alibaba's financial report, Taobao live GMV exceeded 500 billion RMB in the full fiscal year (https://caifuhao.eastmoney.com/news/20210515143306119146910).

The E-Commerce Industry Has Gradually Entered into Refined Operation, Characterized by "Private Domain + Full Scene". Digital marketing gradually promotes the precipitation of the effect of private domain live streaming, which is embodied in domain segmentation, consumer group attribute labeling, market positioning and traffic realization. E-commerce live streaming began to expand from the front end to the downstream, and developed into a refined operation of the whole scene of private domain traffic. Through the study of loyal fans in the private domain, label consumer groups, carry out crowd portraits, achieve thousands of faces, CRM management. Through the digital marketing model of big data, market positioning and market segmentation can be realized, the mind of different consumers can be analyzed, and the content output and item recommendation of the live room can be created (Xurong and Zhirui 2021). Through data analysis of big data, a large number of consumers are managed by labeling. The contents concerned by the public are sorted and merged, and classified by region, age, income, content of interest and consumption behavior. Audiences who have similar demand are gathered. The data operation realizes the character portrait, and then matches with the resources to achieve precise delivery for different groups. Then the private domain traffic conversion is realized.

Live Streaming E-Commerce Shows the Diversification of People, Goods, Fields and Channels. The dimensions of live streaming e-commerce include the identity of the host, the category of live streaming scenes and channels. The diversity of people, the head anchor change quickly, people's attention to the broader development of the smaller anchor. The development of anchor structure follows the "forest law", and anchor's identity and hierarchy are diversified. The diversification of goods

moves from the traditional strong category to the new category extension, promote the brand and operation diversification. The diversification of the field, the live streaming scene is more diversified, to the offline and upstream scenes of the industrial chain expansion. Personalized full-scene live marketing meets the diverse interest needs of consumers. E-commerce live streaming breaks through the time and space constraints to deliver goods, enabling consumers to enjoy a full-scene consumption mode, including the integrated services of live streaming, shopping guide and drainage, online consumption and home delivery. As regular customers become fans of the live room, businesses can push live streaming information, develop the fan effect of top anchors, introduce and demonstrate the features and quality of products, promotion methods, lottery interaction and purchasing methods. E-commerce live streaming fully creates offline scenes, making consumers feel immersive in purchasing. Content and form diversification, the head of the form of diversification and pan-entertainment trend is obvious. Perceived entertainment have a positive impact on consumer repurchase intentions (Chen et al. 2020).

2.4 Problems Existing in the Current Situation and Characteristics of E-Commerce Live Streaming, Future Trends and Solutions

Not Enough Regulation of the Industry. There are industry problems and loopholes in e-commerce live streaming, which cause the trust crisis of consumers. In the live streaming industry of e-commerce, consumers' rights and interests are damaged due to the difficulty in ensuring the quality of goods, lagging behind in follow-up guarantee and traffic fraud (Qingxin 2021). From the perspective of enterprises, the whole process of live streaming of e-commerce and after-sales service monitoring will be resumed. It needs timely response to the live room emergency, so that consumers have a better viewing experience. In the process of live streaming, pay attention to the use of words, and do not use exaggerated, false propaganda, in line with the provisions of live streaming. Timely help customers to track the logistics situation, deal with the use of products, timely deal with the return of goods.

Low-Price Promotion Will Damage the Corporate Image, Loss of Intangible Assets. Therefore, the promotion should be carried out in the form of reducing the price, and the promotion should be carried out in the form of limited time activities and member points, so as to increase the purchase and conversion of members. Breakthrough with goods thinking, balance sales and brand building. Low-price promotion methods does not attract customers very much as time goes by Lu and Siegfried (2021).

Consumers are Younger and Corporate Brands Need to Turn to the Right Platform in Time. Douyin users are evenly distributed by gender and region, and are younger. 12 PM and 21 PM are more active between 8 and 17 PM during weekends.

How can enterprises build marketing and operation positions on Douyin? Management is divided into flow management, content management, position management and closed-loop management. Short-term operation based on campaign demand, mutual drainage between live streaming and brand name, natural traffic into brand name through challenge + national task + topic challenge, and advertising traffic into platform hard advertising. The long-term operation is brand position management, transforming the store and brand number, perfecting the function of the brand landing page and brand number, forming an operation cycle, shortening the link through search. Through this series of actions, a huge amount of cloud map, brand marketing data, brand communication data, target user group analysis, it provides CRM-oriented long-term services. The Bilibili video website, which is frequented by young people, should be arranged as soon as possible. Most of the people who are born from 1980 to 1990 pursue novelty (Lu and Siegfried 2021). Firstly, the output of advertising content should be carried out to let users know the brand, which can be divided into different delivery methods, including exposure, precision and community. Secondly, let the advertisement, not only the content occupy the user's mind, implant the young people's favourite film and television variety shows, e-sports, live streaming, virtual idol and big events, realize the brand equity and content precipitation. Next, it will spread and let UP owners participate in brand topics, receive business orders and carry out operation activities. The last step is to let the advertising content to help users transform, realize different circles of grass, invitation and bullet-screen advertising laying.

The Whole Link Efficiency of E-Commerce Live Streaming Still Has Room for Improvement. First of all, online and offline get through, shopping guide double ability. In this way, stores can serve offline consumers as well as online live streaming services for online consumers. Second is to ultra-fast flexible supply chain. Live room after the deal after the order production, 2 days to complete the production, the third day of delivery, a week to the hands of consumers. Third, cloud release, AR exhibition hall and AI anchor. Stay indoors and go shopping at exhibitions. Many people are anchors. As long as you have professional ability in a certain field, you can quickly realize business connection and realization through live streaming tools. Canton Fair changed to net fair. Content creators, KOLs and stars are closer to the commodities and have more commercial realization paths. Shopping malls, wholesale markets, factories, stadiums, cinemas, stores, vegetable greenhouses, seafood markets, vegetable markets and other scenes have ready-made live rooms.

3 Conclusion

E-commerce live streaming has undergone many years of evolution from its formation to now. The epidemic has also led to the second growth of e-commerce live streaming. With the support of big data technology, digitalized labels enable consumers to be more accurately introduced into the theme and commodities of e-commerce live streaming. All links of e-commerce live streaming are developing

towards more diversified and complex forms. These are the upgrading process of e-commerce in the process of development. However, in this process, there are also some problems and pain points, which need to be solved through analysis. First of all, industry supervision and enterprises' adherence to the principle are important prerequisites for the healthy and sustainable development of e-commerce live streaming, which can ensure the rights and interests of consumers. Secondly, companies should not always choose to attract consumers with continuous lower price promotions. In the long run, the brand image that the price of the enterprise is consistent with the product positioning is also the key factor that makes the enterprise trusted by consumers in the long run. Thirdly, enterprises should pay attention to the changes of consumer groups, and then have strategies to deal with them. The younger consumers should make enterprises pay more attention to the interests and characteristics of this group, and cater to their preferences, so as to develop more matching platforms and delivery strategies. Fourth, in addition to the efforts of the internal e-commerce department, the whole industry chain should be developed in a more efficient direction. The online features of live streaming are utilized to better enable consumers to experience services that can only be experienced offline and accelerate the realization of content.

References

Ai Mei Reporting Center. https://baijiahao.baidu.com/s?id=1699187523005358264&wfr=spider&for=pc. Last accessed 2022/07/05

Alibaba 2021 Financial Report, East Money. https://caifuhao.eastmoney.com/news/20210515143306119146910. Last accessed 2022/7/10

Cai J, Wohn DY (2019) Live streaming commerce: uses and gratifications approach to understanding consumers' motivations. In: Proceedings of the 52nd Hawaii international conference on system sciences, P2554.HICSS

Chen Y, Lu F, Zheng S (2020) A study on the influence of E-Commerce live streaming on consumer repurchase intentions. Int J Mark Stud 12(4):48

CNNIC (2022) The 49th statistical report on China's internet development. China Internet Network Information Center, p 52

Dong C, Zhenshan W, Yongbo S (2021) Research on the nature of live streaming with goods: subversive innovation or expansion of traditional E-commerce model. Bus Econ Res J (5):86–89

Fengju H (2020) Analysis on the development trend of E-commerce live streaming, P194, Creative Commons. http://creativecommons.org/licenses/by-nc/4.0/

GUOJI PRO (2022) Annual data report of live E-commerce in 2021—Douyin & Kuaishou, pp 3–4, Guoji Data, DJyanbao.com

Jenny H (2020) The boom in livestreaming E-commerce. Journal 581(05):58–59 (China's Foreign Trade)

Lingqi L, Yongquan H (2021) The impact of COVID-19 on short live video content creation: a theoretical framework. Modern Commer J 17:78–80

Lu Y, Siegfried P (2021) E-commerce live streaming—an emerging industry in china and a potential future trend in the world, Munich Personal RePEc Archive

National Bureau of Statistics. https://finance.sina.com.cn/jjxw/2022-06-17/doc-imizirau8985028.shtml?cref=cj. Last accessed 2022/07/10

Qingxin W (2021) E-commerce live streaming quickly becomes popular and the industry enters the reshuffle revolution period. Modern Mark: Bus Edn J 1(2):94–95
Weiwei L (2021) Current situation and development trend of "Live Streaming +" new marketing mode. China Manage Informatization J 24(13):105–107
Xiaotong E (2020) Innovation of e-commerce live streaming in the post-epidemic era. Herald News Res J 11(20):99–101
Xurong G, Zhirui H (2021) E-commerce live marketing system architecture from the perspective of retail digital transformation. Bus Econ Res J 13(4):79–82
Ying L (2021) Research on the application and strategy of e-commerce live streaming in marketing of small and medium-sized enterprises in the post-epidemic era. Economy Forum J 11:124–125
Zhi L, Yuxuan Y, Xiaohuan L (2021) Digital technology and application. Journal 39(9):195–196

Difference Analysis and Suggestions on the Application of Quantitative Methods in Public Policy Analysis Between China and the United States

Zhanfeng Lin

Abstract This paper compares the similarities in the application of quantitative methods of public policy analysis between China and the United States, mainly from the aspects of research object, research theme, research purpose and research methods. It also compares the differences in the application of quantitative methods in public policy analysis between China and the United States. This part mainly expounds the differences in the application of quantitative methods in the public policy analysis of the two countries, which is the key part of the paper. The fourth part is responsible for public policy analysis in China and the United States of America quantitative methods in the application of different reasons are analyzed. The fifth part, based on the fourth part, analyzes the reasons, and puts forward corresponding countermeasures, and draws on the successful experience of the development of the discipline of public policy analysis in the United States to promote the continuous development of public policy analysis in China.

Keywords Public policy · Quantitative method · United States · China

1 Introduction

Since the early 1980s, the discipline of public policy analysis in my country has experienced a process from scratch, from a few people involved to becoming a dominant discipline. Especially in the past ten years, my country's disciplinary system of public policy analysis has gradually improved, the number of scientific research talents has increased year by year, and academic achievements have continued to emerge (Steinebach and Knill 2022). However, compared with developed countries, especially the U.S., the birthplace of public policy analysis, the development level of public policy analysis in my country is still very backward. How to promote the development of my country's public policy analysis discipline and narrow the gap

Z. Lin (✉)
Department of Business, Beijing Technology and Business University, Beijing, China
e-mail: 18610663739@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_39

with the American public policy analysis discipline is undoubtedly an urgent problem to be solved in developing my country's public policy analysis discipline at this stage (Greenberg 2009).

The development of the discipline is inseparable from the guidance of methodology. Public policy analysis research started late in China, and its procedure is still in a weak position in the fundamental public policy analysis research, which also restricts the development of the public policy analysis discipline to a certain extent. Inadequate application of quantitative methods in many methodologies is one of the main reasons why the analysis level of public policy research in my country lags behind the advanced international level. Quantitative analysis based on rational analysis is the mainstream of contemporary public policy analysis (Meyer and Gohagan 1981).

Therefore, this paper compares and analyzes the application of quantitative methods of public policy in China and the U.S., finds out the reasons for the different applications of quantitative methods for public policy in China and the U.S., and finally proposes to improve my country's public policy according to the reasons.

2 Similarities in the Application of Quantitative Methods in Public Policy Analysis of China and the United States

This part takes the authoritative journal of public policy analysis in the U.S. named *Public Administration Review* (Selamawit 2021). The core journal in the field in China as a sampling frame selects the public policy analysis papers that use quantitative methods as a sample. 109 American papers and 108 domestic papers that meet the sample selection criteria are obtained. This sample is the basis for this paper to compare the similarities and differences between the quantitative public policy analysis between China and the United States (Kim Jin Young 2016). This chapter is mainly a comparison of the similarities between the two.

2.1 From the Perspective of the Main Body of Research is Mainly Based on Teachers and Students in Colleges and Universities

Teachers and students in colleges and universities mainly refer to professors, associate professors, lecturers, and graduate students engaged in quantitative public policy analysis. The professors play a leading role in the quantitative analysis team of Chinese public policy. It plays a vital role in the quantitative analysis of public policy (Koroviy 2021).

Government has a relatively minor influence on non-governmental research organizations on public policy issues. It has more significant advantages in the independence, objectivity, flexibility of study, the breadth of vision, and the long-term perspective (Bailey 1993). As a part of the government department, it is easier to obtain internal information related to public policy and inconvenient to be made public, based on mastering complete information, using various scientific public policy quantitative analysis methods to study government public policy issues (OECD 2017). In addition, government policy researchers are closer to government policymakers and policymakers, so findings are easier to communicate and more acceptable and acceptable.

2.2 From the Perspective of the Research Themes, They Are All Based on the Construction and Evaluation of Public Policy Issues

The construction of public policy issues refers to the process in which policy decision-makers select some problems. Most people are more concerned about and can solve public policy issues from many general problems and integrate these policy issues into the policy agenda in a standardized and structured manner for discussion (Bacchi 2004). The construction of public policy issues is the starting point of the public policy process. Only the problem construction is scientific and reasonable, and the formulation, implementation, and evaluation of the problem can be carried out smoothly. To some extent, the discovery and determination of the problem are more important than the solution (Bacchi 2004).

Evaluation in the modern sense began to appear in the Hawthorne experiment in the U.S. in the 1930s (Francis 2010). But in terms of public policy evaluation, evaluating various social action programs in sociological research methods began with analyzing the effectiveness of U.S. President Roosevelt's New Deal program based on Steven's experimental design (https://www.loc.gov/classroom-materials/united-states-history-primary-source-timeline/great-depression-and-world-war-ii-1929-1945/franklin-delano-roosevelt-and-the-new-deal/). Since then, evaluation research has gradually become a trend.

Public policies are relatively stable, and after a public policy is introduced, it generally is maintained for a long time until the policy problems it points to are appropriately resolved. Of course, public policies sometimes change and adjust accordingly to the policy environment and objectives because policy balance can be achieved only in this way.

2.3 *From the Perspective of the Research Methods, All Prefer Statistical Methods*

Public policy analysis is a new, interdisciplinary, and emerging discipline, so it also draws on excellent research methods from other fields, such as quantitative research methods and tools (Szostak 2005). Statistics is the foundation and core of quantitative analysis methods. The research object of statistical analysis methods is the quantitative relationship and characteristics between variables, which is a methodological science of data collection, collation, induction, and analysis and is an essential quantitative research method (Ichino 2011). The is now widely used in various fields, including policy science, which provides reliable statistics for public policy formulation, implementation, evaluation, and other activities.

As seen from Fig. 1, among the five types of quantitative methods, both China and the U.S. prefer the application of statistical analysis methods, and the frequency of use of various ways in academic journals in China and the U.S. is the highest (Greenberg 2009). 53 of the 108 sample papers in China used or mainly used statistical analysis methods, accounting for 49.1% of the total number of analytical methods and nearly half of the total number of analytical methods. In the U.S., 44 of the 109 sample papers used statistical analysis methods, accounting for 40.4% of the total number of analytical methods. Although the proportion of absolute analytical methods is not as high as that of China, it is also the highest proportion of all analytical techniques, so statistical analysis methods are also the most frequently used in quantitative analysis of public policy in the U.S. (Davis et al. 2021).

Statistical analysis methods have become the mainstream research methods in the quantitative analysis of public policies in China and the U.S. because, on the one hand, statistical analysis methods are relatively simple. The quantitative knowledge of public policy analysts is not high, and it is easy to be accepted and applied by quantitative public policy analysts. On the other hand, as mentioned above, the quantitative analysis of public policy in China and the U.S. mainly focuses on the construction of public policy issues, and such research topics are relatively more suitable for statistical analysis methods.

Name	Operations research Analysis	Systems Science Analysis	Econometric analysis	Statistical Fractionation	Mathematical analysis	Total
Administration in China	13	6	30	53	6	Frequency
Rate	12%	5.6%	27.8%	49.1%	5.6%	%
Public Administration Review	15	17	22	44	11	Frequency
Rate	13.8%	15.6%	20.1%	40.4%	10.1%	%

Fig. 1 Quantify the frequency of use of analytical methods

2.4 From the Perspective of the Research Aim, All Improve the Quality of Public Policy

Quantitative analysis is one of the most basic and essential research methods in public policy analysis, and the focus of applying quantitative analysis methods in public policy analysis in China and the United States is different. But the purpose of using quantitative methods is roughly the same, all-in order to overcome the shortcomings in public policies and improve the quality of public policies. The quantitative analysis method of public policy in China and the U.S. generally enhances the quality of public policy from the following three aspects:

Quantitative Research is Conducive to the Optimization of Policy Formulation. Introducing quantitative methods in public policy analysis can optimize policy formulation to a certain extent. Statistical methods can infer the essence of public policy research objects through the data analysis of public policy research objects and then find out the laws of the public policy formulation process and optimize policy formulation. The rigor and accuracy of mathematical methods can help policymakers overcome rash thinking and hasty decision-making in the policy-making process (Newans and Siddiqui 2021).

Quantitative Research is Conducive to the Standardization of Policy Implementation. If the policy plan becomes a reality, it must implement effectively. Even the best policy plan can only be a blank piece of paper if there is no policy implementation. Because policy implementation is so important, we must take various measures to standardize it (Galvani 2017). Among the multiple efforts to standardize policy implementation, quantitative methods are among the most effective in recent years. There are many reasons for irregular policy implementation, and the imperfect administrative accountability system is one of the critical reasons.

Quantitative Research is Conducive to Achieving Scientific Policy Evaluation. Policy evaluation is a political act that judges policies' effectiveness, efficiency, effectiveness, and value and is an essential link in the organic chain of policy operation. But for a long time, people have only seen the importance of policy formulation and implementation, and there is a lack of attention to policy evaluation, even if the effect of policies is sometimes evaluated, but the outcome is not satisfactory (Ralston 2015). The main reason for this phenomenon is the subjectivity of policy evaluation standards, and the evaluation methods mostly use qualitative analysis methods. Hence the quantitative methods are required.

3 Differences in the Application of Quantitative Methods in U.S.-China Public Policy Analysis

3.1 Differences in Data Collection Methods

Achieving good policy research results depends on adequate data collection and correct analytical methods. The full use of data is the premise for promoting in-depth research, and the accurate analysis method is to improve the efficiency of research and ensure that the research results are correct to the tool.

Primarily, literature method, also known as non-intrusive research or non-responsive research, are methods of obtaining data relevant to the purpose of the study based on the analysis and organization of a large amount of literature. Content analysis can be divided into qualitative and quantitative content analysis, but mainstream and large-scale content analysis belong to the quantitative content analysis type (Feng and Li 2017). Policy researchers must first summarize quantitative laws from external and superficial content analysis and then use these laws to explore the profound interpretation of the content analysis (Gao et al. 2015). Therefore, content analysis results are often quantitative descriptions. The primary goal of content analysis is to examine the frequency of a particular item in the content or consider the proportion of a specific category in the entire range.

Posteriorly, the survey method is commonly used in data collection and analysis in public policy research, which is divided into two types: self-administered questionnaires and structured interview methods, seen as Fig. 2. Sampling, questionnaire survey, and statistical analysis are the three essential elements of the survey method. Survey research is the most flexible method of data collection, allowing general conclusions to be drawn from relatively small samples representative of functional populations, meeting the broad information needs of policymakers.

Thirdly, the observational method, also known as the fieldwork method, is a qualitative policy research method mainly used to obtain qualitative information, usually in the form of participatory observations and case studies. The goal of the observational method is more to construct a theory than test a hypothesis. The typical approach is to draw preliminary general conclusions from initial observations, make further observations inspired by these conclusions, and revise the findings.

Finally, the experimental method can be repeatedly verified to obtain more reliable research results. Policy researchers typically select a group of subjects, stimulate

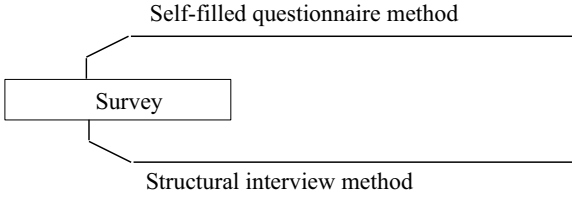


Fig. 2 Classification of survey methods

them with a policy variable, and then watch the responses of that group of subjects and compare them to a control group to draw a causal relationship between the policy variables.

3.2 The Primary Method of Data Collection in China's Public Policy Analysis

The data collection method of China's public policy quantitative analysis papers is mainly based on the literature method. 65 documents using the bibliographic method, the number of articles that specifically used content analysis, secondary analysis, and analysis of existing statistical data is shown in Fig. 3. There are 39 content analyses, making it the most frequently used data collection method in the literature method.

Second, various data collection methods are unbalanced in distribution. It is clear from the Fig. 3 that the bibliographic method accounts for the highest proportion of all data collection methods, and the other three data collection methods together are less than half of the method.

Finally, only 2 in the 108 papers using the experimental method were sampled, accounting for 1.9% of the total. Compared with the backward status quo of quantitative analysis of public policies in China, it should be said that it is not too much. Currently, China urgently needs to expand the scope of experimental methods and improve data collection methods because this is one of the foundations for improving the efficiency and quality of data collection.

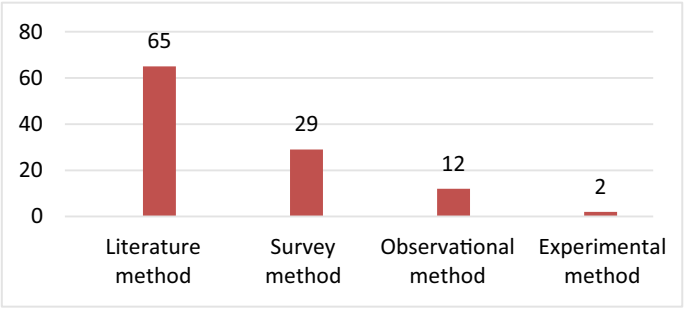


Fig. 3 Application of data collection methods in China

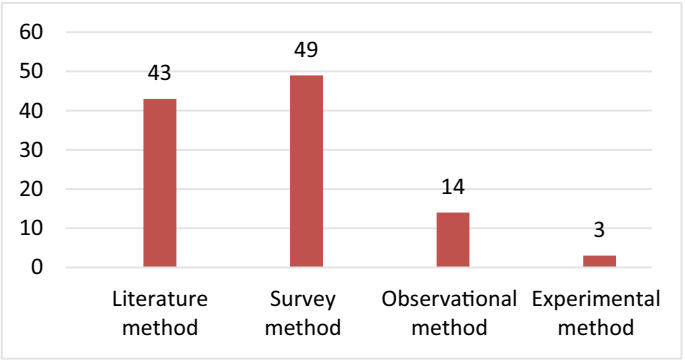


Fig. 4 Application of data collection methods in the US

3.3 The Main Methods of Data Collection in American Public Policy Analysis

The data collection of quantitative analysis papers on public policy in the U.S. mainly uses the survey method. According to the previous article, the survey method is primarily divided into two categories: questionnaire filling method and structured interview method, and the self-filled questionnaire includes individual sending method, centralized filling method, and mail-filled answering method, while structured interview has two types: face-to-face interview method and telephone interview method. In the 49 sample papers using the survey method, the specific application of these methods is shown in Fig. 4.

As can be seen from the figure, the self-fill questionnaire method is the most used data collection method in the survey method, and the number of papers using the survey method is 35, accounting for 71.4% of the total number of documents using the survey method. Specific to the self-fill questionnaire method, the mailing method is the most critical data collection method in the self-fill questionnaire method. Of the 35 papers using the self-fill questionnaire method, 20 use the mailing method, and the usage rate is as high as 57.1%.

The mailing method mentioned here mainly refers to sending online questionnaires, and the network's directness, extensiveness, flexibility, and freedom make the online questionnaires available. The structure access method is another manifestation of the survey method and can be used as a complementary method for data collection. This method is for researchers to send interviewers to ask questions and communicate with interviewees face-to-face or by phone according to the needs of the study and collect data during questions and exchanges. Typically, structured visits in the U.S. are usually conducted face-to-face. Figure 4 that ten papers are using the face-to-face interview method, accounting for 71.4% of all documents using the interview method.

The specific data collection methods used by China and the U.S. (excluding the content analysis that both China and the U.S. prefer to use) also have differences. This difference is mainly manifested in secondary research and the study of existing statistical data. China focuses more on secondary analysis, while the United States focuses on analyzing existing statistics, that is, the analysis of officially published information.

4 Conclusion: Strengthen the Application of Quantitative Methods in the Analysis of Public Policies in China

There are many reasons for the differences in quantitative public policy analysis between China and the U.S. The primary reason is the difference in the degree of development of the discipline of public policy analysis between China and the U.S. In addition, the low degree of differentiation of disciplines in Chinese public policy analysis has also affected the profession's development.

By comparing and analyzing the similarities and differences in the application of quantitative methods in public policy analysis between China and the United States, this paper finds out the reasons for the different application of quantitative methods in public policy analysis between the two countries, and then on the basis of cause analysis, proposes five countermeasures to improve the development of quantitative analysis of public policies in China: Drawing on the successful experience of the development of public policy analysis disciplines in the U.S., we will promote the continuous development of public policy analysis disciplines in China; Strengthen the training of quantitative knowledge of policy researchers and improve the quantitative analysis level of researchers; Improve the awareness of quantitative analysis among teachers and students of colleges and universities engaged in quantitative analysis of public policies; Deeply promote the disclosure of government information and promote the improvement of data accessibility; Increase funding for quantitative analysis and research on public policy.

References

Bacchi C (2004) Policy and discourse: challenging the construction of affirmative action as preferential treatment. J Eur Publ Policy 11:128–146. https://doi.org/10.1080/1350176042000164334

Bailey SJ (1993) Public choice theory and the reform of local government in Britain: from government to governance. Public Policy Adm 8:7–24. https://doi.org/10.1177/095207679300800202

Davis AL, Zare H, Kanwar O, McCleary R, Gaskin DJ (2021) Programs and policies targeted to improve access to dental care for low income adults and children in the US: an integrative literature review. J Dentistry Oral Disorders 7. https://doi.org/10.26420/jdentoraldisord.2021.1166

Feng F, Li Q (2017) Quantitative analysis of policy transfer among China's national innovation independent demonstration zones. Public Adm Res 6:19. https://doi.org/10.5539/par.v6n1p19
Francis A (2010) Elton Mayo's Hawthorne experiment and it's contributions to management. https://www.mbaknol.com/management-principles/elton-mayos-hawthorne-experiment-and-its-contributions-to-management/
Galvani F (2017) Bridging the implementation gap in poor areas: a study of how municipal socio-economic characteristics impact intergovernmental policy implementation. Soc Policy Adm 52:408–433. https://doi.org/10.1111/spol.12346
Gao X, Song W, Peng X (2015) National innovation demonstration zones leading China's regional development. Mod Econ 06:1056–1063. https://doi.org/10.4236/me.2015.610102
Greenberg M (2009) Energy sources, public policy, and public preferences: analysis of US national and site-specific data. Energy Policy 37:3242–3249. https://doi.org/10.1016/j.enpol.2009.04.020
Ichino M (2011) The quantile method for symbolic principal component analysis. Stat Anal Data Mining 4:184–198. https://doi.org/10.1002/sam.10111
Koroviy V (2021) The main directions of public financial policy. Agrosvit 51. https://doi.org/10.32702/2306-6792.2021.12.51
Library of Congress: President Franklin Delano Roosevelt and the New Deal, Great Depression and World War II, 1929–1945, U.S. History Primary Source Timeline, Classroom Materials at the Library of Congress, Library of Congress. https://www.loc.gov/classroom-materials/united-states-history-primary-source-timeline/great-depression-and-world-war-ii-1929-1945/franklin-delano-roosevelt-and-the-new-deal/
Meyer SM, Gohagan JK (1981) Quantitative analysis for public policy. J Policy Anal Manage 1:157. https://doi.org/10.2307/3324159
Newans J, Siddiqui N (2021) Barriers contributing to policy deviation: a mixed methods study of policymakers and frontline nurses. Am J Nurs Res 9:164–170. https://doi.org/10.12691/ajnr-9-5-2
OECD (2017) Debate the issues: complexity and policy making
Ralston JJ (2015) The unscientific determinants of voting on a controversial scientific issue: an evaluation of biofuels policy in the U.S. Congress. Rev Policy Res 32:323–344. https://doi.org/10.1111/ropr.12124
Selamawit W (2021) Basis for policy formulation: systematic policy analysis or intuitive policy decision? J Public Adm Policy Res 13:11–19. https://doi.org/10.5897/jpapr2015.0348
Steinebach Y, Knill C (2022) Comparative studies of public administration and public policy beyond the nation state. J Comp Policy Anal: Res Pract 24:201–209. https://doi.org/10.1080/13876988.2021.1958658
Szostak R (2005) Interdisciplinarity and the teaching of public policy. J Policy Anal Manage 24:853–863. https://doi.org/10.1002/pam.20146
Young KJ 이석환 (2016) The comparison of policy-makers' subjective perception and objective quantitative analysis on the path of policy diffusion. Korean Public Manage Rev 30:249–270. https://doi.org/10.24210/kapm.2016.30.4.009

Duration in the Bond Market and Application

Chaoyuan Jia

Abstract Since how do the bond prices change as the interest rates fluctuate, the sensitivity, in particular, is a concern of many investors, people are making efforts to have a quantitative indicator of the relationship between changes in interest rate and bond prices. Under this condition, Frederick Macaulay created a new term: duration for measurement. He successfully build a relationship between the interest rate changes and bond prices. With the help of duration, people often use a method called duration immunization in order to insulate their bond portfolios from interest rate risk. Though this strategy can be proved feasible both theoretically and mathematically, there is still a number of limitations with it. This paper makes a comprehensive review on the definition, types, deficiencies and potential solutions of duration immunization in the bond market. Specifically, this paper hold the view that the potential solutions for the deficiencies can be solved from the aspects of future cash flow.

Keywords Duration · Interest rate · Immunization

1 Introduction

From the graph (Fig. 1) people can only get an ambiguous relationship between the interest rate and yield to maturity. However, they still need a quantitative factor in having a clear understanding of the connections. People are wondering whether there is a conception like the effective mature date to reflect the interest rate risk. In this case, the calculation of duration provides people with a quantitative indicator for managing the risks.

Obviously, how do the bond prices change as the interest rates fluctuate, the sensitivity, in particular, is a concern of many investors.

Since there is an inverse relationship between the bond prices and yields, when the interest rates fluctuate roughly, bondholders will have to experience captain gains

C. Jia (✉)
Nanjing Audit University, Nanjing 210000, China
e-mail: 191091215@stu.nau.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_40

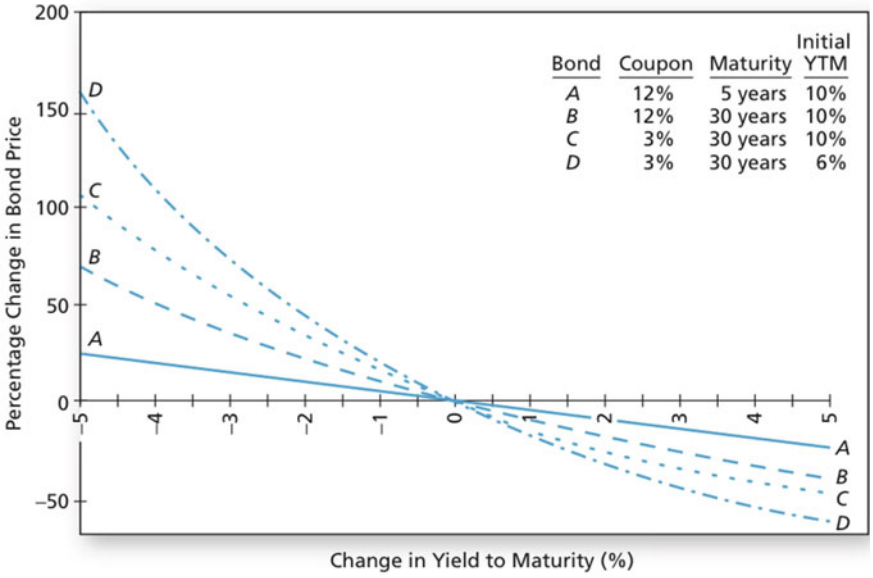


Fig. 1 Change in bond price as a function of change in yield to maturity. *Source* Investment

or losses in this process. Even if the interest and principals of bonds are guaranteed, which is similar to the bank savings, bonds are still at the mercy of the interest rate. A number of investors hate risks. Instead, they want a relatively fixed income at the maturity date or to insulate their portfolio from the fluctuations in interest rate altogether. Just as the words in the book Investment: some institutions, such as banks, are concerned with protecting current net worth or net market value against interest rate changes (Zvi et al. 2011). Some other investors such as pension funds may face some future liabilities. These investors are more concerned with the fixed income in the future rather than making a great profit. People need a strategy in order to help them manage risks dealing with interest rate risks.

2 Definition

In 1938, Macaulay described what he called bond duration as a measure of average bond maturity (Livingston and Zhou 2005). He suggested taking all the cash flow of a bond into consideration. Macaulay's duration equals the weighted average of the times to each coupon or principal payment. The weight assigned to each cash flow of the bonds indicates its importance of it to the overall value of certain bonds. According to Frederick Macaulay, the weight of each payment is the present value of certain cash flows divided by the bond price.

The weight assigned to the payment at time t is.

$$w_t = \frac{\frac{CF_t}{(1+y)^t}}{\text{Bond price}} \tag{1}$$

Using these values multiplied by the time t, and then add up all the values, we can get Macaulay's duration formula.

$$D = \sum_{t=1}^{T} t \times w_t \tag{2}$$

3 Duration of the Set of Bonds

In theory, there is no difference between the duration of a single bond or a set of bonds. This is because a set of bonds can be combined into one bond. We can add up all the payments of the bonds within a portfolio and view it as the payment of a single bond. According to the definition of duration:

$$D = \sum_{t=1}^{T} t \times \frac{\frac{CF_t}{(1+y)^t}}{\text{Bond price}} \tag{3}$$

The cash flow of certain portfolios can be divided into the different cash flows of the bonds within it, and so do the bond price. We assume that there are only two bonds in this portfolio: Bond A and Bond B. We use CF_A, CF_B to stand for the cash flow and BP_A, BP_B for the bond price.

$$D = \sum_{t=1}^{T} t \times \frac{\frac{CF_A+CF_B}{(1+y)^t}}{BP_A+BP_B} \tag{4}$$

$$= \sum_{t=1}^{T} t \times \frac{\frac{CF_A}{(1+y)^t}}{BP_A+BP_B} + \sum_{t=1}^{T} t \times \frac{\frac{CF_B}{(1+y)^t}}{BP_A+BP_B} \tag{5}$$

$$= \sum_{t=1}^{T} t \times \frac{\frac{CF_A}{(1+y)^t}}{BP_A} \times \frac{BP_A}{BP_A+BP_B} + \sum_{t=1}^{T} t \times \frac{\frac{CF_B}{(1+y)^t}}{BP_B} \times \frac{BP_B}{BP_A+BP_B} \tag{6}$$

$$= D_A \times \frac{BP_A}{BP_A+BP_B} + D_B \times \frac{BP_B}{BP_A+BP_B} \tag{7}$$

Now, certain investor can safely conclude that the duration of the portfolio of bonds is equal to the weighted sum of the duration of the bonds in this portfolio, the weight of each duration is associated with the portion of the market price at that date.

4 Passive Bond Management-Duration Immunization

4.1 Definition

In order to hedge the interest rate risks, investors make a portfolio that is made up of a set of bonds. Within this portfolio, influences from coupon reinvestment and market price are able to offset each other. Investors can insulate their portfolios from interest rate risks altogether (Richard et al. 2011). immunization techniques refer to strategies used by such investors to shield their overall financial status from exposure to interest rate fluctuations (Fong and Vasicek 1984). It is a passive way of managing the bonds meaning that investors do not chase extra profits from the capital market.

4.2 Conditions to Apply the Methods

This is a method that is meant to separate the whole portfolio with the changes in the interest risk. By using this method investors can make the whole set of bonds to have a fixed income at the maturity date and manage the risk of fixed-income contract (Hauser et al. 2001). In the real world, two famous users of this strategy are insurance companies and pension funds. This is because pension funds have the obligations to pay at a predetermined date and amount, and many other financial institutions are concerned about protecting their net market value against the changes in interest rates.

4.3 Reasons Why This Method is Useful in a Theoretical Way

When the interest rate changes, there are mainly two kinds of risks that may arise-price risk and coupon reinvestment risk. The market price risk stands for the risk that people have to bear some loss when selling their bonds before the maturity date. Coupon reinvestment risk stands for the risk that people cannot reinvest the coupon they get at the rate equaling to the TYM of certain bonds and face some loss.

The reason is simple, when we are creating a set of bonds, there will be some bonds with coupons, so we have to face the coupon reinvestment risk. When the date to pay the liability comes, to pay back the liability, we will have to sell the bonds in certain portfolios before their mature date, in this case, people have to face the market price risk.

When the interest rate rises, the price of selling a bond will fail to live up to the expectations when the investors bought it causing some losses. At the same time, the coupon reinvest gain will rise, and the investors will get some extra profits, the price of a bond will be determined by the combined influences of these two kinds of risks. The bond price is the result of the combing effects of these two risks.

Table 1 The combined influences from coupon reinvestment risk and market price risk

	The accumulated value of the reinvested coupon	Selling price	The overall gain of the bond
Interest rate remains at 10%			
1	10*(1 + 10%)^2 = 12.1		
2	11		
3	10		
Sale		100	
			133.1
Interest rate falls to 9%			
1	11.881		
2	10.9		
3	10		
Sale		100.917	
			133.698
Interest rate increases to 11%			
1	12.321		
2	11.1		
3	10		
Sale		99.099	
			132.52

For example, there is a bond whose face value is $100, the coupon rate is 10%, and it will mature in 3 years. When the interest rate rises or drops 1%, the final gain for investors is shown below in Table 1 (It is assumed that the interest rate is 10%).

It can be safely concluded that: when the interest rate increases, the reinvestment gain of certain bonds will increase, while they have to bear some capital loss and vice versa. The final gain for investors is determined by the combing effect of these two kinds of risks.

Theoretically, investors are able to create a set of bonds in which the influence from the price risk can be offset by the reinvest rate, making this set of bonds immune to the changes in the interest risk. In this case, investors can get a fixed income. And according to the calculation, when we can match the duration of a certain set of bonds with the duration of the liability, these two kinds of effects can offset each other, and the whole set of bonds will be able to pay off the liability in the future regardless of the changes in the interest rate (Fooladi and Roberts 1992).

4.4 The Mathematical Proof of This Method Dealing with Interest Rate Risks

We can start from the pricing model of bonds, PV stands for the present value of a bond and T stands for the maturity date, and r is the interest rate. In the beginning, we use the formula of bond pricing.

$$PV = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \cdots + \frac{CF_T}{(1+r)^T} \tag{8}$$

Then we take the first derivative of PV with respect to r.

$$\frac{dPV}{dr} = -\frac{1}{1+r}\left[\frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \cdots + T\frac{CF_T}{(1+r)^T}\right] \tag{9}$$

Divide PV on both sides of this equation

$$\begin{aligned}\frac{dPV}{dr} \times \frac{1}{PV} &= -\frac{1}{1+r} \times \frac{1}{PV}\left[\frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \cdots + t\frac{CF_T}{(1+r)^T}\right] \\ &= -\frac{1}{1+r}D\end{aligned} \tag{10}$$

$$\frac{dPV}{dr} = -\frac{1}{1+r}D \times PV \tag{11}$$

Then this paper is going to discuss the changes in the future. $FV = PV \times (1+r)^t$, t is a time in the future, not necessarily the maturity date. The first derivative of FV with respect to r:

$$\frac{dFV}{dr} = \frac{dPV \times (1+r)^t}{dr} \tag{12}$$

$$= \frac{dPV}{dr}(1+r)^t + t(1+t)^{t-1}PV \tag{13}$$

$$= -PV\frac{1}{1+r}(1+r)^t D + t(1+t)^{t-1}PV \tag{14}$$

$$= PV \times D(1+r)^{t-1} + t(1+t)^{t-1}PV \tag{15}$$

$$= (t-D)\left[PV \times (1+r)^{t-1}\right] \tag{16}$$

It is obvious that $PV \times (1+r)^{t-1}$ is always greater than 0, whether the whole equation is greater or less than 0 depends on $(t-D)$. Then we can talk about different situations individually.

When $t = D$, the duration of the portfolio equals the duration, $\frac{dFV}{dr} = 0$. In other words, when the interest rate changes, there will be no changes in the price. When

the interest rate rises, the present price of the bonds should drop while the reinvesting value increases, offsetting each other and vice versa.

When t > D, the duration of the portfolio is greater than the duration, $\frac{dFV}{dr} > 0$. Though the present value of the bonds will drop when the interest rate rises, the whole value of the bonds will increase indicating that the reinvestment risk is the key factor.

When t < D, the duration of the portfolio is shorter than the duration, $\frac{dFV}{dr} < 0$. The whole value of the bonds will drop as the interest rate rises indicating that the influence of the market price risks is greater than the coupon reinvest risk.

5 Different Kinds of Duration Immunization

5.1 Single Liability Immunization

This kind of immunization refers to the situation in which there is only one liability for the company or investors to pay back in the future.

There is an example to help explain this: if Company A has to pay $10,000 in 3 years' time and the market interest rate is 10%, there are there main kinds of methods for the management to use in this process.

One of the methods is buying a zero-coupon bond or a number of zero-coupon bonds with a principal of $10,000 and will be mature in 3 years. Another method is buying a coupon bond or a number of coupon bonds with the YTM of 8%. In this case, an investor is supposed to buy $7513 of that kind of bonds. However, in real life, the bonds mentioned in the two choices above are hard to find, let alone that the date to repay certain liability is varying from time to time. In this case, we can use many other bonds in the market to create a portfolio of bonds artificially.

5.2 Single Liability Immunization

This refers to the situation where the investors or companies have to repay a series of cash flows in the future. This phenomenon is common in our daily lives such as pension funds or insurance companies that at aiming at life insurance.

Under this circumstance, we can view the cash flow arising from each time as a single liability, thus separating a series of cash flows into a number of single bonds. Then the investors can repeat the methods of the single liability.

While there is another strategy in order to hedge interest rate risk. This method contains making a portfolio of bonds whose duration is equal to the weighted sum of the cash flow of the liability. Though this method is relatively easy in creating and managing, there are many theories showing that only letting the duration of a

certain portfolio of bonds be tantamount to future liability cash flow cannot hedge the interest rate risk completely, but this passage is not going to look at this method.

6 Limitations of Duration Immunization

The strategy of hedging the interest rate risk of multiple liabilities can be viewed as the combination of a number of single liabilities. As a result, only discussing the limitations of the method for single liability is enough.

Duration immunization hedges the interest rate risk at the expense of potential future gain. As can be seen above in Table 1, though the total value of the created portfolio will not drop dramatically when the interest rate rises when the interest rate is decreasing, the total value remains almost the same. Obviously, immunization is a passive strategy only in the sense that it does not involve attempts to identify undervalued securities (Prisman 1986). The Investors want to fix the further interest just like the forward contract does. Investors do not predict further interest rates actively and try to adjust their assets in order to gain the most return. Instead, they want to realize the predetermined goals of return and avoid the risk brought by interest rate fluctuations. If investors are not sure of their forecasts, they may well opt for a less risky strategy even if it means giving up some returns (Guedes and Opler 1996).

Investors have to gain a full picture of not only the future cash flow arising from the liability but also the cash flow of the bonds they use. Otherwise, they cannot calculate the exact duration of certain liabilities and the bonds. However, in real life, there are many bonds whose future cash flow is uncertain such as the convertible bonds making the calculation of duration difficult. In addition, future cash flow of bonds can be hard to get, the investors may not have an exact date to pay off their liabilities. Thus, creating a set of bonds whose weighted duration is equal to the liability is impossible from time to time. In other words, the choosing of proper bonds in creating wanted portfolios is difficult in some cases.

This simple matching of the duration of bonds and the liability is based on the assumption that there is a parallel moving of the yield curve. In other words, when the market interest rate changes, the yield of bonds with different maturity dates is changing to the same degree (Bierwag et al. 1992). However, if we take risks and inflation into consideration, the interest rate will change in accordance with the time length. If inflation is an important source of risk for long-term investors, borrowers must offer some extra incentive if they want investors to lend long and the extra volatility of long-duration bonds may be a concern. Meanwhile, in real life, even the financial instruments with the same mature date are likely to have different reactions to the changes in interest rates.

The portfolio created is only immune to the interest rate changes for a limited period of time, rather than permanently. Since the interest rate, time, buying or selling assets, etc. are changing from time to time, the duration of different bonds and liabilities is changing as well. As interest rates and asset duration change, a manager has no choice but to rebalance the portfolio of fixed-income assets continually. However,

due to the transaction fees or fees for doing research, the expense of rebalancing the portfolio is quite high.

7 Solutions

Knowing about the accurate date of further cash flow seem to be impossible while having a range of future cash flow is practical in most cases. The investors can make some surveys in advance in order to get the best estimation of the date. Then they can create the sets of bonds accordingly. However, even if creating the set of bonds according to the best estimation, it is common that people still have to face some interest rate risk. This is because there will always be some deviation between the estimation and the real mature date.

Since the expense of rebalancing is quite high, people can do a calculation before creating a portfolio of bonds in order to figure out the loss arising from the interest rate changes. Then they can compare the losses with the expense of matching the duration again to decide whether to rebalance. This passage is not going to talk about the practical usage of this method. We also have to know that rebalancing is inevitable. Even though in some extreme cases, interest rates do not change, asset duration will change solely because of the passage of time.

Other limitations of duration immunization arise from the application of duration such as the supposing there is a parallel moving of the yield curve and not taking default risk into account (Fooladi et al. 1997). In this case, investors can use another method such as cash flow matching to hedge the interest rate risk as well. They create a portfolio of bonds the cash flow pattern of which is just the same as the liability to be paid off. Therefore, investors can get rid of the limitations of duration itself. Another way is that people can just ignore the traditional formula and create new ones to better describe the relationship of bond prices and interest rate (Tchuindjo 2008).

8 Conclusion

The calculation of the duration of investment portfolios can provide people an insight into their risks towards the interest fluctuations. At the same time, they can also use duration during the process of deciding how to build their own portfolios which are called duration immunizations. Though there are some limitations to these methods, they can help people to manage risks dealing with interest rate risks.

References

Bierwag GO, Corrado CJ, Kaufman GG (1992) Duration for portfolios of bonds priced on different structures. J Banking Finance 16(4)
Fong H, Vasicek O (1984) A risk minimizing strategy for portfolio immunization. J Finance 39(5)
Fooladi I, Roberts G (1992) Bond portfolio immunization: Canadian tests. J Econ Bus 44(1)
Fooladi IJ, Roberts GS, Skinner F (1997) Duration for bonds with default risk. J Banking Finance 20(1)
Guedes J, Opler T (1996) The determinants of the maturity of corporate debt issues. J Finance 51(5)
Hauser S, Rozenkranz M, Ben-Zion U, Yaari U (2001) International hedge of fixed income contracts. J Portfolio Manage 27(2)
Livingston M, Zhou L (2005) Exponential duration: a more accurate estimation of interest rate risk. J Financial Res 28(3)
Prisman EZ (1986) Immunization as a MaxMin strategy: a new look. J Banking Finance 10(4)
Richard A, Stewart C, Myers F (2011) Principles of corporate finance, 10th edn. McGraw-Hill/Irwin, New York
Tchuindjo L (2008) An accurate formula for bond-portfolio stress testing. J Risk Finance 9(3)
Zvi B, Alex K, Alan JM (2011) Investments, 9th edn. McGraw-Hill/Irwin, New York

Eco-Friendly Hydro-Power: Turbulent

Peixuan Shao

Abstract Conventional sources of electricity generation are rapidly depleting, and their extraction is causing irreversible damage to the environment. Hydropower, like other renewable energy sources, has been massively underutilized because it cannot produce enough energy to meet current energy demands. Renewable energy sources at their current power production scale, along with a centralized power grid system, mean that we must rely on conventional energy production to meet everyday needs. This research aims to examine hydro-power, recognize its potential for electricity generation, and see it as a way forward in a long journey to sustainability and renewability. By reviewing data provided by Turbulent.be, EIA, UNIDO, etc., the research findings proved that renewable energy at its current stage could not fully replace conventional energy. In short, renewable energy sources must find a way to increase production scale without affecting the environment.

Keywords Turbulent · Hydro-power · Micro-hydro turbines · Renewable energy · Off grid power system · Decentralized power grid

1 Introduction

In a society dependent on electricity for anything beyond basic needs, many have turned a blind eye to the harm conventional energy sources cause to the environment. Oil, gas, and coal take up a total of 84.3% of the world's total energy production (Oil 33.1%, Gas 24.2%, and Coal 27%), with renewables only accounting for 11.3% of total energy production (Ritchie et al. 2020). The issue with renewable energy is that too many factors limit its potential. Take hydropower, for example. Weather, seasonality, river flow, or geographical location could all impact and restrict power

P. Shao (✉)
College of Arts and Sciences, University of San Francisco, 6700 Balfour Rd, Brentwood, CA 94513, USA
e-mail: jaspershao7@yahoo.com

2130 Fulton St, San Francisco, CA 94117, USA

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_41

production. Nevertheless, just because a source is renewable doesn't mean it is suitable for the environment. Hydropower produces a majority of power through reservoirs and dams, which can negatively affect the environment, forcefully altering surrounding ecosystems and evicting animals from their natural habitats, not to mention the natural resources needed to construct such structures (World Small Hydropower Development Report). However, that's where Turbulent comes in, a small-scale power production turbine designed to supply individual homes or small communities in developed or developing nations.

Hydropower depends on the environment, and its power output can vary in response to seasonality or environmental changes. To eliminate such problems, a company in Belgium has created turbulent, an off-grid micro-hydro power turbine able to supply from 5 to 200 kWh of clean, renewable power. This research aims to determine if a renewable energy source like turbulent can fit the demand for people's energy consumption. Background will provide essential information regarding hydro-power and Turbulent. The research portion will discuss the technical specifications and requirements needed to provide electricity. The critique part will discuss the disadvantages and shortcomings of Turbulent's power production and its ability to meet power demands. This research provides insight into the future and renewable energy, and solves an important problem for the development and leaders in the field of renewable energy. As the earth's resources deplete and its skies become polluted with toxins, renewable energy is becoming more and more relevant than ever.

2 Related Background

2.1 Why Turbulent Hydropower Needs to Be Recognized

Turbulent hydro-power system is powered by the natural phenomenon of a water vortex. Each vortex generator can deliver 15–100 kW. It can be installed on any river with a high difference and an acceptable flow rate (Engineering For Change)—turbulent features three different power supply systems. An off-grid system is suitable for remote locations and supplies power directly to your house. Micro-grid systems can power small communities without power interruptions. Or on-grid systems that supply power to a power station to reduce the probability and impact of a power shortage. The U.S. Energy Information Administration reports that in 2020, customers experienced 1.33 billion outage hours (Hering 2021). The world relies on finite energy sources such as fossil fuels, coal, and gas. All of these are depleting at an alarming rate, not to mention the devastating environmental impact.

2.2 The Point of No Return?

An IPCC report in 2007 reported that we are close to the point where greenhouse gas emissions and carbon dioxide will bring irreversible change to the environment (Climate Change 2007: The Physical Science Basis). Crude oil deposits such as coal, natural gas, and oil are expected to be depleted by 2052. With conventional power sources quickly depleting and renewable energy on the rise, it is essential to define what it is. Renewable energy sources are mainly natural processes that can be continuously harnessed, such as solar, hydro, wind, and geothermal. Hydroelectric is the most common renewable energy source, primarily dams and reservoirs, which relies on changing the ecosystem and trapping the water for electricity generation. Micro-hydropower is more eco-friendly as it does not rely on altering or blocking the course of a river, which could cause potential damage to the surrounding ecosystem. Micro-hydropower is ideal for providing power to nearby settlements. It simply 'borrows' the flow of the river to spin, control, and rotor and return it to the normal flow of the river without depleting or altering the river's natural resources (A Revolutionary HYDRO POWER Technology to Sustainably Exploit Super-Low-Head Water Steps). One company at the forefront of micro-hydropower is Turbulent. They believe that the future of reliable and renewable hydroelectricity lies within a decentralized power system. The company's primary goal is to deliver clean energy to everyone and everywhere at a lost cost without harming the local eco-infrastructure. A demonstration plant in Chile can produce 15 kW at 50% efficiency, which is enough to power up a community of 60 homes. Micro-hydropower plants like turbulent effectively eliminate the need for dams and reservoirs, which could cause floods and destroy natural habitats during and post-construction. It also removes the risk of carbon monoxide and methane emissions from the decomposition of organic matter in still bodies of water. The field of renewable energy is emerging with new concepts. Turbulent's innovative design can provide reliable power without damaging the surrounding eco-infrastructure.

3 Research

3.1 Technical Specifications

Turbulent is designed for green, decentralized, off-grid living. For a site to be suitable for Turbulent hydro-power, it will require a drop of 1.5–5 m and a minimum flow of 1 m^3/s for the turbine to function. Head and flow are critical to creating electricity from hydro-power. "Head and flow are the two most important facts of a hydro site. This will determine the hydro system's volume of civil constructions, canal size, turbine size, and power output. Inaccurate measurements can result in lower efficiency and higher cost" (Turbulent). Turbulent also considers the environmental impacts during construction when assessing a site. It will require an already

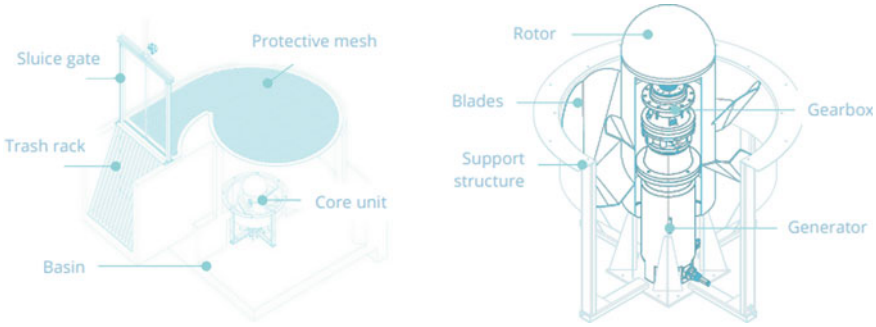


Fig. 1 Core unit and turbine blueprint

constructed road nearby to avoid unnecessary roadworks when installing the turbine. The turbines are prefabricated and shipped to the site, while the canals to redirect the water will be constructed on-site. Figure 1 shows more detailed site requirements for each model of its turbine:

As shown in Table 1, each turbine model will require slightly different site conditions to function properly and provide reliable electricity (Turbulent. 15–70 kW. Vortex Turbine). For turbine models ranging from 5 to 70 kW, the river must have a minimum flow of 0.7 m^3/s and a maximum flow of 4 m^3/s in a cross-sectional area. Each model differs in its power output, varying from 17.4 to 79.5 kW. To put this into perspective, EIA reports that in 2020, the average U.S. household consumes 10,715 kWh per annum (Hydro-power: Setting a Course For Our Energy Future 2004), which means a 70 kW unit can supply 5 U.S. households without issues.

3.2 Reliant Hydro-Power

The turbines are designed to operate at a low rpm to reduce shear stress and have a slow pressure rate difference inside and outside the turbines to ensure no marine life is harmed when passing through.

The system is designed in a way to prevent any damage from flooding. During a flood, the entire turbine can withstand and be submerged up to 10 m below the water. Water enters the structure as the sluice gate opens, and the trash rack collects any large debris that may cause damage to the core unit. Its circular design creates a whirlpool that spins the rotor blades and powers up the generator. Turbulent features three power supply systems, On-Grid, which provides low cost and the cleanest possible electricity. “A good quality grid is available near the turbine installation and consumers. The turbine will decrease your electricity bill considerably. The backbone is an induction generator coupled to the grid and will provide over 90% uptime” (Turbulent). Turbulent’s off-grid system provides reliable remote electricity and a smart on/off-grid system to ensure energy availability during peak demand and

Table 1 System specifications (courtesy of turbulent.be)

Vortex turbine models 5 to 7 kW				Value	Unit
Min flow				0.7	m^3/s
Max flow				4	m^3/s
Min head				1	m
Max head				4.4	m
Min. speed				80	rpm
Balde tilt angle range				(−14) to 14	deg
Stainless steel type				304	–
Representative models	15 kW	30 kW	50 kW	70 kW	Unit
Turbine hydraulic output	17.4	34.9	56.8	79.5	kW
Electrical output	15	30	50	70	kW
Maximal energy generation	120,000	240,000	400,000	560,000	kWh
Nominal flow	1.5	2.2	3.1	3.8	m^3/s
Nominal head	2	2.8	3.25	3.7	m
Impeller diameter	1140	1200	1300	1500	mm
Rotor height	550	580	625	730	mm
Vortex turbine core weight	275	300	360	475	kg
Generator and gearbox weight	350	600	950	1200	kg
Electrical cabinet weight	270	330	390	480	kg

blackouts. Its core unit is designed to operate for more than 25 years, after which maintenance of the rotor and gearbox is needed.

3.3 Project Development and Turbulent Current Applications

Four stages are required for the site to qualify for a Turbulent turbine. A Pre-study stage, where a Turbulent technician will provide a primary assessment of the proposed site, provide an estimation proposal for detailed engineering, and determine the financial and technical viability (Frequently Asked Questions (FAQs)-U.S. Energy Information Administration (EIA)). Once the preliminary site assessment has been approved, it moves on to stage 2: Technical Design and Preparation. Stage 2 includes implementation planning, technical preparation and production documents, and working in tandem with local distributors, reducing investment costs (Frequently Asked Questions (FAQs)-U.S. Energy Information Administration (EIA)). Stage 3 is concerned with the turbine's construction, what materials are needed, the hydraulic system's revision, and the connections to an on-grid system. The turbine installation can be completed within six months (Frequently Asked Questions (FAQs)-U.S. Energy Information Administration (EIA)). Stage 4 is the maintenance of installed

turbines. A site must have a cell signal for Turbulent to remotely monitor the system and maintain the turbine as needed, whether it be a software update or hardware maintenance. Turbulent currently has applications in France (5.5 kW), Estonia (5.5 kW), Indonesia (13 kW), Chile (15 kW), and Portugal (5 kW) (Four steps to get a Turbulent plant going). This small-scale power production is excellent for providing a single site with reliable power without relying on fossil fuels. Turbulent is an excellent supplemental power source. However, it can be challenging for a location to rely entirely on hydro-power for stable, year-long power upkeep.

4 Critique

4.1 Disadvantages of Turbulent

(1) The Issue of Scale

While there are many benefits to a micro-hydropower plant, the scale issue is vital to address. The most significant problem with micro-hydropower plants such as Turbulent is the lack of capacity to store energy generated, meaning that energy surplus will be wasted if not kept on an on-grid system.

(2) The Issue of Flexibility

Unlike other conventional forms of electricity generation, micro-hydropower plants cannot adapt to the power demand. It relies on the river's flow, and power production will fluctuate during the summer or winter and provide more electricity during the wet months. Combined with the ongoing climate chaos and global warming, this unpredictability makes it hard for Turbulent at its current stage to provide reliable electricity year-round. At this time, Turbulent should be used in conjunction with other renewable/reliable energy sources.

(3) The Issue of Location

The site's location is also a significant factor in deciding whether or not a site is suitable for micro-hydro power plants. It is vital that the site has a height difference and is a relatively straight part of the river, which means turbulent is more successful in other regions such as Chile, Brazil, and Canada, where the distance from land to water is much closer than that of Africa, Australia, and parts of Asia.

As seen in Fig. 2, some countries and regions do not have access to fresh water (as shown in color codes: red, orange, and yellow). This makes it harder for some areas to get power. Since turbulent advocates for a decentralized power system, it is almost impossible for them to give power to regions that have limited access to water sources. Turbulent's current scale of electricity generation is designed to supply power to developing nations, where power demands are much lower than in first-world nations. It is challenging to deliver power to countries with high power demands. To put this into perspective, an average U.S. household consumes 30 kWh

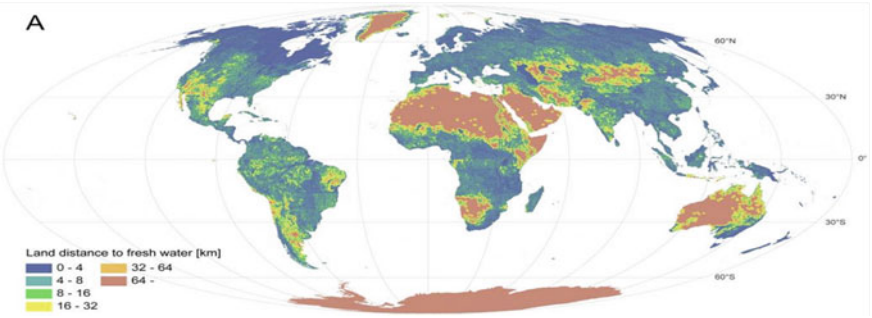


Fig. 2 Land distance to fresh water (km)

per day, which is essentially one turbulent turbine per household, and that's not accounting for the power used by other buildings such as offices, schools, malls, and other multipurpose buildings.

4.2 Impacts on Marine Life

It is also important to discuss the turbulent impact on marine life and address the misconception of fish-friendly. Turbulent is fish-friendly, meaning that it is designed to protect marine life. However, it isn't fish-safe. Injuries can still occur when marine life enters the turbine system, although it may not be as severe as other forms of hydro-power. According to a study conducted on the fish friendliness of Turbulent, the researchers identified six potential damage mechanisms when marine life enters the turbine: Abrasion, Grinding, Strike, Pressure, Cavitation, and Shear stress (A global solution, with ongoing innovation). Abrasion is the "rubbing action of a fish against a turbine system component or objects in the flow field." When a fish is caught within the vortex field and causes damage by scraping with the components within the turbine system, abrasion damage is dependent on flow discharge and velocity, the number of turbine blades and spacing between them, and the geometry of flow passages" (Turbulent). Grinding and strike occur when marine life is drawn into the turbine system colliding with components within the core unit, causing damage. This could cause scale, mucous loss, eye injury, and internal bleeding. Data and simulations regarding fish mortality varied between 0% at 20 m/s and 100% at 44 m/s. Marine life is also subjected to rapid pressure changes within the turbine system. "Damage due to pressure is dependent on the amount and rate of change of pressure experienced by the fish as well as the type of the fish… Swim bladder rupture and embolism are caused by suddenly and severely lowering the pressure from the fish's acclimated pressure" (Turbulent). Cavitation is the rapid process of vaporizing and condensing liquids, and shear stress "is expressed as the force acting on an area parallel to its direction… The highest shear stress values are found close to

the interface between the flow and solid objects it speeds by, such as the blade leading edges, vanes, and gates" (Turbulent). Although there are several potential damage factors to marine life, compared with other micro hydro turbines, the low-pressure difference and big clearance gap between the blades make it more fish-friendly than other designs.

5 Conclusion

Turbulent is an excellent foresight into the future of green eco-power and presents a unique way to move off of centralized power grid systems. However, its accessibility and power production output leaves much desired at its current stage. Can we move on from conventional power to renewable power? The simple answer is no. The main issue seems to be scale; renewables do not have enough capacity to supply and keep up with the ever-growing energy demand. Due to Turbulent Hydro-power being a new technology, there hasn't been enough first-hand information from the consumer level on its reliability and power output. Since Turbulent currently only has applications in developing countries, it's hard to predict how they will adapt to energy demands in developed nations or nations with limited water access. While perfect for an off-grid system, Turbulent is not adequately adapted to an on-grid system like most nations. This research is by no means complete, limited by the trivial amount of research on turbulent and micro-hydropower. This research strives to construct a vision of a sustainable future by examining the limits and advantages of a renewable system like turbulent. As more research and newer technology arise, I can say for Turbulent and other renewable sources alike that this is the way forward into a sustainable future. It will be a slow process as society adapts to renewable power. However, I am confident that this sacrifice is minuscule compared to the benefits it yields.

Acknowledgements Firstly, I would like to thank the Environmental Studies department and my University of San Francisco professors. They have provided me with support and encouragement in a field of study that was new and frightening to me. Without their guidance, I could have never come to realize the climate chaos we face and start to advocate for a sustainable future. Secondly, I would like to thank Professor R.K.A at Washington University in St. Louis, who, during my research, provided me with valuable information regarding hydro-power and in this research paper. Lastly, I would like to thank everyone who has helped me during the research process, writing, finalizing drafts, and submission processes of this paper. Without all their support and encouragement, I could not have completed my research.

References

A Revolutionary HYDRO POWER Technology to Sustainably Exploit Super-Low-Head Water Steps. Periodic Reporting for Period 1-Turbulent (A Revolutionary HYDRO POWER Technology to Sustainably Exploit Super-Low-Head Water Steps). CORDIS, 24 Nov. 2020. cordis.europa.eu/project/id/873765/reporting

Climate Change 2007: The Physical Science Basis: Summary for Policy Makers, a Report of Working Group I of the Intergovernmental Panel on Climate Change; and: Technical Summary, a Report Accepted by Working Group I of the IPCC but Not Approved in Detail; and: Frequently Asked Questions. Intergovernmental Panel on Climate Change, 2007

Hydro-power: Setting a Course For Our Energy Future. U.S. Department of Energy (2004)

Frequently Asked Questions (Faqs)-U.S. Energy Information Administration (EIA). www.eia.gov/tools/faqs/faq.php?id=97&t=3

Hering G. U.S. Power Outages Jumped 73% in 2020 amid Extreme Weather Events. S&P Global, 19 Jan. 2021. www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/us-power-outages-jumped-73-in-2020-amid-extremeweather-events62181994#:~:text=Utility%20customers%20experienced%201.33%20billion,aggregator%20of%20utility%20blackout%20data.

Ritchie H et al (2020) Electricity Mix. Our World in Data, 28 Nov. 2020. ourworldindata.org/electricitymix#:~:text=In%202019%2C%20almost%20two%2Dthirds,and%20nuclear%20energy%20for%2010.4%25

Turbulent. 15–70 K.W. Vortex Turbine, 0a35d52e-880d-4147-a4e4-f16ad754db6c.filesusr.com/ugd/20e303_d7ee62c65ebf4d7a9dabf0ff6af5716e.pdf

Turbulent Vortex Turbine. Engineering For Change. www.engineeringforchange.org/solutions/product/turbulent-vortex-turbine/

TURBULENT. PROJECT DEVELOPMENT. Four steps to get a Turbulent plant going https://www.turbulent.be/project-development

TURBULENT. PROJECTS. A global solution, with ongoing innovation. https://www.turbulent.be/projects Turbulent, "Report on Fish Friendly Design of the Turbulent Vortex Turbine." Eco-Friendly Hydro-power for Anyone, Anywhere, 0a35d52e-880d-4147-a4e4-f16ad754db6c.filesusr.com/ugd/20e303_928f5876a52b4693a26c4fed0faa0a67.pdf

UNIDO World Small Hydropower Development Report. www.unido.org/our-focus-safeguarding-environment-clean-energy-access-productive-use-renewable-energy-focus-areas-small-hydro-power/world-small-hydropower-development-report.

Hydro-power Measurement Manual. Turbulent, 0a35d52e-880d-4147-a4e4-f16ad754db6c.filesusr.com/ugd/e8b55a_f603a99a8bfc41b293f7eea9e85be42b.pdf

Effects of Population Aging on Japan's Economic Growth

Zekai Zhao

Abstract Recently, population aging has become severe in Japan. According to the data collected by Statista Research Department, the population aged 65 years and older in Japan possessed 28.4% of the total population in 2020 compared to 10.4% in 1986. This paper investigates how recent population aging affects several factors in Japan's economy that have influence on the short-term and long-term economic growth in Japan. I investigated three factors from three aspects, which are replacement ratio of pension from the income of retired people perspective, productivity index and average retirement age from the aspect of the overall productivity of the economy, and the saving index after the population aging from the perspective of the accumulation of capitals in the economy. This paper found out that population aging will negatively affect Japan's economic growth by observing a decrease in the replacement ratio of pension, a stable productivity with an increase in the retirement age, and the decrease in the overall aggregate saving of Japanese. There are also several recommended policies which may potentially eliminate the effect of population aging on Japan's economic growth with the evaluation of the effectiveness of each of them.

Keywords Population aging · Economic growth · Japan

1 Introduction

Due to the continuously severity of population aging in Japan, there was numerous research that investigated and analyzed the effect of aging on the economy growth in Japan. The research done by Bloom et al. in 2008 focused on the population aging and economic growth in Asia between 1998 and 2005. It concluded that there are several accounting effects on economic growth from population aging in Asia by researching into several behavioral responses due to the population aging including female labor force decline, increasing saving, and an increase in education. It suggested that the

Z. Zhao (✉)
Beijing Huijia Private School, Beijing 102299, China
e-mail: 23zhaozekai@huijia.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_42

effect of aging on economic growth will be ambiguous, since different countries may response differently when facing population aging (Bloom et al. 2010). The research done by Yoshino and Miyamoto in 2017 focused on the investigation of the effectiveness of fiscal and monetary policies faced with aging population in Japan. It found out that an increase in the proportion of working age population will lead to an increase in aggregate demand by increasing labor supply in the long run. It also found out that the population aging in Japan will negatively affect the effectiveness of fiscal and monetary policies in Japan (Yoshino and Miyamoto 2017). The study done by Faruqee and Muhleisen in 2001 investigated the effect of population aging on the fiscal sustainability of Japan. It examined the output loss caused by demographic changes and assesses the effect of aging on government's finance in Japan. It also investigated important fiscal policy options to address the effect of aging by comparing with effects on economic growth and welfare (Faruqee and Mühleisen 2001). Another research done by Katagiri in 2021 investigated the economic consequence of population aging in Japan. Specifically, it examined the change in demand structure in Japan's economy due to the change in the demographic structure (Katagiri 2021).

2 Data and Method

Economic growth is a general term that is used to describe the performance of an economy. It can be divided into two types, which are short-term economic growth and long-term economic growth. Short-term economic growth is the measurement of the real-GDP of an economy and can be demonstrated graphically through the increase or the right shift of aggregate demand of a country (Katagiri 2012). Aggregate demand can be measured by the sum of a country's consumption, investment, government spending, and net export. Long-term economic growth is the measurement of the average economic growth over long time period. It can be measured graphically by the increase or right shift of long run aggregate supply curve of a country. Long run aggregate supply can be quantified as the productivity of the country. In order to measure the economic growth, this paper will investigate the effect of population aging on the aggregate demand and long run aggregate supply of Japan. Since the population aging affect mainly on the consumers in the economy, the effect of population aging on aggregate demand can be demonstrated through two aspects of the it, which are the fluctuation of income and the trend of saving and investment. For retired people, the most important part of their income is the retirement pension. In this case, the specific measurement of the fluctuation of income is the replacement ratio of pension, which is the percentage of the money received after the retirement compared to the income before the retirement (Goh and McNown 2020).

In addition, the trend of saving and investment can be measured by the fluctuation of the saving index, which measures the level of aggregate saving in Japan and can also be used to measure the level of investment, which is the accumulation of capitals, due to the similarity of saving money in banks and investment. The productivity of

a country can be quantified and measured through multiple aspects, including the quantity and quality of labor, lands, capitals, and entrepreneurships. In order to infer relationship of productivity of Japan and the population aging effect in Japan, it is necessary to obtain the data of productivity as well as the variation of average retirement age of Japan.

3 Result and Discussion

After the comparison on groups of data of replacement ratio of pension, productivity index, and saving index of Japan, they are clearly showing that population aging can generate significant effect to the economic growth in Japan. The results showed that the replacement ratio of pension will continuously decrease in the future in Japan, the productivity index remain constant while the retirement age keep increase, and the saving index continue to decrease in Japan's economy. However, it is possible to relieve the threat of population aging through several policies that can potentially assist the growth of economy in Japan (Faruqee and Mühleisen 2003).

3.1 Replacement Ratio of Pension

Result Analysis. According to the data provided by the Organization for Economic Co-operation and Development, the gross replacement ratio of pension in Japan was 50.8% in 2020, but 62.3% in 2009. Essentially, residents in Japan in 2009 could receive 62.3% of their average earning from their original workplace after the retirement (Bos and Weizsacker 1989). However, people who retired in 2020 could only acquire 32.4% of their average salary from their original jobs after the retirement. The data provided by OECD illustrates a major difference in the amount of disposable income for retired people from 2009 to 2020. Since there is an obvious population aging phenomenon in Japan, older and retired people possess the major part of population in Japan. If the replacement ratio of pension in Japan is decreasing while the portion of older people in the overall population in Japan is increasing, the overall purchasing power in Japan will decreasing. The major part of the population is facing a continuously decrease in the disposable income, so that the amount of goods and services consumed by these people will be decreased. The basic requirement for achieving the short-term economic growth is the stability of the amount of goods and services consumed by the local residents. Hence, the decline of purchasing power can negatively affect the short-term economic growth in Japan. According the prediction made by Japan government, the replacement ratio of pension will continue to decline in the future. This persistent decline will pose potential threat to the long-term economic growth if the demographic structure in Japan doesn't alter in the future. As a result, several policies may have the potential to reduce the negative consequences generated from the population aging in Japan.

Proposed Policy. One of the policies that can to some extent eliminate the effect of population aging on the economic growth is the reduction of taxation for retired residents in Japan (Ogawa 2005). Currently, according to the data of pension system in Japan from the OECD, there is a fixed amount of deduction of JPY 400,000 for every retired people who receive pension. For people who receive JPY 3.6 million annually, the taxation rate after the deduction is approximately 25%. Specifically, a quarter of one's annually pension income will be extracted. Decreasing the taxation rate can increase the portion of disposable income from the pensions. So that it can stimulate the consumption of goods and services and investment on the capital in Japan's economy and therefore incentivizing the economic growth.

However, the effectiveness of such policy is questionable. One major consideration of the effectiveness is the extent of the marginal propensity of income. If the marginal propensity of consumption takes up a large portion of the marginal propensity of income, taxation decline may be an effective tool to stimulate Japan's economy. However, due to the common conservative personality for older people, the marginal propensity of saving will essentially take up a large part of marginal propensity of income. Hence, the effectiveness of cutting taxation should be reevaluated according to the marginal propensity of pension in Japan economy.

Another policy that can potentially benefit Japan's economy is the popularization of investment. With the development of communication devices, investment or stock market can be manipulated easily through cell phone (Kato 2022). If the government dispatches volunteers to the local community to propagate the benefits and method to do investment to older people, the willingness and capability for older people invest capitals will be increase. The increase in investment can boost the aggregate demand of the economy, and therefore increase the real GDP of Japan and achieving economic growth.

However, the feasibility of the policy is debatable. The government should consider the efficiency of the popularization of benefits for investment. If the time required to comprehensively convey the information to large portion of retired people is long, the relatively low efficiency of the policy can decrease the necessity of the implementation.

Nevertheless, although the feasibility of popularization of benefits for investment is questionable, it doesn't significantly decrease the government revenue. On the contrary, the government will lose a great amount of tax revenue through taxation reduction.

3.2 Productivity and Retirement Age

Result Analysis. According to the data provided by the trading economic, there isn't significant decrease in the productivity of Japan's economy. However, the average retirement for both men and women increase from 60 in 2012 to 65 in 2020. Although the current productivity enables the economy to produce at a stable level of output, which means that the economic growth is neither significantly enhanced

nor massively decreased, the increase in the average retirement age can potentially poses a threat to the long-term economic growth. The inconsistence of the change in the productivity and average retirement age can be explained by the phenomenon that people began to delay their retirement in order to maintain the productivity of each company. Additionally, the Japan government approved to raise the legal retirement age to 70 in 2021. So that the working age will continue to increase in the future. Although the increase in the retirement age will not remarkably affect the economic growth in the short term, the long-term economic growth may be affected. The relationship between age and individual productivity is negatively correlated. For instance, if the average age of workers in a company was 50 now and 55 in the future, the total productivity will decrease as the time goes on. In this case, the overall output of the economy will decrease due to the persistent decrease in the productivity. It can affect the long run aggregate supply of the economy. When measuring the long run aggregate supply, the component should include all of the factors of production. Assuming that the quantity and quality of lands, capitals, and entrepreneurship are constant, an increase in the average worker's age will decrease the quality of the labor forces, which can negatively affect the long run aggregate supply in the economy and thus threaten the long-term economic growth.

Proposed Policy. Several actions can be taken by the government in order to eliminate the effect of increasing average working age on the long-term economic growth.

From the perspective of workers, the major factor that decrease their productivity is the health situation. The government can enhance the health situation to some extent by improving the healthcare system. If the medical technology is enhanced through research and development funding by the government, the productivity of the country both in short-term and long-term might increase. In the short term that the research and development cannot be done, the government can provide free and comprehensive physical examination to all workers. The improvement on the healthcare can enhance the quality of labor force in Japan, and therefore increase the economic growth.

However, funding the research and development on medical technology can generate massive opportunity cost for the government. Thus, the effectiveness of this policy is questionable and should be well-considered by balancing the benefits and costs of the implementation of such policy in both short term and long term.

Another way to increase the country's productivity is to attract talents to immigrate the country. If people from other countries, who possess unique talents and master special skills can immigrate to Japan, the population aging will therefore generate insignificant effect to the economy. Because all the workers are from all around the world, the increase in the local working age will not threaten the overall productivity of the country.

Nevertheless, in order to attract foreign talents to immigrate to Japan, the government have to create financial stimulus to them, such as providing free accommodations and transportation, which can also generate a great amount of costs. Hence, the effectiveness and feasibility of that policy are debatable and require reevaluation.

3.3 Saving Index

Result Analysis. The decline of the aggregate saving can also contribute to the negative effect on economic growth due to the population aging in Japan. The average saving rate in Japanese household in the early 1980s was 15% of their disposable income and 2% in 2009 (Nguyen 2020). The significant decrease in the average saving rate can also be explained by the population aging effect and the decline in the replacement ratio of pension. Since the portion of retired people in the overall demographical structure in Japan is increasing, a large component of the population has to rely on the pension for saving. The decline of replacement ratio of pension can cause these people to have less disposable income compared to the time before the retirement. Therefore, they have to extract some portions of the money in which are originally distributed in saving to fulfill their basic requirement of consumption for goods and services. Although extracting income from the saving account and using them to consume goods and services can enable the economy to maintain a relatively stable level of consumption, a decrease in the overall aggregate saving can also negatively affect the growth in Japan's economy. Decrease in the aggregate saving means the decrease in the investment and the accumulation of capitals in Japan's economy, which can lead to a decline in the aggregate demand of the country, and thus affect the economic growth in Japan in both short-term and long-term.

Proposed Policy. The effect of the decline in aggregate saving in Japan can be eliminated or relieved through the management in two aspects, which are the reduction in the tariff or the increase in the interest rates and selling bonds.

The government can reduce the price of the goods and services through the liberalization of international trade. One way to effectively achieve it is the reduction in the collection of tariffs. The tariff is currently managed by the Customs and Tariff Bureau of Japan's Ministry of Finance and the average tariff rate is surprisingly one of the lowest in the world. According to the data provided by the world trade organization, the average tariff rate for all products is 4.3 and 15.5% for agricultural product. Although the high tariff rate toward the agricultural products may be aimed to product the local agricultural industry, Japan's economy will therefore unable to enjoy the benefit of international trade. Due to the relatively small territory and available land sources in Japan, other countries may have comparative advantages for agricultural products. Hence, the average price abroad may be lower than the price for agricultural product in Japan. Therefore, the government can decrease the tariff rate for agricultural product and incentivize international trade in order to attract foreign producers to entry Japan's economy and lower the average price faced by Japan's consumer.

However, one of the major issues of the reduction of tariff is the extraction of property to foreign company. If the price of imported products is lower than the price of domestic product, Japanese consumers may prefer to purchase imported products. Although it will increase the disposable income and stimulate aggregate saving, foreign company can also earn a great amount of profit from the consumption of imported products in Japan market. Additionally, the government may also fail

to protect the domestic agricultural industry and lose tariff revenue in which can be used to increase productivity by improving healthcare system. In this case, the feasibility of this policy is questionable and needed to be well-balanced.

Raising interest rate of saving can also stimulate the aggregate saving of Japan's economy. Increasing the returns rate of saving money and accumulating capital can attract residents to be willing to put a large portion of their money to the bank account for a period in order to earn interests in the future. The government can also introduce several attractive national bonds to the residents, which can increase the willingness for consumers to invest and save their money.

Nevertheless, the willingness to save money and purchase national bonds can also be affected by other factors, including the confidence toward the future of the economy. Since the widespread of COVID-19, people's confidence toward to development of the economy has been significantly decrease. The time for the completely disappearance of the virus is unknown, so it is possible that the confidence toward the economy will maintain at a stable and low level in recent years. Hence, the effectiveness of the policy should be reevaluated considering the time required to raise the investment and saving confidence.

4 Conclusion

In conclusion, recent population aging has severely affect the economic performance of Japan. This paper investigated the consequence of it through the consideration of the income effect, saving affect, and the productivity index. The result showed that recent population aging in Japan decreased the overall income of Japanese due to the decline of replacement ratio of pension, but several policies may potentially eliminate the effect, including reduction in taxation and popularization in investment. The productivity index maintains at a stable level while the average retirement age is increasing, which suggest that the average working age is increasing in order to maintain the productivity. Several potentially effective methods can aid in solving that issues, including improvement on healthcare system and making the country attractive to immigrants. The aggregate saving level is decreasing as a result of population aging, which means that there is a decline in the accumulation of capital, which may harm the long-term economic growth in Japan. Policies that can potentially stimulate the aggregate saving include trade liberalization and raising up interest rate. However, all policies have their own unique strengths as well as limitations that need to be reevaluated.

References

Bloom DE, Canning D, Finlay JE (2010) Population aging and economic growth in Asia. In: The economic consequences of demographic change in East Asia, vol 19, pp 61–89

Bos D, Von Weizsacker RK (1989) Economic consequences of an aging population. Eur Econ Rev 33(2–3):345–354
Faruqee H, Mühleisen M (2001) Population aging in Japan: demographic shock and fiscal sustainability
Faruqee H, Mühleisen M (2003) Population aging in Japan: demographic shock and fiscal sustainability. Jpn World Econ 15(2):185–210
Goh SK, McNown R (2020) Macroeconomic implications of population aging: evidence from Japan. J Asian Econ 68:101198
Katagiri M (2012) Economic consequences of population aging in Japan: effects through changes in demand structure (No. 12-E-03). Institute for Monetary and Economic Studies, Bank of Japan
Katagiri M (2021) Economic consequences of population aging in japan: effects through changes in demand structure. Singap Econ Rev 66(06):1709–1731
Kato RR (2022) Population aging and labor mobility in Japan. Jpn World Econ 62:101130
Nguyen DTT (2020) The effects and solutions of population aging on the japanese economy and society. Int J Mech Prod Eng Res Dev 10(3):16255–16260
Ogawa N (2005) Population aging and policy options for a sustainable future: the case of Japan. Genus 369–410
Yoshino N, Miyamoto H (2017) Declined effectiveness of fiscal and monetary policies faced with aging population in Japan. Jpn World Econ 42:32–44

Explain Disposition Effect with Loss Aversion and Regret

Tong Xue

Abstract Disposition effect is an important behavioral bias showed in empirical evidence which refers to the tendency most people yielded to: selling assets with rising prices too early and holding assets with falling prices for too long. This paper makes a theoretical analysis of the causes of disposition effect firstly. Then regret and loss aversion are combined and introduced into an agent-based model for the first time. Through mathematical and computational methods, this paper verifies that the final model is valuable for both investor and researcher. The results of this paper are expected to provide in-sights into the formation of disposition effect and help to prevent it.

Keywords Disposition effect · Agent-based model · Behavioral bias

1 Introduction

1.1 Behavioral Finance

Behavioral finance is a critique of traditional financial theory: efficient-market hypothesis, which claims that investors are rational and requires that irrational investors do not systematically make the same cognitive errors or follow the same biases. Therefore, deviations from rationality do not impact in a systematic way on prices. It is assumed that even if investors are irrational the net effect cancels out. However, behavioral economists believe irrational behaviors are not just noise but have a real impact on the markets. Behavioral finance aims to explain behavioral biases and their influence on financial market participants' decisions and asset

This thesis was revised and upgraded on the basis of my graduation thesis, which was submitted to University of Leeds.

T. Xue (✉)
University of Leeds, Leeds LS2 9JT, UK
e-mail: xuetong_uk@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_43

market prices. Since behavioral finance established, it has been a discipline with bright characteristic, formidable vigor and good prospects.

1.2 Reasons of the Disposition Effect

Hersh Shefrin and Meir Statman identified and named disposition effect in 1985 (Shefrin and Statman 1985). And it has been described as one of the most robust facts about the trading of individual investors by Barberis and Xiong (2009). Despite this, the underlying causes of it remains unclear (Barberis and Xiong 2009).

Traditionally, prospect theory (Kahneman and Tversky 1979), one of building blocks of behavioral finance, is perhaps the leading explanation for the disposition effect (Grinblatt and Han 2005). It is a critique of expected utility theory as a descriptive model of decision making. In efficient market theory, utility is determined by the value of wealth, while from the perspective of prospect theory, value is determined by the gain or loss at present period compared with the previous period. According to prospect theory, investors tend to avoid risks after huge gains, while investors tend to prefer risks after huge losses. Therefore, after suffering huge losses, biased investors will tend to continue to hold, that is to say, take greater risks to wait for returns. Besides, prospect theory illustrates that investors show more averse to losses than attracted to similar sized gains. The value function is convex for losses, concave for gains in prospect theory. It is a S-shaped value function steeper in the loss domain than the gain domain. This is loss aversion, meaning people's measurement of gain and loss is asymmetric. The pain after loss is more than the happiness brought by the same amount of gain. The loss is too painful so investor holds off selling the stock in order to escape the pain that will be accomplished after selling stocks. Moreover, the reflection effect that introduced by prospect theory is also one of the reasons of the disposition effect.

However, there are critiques of the prospect theory explanation. It predicts not convincing, even the opposite, results in some cases. Hens and Vlcek (2001) found that prospect theory can only explain ex-post disposition behavior but not ex-ante disposition behavior in their particular model. Similarly, in Barberis and Xiong's (2009) example, the investor would not have bought stocks in the first place only if its expected return must be reasonably high according to prospect theory. Both Barberis and Xiong (2009) and Hens and Vlcek (2001) suggested that prospect theory cannot explain the disposition effect alone after theoretical discussion and simulation. Summers and Duxbury (2012) also gave the same conclusion: Merely experiencing prior gain or loss not sufficient to produce disposition effect. Shefrin and Statman (1985) built their theoretical model to explain the disposition effect contained four elements prospect theory, mental accounting, regret aversion and self-control. It has been noticed that the emotion of wanting to avoid regret drives the behaviors related to disposition effect. When an investor closes his position and loses money, he will be penitential because he realizes that he made a wrong investment decision.

A better way to address the disposition effect is to combine prospect theory with other effects. In this paper, I choose prospect theory and regret as two reasons of disposition effect. Through mathematical and computer methods, the combination of prospect theory and regret produced disposition effect in my simulated financial market.

1.3 A Literature Review of Agent-Based Model

Traditional theories and models for financial markets fail to explain the new problems such as stylized facts and behavioral biases. The interaction between investors, which is a significant factor influencing the choices of individuals, has been ignored. The outbreak of the financial crisis promoted experts to look for new methods of research in financial markets. Agent-based models are computational models used to simulate the behaviors and interactions of autonomous agents. The agents include both individual and collective entities such as organizations or groups. Agents are generally regarded to have limited rationality in agent-base model, having a coincidence with the idea of behavioral finance. Importantly, Monte Carlo simulation is used to introduce randomness. As a result, agent-based model is useful for reproducing and understanding the stylized facts observed in the financial time series including volatility clusters and so on, receiving increasing attention.

Kirman's (1993) research on ant colonies' behavior is the inspiration and foundation of Lux's research on herding effect. Lux (1995), tried to mathematize the herd effect and give the equation definition in 1995 (Lux 1995). He analyzes the financial markets with herd effect and came to the conclusion that herd effect can lead to periodic bubbles in the market. This provides a technical analysis explanation for the stylized facts. Alfi et al. (2009) constructed a basic agent-based model in 2009, which is an improvement of Lux-Marchesi model (Lux and Marchesi 1999, 2000). Their main contribution is that this model is open so that adding new factors especially behavioral biases is practicable.

The models of Franke and Westerhoff (2012) are based on structural volatile volatility. They collected two widely accepted method with explicit formulas describing market fractions of agents: the transition probability approach and the discrete choice approach. Then, they gave four factors that influence investors' switching behavior and obtained four combinations of these factors. After testing the performance of several models they got the winner model, which uses discrete choice approach and contains three factors: herding, pre-deposition and misalignment. They also obtained the optimal values of some parameters through computational methods. This provided great convenience for later researchers.

Pruna et al. (2018) introduced the factor concerning regret into one of the models (TPA-HPM model) of Westerhoff et al. (2012). This is the first paper discussing the implications of the disposition effect on agents' interactions and the asset price dynamics. They tested the influence of regret factor on simulated financial markets and concluded that regret factors may lead to the disappearance of some stylized facts.

Pruna et al. (2020) introduced loss aversion into an agent-based model. Different from the previous model (Pruna et al. 2018), they used another model of Franke and Westerhoff's models (Franke and Westerhoff 2012) instead of the winner one. They tested the influence of loss aversion on the price and return of risky asset in financial market. It is claimed that the model with loss aversion is closer to the real data than the original model, that is, 6686 observations of the Standard and Poor's Index from 1980 to 2007.

Researches on the analysis of disposition effect by agent-based models are not sufficient. For the reappearance of disposition effect, most articles only use one of the theoretical causes or just consider the results brought by disposition effect (Kaustia 2010). This paper discussed the gradually complicated situation to analyze each factor in detail. The final model is constructed with both regret and loss aversion.

2 Model

2.1 Fundamentalists

Investors are divided into two categories: fundamentalists and chartists. Fundamentalists believe that a fundamental price pf exists referring to the value of the stock. They get the fundamental value through economic analysis. In general, great institutions and groups are fundamentalists with longer time scale. They do not pay much attention to temporary fluctuations, but to price deviations. pf is assumed to be a fixed constant for every fundamentalist in this model: $\mathrm{pf} = 0$. When the real price is greater or less than the pf, fundamentalists tend to sell or buy the stock respectively, making the price approach the reference value. Therefore, fundamentalists stabilize the market. The stochastic equation for the stock price that describes the fundamentalists' behavior is:

$$p_{t+1} = p_t + \gamma\left(p_f - p_t\right) + e_t, \quad e_t \sim N\left(0, \sigma^2\right) \tag{1}$$

where e is the white noise that obeys the normal distribution. γ is the strength of the fundamentalists' motion. γ is in the interval (0, 1), and I tested three values of it. It is shown that when γ is 0.006, the prices fluctuate around the fundamental value 0 and the amplitude does not exceed 0.5. There is no significant bubbles and crashes while the prices are vicissitudinous. This simulation reproduces the stabilizing effect of fundamentalists on market prices successfully. In a financial market which only composed of fundamentalists, the market price will keep around the fundamental value and there is no bubbles and crushes as fundamentalists make quite slight distribution to them. Therefore, I choose $\gamma = 0.006$, which is also the choice of Alfi et al. (2009).

2.2 Chartists

Another type of agents are chartists. They are trend-follower who only follow trends in the positive or negative direction. Consequently, they have a relatively shorter time scale and they make the important contribution to the surge of the market price such as bubbles and collapses. Chartists are assumed to have memory with length M, which means they only remember the historical prices from M periods ago to present period t. Moving average is used to describe this. The stochastic equation for the stock price that describes the chartists' behavior is:

$$p_{t+1} = p_t + \frac{b}{M-1}(p_t - p_{Mt}) + e_t, \quad e_t \sim N\left(0, \sigma^2\right) \tag{2}$$

p_{Mt} is the moving average performed on the previous M time steps:

$$p_{Mt} = \frac{1}{M}\sum_{i=0}^{M-1} p_{t-i} \tag{3}$$

The parameter b is the strength of the chartists' motion. As chartists have short time scale, I used $M = 3$ for the memory length of chartists. Graph 2 shows the price fluctuations in Eqs. (2) and (3) with different values of b. The lines are blue, green and red that correspond to b equals to -1, 0 and 1 respectively. We can see from the image that the red line has the largest fluctuation, followed by the green line, and the blue line has the smallest fluctuation. As chartists tend to make the price process more volatile, we use $b = 1$ (red) as the repulsive potential describing chartists' action (Alfi et al. 2009) (Fig. 1).

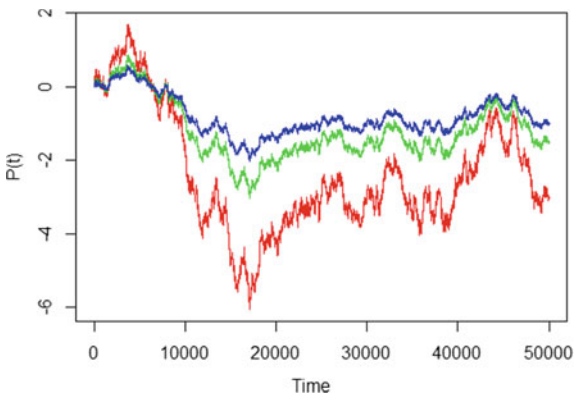


Fig. 1 Price (chartists)-choice for b

2.3 Asymmetry

The risk asset price determined by excess demand is related to the interactions of fundamentalists, chartists and their environment. The market maker adjusts the price for the next period t + 1 using the equation below:

$$p_{t+1} = p_t + \mu\left(n_t^f d_t^f + n_t^c d_t^c\right) + e_t, \quad e_t \sim N\left(0, \sigma^2\right) \tag{4}$$

Here, n^f is fundamentalists' market fraction and n^c is chartists' market fraction. Both of them are positive and have the limit equation.

$$n^c + n^c = 1 \tag{5}$$

Market maker reacts to the imbalance between demand and supply by proportionally regulating the price with μ. μ is a constant greater than 0. e is still the white noise.

To describe the price fluctuations in detail, we introduce the equation for excess demand which is the main reason for the price fluctuations in our simulated market. df and dc are set to be the net demand of fundamentalists and chartists respectively. And d is the total demand:

$$\begin{cases} d_t^f = \phi\left(p_t^f - p_t\right) + e_t^f, e_t^f \sim N\left(0, \sigma_f^2\right) \\ d_c^f = \chi\left(p_t - p_{Mt}\right) + e_t^c, e_t^c \sim N\left(0, \sigma_c^2\right) \\ d = n_t^f d_t^f + n_t^c d_t^c \end{cases} \tag{6}$$

φ and χ are constants representing the aggressiveness of the investors' demand respectively. Here, μφ is the same as γ and μξ is the same as the factor b/(M − 1) before. e^f is white noise of fundamentalists and e^c is white noise of chartists. As e is the white noise from the perspective of the whole market, it is depended on e^f and e^c (Lux and Marchesi 1999):

$$\sigma_t = (n_{t-1}^f)^2 \sigma_f^2 + (n_{t-1}^c)^2 \sigma_c^2 \tag{7}$$

Any individual is allowed to switch his or her strategy (either from chartist to fundamentalist or vice versa) at any time step t, which is the result influenced by other investors. The probabilities of switching are defined to address the dynamic process of market fractions. The probabilities shifting from chartist to fundamentalist and vice versa are denoting by p^{cf} and p^{fc}. Equations for them are (Lux 1995):

$$\begin{cases} p_t^{cf} = \min(1, \upsilon \exp(a_t)) \\ p_t^{fc} = \min(1, \upsilon \exp(-a_t)) \end{cases} \tag{8}$$

Here, a is the switching index related to several factors (Pruna et al. 2018; Franke and Westerhoff 2012):

$$a_t = \alpha_0 + \alpha_n(n_t^f - n_t^c) + \alpha_p(p_t - p_t^f)^2 \tag{9}$$

α_0 is the predisposition parameter describing the fact that every agent has his or her initial preference to be either a fundamentalist or chartist. When $\alpha_0 > 0$, the priori preference is for fundamentalism while $\alpha_0 < 0$ the circumstance is opposite. αn is the herding parameter. $\alpha_n > 0$, since the herd effect does exist. And $\alpha_p > 0$ captures the influence of price discrepancy.

The adjustment equations describing market fractions for the next period t + 1 are defined by the discrete choice approach (Franke and Westerhoff 2012):

$$\begin{cases} n_{t+1}^f = n_t^f - p_t^{fc} n_t^f + p_t^{cf} n_t^c \\ n_{t+1}^c = 1 - n_{t+1}^f \end{cases} \tag{10}$$

Although the champion model of Franke and Westerhoff (2012) uses the method of discrete choice, the way we use to test the effect of regret factor is to change the conversion probability. Therefore, discrete choice approach which is more dependent on the conversion probability is chosen.

Some factors are fixed the same as those in the DCA-HPM model in Franke and Westerhoff (2012): $\varphi = 0.12$; $\chi = 1.50$; $\mu = 0.01$; $\alpha_0 = -0.327$; $\alpha_n = 1.79$; $\alpha_p = 18.43$; $v = 0.05$; $s^f = 0.758$; $s^c = 2.087$. Therefore, $\mu\varphi$ is equal to 0.0018, which is the same order of magnitude as γ in the first model. Both of them are less than 0.01.

I ran the program for 100 times and got the average value of 100 n^f, which is 0.96. This means that in this asymmetric model, fundamentalists occupy a large share of the simulated market. This result is similar to that in Pruna et al. (2018, 2020). The trades with relatively large market shares in financial market are always institutions who have formidable ability of economic analysis. They tend to deduce the fundamental value and behave as fundamentalists. It is reported that fundamentalists have relatively greater proportion in real market generally (Alfi et al. 2009; Franke and Westerhoff 2012).

2.4 Regret

Regret makes great contribution to the disposition effect as it makes investor give up their new choice and hold the asset for long time to avoid regret after the decision. Therefore, whenever they find themselves in a losing strategy the biased investors pretend not to realize the loss. As the result, the biased agents stick to the strategy and hope that their bad luck will soon reverse. Formally, the probability of the biased agents switching types decreases when they are losing money. The redefined probabilities of switching are (Pruna et al. 2018):

$$\begin{cases} \widehat{p^{cf}}_t = p_t^{cf} - \lambda p^{cf}, if\ w_t^c < 0 \\ \widehat{p^{fc}}_t = p_t^{fc} - \lambda p^{fc}, if\ w_t^f < 0 \end{cases} \tag{11}$$

where w^c and w^f are profits earned by chartists and fundamentalists respectively:

$$\begin{cases} w_t^c = \eta w_{t-1}^c + (1-\eta) g_t^c \\ w_t^f = \eta w_{t-1}^f + (1-\eta) g_t^f \end{cases} \tag{12}$$

η is the memory coefficient in [0, 1). And gf and g^c are short term capital gains realized by fundamentalists and chartists respectively:

$$\begin{cases} g_t^c = (\exp(p_t) - \exp(p_{t-1})) d_{t-2}^c \\ g_t^f = (\exp(p_t) - \exp(p_{t-1})) d_{t-2}^f \end{cases} \tag{13}$$

Therefore, the market fractions are:

$$\begin{cases} n_{t+1}^f = n_t^f - \widehat{p^{fc}}_t n_t^f + \widehat{p^{cf}}_t n_t^c \\ n_{t+1}^c = 1 - n_t^f \end{cases} \tag{14}$$

The stock prices and returns are shown in Figs. 2 and 3.

It can be seen that the introduction of asymmetry changed the market share of the simulated market, which made the artificial market closer to the real financial market situation. Asymmetric models show many stylized facts that are often observed in real financial markets.

However, the addition of regret factors after asymmetry makes the simulated market lose most significant stylized facts. There are no peaks and valleys so that there is no fat tail. After a sharp decline, there was no relatively large increase.

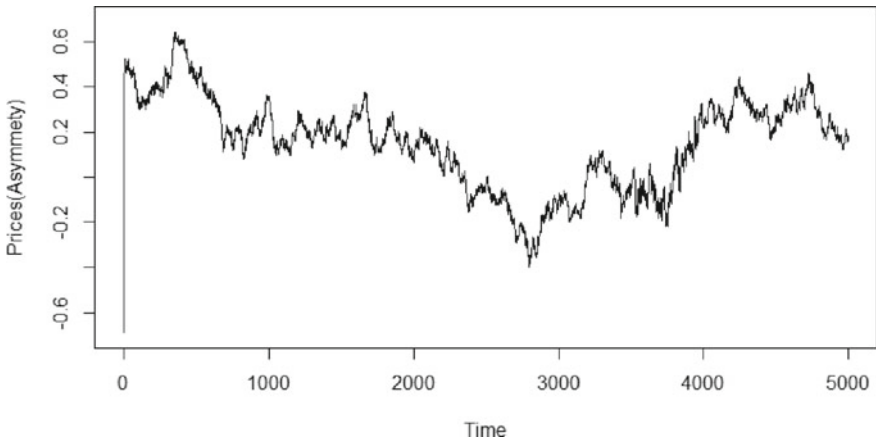


Fig. 2 Price (asymmetry)

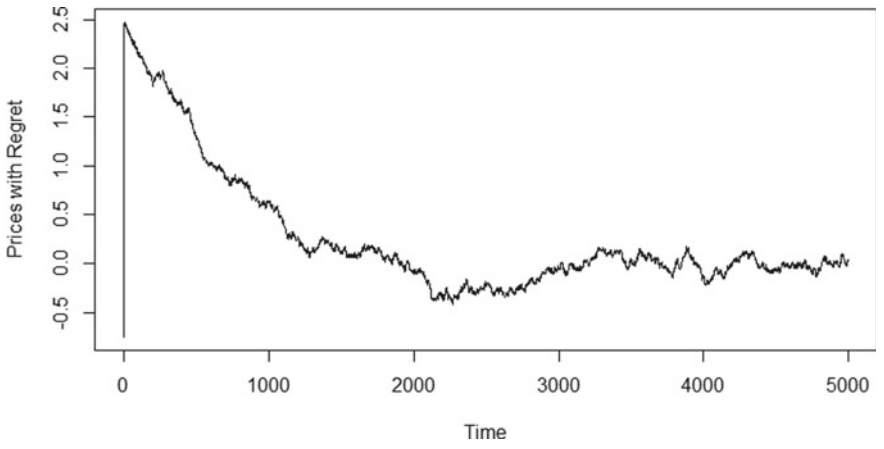


Fig. 3 Price (regret)

Therefore, volatility clustering also does not appear. The model with regret cannot reflect the real situation of the financial market.

2.5 Loss Aversion

Loss aversion is a result from prospect theory and mental accounting analysis. According to theoretical analysis, this is another reason for disposition effect. Loss aversion means people weigh losses more than gains of the same magnitude. And that influences agents' switching process. Loss averse agents consider an asymmetric wealth function. ρ is the loss aversion coefficient, which is argued to be 2.25 by Tversky and Kahneman (1992). v is the value of the gains or losses considered by investors. v^f and v^c represent the value of fundamentalists and chartists respectively:

$$\begin{cases} v_t^f = \begin{cases} w_t^f, & if\ w_t^f \geq 0 \\ \rho w_t^f, & if\ w_t^f < 0 \end{cases} \\ v_t^c = \begin{cases} w_t^c, & if\ w_t^c \geq 0 \\ \rho w_t^c, & if\ w_t^c < 0 \end{cases} \end{cases} \tag{15}$$

I introduce loss aversion in a way that can be supported by the overall model's definition, which follows (Pruna et al. 2020). They introduce the first term in the attractiveness level at as being proportional to the difference in accumulated wealth:

$$a_t = \alpha_0 + \alpha_n (n_t^f - n_t^c) + \alpha_w \left(v_t^f - v_t^c \right) \tag{16}$$

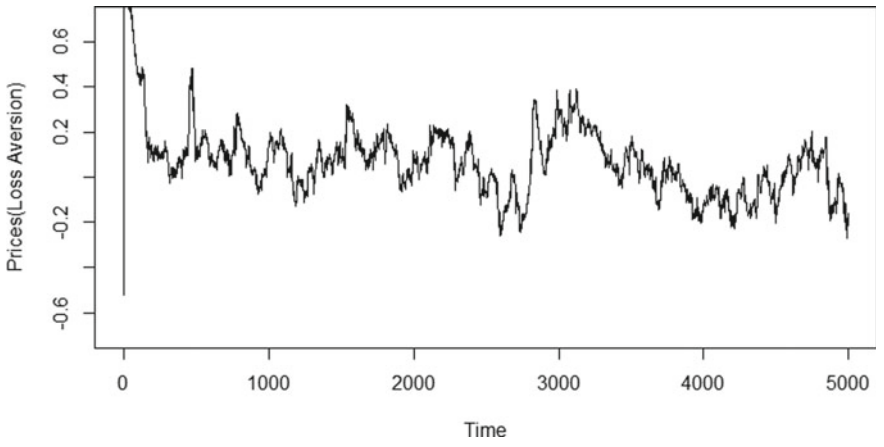


Fig. 4 Price (loss aversion)

However, it is worth noting that Pruna et al. (2020) used transition probability approach to describe the market share, while I still use discrete choice approach (Eq. 11) here, consistent with the previous section. That is for the convenience of describing both regret emotion and loss aversion at the same time in the next model.

In addition, the description of the switching index a Eq. 16 actually conforms to the WHP setting of Franke and Westerhoff (2012). WHP represents wealth, herding and predisposition, which determine the attractiveness a. Therefore, factors are fixed (Franke and Westerhoff 2012): $\varphi = 1.00$; $\chi = 0.90$; $\mu = 0.01$; $\alpha_0 = 2.10$; $\alpha_n = 1.28$; $\alpha_w = 2668$; $v = 0.05$; $s^f = 0.741$; $s^c = 1.705$.

The stock prices and returns are shown in Fig. 4.

Fluctuations of prices seem reasonable, showing absence self-correlation and volatility clustering. However, extreme values are rare so the phenomenon of fat tail is not obvious. However, the market fractions of simulation market change significantly. I ran the program for 100 times and got the average value of 100 n^f, which is 0.64 this time. However, n^f are supposed be greater than 0.9 in most cases (Franke and Westerhoff 2012; Pruna et al. 2020; Bangwei et al. 2014).

2.6 The Final Model

As discussed in Sect. 1, in theory, disposition effect is caused by several reasons including prospect theory, mental accounting, regret aversion, self-control and so on (Shefrin and Statman 1985). Most of the existing articles using agent-based model to discuss disposition effect only consider one explanation (Pruna et al. 2018; Bangwei et al. 2014). That means there is only a single formula or a single term of one equation in their models used to describe disposition effect. That cannot completely reproduce disposition effect in the simulated market. I chose two main reasons for disposition

effect: regret emotion and prospect theory in this article. The aim is to explain these two reasons mathematically, and therefore get quantitative equations to construct my simulated financial market. Therefore, mathematical methods are applied to verify the theoretical conclusion that disposition effect is caused by those reasons.

For the first time, I introduced both loss aversion and regret into the model. The attractiveness is redefined as:

$$a_t = \alpha_0 + \alpha_n(n_t^f - n_t^c) + \alpha_p(p_t - p_t^f)^2 + \alpha_w\left(v_t^f - v_t^c\right) \tag{17}$$

Equation describing market fractions are the same as Eq. 15. I used the same value for the value of parameters.

Figures are given below (Fig. 5).

It can be seen that the image describing price fluctuations has obvious regional symmetry. The price falls are usually followed by the price increase of similar magnitude and vice versa. This is exactly the phenomenon of volatility clustering. This makes the price have more peaks and valleys so that fat tails emerge. In addition, price fluctuations are random and difficult to predict. Absence of self-organization can also be observed. And the market fraction of fundamentalists is 0.94 in this model.

Models that only consider loss aversion or regret can't describe the characteristics of financial markets comprehensively. Because the fluctuations of market fractions in the simulated market do not match the real financial market. The model with both regret and loss aversion can describe most of the facts in the real financial market. Market fraction is also more reasonable. The simulate model is better to reproduce the financial market.

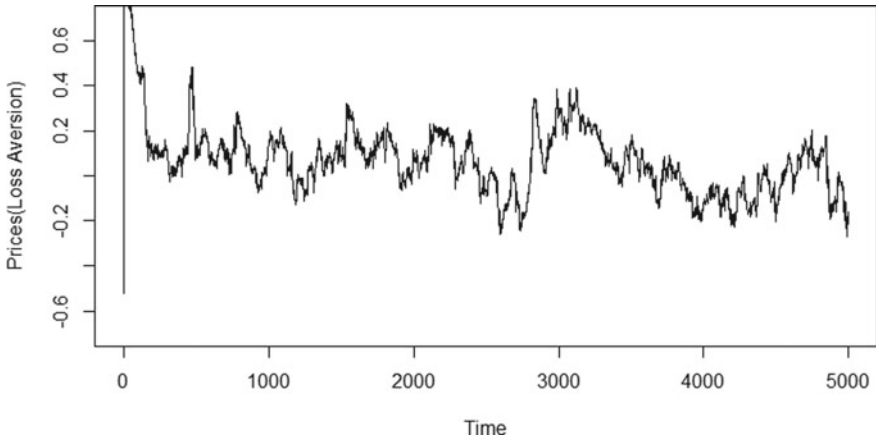


Fig. 5 Price (regret and loss aversion)

3 Application

RStudio is used to realize this simulated financial market based on agent-based model. In order to test whether the multi-agent artificial stock market simulation platform is effective and reasonable, the closing prices of S&P 500 index on 21 opening days from July 1st to July 30th, 2021 are used as reference data, and the predicted prices of the model are compared with those from the real market (Table 1).

The difference between the simulation value and the real price is less than 0.05 in the first six days, and the other differences are all less than 0.2. Table 2 compares various statistical indicators, and it can be seen that the mean difference is less than 0.1, and the variance difference is less than 0.005.

Table 2 compares various statistical indicators. It can be seen that the mean difference is less than 0.1, and the variance difference is less than 0.005. The result means that the simulated data can replicate the stylized facts to some extent.

Therefore, the multi-agent artificial financial market in this paper can predict the price of risky asset to a certain extent, and it has more reference significance for the

Table 1 S&P 500 series and simulation series

Date	Real log closing price	Simulation	Simulation-real
20210730	3.642985	3.786061	0.143076
20210729	3.645339	3.80493	0.159591
20210728	3.643517	3.772824	0.129307
20210727	3.643597	3.752866	0.109269
20210726	3.645641	3.763001	0.117360
20210723	3.644616	3.761732	0.117116
20210722	3.640231	3.756679	0.116448
20210721	3.639356	3.717186	0.077830
20210720	3.635806	3.704268	0.068462
20210719	3.629270	3.688253	0.058983
20210716	3.636203	3.689062	0.052859
20210715	3.639489	3.672997	0.033508
20210714	3.640909	3.664791	0.023882
20210713	3.640403	3.660101	0.019698
20210710	3.641933	3.662362	0.020429
20210709	3.640437	3.649539	0.009102
20210708	3.635566	3.657385	0.021819
20210707	3.639300	3.6393	(0.000000)
20210706	3.637844	3.637844	0.000000
20210702	3.638723	3.638723	0.000000
20210701	3.635478	3.635478	0.000000

Table 2 Statistical properties of S&P 500 series and simulation returns series

	Real log price (the first six days)	Simulation (the first six days)	Real log price	Simulation
Mean	3.639789	3.661196	3.63984	3.700732
Variance	0.00000491	0.00006103	0.000016	0.003144
Skewness	−1.751812	0.032069	−0.751978	0.473312
Kurtosis	3.640317	0.936535	1.04028	−1.291366

Table 3 S&P 500 series and simulation series (six simulation experiments)

Date	Real log closing price	Simulation	Simulation-real
20210730	3.642985	3.670484667	0.027500
20210729	3.645339	3.669253	0.023914
20210728	3.643517	3.663145833	0.019629
20210727	3.643597	3.6634005	0.019804
20210726	3.645641	3.673322	0.027681
20210723	3.644616	3.678400833	0.033785
20210722	3.640231	3.672302	0.032071
20210721	3.639356	3.662247	0.022891
20210720	3.635806	3.656962667	0.021156
20210719	3.629270	3.6548745	0.025605
20210716	3.636203	3.662010667	0.025808
20210715	3.639489	3.672072333	0.032583
20210714	3.640909	3.6546615	0.013753
20210713	3.640403	3.646938	0.006535
20210710	3.641933	3.652520167	0.010587
20210709	3.640437	3.641152	0.000715
20210708	3.635566	3.638939833	0.003374
20210707	3.639300	3.6393	(0.000000)
20210706	3.637844	3.637844	0.000000
20210702	3.638723	3.638723	0.000000
20210701	3.635478	3.635478	0.000000

prediction in the nearest six days. This prediction may be valuable for chartist, that is, most individual investors.

As the number of experiments increased, I found that the data showed stability. When six simulation experiments were carried out, the difference between the simulated value and the actual value became smaller (Table 3). The difference between all simulated values and actual values is less than 0.05. The simulated value here is the average of six experiments.

4 Conclusion

The combination of several reasons leads to the disposition effect, and it is not sufficient to consider a single reason. This paper selects loss aversion, which is proposed by prospect theory, and regret emotion as two set conditions. It is verified by mathematical and computer methods that considering these two factors in an agent-based model at the same time can reproduce the disposition effect in the simulated market. At the same time, only considering regret factor makes the artificial market lose some main stylized facts. Price fluctuation no longer shows fat tail and volatility clustering and absence of auto-correlation. Besides, only considering loss aversion makes great changes in market fraction. The addition of loss aversion to the asymmetry model has greatly changed the market share, which makes the market share of the simulated market quite different from that of the real financial market.

The innovation of this paper is to construct an artificial market with both regret factors and risk aversion. The final model shows stylized facts observed in real markets including absence of auto-correlation, fat tail, volatility clustering and the majority of fundamentalists. And the model successfully reproduces the disposition effect. Moreover, this model is open for researchers to add new factors to study more complex situations.

Finally, the paper compares the data simulated by the innovation model with the real data of S&P 500 Index in July 2021. The results show that the simulated market reproduces stylized facts and disposition effect. Moreover, the difference between the simulated price and the actual value in the first six days is small. I think this forecast is helpful to provide investors with investment reference and avoid disposition effect. In addition, with the increase of test times, the simulation results tend to be stable and closer to the real data, which also proves the effectiveness of the model.

5 Application

For the innovation model, more numerical analysis is needed to determine the parameters. Most of my models use the parameters selected by Franke and Westerhoff (2012). However, with the changes of the switching index in the final model, the parameters in the final model may change to some extent. Moreover, the new switching index does not meet the settings of any model of Franke and Westerhoff (2012). Although the simulation results reproduce the stylized facts to a certain extent, the specific values of the parameters need to be further clarified. Moreover, the fundamental value pf I use is a constant in the models in this paper. This is inconsistent with the reality because the fundamental value of an asset depends on many factors and changes with time. Pruna et al. (2018) put forward that the fundamental value conforms to the geometric Brownian motion. However, my current model has not used this technology. Further work is needed to solve these statistical problems.

References

Alfi V, Cristelli M, Pietronero L, Zaccaria A (2009) Minimal agent based model for financial markets I. Eur Phys H J B 67:385–397

Bangwei L, Wei S, Hongquan L, Lin H, Shanying X (2014) Disposition effect in an agent-based financial market model. Procedia Comput Sci 31:680–690

Barberis N, Xiong W (2009) What drives the disposition effect? An analysis of a long-standing preference-based explanation. J Finan 14(2):751–784

Franke R, Westerhoff F (2012) Structural stochastic volatility in asset pricing dynamics: estimation and model contest. J Econ Dyn Control 36:1193–1211

Grinblatt M, Han B (2005) Prospect theory, mental accounting, and momentum. J Finan Econ 78:311–339

Hens T, Vlcek M (2001) Does prospect theory explain the disposition effect? J Behav Finan 12(3):141–157

Kahneman D, Tversky A (1979) Prospect theory: an analysis of decision under risk. Econometric 47(2):263–291

Kaustia M (2010) Prospect theory and the disposition effect. J Finan Quant Anal 45:791–812

Kirman A (1993) Ants, rationality, and recruitment. Q J Econ 108:137–156

Lux T (1995) Herd behavior, bubbles and crashes. Econ J 105:881–896

Lux T, Marchesi M (1999) Scaling and criticality in a stochastic multi-agent model of a financial market. Nature 397:498–500

Lux T, Marchesi M (2000) Volatility clustering in financial markets: a micro-simulation of interacting agents. Int J Theor Appl Finan 3:675–702

Pruna R, Polukarov M, Jennings N (2018) Avoiding regret in an agent-based asset pricing model. Finan Res Lett 24:273–277

Pruna R, Polukarov M, Jennings N (2020) Loss aversion in an agent-based asset pricing model. Quant Finan 20:275–290

Shefrin H, Statman M (1985) The disposition to sell winners too early and ride losers too long: theory and evidence. J Finan 40:777–790

Summers B, Duxbury D (2012) Decision-dependent emotions and behavioral anomalies. Organ Behav Hum Decis Process 118:226–238

Tversky A, Kahneman D (1992) Advances in prospect theory: cumulative representation of uncertainty. Risk Uncertainty 5:297–323

Exploration of the Appointed Guardianship System of the Civil Code

Shihan Zhong

Abstract The appointed guardianship system in Article 33 of the Civil Code of the People's Republic of China has achieved a breakthrough in the system of guardianship in China. Unlike legal guardianship, which is directly regulated by law, appointed guardianship is unique in that it is freely negotiated by the parties and places more emphasis on the ward's own wishes, thus helping to protect the ward's legal rights and interests more comprehensively. In the context of China's aging society, the appointed guardianship system has a realistic urgency, but China is still in the early stage of exploration, the Civil Code only set the basic rules on appointed guardianship, its normative meaning still needs to be clarified, and a series of specific supporting rules need to be improved. Under this circumstance, it is of great theoretical and practical significance for the sustainable development of China's aging society to learn from the appointed guardianship systems of foreign countries, summarize the existing achievements on the appointed guardianship of adults in China, analyze the factors affecting the operation of the appointed guardianship system, and discuss the existing deficiencies in the scope of the selection of guardians, the difficulties in defining the elements of validity, the lack of registration procedures, the unitary guardianship measures, and the lack of supervision mechanisms.

Keywords Appointed guardianship · Autonomy of the ward's intention · Subjective qualification of guardian · Supervision mechanism

1 Introduction

Article 2 of the Civil Code of the People's Republic of China (hereinafter referred to as the "Civil Code") interchanges the position of personal relations and property relations on the basis of Article 2 of the General Principles of the Civil Law. Although there is no substantial change in the normative meaning, this detailed change confirms

S. Zhong (✉)
Hangzhou Normal University Qianjiang College, Hangzhou 310018, China
e-mail: zsh422127@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_44

that our legislators are paying more and more attention to the protection of citizens' personal rights. In modern society, where the phenomenon of aging is becoming more and more serious, the adult guardianship system is an extremely important part of the protection of the personal rights of citizens. China's adult guardianship system has undergone several legislative reforms, gradually shifting from the initial focus on the protection of property rights to personal rights, and finally creating an appointed guardianship system that focuses on the protection of the rights holder's right to make free decisions and choices.

Article 26 of 2015 Law of the People's Republic of China on the Protection of the Rights and Interests of the Elderly introduced the concept of appointed guardianship for the first time and clearly stipulated the relevant content regarding appointed guardianship with the elderly as the main body. The 2017 General Principles of the Civil Law of the People's Republic of China formally established the appointed guardianship system, requiring an agreement in writing and expanding the range of subject eligibility from the elderly to all adults, so that all subjects with the possibility of being a ward are included in the range, which is a major breakthrough in adult guardianship. Since then, Article 33 of the Civil Code, which is now in force, further stipulates that an adult with full civil capacity may, by prior consultation with his or her close relatives or other individuals or organizations willing to act as guardian, determine in writing his or her own guardian who will perform the guardianship duties in the event of his or her loss or partial loss of civil. This article reflects the affirmation and support of the appointed guardianship system in this civil code, which is rooted in people's lives and protects their most fundamental interests, and reflects the current situation that our citizens have an urgent need for the appointed guardianship system, which is a major impetus to promote the standardization of our legal provisions.

However, while guaranteeing that civil subjects can voluntarily and independently establish appointed guardianship, the rules of the Civil Code regarding appointed guardianship are not very clear, and it is easy to interpret them to find that there are still many specific issues that are not provided for, and there is still a lot of work to be done at the regulatory level. The lack of treatment of these issues will largely affect the application of the appointed guardianship system in practice. Based on this, this paper will analyze in depth the aspects of China's appointed guardianship system that need to be improved at the normative level based on a comparative observation of the relevant systems in foreign countries, and analyze the possible legal application difficulties arising from the practice of appointed guardianship for the reference of the academic and practical circles.

2 The Practical Necessity of the Appointed Guardianship System in China

2.1 A Rapidly Aging Population

The rapid socio-economic development of China has been accompanied by an increasingly serious phenomenon of population aging. Since China entered the aging society in 1999, the proportion of the elderly population has been expanding. The age structure of our population has shifted from growth to near-decline, with significant structural changes, a sharp decline in the number of infants and young children, and an insufficient number of young adults to support the increase in the number of elderly. It took only about 22 years for China to make the transition to an aging society, much faster than France and Sweden, which were the first to enter an aging society and took 115 years and 85 years respectively to make the transition to an aging society (China Development Foundation 2020).

On December 28, 2021, at the high-end seminar on "Implementing the National Strategy of Actively Coping with Population Aging" and the launch of the "Research Report on the Strategy of Actively Coping with Population Aging 2021", the report pointed out that according to the data of the seventh population census in China, the aging of China's population can be summarized into five major characteristics. First, the degree continues to increase, the trend of advanced aging is obvious; second, the speed is obviously accelerated; third, the urban–rural differences expand; fourth, regional differences increase; fifth, the degree of aging and the level of economic development appears a certain degree of deviation. On January 17, 2022, at the Caixin Summit, former Minister of Industry and Information Technology Miao Wei predicted that by 2035, China's population over 60 years old is expected to reach 400 million people, accounting for about 28% of the total population at that time.

Behind the increasing aging of society, there is a growing group of unattended elderly. As family planning became China's basic state policy in 1982, many families have only one child. The only child may die in an emergency in the process of growing up, and the cost of raising a child again is high and the body does not allow it, so the number of elderly people who lose their only child will increase sharply in the future. There are also some families whose children are constantly working in today's highly competitive society and have little time for themselves, so they not only lack the time to care for their parents, but also have no time to go home often. These parents' social circles are narrow and closed, and their legal guardians have no time to take care of them, so the phenomenon of empty nesters and elderly people left behind has become more and more prominent. In addition, there are many celibatarians and Dinks in the process of social development and change, and it is very likely that they lack guardians who can take care of them when they grow old.

The improvement and development of the guardianship system has become the inevitable trend of the times, the traditional legal guardianship system of civil law has been strongly impacted by the reality, and the appointed guardianship system is the one that can reflect the freedom of the ward's will to the greatest extent among

adult guardianship systems. With the gradual aging, the potential for people to enter into an intentional guardianship agreement will increase day by day. It is urgent to improve China's old-age security system and build a relatively mature legal system of intentional guardianship as soon as possible.

2.2 Disease Risks Associated with Increased Average Life Expectancy

While the aging phenomenon is serious, medical technology still continues to develop. July 13, 2021, the National Health and Wellness Commission released the "2020 China's Health and Health Development Statistics Bulletin", the Bulletin shows that China is vigorously promoting the construction of geriatric health services and the integration of medical care, as of the end of 2020, the country has six national clinical medical research centers for geriatric diseases; with geriatric medicine departments of 2642 comprehensive hospitals of second level and above. The "Health China 2030" plan issued by the Central Committee of the Communist Party of China and the State Council also points out that life expectancy in China will reach 79.0 years by 2030. All these figures indicate that the country is trying to promote the use of advanced medical technology for the elderly, and that the life expectancy in China has been generally extended, and that advanced aging will become an important feature of China's aging population.

In the future, the age structure of the elderly population will gradually highlight the phenomenon of "advanced age", and most of the elderly are living with diseases. Along with the gradual decline of memory and intelligence, Parkinson's disease, Alzheimer's disease and a series of other common diseases of the elderly, there will be many elderly people with disabilities and dementia, at the same time, the children of the elderly are also getting older, the burden is heavier, and the care of their parents will become incompetent, and there may even be the situation of offspring died before its eldership. Therefore, appointing a guardian of choice to take care of the elderly is the most reassuring way to ensure that the elderly can be comfortably supervised and that their children can take care of their parents.

2.3 Guardianship Options for Non-elderly Groups

Before the establishment of the appointed guardianship system in China, non-elderly adults with disabilities and dementia could only choose from four guardianship models: legal guardianship, appointed guardianship, agreed guardianship, and testamentary guardianship. Legal guardianship is to determine the guardian based on the conditions and procedures stipulated by law; appointed guardianship is to be appointed by the guardianship authority when there is a dispute between people

who are legally qualified to act as guardians; agreed guardianship is to determine the guardian by negotiation between people who are legally qualified to act as guardians; and testamentary guardianship is to appoint a guardian through the will of the parents of the ward. The common feature of all four is that the guardian can only passively accept the guardianship and cannot choose the guardian according to the guardian's idea, which cannot fully reflect the guardian's true will.

The intended guardian is a way to determine the guardian, the guardian is chosen by the adult when he or she has full civil capacity, and the guardian is chosen solely on the basis of the ward's own will, which is decisive, at the same time, both parties are free to agree on the scope of custody. Compared with the other four guardianship models, the appointed guardianship has priority and the guardianship options for non-elderly groups are more diverse and closer to the real needs of the group.

The system also effectively safeguards the legal rights and interests of a few special groups whose sexual orientation is same-sex. Same-sex couples are not legally recognized in China, they cannot legally marry, they cannot enjoy the same rights and obligations that come with marriage, and their unions lack legal protection. In the event of a partner's betrayal, without the strong protection of marriage law, the violated person cannot effectively defend his or her rights through legal weapons. When these LGBT people without children grow old, people have no obligation to support those who are unable to have children, and the phenomenon of old age without support is likely to happen to them frequently. For them, the appointed guardianship system is by far the most reasonable system to protect their personal rights and interests when they lose or partially lose their civil capacity, and is the best provision. Our people are not very receptive to the existence of homosexuality due to traditional concepts, and our laws do not have clear legal provisions to protect the rights and interests of same-sex couples, but such groups exist objectively, and in the absence of legislative protection for same-sex marriage, in specific situations with realistic urgency, appointed guardianship can play its unique advantage to a certain extent. Signing an appointed guardianship agreement to mutually protect the personal and property rights of same-sex couples, and agreeing to have the right to sign the partner's medical signature, care for the partner's life, and take care of the partner's property in the event of one partner's disability or dementia, is the most secure security this group has had in a long time.

3 Appointed Guardianship in Comparative Law Perspective

The guardianship system is derived from the Law of the Twelve Bronze Tables of early Roman society, it is one of the oldest legal systems in human society. It established the system of "guardianship and conservatorship" for adults, making it a legal remedy in the form of statutory law to protect the rights and interests of adults with physical and mental disabilities. The subsequent revival movement in

Italy in the eleventh century led to the acceptance and transmission of the Roman law of guardianship and its concept of "legislation for the person" to most codified countries, laying the foundation for the guardianship systems of later generations. The concept of "legislation for people" emphasizes that people are the core point of attention in the design of the legislative system and specific legal systems, and that all laws are created around people as subjects, and that the essence of people is to defend their own interests and demand freedom of will. It also emphasizes the need to take care of special groups of people and the interests of those who are less capable (An-Ling 2019). Although this is a legal remedy, the guardian is not chosen by the ward of his or her own volition, and therefore is to some extent flawed and may be at risk of improper guardianship.

With the rise of the human rights movement in the world today, people's awareness of the protection of personal rights has gradually increased, by extension, in the area of appointed guardianship, countries preferred to protect property rights and interests in the old days, and the protection of citizens' personal rights and interests took a secondary place. With the development of modern technology, the rapid dissemination of information network and the improvement of people's comprehensive quality, the concept of protection of personal rights has been further enhanced, and people are more willing to pay attention to whether the inviolability of personal rights and interests is effectively guaranteed.

The types of appointed guardianship systems in place vary from country to country around the world, The United States was the first country to establish this system, and in the 1950s the state of Virginia pioneered the system of continuing agency system (DPA), which was created to circumvent the shortcomings of the legal guardianship system (SeeLindaS). People may choose a trusted natural person or organization to act as his or her agent in the future when he or she loses the ability to think and judge, for financial or health care matters, while he or she is still able to think and act, and this agency is valid continuously or permanently. After the DPA system has been implemented in the United States for several years, its shortcomings have become increasingly apparent. The system lacks a safety defense mechanism to prevent abuse of the agent's authority. Unlike the usual arbitrary agency, in continuing agency, it is impossible or difficult to personally supervise the agent due to the gradual decline of his or her capacity to mean, and therefore, the supervisory function should be compensated for in the DPA legal system, but the DPA lacks this procedure (Xia 2011).

Germany established a system of preventive representation based on the U.S. system of continuing representation, which gives priority to respecting the true intentions of the person under care by appointing a suitable caregiver for the adult according to his or her specific situation, and later added provisions in the areas of medical care and residence. The German Care Act, which came into force in 1992, abolished the traditional system of declaration of confinement and the guardianship and conservatorship of adults and replaced it with a system of "care". A caregiver is established by the guardianship court upon application or appointed ex officio, and the establishment of a caregiver does not render the person under care incapacitated or limited in capacity. The capacity of the cared-for person is not ipso facto lost or

limited by the choice of the caregiver, and the cared-for person can still act legally according to his or her own will (Jinxia 2012).

After the revision of the French Civil Code in 1968, France broke through the flaws of the original Roman law "guardianship and conservatorship" legal remedy system and established a new "judicial assistance + guardianship + conservatorship" model, in which the legislature stipulated that the court judge must determine which of the "judicial assistance", "conservatorship" and "guardianship" protection measures should be taken by the guardian according to the specific degree of the client's disability and dementia, giving the ward the right to make his or her own decisions. Access to justice is a temporary measure of protection that applies to two main categories of people: adults who need temporary protection or adults who need assisted representation for certain specific legal acts. The opening of such protection measures does not affect the integrity of the protected person's capacity to act. Conservatorship can only be applied when the protection of the ward is not satisfied by judicial assistance. With this model of guardianship, the surety cannot act in the place of the ward, but only provides the necessary assistance to the latter, and the free will of the ward is respected to a greater extent. There is room for applying guardianship only when neither access to justice nor conservatorship is sufficient to provide the necessary protection for the adult (Bei 2019). In 2007, the French Civil Code amended the guardianship system for adults, establishing a "future guardianship agreement" based on the existing "judicial assistance + guardianship + conservatorship", whereby the guardian and the ward negotiate the content of their future guardianship.

After studying the existing guardianship systems in other countries, Japan revised its domestic guardianship system in 1999 and formally established the arbitrary guardianship system, and the arbitrary guardianship law came into effect in 2000. The law clearly stipulates that the content of the contract of arbitrary guardianship shall be freely agreed upon by the parties. Among the legal acts that are the subject of arbitrary guardianship are not only property management matters, but also a fairly wide range of personal guardianship matters (medical contracts, contracts related to residence, contracts for access to welfare facilities, personal care contracts, education contracts, etc.) (Guoqi 2004). In the case of a contract of arbitrary guardianship, a notarial certificate made by a notary public is required in order to guarantee a legal and valid contract (Yongnan 2012). The public authorities are required to exercise public supervision over arbitrary acts of representation performed by the guardian after the agreement has entered into force.

In the past few decades, foreign countries such as the United States, Germany, France, the United Kingdom and Japan have carried out different degrees of legislative reforms to adapt to their national conditions, so that the legal system of intentional guardianship has gradually matured. Different countries and regions have presented different specific systems according to their national conditions, but all have the same approach, no matter which model is chosen, the essence is the same, they all respect the true will of the ward to the greatest extent, the original intention is to better serve the human rights, to protect the rights of the ward, for China's appointed guardianship mechanism are rich reference value.

4 Existing Problems of the Appointed Guardianship System and the Path to Improvement

4.1 Roughness of the Selection Criteria of the Guardian Subject

Natural Guardian. Appointed guardianship unlike other general agreements, the parties to such agreements are special subjects who are in a vulnerable position as they are already mentally disabled persons in need of guardianship after the agreement becomes effective. The choice of a suitable guardian is the prerequisite for protecting the rights and interests of this type of warded group, so it is reasonable to clarify the scope of suitable subjects for guardianship at the legal level, but the Civil Code only stipulates that such guardians must be adults with full civil capacity and the ward is willing to have them as guardians, and does not restrict the rest of the conditions at all. The scope of application of the principal qualification is not detailed enough, and the qualification restriction is not clear enough to affect the normal performance of the appointed guardianship contract obligations, and the existing legal provisions only confirm the positive conditions of guardianship without regulating the negative conditions, which is not conducive to protecting the legitimate rights and interests of the vulnerable groups under guardianship.

In the author's opinion, on the basis of positive confirmation of the qualification of the guardianship subject should also regulate certain negative conditions, such as alcohol and drug addicts, defaulted executors, people with criminal records, people with lack of financial capacity, etc. should be excluded from the scope of the appointed guardianship, in order to reduce the insecurity of the person and property of the ward in the process of contract performance. It is suggested that the judicial interpretation of the Supreme Court can be subdivided at the negative level by giving examples to further limit the normative scope of the elective subject, to prevent legal risks, and to maximize the protection of the legitimate rights of the appointed guardianship wards of such disabled and mentally disabled groups.

Social Guardianship Institutions. The current situation of aging, fewer children and rapid population mobility has led to a decrease in the number of traditional guardians centered on relatives, and more guardians are looking for natural persons or social groups other than relatives to act as their guardians, which means that the appointed guardianship system, called "life trust", has a very broad business prospect. Social guardianship groups belong to the mimetic sense of human beings, which well avoid the instability caused by the birth, old age, sickness and death of natural guardians, and play an indelible role in solving the increasingly serious elderly problem in China. The early socialization of guardianship can effectively solve the social problem of the lack of intended guardians and is the current trend. However, due to the rapid aging process in China, the existing social guardianship force is not adequately equipped, so the formation of a specialized agency that can carry out social guardianship is a matter of urgency. The state can provide policy subsidies and

facility support to social institutions willing to enter the guardianship industry at this stage by formulating related policies, and social guardianship institutions meeting the criteria should be qualified to become qualified subjects of appointed guardianship, which is also conducive to making up for the shortage of intended guardians as early as possible and promoting the vigorous development of China's elderly industry.

As a professional organization in the social guardianship industry, the creation of a complete and efficient operation and supervision dual-track model is the core factor to ensure its long-term guardianship stability, so it is necessary to establish a unified social guardianship agency qualification threshold. Agencies that have not obtained the relevant guardianship qualification are not suitable to act as guardianship subjects, and social guardianship personnel in the agency have not received systematic training, are not clear about the terms of reference of guardianship, and may have a lack of professionalism. At the same time, because the scope of practice involves the legitimate rights and interests of the disabled and demented groups in terms of personal and property, these professional organizations should be strictly controlled at the regulatory level, and it is recommended that they be supervised by departments with strong credibility, such as the civil affairs department and notary public, so that the public can feel more at ease.

4.2 Ambiguity in the Definition of the Effective Elements

According to the relevant legislation on the appointed guardianship system in foreign countries, the entry into force of the appointed guardianship agreement can be divided into three forms: transfer type, immediate type and future type. The relevant provisions of Article 33 of the Civil Code of China indicate that the type of entry into force of the appointed guardianship contract in China belongs to the future type, where the validity and entry into force of the contract are separated, and the appointed guardianship agreement signed by the parties is a conditional contract, the elements of which depend on the state of the principal's capacity to act. Only when the principal is incapacitated or partially incapacitated, the principal can apply for an appraisal. When the effective element is externalized into a manifestation, the boundary is blurred and it is usually difficult for the principal to clearly determine whether the principal meets the criteria for the contract to take effect. The period between the application and the effective date of the agreement is a blind spot, at this time the need for guardianship of the principal should be temporarily under the care of the legal guardian.

In practice, in order to facilitate the operation, the experience of pioneering countries such as Germany and France can be drawn upon to establish a directory of hospitals and physicians qualified to conduct capacity appraisals as determined by the competent authorities to ensure the authority of the appraisal documents (Jinxia 2018). China's identification of the client's ability to act and the degree of institutions suggested that one of the hospital institutions and forensic institutions qualified to identify the ability to act can be selected to establish a unified national standard for the determination of the ability to act, the determination of professional doctors or

professionals to issue identification documents. There may also be cases of special procedures to declare the client as a person with no or limited civil capacity directly to the court by the entrusted person, but the institution ultimately entrusted by the court to identify the capacity should still be a recognized medical institution or forensic institution to ensure the fairness of the unified standard.

4.3 Lack of Procedural Element Guarantees

China's appointed guardianship system does not specify the registration procedures for the validity and entry into force of the contract, which are currently general provisions in principle, and no rules have been introduced, and the contracts entered into by the parties privately are generally hastier, which in the long run will lead to a series of disputes about whether the agreement is established and valid, and when it takes effect. In judicial practice, it is difficult to determine whether the contract is valid and effective, and the personal and property rights and interests of the ward who has lost the ability to identify are also easily put in danger, while strengthening the credibility of the agreement through registration can effectively help avoid similar disputes.

Most countries around the world have established registration authorities for appointed guardianship agreements. Japan requires parties to register with a designated legal office or local legal office; the United Kingdom requires registration with a special public guardianship office; France does not require mandatory registration, but most parties still prefer to register with a notary; and Germany encourages appointed guardianship clients to register with a notary, with a high rate of registration at the Federal Notary Association registration center. Although the specific registration bodies vary from country to country, their role is to guarantee the effective conclusion of the agreement and to urge guardians to perform their duties diligently in accordance with the law so that the rights holders can enjoy their due rights without fear.

In December 2017, the Ministry of Justice issued the first guiding case on "Notarization of Appointed guardianship Agreements for the Elderly", which clarified the key points of notary authorities in handling notarization of appointed guardianship for the elderly, standardized the subject of application for notarization of appointed guardianship for the elderly, the content of notarization review, the specific procedures of notarization, as well as the main content of intentional guardianship agreements and the confidentiality obligations of notaries, and regulated the handling of notarization of intentional guardianship cases (Anjie 2017). Later, the Ministry of Justice issued a notice on May 28, 2021, "Opinions on Optimizing Notary Services to Better Benefit Enterprises and the People," which mentions in the section on balanced allocation of service resources that "actively explore the development of notarization of intentional guardianship agreements, and notary institutions shall not disclose the contents of the agreement to a third party other than the parties to the agreement." The implementation of these measures, which have led to a closer connection between

notary and guardianship, confirms the general direction of the national policy. In order to effectively protect the rights and interests of these adults with disabilities, notaries should be involved throughout the process of concluding and validating the appointed guardianship agreement. We hope that the notary registration system will be established at the legislative level as soon as possible.

4.4 Lack of Clarity in the Content of Guardianship Duties

Articles 34 and 35 of China's Civil Code generalize the duties and powers of the guardian, requiring the guardian to protect the personal and property rights and other lawful rights and interests of the ward in accordance with the law, and shall perform the guardianship duties in accordance with the principle of what is most beneficial to the ward, and shall not dispose of the ward's property except for the purpose of safeguarding the ward's interests.

Although these legal provisions impose restrictions on guardianship, they are too broad and not very specific. The contract of appointed guardianship is essentially a contract of attorney with conditions of validity, the principal can grant the attorney's right of agency, and the content of the contract is also formed by the joint agreement of the principal and the attorney, which can agree on all matters of guardianship or only some matters, depending on the true will of the parties, and in principle it is not appropriate to interfere too much. However, the appointed guardianship contract is different from the general entrustment contract, in which the principal is not a person of full civil capacity when the contract takes effect, and the unclear responsibility of guardianship in practice causes damage to others or to oneself, which often leads to disputes over tort compensation. It is recommended that the relevant judicial interpretation requires the appointed guardianship contract to clearly and specifically list the specific duties of the guardian, the consequences of infringement or breach of contract, and the matters responsible for assisting in handling. These include the types of guardianship matters, the degree of guardianship (agency, assistance), the rights and obligations of the guardian, the appointed guardianship contract and the conditions for release of guardianship, etc. (Yingjia 2021). Since the negotiated guardianship agreement can include not only property rights but also personal rights, mandatory provisions should be made for certain specific matters to avoid disputes that may arise between the parties in the future, such as voting in elections, medical decisions, organ donation, marriage registration, adoption and other rights with significant personal matters should be required to be notarized by both parties separately for special authorization.

Except for the specific guardianship matters agreed in the appointed guardianship contract, all other matters should be handled with the assistance of the ward according to the ward's remaining capacity to express his or her intention, respecting the ward's current wishes to the greatest extent possible and giving full play to his or her right to make independent decisions.

4.5 The Lack of Monitoring Mechanism

The appointed guardianship system has become an important legal protection for the legal rights and interests of the disabled and demented group, but the supporting supervision system is still in a blank state, which will certainly lead to problems such as abuse of power or negative performance of guardians.

When the contract signed between the two parties of the appointed guardianship comes into effect, the principal is already in a special situation of disability and dementia, if the entrusted person is not strictly supervised, the rights and interests of the principal will not be effectively protected to a great extent, and the status of the two parties is not equal, when the guardianship infringement phenomenon occurs, the consequences are unimaginable, so it is necessary to accelerate the improvement of the appointed guardianship supervision system.

From the very beginning, the UK's continuing agency system introduced a mechanism of public intervention and supervision, requiring that the contract for the grant of continuing agency be registered by the Court of Protection and approved by a decision of the Court of Protection before it can become effective, (Wang 2016) and that the court needs to continuously monitor the exercise of continuing agency at a later date. In Japan, a dual supervision mechanism of private supervision by the intended guardian and public supervision by the family court has been established, stipulating that the appointed guardianship contract can only be effective if the family court chooses an arbitrary guardian, and that both the intended guardian and the intended guardian supervisor are subject to the supervision of the family court (Yukinori 2003). In addition to these two common supervision models, the U.S. has a purely private sector supervision system without the intervention of public authority, but as a result, the problem of guardianship infringement has emerged, and the possibility of protection of legitimate rights and interests has been weakened, and the situation is more serious, which deserves our consideration.

Combined with our current national situation, the intervention of public power in the guardianship prevention mechanism of appointed guardianship is essential. However, it would be unwise to rely solely on public power. China's current judicial and law enforcement resources are more limited, investing a lot of time and energy in guardianship supervision will consume the already inadequate social resources, so I believe that the Japanese supervision model is worthy of reference, which can combine private supervision with public power supervision, and the appointed guardianship supervision measures can be jointly implemented by the supervisor and the supervising government department, forming a private supervisor-based, public power agency-supported This will form a monitoring mechanism with private supervisors as the main body and public authorities as the secondary body, effectively saving public costs.

In terms of private supervision, the supervisor is freely chosen by the ward as an appropriate subject, and can be the closest living mass self-governance organizations such as residents' committees and villagers' committees, as well as trusted close relatives and close friends, which gives the ward ample opportunity for meaningful

autonomy, and the guardian is required to report the ward's recent status to the supervisor on a regular basis. In terms of public supervision, many countries tend to choose the courts as a judicial organ to act, but after the reform of the system in our courts, there are fewer people and more cases, and judges do not have much time to allocate, so the efficacy of supervision of appointed guardianship will be greatly reduced. The civil affairs department, as a permanent state administrative agency in charge of social administrative affairs, its own credibility is beyond doubt, and its own work is closely related to the people's lives, to protect the basic livelihood of the people, staff need to be in frequent contact with the people, so it is easy to understand the situation of the parties to the appointed guardianship agreement, which largely helps the supervision work. The author believes that the civil affairs department is the appropriate public supervisory body in China, in the supervision of the link has the ability to do a good job of prevention, can properly protect the legitimate rights and interests of the ward.

5 Conclusion

Appointed guardianship is a brand new system in China, it has not been developed for ten years since it was first introduced in 2015. It was established and applied primarily to meet the guardianship needs of the growing elderly population, the LGBT community, and children with intellectual or mental disabilities who are the only remaining children of deceased parents, etc. Based on the adult guardianship system, appointed guardianship also focuses more on the ward's right to self-determination.

According to the data released by the National Bureau of Statistics, China Health Care Research Institute predicts that China will officially enter the platform period of high growth of aging population from 2022 onwards. China is facing a huge pressure to cope with the aging population, but at the same time, as a new industry, the health and elderly care industry will really usher in a golden period of development. The social transformation cannot be separated from the legal transformation, China's Civil Code, which came into force in 2021, only provides for the principle of appointed guardianship, and currently lacks supporting specific implementation rules, which needs to be improved. The increasingly serious aging society requires us to pay more attention to the existing shortcomings of China's appointed guardianship system, to combine the experience of overseas legislation on appointed guardianship with local conditions, to reform the many legal problems exposed in judicial practice to meet the needs of society, to achieve full respect for the surviving consciousness of the ward, and to build an effective appointed guardianship system. The value of appointed guardianship is in line with the international concept of human rights protection and the trend of codification of civil law, which promotes interpersonal harmony and contributes to the sustainable development of society.

References

An-Ling F (2019) Autonomous guardianship of adults in China's civil code: concepts and rules. Chin Jurisprud (4)
Anjie J (2017) A vivid case is better than a pile of documents—Ministry of Justice releases three guiding cases of notary public for the first time. Legal Daily (12)
Bei L (2019) Inadequacy and improvement of the guardianship system under the uniform rule model—a review based on the General Principles of Civil Law. Legal Sci (2)
China Development Foundation. China Development Report 2020: Trends and Policies on Population Aging in China, 2020-06-11
Guoqi L (2004) Comparative study on the guardianship system of adults in China and Japan. Jilin University
Jinxia L (2012) The significance of adult guardianship reform in Germany and Japan. J China Youth Polit Acad 31(05):119–124
Jinxia L (2018) Several issues in the implementation of appointed guardianship for the elderly in China. Beijing Soc Sci (10)
SeeLindaS. Whitt: on Durable Powersasarl Alternative to Guardianship: Lessons We Have Learned, 37TetsonL. Rev.
Wang W-L (2016) A comparison of supervision models in the British and American continuing agency system. Shandong Soc Sci (1)
Xia L (2011) Outline of the intentional guardianship system. Jurisprudence (4)
Yingjia L (2021) Study on the adult intentional guardianship system in the perspective of civil code. J Guangdong Open Univ (3):56
Yongnan F (2012) Study on the Japanese adult guardianship system. Jilin University
Yukinori U [Japan] (2003) A brief discussion of the revision of the Japanese adult guardianship system. In: Tao D (ed) Studies on civil and commercial law in China and Japan, vol I. Law Press, Beijing

Exploring the Influence of Social Pension Insurance on the Elderly's Subjective Well-Being

Xiao Yongqi

Abstract The aging population is a growing problem in China, and the subjective well-being (SWB) of the elderly has attracted much attention. Social pension insurance is one of the important sources of the elderly's income. This paper focuses on its influence on the elderly's subjective well-being from Maslow's hierarchy theory of needs. By classifying and summarizing the existing literature, this paper explores the impact of the implementation of pension insurance in different regions in urban and rural areas on the SWB of the elderly, and its influence on the physical and mental health of the elderly. It is found that pension insurance has different influences on the SWB of the elderly under different situations, but the influence is generally significant.

Keywords Social pension insurance · The elderly · Subjective well-being · Maslow's hierarchy theory of needs

1 Introduction

Population aging is a common problem faced by the world in the twenty-first century. Presently, China has become an aging society. From the survey on the age structure in the Seventh National Population Census in 2020, it can be seen that the proportion of people over 60 years old in China has increased 5.44% compared with 2010, reflecting the worse situation of population aging. China ranks first in the world in terms of both the growth rate and the number of the elderly. The population over 60 has reached 260 million. This serious aging problem has brought great challenges to China's pension system. At the same time, due to the increasing proportion of the elderly, problems caused by this group have become hot social issues, and the subjective well-being of the elderly has gradually become widely discussed among scholars.

X. Yongqi (✉)
Nanjing Institute of Technology, Nanjing, Jiangsu, China
e-mail: 2309529822@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_45

There has been sufficient existing research related to social pension insurance in China. Zhang et al. have evaluated the effect of the new-type social pension insurance policy for rural areas and came to the conclusion that this policy has a significant impact on the rural elderly (Chuanchuan et al. 2014). Zheng and Sun studied and reflected on the current situation of urban workers' basic pension insurance, then put forward suggestions for future development (Bingwen and Yongyong 2012). After the new-type social pension insurance system and urban workers' basic pension insurance were combined into the unified basic pension insurance system for urban and rural residents, Deng and Xian put forward the problems and countermeasures facing its implementation (Dasong and Mihua 2015). Jia et al. summarized the literature and materials about China's pension insurance system in the recent decade and put forward the prospect of its development trend (Zhike et al. 2021). However, the subjective well-being of the elderly receives the attention of scholars much later, and there is little research on it. The research that combines the two together as the object is even more lacking.

2 Methods

The hierarchical Theory of Needs was proposed by Maslow in 1943. The specific content of hierarchical Theory is divided into 5 levels, physiological needs are kind of low-level needs, such as food, water, air, sleep, sex, etc., which are the most important and powerful among human needs; safety needs refers to low-level needs, such as stability, safety, order, freedom from fear and anxiety, etc.; belongingness and love need refers to the one requesting emotional connection or relationship with another person; esteem needs means Esteem and hopes to be respected by others; self-actualization needs refers to the pursuit of realizing one's ability or potential and making it perfect. This paper studies the subjective well-being of the elderly on the basis of Maslow's hierarchy theory of needs and establishes a relationship with social pension insurance. This paper combines social pension insurance with the subjective well-being of the elderly. Targeting six papers from CNKI and Springer Link between 2010 and 2021, it discusses the impact of social pension insurance as an objective factor on the subjective well-being of the elderly.

3 The Influence of Social Pension Insurance on the Elderly's Subjective Well-Being

3.1 The Influence of Urban and Rural Social Pension Insurance on the Subjective Well-Being of the Elderly

In the Hierarchical Theory of Needs, this section will discuss physiological needs and safety needs. Social pension insurance is divided into social pension insurance for urban and rural residents and pension insurance for urban employees. The insured objects of basic pension insurance for urban employees are various urban enterprises and their employees, individual-owned business, and flexible employment, and most of the beneficiaries are the elderly in urban areas. The pension is calculated based on factors such as years of payment, the basic amount, and local average salary. The payment amount is high, but the treatment is better. The social pension insurance for urban and rural residents targets people who do not have the insurance for urban employees, and the elderly in rural areas account for a large proportion of them. This system calculates benefits based on the total payment and state subsidies. The payment amount is low, but the treatment is worse than the former. The most direct benefit of social pension insurance to the elderly is the economic subsidy. The impact of income level and economic conditions on the subjective well-being of the elderly is also a hot discussion topic among scholars. Taking Zhengzhou City as an example, Li believed that the pension of social pension insurance for urban and rural residents is too little and has a huge gap between pension insurance for urban employees (Wei 2011). Sang and Hu also believed that the difference between urban and rural areas will lead to an increasing gap in pension insurance benefits (Zhenzhen and Yingying 2021). According to the research of Min rural areas, and the economic benefits brought by pension insurance can lead to higher happiness in the elderly (Peng and Changcheng 2014). Social pension insurance is still not popularized in a few remote areas. The education level of the elderly in rural areas is less developed, and they have an insufficient understanding of pension insurance. Under economic and cultural constraints, the elderly in rural areas enjoy fewer benefits of social pension insurance than those in urban areas. There is great potential in improving their subjective well-being. The improvement of the pension insurance system can draw more attention to the elderly in rural areas.

3.2 The Influence of Social Pension Insurance on the Subjective Well-Being of the Elderly in Regions of Different Economic Conditions

This section is also studied on the basis of physiological needs and safety needs in the Hierarchical Theory of Needs. The economic distribution in China can be

divided into eastern, central, and western areas. The level of economic development directly affects the effect of the implementation of social pension insurance in various regions. Different economic conditions will lead to different government expenditure on social pension insurance. Although it is regulated that the financial assistance of the central government for eastern areas is 50% and for middle and western areas is 100%, it is far from sufficient for the huge economic gap between regions. Sang and Hu believed that the pension insurance system in many remote areas of China is not perfect, and the distribution among social groups is unfair (Zhenzhen and Yingying 2021). Wang's research showed that the implementation of the new-type rural social pension insurance significantly increased the self-assessed life satisfaction of the benefited elderly in the central and eastern regions, and also significantly reduced depression of the elderly in the central and western regions. However, in the western region, it did not have a significant impact on the self-assessed life satisfaction and depression index of the elderly. The reason for this phenomenon is the economic gap between regions (Zhen and Tianqi 2021). Scholars have found that the economic gap between regions has a significant impact on the subjective well-being of the elderly. Although there are regulations that clearly indicate that the financial subsidies in less developed regions should be greater than that in economically developed regions, the financial ability of each region restricts the implementation of the local social pension insurance system. The elderly in economically underdeveloped areas receive low pensions due to themselves and the region, and their subjective well-being is also insufficient. Based on the current economic background, the establishment of the social pension insurance system must conform to the social background and the needs of different regions without exceeding the state's ability to pay, and its content should be flexibly adjusted according to different needs. Only by implementing a social pension insurance system that adapts to local conditions, can it better improve the subjective well-being of the elderly.

3.3 The Influence of Social Pension Insurance on the Physical and Mental Health of the Elderly

This paragraph will relate to belongingness and love need and esteem needs in the Hierarchical Theory of needs. Pension is the main source of income for the elderly, and the economic level affects many aspects of the old people's life, such as physical and mental health. The self-health assessment can best reflect the physical and mental health of the elderly. Chen and Zhang found in their research that based on the self-health assessment, the welfare brought by social pension can significantly improve the subjective well-being of the elderly (Dong and Yuyang 2015). This conclusion is consistent with the hypothesis confirmed by Xu and Zhou that elderly people who have better self-health assessment results will have higher subjective well-being (Peng and Changcheng 2014). Through research, Zhao et al. found that negative emotions have a worse impact on subjective well-being (Ke et al. 2014). Zhang et al.

conducted a survey on the elderly in Changchun City, and the results showed that the elderly with high subjective well-being only accounted for 55.0%, those with a middle level of SWB accounted for 43.8%, and those with low SWB accounted for 1.2%. The elderly in the community with medium and low levels of subjective well-being account for nearly a half. Anxiety and worry about their own physical health and various factors are important reasons for the decrease in subjective well-being (Xiumin et al. 2017). This conclusion only targets the elderly in the community. Those living in rural areas have low living standards and are more likely to have negative emotions and worse physical health than the elderly in urban areas. The subjective well-being of this group will be affected more significantly. Although physical and mental health is an aspect that indirectly affects the subjective well-being of the elderly, it can reflect the thoughts and health conditions of the elderly. Physical and mental health directly restricts the life of the elderly. The social pension insurance system could expand its content by learning from and connecting with the content about the elderly in medical insurance.

4 Conclusion

This paper analyzes the influence of social pension insurance on the subjective elderly's well-being from Maslow's hierarchy theory of needs. Through the classification and summary of existing literature, this paper studies the impact of social pension insurance on the subjective well-being of the elderly from three aspects, and draws the following conclusions. First, the impact of social pension insurance on the subjective well-being of the elderly in rural areas is stronger than those in urban areas, due to the poor economic conditions of the rural elderly and different types of social pension insurance. Second, different economic conditions in eastern, middle, and western regions lead to different levels of social pension insurance. Social pension insurance has a stronger impact on the subjective well-being of the elderly in economically less developed areas. Third, the implementation effect of the social pension insurance system will affect the physical and mental health of the elderly, which directly and significantly affects their subjective well-being. Specifically, social pension insurance has different degrees of influence on the subjective well-being of the elderly in different situations. The elderly will measure the importance of social pension insurance according to their own circumstances, but due to population aging and the unbalanced economic development in China, social pension insurance will have a significant impact on the subjective well-being of the elderly.

Regarding social pension insurance and the subjective well-being of the elderly, the author believes that future research can develop into two directions. First, this issue could be further researched in-depth. Refining all variables involved will make their relationship more complicated but the results will be more obvious. Second, this issue can be expanded. For example, many other factors affect the subjective well-being of the elderly, and whether these factors are related to social pension insurance is also a research focus.

References

Bingwen Z, Yongyong S (2012) On China's urban employees' basic pension insurance fund—the nature, causes and solutions for the imbalance of revenue and expenditure of the fund in half of Chinese provinces. J Shanghai Univ (Soc Sci) 29(3):1–16

Chuanchuan Z et al (2014) Policy evaluation of China's new rural pension program. China Econ Q 14(1):203–230

Dasong D, Mihua X (2015) A new basic old-age insurance system for rural and non-working urban residents problems and countermeasures of implementation. Econ Rev 9:8–12

Dong C, Yuyang Z (2015) Different modes of supporting the elderly in China's rural areas the influence analysis of happiness. J Agrotech Econ 4:78–89

Ke Z et al (2014) Correlation between mental health and subjective well-being in aged people of rural areas of Chongqing. Lab Med Clin Prac 11(18):2513–2515

Peng X, Changcheng Z (2014) Factors associated with subjective well-being in Chinese elderly people—empirical study based on Anderson's health behavioral model. Soc Sec Stud 2:43–52

Wei L (2011) On pilot project of basic pension for rural and urban residents. China Open J 158:81–82

Xiumin Z et al (2017) Analysis on the status and influencing factors of subjective well-being among community elderly. Popul J 39(223):88–96

Zhen W, Tianqi L (2021) The effect of social pension on the subjective wellbeing of the rural elderly: a study from CHARLS data. Sci Finan Econ 4:105–117

Zhenzhen S, Yingying H (2021) China's social pension insurance system establish conditions and constraints. Employ Sec 08:36–37

Zhike J et al (2021) Research on China's elderly caring insurance systems: review and prospect. J Guizhou Univ Nationalities 5:71–89

Exploring Tourism's Recovery Under the Post-COVID-19 Epidemic

Feng Zhao

Abstract As the COVID-19 epidemic raging all over the world, the tourism industry is facing various challenges. In order to ensure the sustainable development of the tourism under the epidemic situation, it is of great significance to take effective measures to deal with the risks. At the same time, this subject needs further study. This paper first analyzes the influence of COVID-19 on tourism, then introduces a new theory, namely "three-dimensional tourism" development theory, to analyze the factors affecting the development of tourism, and finally puts forward four corresponding suggestions, including promoting the application of media technology, improving tourism insurance, making flexible tourism plans and changing the sustainability of the tourism sector.

Keywords Tourism development · COVID-19 epidemic · "Three-dimensional tourism" development theory

1 Background

Due to the global outbreak of COVID-19 epidemic in 2019, great changes have taken place in human life around the world, and many industries have negatively affected by the global spread of COVID-19 virus. Due to the increasing demand for emergency medical services and the rising death toll, the national medical and health care system is under pressure. International trade and global supply chains are being disrupted by the epidemic situation (Mishra 2020). Since 2020, visa and immigration have been restricted and blocked in many countries. In addition, the construction industry, oil industry, aviation industry and food industry around the world are also seriously affected.

At the same time, COVID-19 has brought a global tragedy to the tourism. Countries have closed their borders on a massive scale (Mccorkle 2020). As a

F. Zhao (✉)
The University of Queensland, Brisbane, QLD 4072, Australia
e-mail: feng.zhao@uq.net.au

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_46

result, by 2020, international tourism industry has dropped to the level of 30 years ago (https://www.unwto.org/covid-19-and-tourism-2020). According to the World Tourism Council, as many as 75 million workers will face the risk of unemployment during the epidemic. According to the research of WTTC, the potential loss of tourism and tourism GDP in 2020 would be as high as 2.1 trillion dollars. In addition, WTTC estimates that 1 million jobs are lost in the tourism industry every day (Škare et al. 2021).

Several popular studies on the influence of COVID-19 on tourism have been discussed. People are used to staying where they are, because they will be influenced by anxiety, fear and insecurity for a long time (Uğur and Akbıyık 2020). The closure period caused by COVID-19 can reduce the emission of carbon dioxide, thus protect the oceans. Similar sustainable practices can significantly reduce the impacts of climate change on the oceans (Al Shehhi and Abdul Samad 2021). This crisis provides an excellent opportunity for mankind to choose a new direction and take a more sustainable road. Specifically, COVID-19 has provided a unique opportunity for public, private and academic actors to turn to environment-friendly and more balanced tourism (Ioannides and Gyimóthy 2020).

Based on the analysis of the influencing factors of tourism development, this paper introduces the development theory of "three-dimensional tourism", that is paying attention to the attraction, accessibility and security of the destination. Based on the analysis of the present situation and this theory, this paper discusses the influence of COVID-19 on the tourism, and puts forward some corresponding suggestions.

The collapse of the tourism under the coronavirus epidemic has not received enough attention. This study hopes to arouse the attention of the academic circles to the tourism industry, and let more researchers pay attention to and study the challenges and threats faced by the tourism industry after the outbreak of the COVID-19 epidemic. In addition, based on the three major factors affecting the development of tourism and the corresponding theories, this paper makes a full analysis, and its conclusions and suggestions will play a guiding role in the revival of tourism. This also has social and commercial significance.

2 Theory

In addition to the homogeneity of the factors affecting tourism development, this paper also puts forward the development theory of "three-dimensional tourism", and analyzes the three dimensions of destination attraction, accessibility and security.

2.1 Destination Attraction

The attraction of destinations influences the development of tourism in many ways. In order to realize the sustained satisfaction and loyalty of tourists, it is necessary

to develop attractive tourism products. At the same time, as the industry is highly competitive, it is extremely important to create and maintain a sustainable positive impression (Moreira and Iao 2014). Specifically, the attraction of destinations mainly includes tourism resources, social media, brand and identity, political climate and so on.

Tourism Resources. Tourism resources should be the fundamental factor for tourists' choices. The competitiveness of tourists depends highly on the core tourism resources, including cultural resources, heritage resources, natural resources and creative resources (Dwyer and Kim 2003). These resources can be designed in various ways to attract tourists to the destinations. When a person is interested in a specific scenic spot, his inner strong inner desire will stimulate the local tourism economy as a whole, thus promoting the development of local tourism industry. However, a region's tourism resources are not static. Consider the increase or decrease in the quantity and quality of resources. Therefore, all kinds of changes in tourism resources make this industry relatively fragile.

Social Media. Social media is playing an important role in the development of tourism. On the one hand, the tourism benefits from the "everything is connected" attribute of social media, especially in the marketing and management fields. Mahmood (2012) believes that social media has many advantages in all aspects, including contact with overseas audiences, immediacy, unlimited time, easy access, overcoming jet lag and ubiquitous interaction. Therefore, based on the application of social media (network, mobile, cloud, etc.), tourism can operate more effectively. On the other hand, the use of social media may not be fair or objective. Without the standards, rules or standards for qualification, verification and examination, tourism management must deal with some problems (Khan 2012). The use of free social media may be abused by competitors. In addition, travelers or customers may exaggerate, so that the local tourism or hotel industry may be adversely affected by the predicament. Therefore, social media is a double-edged sword in tourism.

Brand and Identity. Building a successful tourism brand and creating a unique identity can help the development of tourism. Tourists' choice behavior will be influenced by the perceived image of a place, which has been proved to be improved (Ekinci and Hosany 2006). The connection between the unique brand personality and the tourism products is necessary, which is conductive to the expansion of the tourism economy. For example, France is romantic. Spain is friendly and enthusiastic. Germany is rigorous. China is a country with history and culture. Therefore, brand and identity should be regarded as all kinds of business cards in one's mind, which will influence the impression, expression and choice of tourists.

Political Climate. Political climate, views and opinions generated by the public's perception of a country's wide range of political and social issues, is a major factor in the competitiveness of tourist destinations (https://www.infobloom.com/what-is-a-political-climate.htm). Generally speaking, the attraction of a destination and the tourists' overall perception are closely related to the political climate of a country (Mak 2008). In other words, the attraction of a destination will affect the subjective

perception, destination selection and subsequent behavior of the individual. The tourism market largely depends on tourists' overall impression of their destination. In particular, political instability and public unrest have adversely and seriously affected the development of tourism. Therefore, in order to avoid the negative impact of government actions, policies and legislation on the tourism market, the destination should balance various variables of political climate, including political fragility, terrorism, racism and social unrest.

2.2 Accessibility

Accessibility refers to the ease of access to a region or the availability of goods or services (Anciaes 2017). The accessibility of the tourism requires the tourism departments to meet the mobility and basic needs of tourists. From the perspective of accessibility, transportation and infrastructure have a particularly important impact on the choice and experience of tourists.

Transportation. As an important part of the successful development of tourism, traffic will lead to the emergence of new attractions and the expansion of existing attractions (Kaul 1985). A stable comprehensive transportation system can ensure the resettlement of tourists and expand the target market. The reason is that when tourists make decisions, they will consider whether the traffic and related impressions will bring them a satisfactory experience. Therefore, in order to meet the needs of tourists, if there are convenient modern airports, seaports and highways around the tourist destination, it will bring advantages to the tourism industry.

Infrastructure. Tourism infrastructure is the most important part of existing tourism resources. Tourism infrastructure includes not only various facilities to meet tourists' needs, but also a large number of services to improve tourists' satisfaction in the process of tourism (Jovanović and Ivana 2016). Specifically, this extensive tourism infrastructure includes supporting the auxiliary facilities, systems, processes and resources, such as building facilities, public services, health care systems and accommodation services. It can be said that the competitiveness of the tourism sector depends on intensive investment in infrastructure and continuous modernization to some extent.

2.3 Security

The tourism security is a key factor affecting tourists' choices, participation and satisfaction (Perry and Potgieter 2013). Besides the political climate mentioned above, the security of tourists also includes human factors and natural factors.

Destinations should control security-related human factors to ensure a good travel experience and a positive destination image. It is necessary for local communities to

maintain low crime rates, visual security, sanitary facilities, good public health, etc. Epidemics are rather terrible news for tourism. Even if the epidemic breaks out all over the world, it may also lead to a sharp decline of global tourism. The SARS epidemic crisis in 2002 and the "H1N1" epidemic in 2009 led to a sharp drop in tourism expenditures and the number of visitors (Škare et al. 2021). Besides, we should also pay attention to natural factors in tourism management. Natural disasters such as drought, mountain torrents, tsunamis and earthquakes occur frequently, which means risks and dangers to tourists. Therefore, how to overcome the objective shortcomings should be a constant concern of tourism industry.

3 Analysis

Due to the impact of the COVID-19 epidemic, the world tourism industry is facing enormous challenges and risks.

Take sports-related tourism destinations as an example. Due to the epidemic (Svensson and Radmann 2021), all kinds of sports events around the world have to stop. Tourists' desire to watch sports events, visit sports attractions and participate in sports activities is strongly discouraged, which has a negative impact on the whole tourism industry to a large extent.

The COVID-19 epidemic also affects the tourism industry by blocking traffic and infrastructure. In order to prevent the spread of the virus, policy makers all over the world have taken measures to restrict the population movement (İÇ et al. 2021). Blockades and movement restrictions are very common in the war against epidemic. In this sense, in order to keep the distance and reduce personal contact when necessary, most public transport must be restricted. This lack of mobility has caused a fatal blow to the tourism industry. In addition, infrastructure related to the tourism industry is impacted, which leads to the return of its functions and hinders the development of the tourism industry. COVID-19 has brought obvious security problems and hindered the development of tourism.

Besides human factors, this terrible disease also poses a serious threat to human life and security, and many people die every day in COVID-19 (Joshi et al. 2021). Obviously, the tourism market is under threat. People are not only facing psychological challenges, but also need to minimize the risk of infection. This is a difficult period for the world tourism industry.

However, risk creates opportunities. Tourism also benefits from the outbreak of coronavirus. From the perspective of tourism resources, the restriction or closure of scenic spots has brought valuable opportunities for its own objective recovery and rehabilitation. In particular, natural resources and historical sites must have enough time to adjust and update in order to keep the best conditions. Effective protection and preservation are the foundation of sustainable development of tourism. In addition, getting relatively full enjoyment from various facilities and services can improve the experience of tourists to a certain extent. This is because due to the global outbreak of COVID-19, fewer tourists share more resources than ever before. Generally speaking,

when people experience a higher quality service from their infrastructure, they are more likely to get a higher level of satisfaction during their travel.

4 Recommendations

The wide application of new media technology can relieve the pressure of the global tourism downturn, thus winning time and new opportunities for the adjustment and renewal of the tourism, especially in sports events. In the absence of on-site sports activities, new media technologies such as social media platforms can provide sports organizations and athletes with a way to re-engage with consumers and promote sports activities. In other words, with the help of new media technologies, organizations and individuals can share the convenience of interactive and user-generated content (Hayes 2020). This innovative way has stimulated a large number of spectators to participate remotely, and made all kinds of sports activities survive. The Tokyo Olympic Games in 2021 is a typical example. After a part of tourism demand is released, it will win time and opportunity for the renewal and reorganization of tourism industry.

Travel insurance can help travelers minimize economic losses and reduce their anxiety and worry. Travel insurance refers to the cancellation of travel and the assurance of medical first aid, health and accident assistance, etc. for the purpose of protecting the personal rights and interests of travelers. Under the threat of the COVID-19 epidemic, travel insurance should be included in the needs of people with financial capacity (Uğur and Akbıyık 2020). This will encourage individuals to travel.

Besides, allowing flexible travel plans is also an effective way to ensure the mobility of tourists. Especially, travelers can change the date and place without extra charge when dealing with sudden crises, which will be very attractive to tourists.

Optimistically, the major stakeholders in the tourism industry have the opportunity to take advantage of this period of retrogression to carry out far-reaching structural reforms in the tourism sector. COVID-19 urges people to consider how to maintain sustainable development of tourism before the crisis, rather than returning to the previous business model in time (Romagosa 2020). Faced with this sudden opportunity, governments, citizens, communities, companies and scholars all need to make efforts to contribute to a more sustainable development of tourism.

5 Conclusion

This paper introduces the current situation of the world tourism industry affected by COVID-19, and discusses how the tourism industry can cope with this dilemma. Based on the tourism development theory of independent innovation, this paper analyzes the influence of COVID-19 on tourism. The most important thing is to put

forward some practical suggestions to deal with these negative impacts and embrace opportunities with a positive attitude.

This paper puts forward a new theory to analyze the factors affecting the development of tourism, which includes three parts, namely, the attraction, accessibility and security of the destination. Through the analysis of the current tourism industry, i.e. the restrictions on event tourism, traffic barriers, infrastructure and security, people pay full attention to the development of the current tourism industry. In order to promote sustainable tourism, the tourism sector should pay attention to the application of three key elements: media technology, tourism insurance and flexible tourism planning, which are of guiding significance in overcoming the challenges in the development of epidemic tourism.

There are still some limitations in this study. How to adjust the tourism development in different region under different conditions needs further research. This paper focuses on general abstract situations, not the specific situations. It is more practical and beneficial to extend the analysis to specific fields. Future research should focus on certain countries or cities in different periods of the epidemic. With the joint attention and efforts from all walks of life, the tourism industry will recover after the epidemic.

References

Al Shehhi MR, Abdul Samad Y (2021) Effects of the Covid-19 pandemic on the oceans. Rem Sens Lett 12(4):325–334

Anciaes P (2017) Accessibility issues in travel and tourism

Dwyer L, Kim C (2003) Destination competitiveness: determinants and indicators. Curr Issue Tour 6(5):369–414

Ekinci Y, Hosany S (2006) Destination personality: an application of brand personality to tourism destinations. J Travel Res 45(2):127–139

Hayes M (2020) Social media and inspiring physical activity during COVID-19 and beyond. Managing Sport Leisure 1–8

İÇ BA, Atlihan OK, Aydin B, Gulseven O (2021) The impact of public transportation on COVID-19 in the United Kingdom. Available at SSRN 3766154

Ioannides D, Gyimóthy S (2020) The COVID-19 crisis as an opportunity for escaping the unsustainable global tourism path. Tour Geogr 22(3):624–632

Joshi P, Tyagi RK, Agarwal KM (2021) Technological resources for fighting COVID-19 pandemic health issues. J Ind Integr Manage 6(02):271–285

Jovanović S, Ivana ILIĆ (2016) Infrastructure as important determinant of tourism development in the countries of Southeast Europe. Ecoforum J 5(1)

Kaul RN (1985) Dynamics of tourism: a trilogy, vol 1. The Phenomenon. Vol. II: Accommodation, and, 3.

Khan MA (2012) Social media's influence on hospitality and tourism management. J Bus Hotel Manage 1(1):1–2

Mak J (2008) Developing a dream destination: tourism and tourism policy planning in Hawaii. Versa Press, United States of America

Mccorkle W (2020) Problematizing immigration restrictions during covid-19 in the social studies classroom. Res Soc Sci Technol 5

Mishra MK (2020) The world after covid-19 and its impact on global economy. EconStor Preprints

Moreira P, Iao C (2014) A longitudinal study on the factors of destination image, destination attraction and destination loyalty. J Soc Sci 3(3):90
Perry EC, Potgieter C (2013) Crime and tourism in South Africa. J Hum Ecol 43(1):101–111
Queen J. What is political climate? https://www.infobloom.com/what-is-a-political-climate.htm. Last accessed 2021/7/19
Romagosa F (2020) The COVID-19 crisis: opportunities for sustainable and proximity tourism. Tour Geogr 22(3):690–694
Škare M, Soriano DR, Porada-Rochoń M (2021) Impact of COVID-19 on the travel and tourism industry. Technol Forecast Soc Chang 163:120469
Svensson D, Radmann A (2021) Keeping distance? Adaptation strategies to the covid-19 pandemic among sport event organizers in Sweden. J Glob Sport Manage 1–18
Uğur NG, Akbıyık A (2020) Impacts of COVID-19 on global tourism industry: a cross-regional comparison. Tourism Manage Perspect 36:100744
UNWTO Homepage. https://www.unwto.org/covid-19-and-tourism-2020. Last accessed 2021/6/16

The Comparison Between Stock Market and Bond Market

Junzhe Huang and Qianwen Qin

Abstract Capital market is an important part of financial market. Countries, companies and individuals invest in capital markets. Stock market and bond market are two important sub-markets in capital market. These two markets are the main financial instruments in the securities market. For investors, they are all selected investment tools in order to obtain a certain income. For fundraisers, they are all means of raising capital through public offerings. Some people compare the stock market to the rabbit and the bond market to the turtle. Stocks are like rabbits, jumping fast but uncertain, while bonds are like turtles, climbing slowly but steadily. Which market an investor chooses to invest in depends on many factors. In this paper, investors' investment psychology, namely risk tolerance, will be taken as one of the factors for in-depth analysis. What is their attitude towards the stock market and bond market, and what characteristics of the two markets will affect the change of investors' attitude.

Keywords Stock market · Bond market · Risk tolerance

1 Introduction

Investors are debating whether it is better to invest in stocks or bonds. Both markets have their strengths and inevitable weaknesses. While people expect high returns in the stock market, they also face the risk of losing everything. When people can avoid high risk in the bond market, they can't expect to return as high as the stock market. Even so, both markets are used as important financial instruments by investors and financiers. They take advantage of the market's advantages to obtain returns, while

Junzhe Huang, and Qianwen Qin authors are contribution equally.

J. Huang (✉)
Malvern College, Xinjin, Chengdu 610083, China
e-mail: alan.huangjunzhe@malvernchengdu.cn

Q. Qin
Maple Leaf International School, Haikou 570100, Hainan, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_47

aiming at the market's disadvantages to take some strategies to minimize risks. There is investment, there is risk, investors face the psychological state of risk is very important. Their mental capacity, physical condition, and time are all factors that affect which market they choose to invest in. This also shows that the stock market and bond market have other characteristics that affect the decisions of investors and financiers in addition to the differences in returns and risks.

2 Stock Market

What is the stock market? Which is made up of many exchanges, such as the New York Stock Exchange. The stock would be listed on a specific exchange that would bring the two parties together and treat them like a market for the stock. The exchange influences the price of each stock based on supply and demand (Arielle O'Shea is a NerdWallet authority on retirement and investing n.d.).

More specifically, if an investor buys shares in a company, in principle the investor already belongs to one of the owners of the company and enjoys a set of rights. For example, participating in the company's major decisions, receiving profit dividends of listed companies, enjoying the benefits of rising stocks and so on. Investing in a good stock also means a higher return, as the barriers to entry to the stock market are much lower than those to real estate, private equity and other assets. This is one of the reasons many investors choose to enter the stock market.

2.1 The Advantages of the Stock Market

In recent years, some investors have gained gains by investing in stocks through their own planning. Thus, the stock market has its own advantages. As mentioned above, if investors buy stock in a public company and the stock appreciates, they can earn extra dividends. In addition, the stock market can effectively resist the problems caused by inflation. During the period of inflation, you can put money into the stock market, which can effectively prevent the depreciation of capital and have a certain value preservation effect. Not only that, stocks have the advantage of strong liquidity. If, for example, an investor needs to use his money, he can sell the stocks he holds that day and move the money out at the next trading day. And the amount of stock investment is flexible. Each investor can buy stocks at the corresponding price according to their actual economic situation. In addition, stock is a kind of diversification from investment. People can buy some stocks with the money they earn from work, but not just one kind of stock. They can buy many kinds of stocks, such as real estate, medical care, new energy and so on, so that investors' income can be diversified. The process of buying shares is simple, not complicated.

2.2 The Disadvantages of the Stock Market

There are also some obvious advantages to stock investing. The price of a stock may be volatile, but this is usually related to the company's policies, but individual investors have no influence on the company's policies. Shares represent ownership of a business, and generally investors are the last ones to get paid. When a company gains gains from its stock, it must first pay the expenses of its employees and creditors, and pay taxes before distributing the best money to investors. If the company gains less profits from its stock, investors will get a relatively lower amount of money. And, investors of listed companies are sometimes unable to obtain relatively complete information of the company. When the information becomes limited, investors' decisions will change, resulting in decision-making errors. Stocks are more risky and may cause money to not circulate properly in the market. Take, for example, 1929! Under the influence of some entrepreneurs, almost everyone bought stocks at that time. However, the stock market was controlled by some people. They sold stocks and drove down the price, which finally led to the stock market crash and serious inflation. Moreover, buying and selling stocks also requires certain theoretical knowledge and ability of investment, otherwise people may blindly buy stocks during the Great Depression. For another example, the global financial crisis happened in 2008, when the stock market also received a shock, the reason is that monetary policy at that time there was a problem, after the 911 terrorist attacks in 2001, the federal reserve to avoid economic weakness, released more liberal economic policies, to cut interest rates six times, lead to the low interest rates, when the U.S. This allowed capital to flow into the real estate market, which led to the rapid rise of the housing price and the emergence of a huge real estate bubble. Later, the real estate bubble burst and an economic crisis occurred, and we found that the stock market would be impacted and affected by other markets.

3 Bond Market

The bond market is a financial market where participants can issue new bonds or buy and sell other bonds, usually in the form of bonds, and also include public and private bills. Unlike bank loans, bonds may be held by retail investors and traded more frequently than loans (Mayyan nodate).

Bond markets predate capitalist economies. Simply put, a bond is like an IOU. The issuer of a bond borrows money from an investor and uses the bond to record how much money is borrowed, for how long, and at what interest rate. When the bond matures, the investor gets the principal and interest back. Compared with the stock market, the entry threshold of the bond market is relatively high, which also makes many investors dare not easily invest in the bond market.

3.1 The Advantages of the Bond Market

Compared with stock market, investors' money will be safer if they choose to invest in bond market.

Bonds and stocks have a difference, bonds represent debt, and stocks represent shares, generally speaking, investing in bonds is safer than investing in stocks. That is because debt holders have priority over shareholders. For example, if a company goes bankrupt, bondholders can get at least some of their money back, but stock investors can lose their entire investment. And you have several options, like corporate bonds, government bonds, if your goal is to protect principal, then you can choose relatively stable government bonds.

The other big advantage of bond market is that it can help investors to predictable their returns. In fact, in the long run, the return of stocks is better than that of bonds, but in some cases, people need to guarantee the safety of money and predict the direction of money, for example, some people want to earn a certain amount of money from bonds after retirement, they can see the direction of the bond before retirement, after retirement directly get the return of the bond (Team 2022).

3.2 The Disadvantages of the Bond Market

"The bond market also has the disadvantage of being vulnerable to rising interest rates, market volatility and credit risk". When interest rates fall, bond prices rise, and vice versa, when interest rates rise, bond prices fall (Academy 2022). If market interest rates rise, investors may lose market prices for their bond investments. Fluctuations in the bond market can also affect the price of individual bonds. What credit risk means is that if the issuer has a series of problems, such as a break in cash flow, the issuer may not be able to return interest and principal to investors (Basu 2019). Bond markets are relatively stable, but that depends on the creditworthiness of the issuing country. For example, the reason why no one buys the bonds of Zimbabwe is because Zimbabwe is printing a lot of money, which leads to a lot of inflation, and it can't be traded internationally, so the bonds are not creditworthy and can't be bought. Let's take another example. Recently, the yen depreciated, and the main way to make profits by issuing bonds in Japan is through low profits. However, due to the influence of some entrepreneurs, a large number of bonds were sold, and the Japanese government had to carry out repurchase, which led to the devaluation of currency and low credit of bonds.

4 Investment Psychology of Investors

Investing can help people achieve their financial goals. When people make an investment, they should consider the investment risk, in other words, how much risk the investor can bear.

Risk tolerance refers to how much loss an investor can bear in the investment process (Risk tolerance and Time Horizon. Fidelity. 2022). For example, by comparing the stock market and bond market, it can be concluded that the return rate of stocks is higher than that of bonds. From the data in the stock market, the stock price is mostly fluctuated, it may fall and then rise, and then after a period of time, rise or fall again. Such volatility is risky, but investors have to tolerate short-term volatility if they want to invest in the stock market for the long term and achieve higher returns. At this point, risk tolerance can be a measure of how much investors are willing to tolerate in the stock market in exchange for potential long-term growth. Understanding risk tolerance is important. Many investors who invest in the stock market want to avoid the consequences of stock losses, which can affect their mood and even their lives. Therefore, if you want to invest in the stock market, you need to understand the risks of the stock market and consider the degree of risk tolerance in the investment plan.

Compared with the stock market, the risk of the bond market will be relatively small. Interest rate volatility is one of the risks that the bond market will have (Davy Select n.d.). Bond prices rise when interest rates fall, so before investing in bonds, investors need to evaluate the duration of bonds (short, medium, or long term) in relation to the interest rate outlook to ensure that they are satisfied with the volatility in bond prices that may result from interest rate fluctuations.

Generally speaking, those who invest in the stock market have a higher risk tolerance, while those who invest in the bond market have a lower risk tolerance. For people who are about to retire, for example, the bond market is a good tool for them to achieve their financial goals because they don't have to take high risks and don't have to spend a long time (buying short-term bonds) (IG 2022).

5 How Do Investors Deal with Risks in the Stock Market and the Bond Market

Both stock market and bond market are risky. From the above understanding of the stock market and the bond market, investors know that both of them have a certain disadvantage. So how can investors avoid some of that risk? Say the stock market first, after buying shares, shareholders invest in stocks after growth, the company will get profit, but in the process, if the company caused by improper operation risk will let shareholders, so this time investors must make the company management transparency, for shareholders to see the company operation, to reduce the risk of investors are received. In daily life, many investors may blindly follow the trend,

resulting in losses of some interests. Therefore, investors need to accumulate certain economic knowledge to solve investment problems. It is estimated that the world every ten years will occur a large-scale stock market crash, such as: the United States 1929 to 1933 economic crisis, 2008 global economic crisis, so investors still need a certain investment mentality. Then there's the bond market "Bondholders may lose much or all their investment in case a company goes bankrupt. In the economy such as the USA, bondholders are given much leverage and protection laws in case of bankruptcy. This means investors are expected to receive some or all of the invested money. But in many countries, there are no protection for investors." In this case, investors get investment basic principal, the method to solve the problem of this kind can only choose a conservative method of bond investment, can choose the national debt, because relative to corporate bonds, the credibility of national bonds and stability more than corporate bonds, when investors feel direction or more cautious, can choose the national debt. In addition, the liquidity of bonds is not very good, and it takes a certain time for investors to pay out their principal and profits after investing money. In this case, investors must arrange their investment plan and the direction of capital use. In general, each market has its own special advantages and disadvantages, investors need to choose their own investment mode according to the actual situation, so as to maximize their investment.

6 Conclusion

The bond market is different from the stock market. The first difference is that the stock market has an exchange. Stocks can be traded on exchanges, but bonds cannot. Another difference is that bond and stock markets expose investors to different risks. In the stock market, investors may face currency risk, liquidity risk, which often affects the company's cash and earnings. Bonds are vulnerable to interest rates. When interest rates rise, bond prices fall. When interest rates are high and investors need to sell bonds, they may make less money (Morah 2021).

From the nature, the stock reflects the ownership of the company, the investors who buy the stock have the right to participate in the management of the company, but the investors who buy the bond do not have this right. From the perspective of income, the interest rate of bonds is determined before the purchase, so investors who buy bonds can predict the future income, but investors who buy stocks can't. When investors buy stocks, the dividend yield is uncertain, and the dividend income depends on the company's earnings. More profit means more gain, less profit means less gain, and no profit means nothing. Bonds outperform stocks in terms of the order of return, because companies must pay interest on bonds before they pay dividends, and if the company faces bankruptcy, bonds are paid first, followed by dividends (Diffen. Diffen.com. 2022). From the perspective of investment risk, the principal can be recovered when the bond matures, but the stock is uncertain. If a company develops well, the value of the stock will double, and investors will benefit from it, but otherwise they will lose.

Second, investors' risk tolerance can help them choose the right financial instruments and the right investment portfolio. Time horizon can also reflect the risk tolerance of investors from the side. For example, as mentioned above, investors need to withstand short-term fluctuations in the stock market if they want to obtain high returns in long-term stock investment. This reflects that investors in the stock market have both a high risk tolerance and a long-term investment. The bond market is lower than the stock market. The bond market is safer than the stock market, and investors can predict future income streams at constant interest rates, but in the stock market, investors cannot predict. Therefore, in the bond market, investors do not need to have a high risk tolerance.

To sum up, the stock market and the bond market are two very important markets, which have different characteristics. Understanding the advantages and disadvantages of these two markets can help investors make some choices and decisions. In addition to market analysis, investors also need to understand their own requirements, such as the risk tolerance described above. Investors can combine the two to specify portfolios and future plans to achieve their investment goals.

References

About the authors: Arielle O'Shea is a NerdWallet authority on retirement and investing (n.d.) Stock market basics: what beginner investors should know. NerdWallet. Retrieved 11 July 2022, from https://www.nerdwallet.com/article/investing/stock-market-basics-everything-beginner-investors-know

Academy Y (2022) 7 points comparison of stocks vs bonds. Yadnya Investment Academy. Retrieved 21 July 2022, from https://blog.investyadnya.in/comparison-of-stocks-vs-bonds/.

Basu C (2019, March 5) Advantages and disadvantages of bonds. Finance. Retrieved 11 July 2022, from https://finance.zacks.com/advantages-disadvantages-bonds-2350.html

Davy Select (n.d.) Risks of investing in bonds. Retrieved 15 July 2022, from https://www.davyselect.ie/investment-choices/risks/risks-of-investing-in-bonds.html

Diffen. Diffen.com. (2022) Stocks vs bonds—difference and comparison. Retrieved 21 July 2022, from https://www.diffen.com/difference/Bond_vs_Stock

IG (2022) What's the relationship between stocks and bonds? Retrieved 21 July 2022, from https://www.ig.com/en/trading-strategies/what_s-the-relationship-between-stocks-and-bonds--210702.

Mayyan (nodate) Advantage and disadvantages of bonds. Retrieved from https://www.myayan.com/advantages-and-disadvantages-of-bonds

Morah C (2021, December 7) Bond market vs. stock market: what's the difference? Investopedia. Retrieved 11 July 2022, from https://www.investopedia.com/ask/answers/09/difference-between-bond-stock-market.asp

Risk tolerance and Time Horizon. Fidelity. (2022, Feb 15). Retrieved 15 July 2022, from https://www.fidelity.com/learning-center/personal-finance/risk-tolerance-time-horizon

Team TI (2022, Feb 8) Some of the advantages of bonds. Investopedia. Retrieved 11 July 2022, from https://www.investopedia.com/investing/bond-advantages/

How Does New Media Affect Business Negotiations?

Haotian Wang

Abstract With the development of science and technology, people have entered the era of new media. New media has had an impact on all aspects of society, and it has also affected business negotiation, changing the traditional business negotiation model. This article starts with the origin, concept and characteristics of business negotiation and new media, analyzes the influence of different forms of new media on the preparation stage of negotiation, negotiation process and between multiple rounds of negotiation, and points out that new media plays an important role in business negotiation. Only by deeply understanding the important role of new media in business negotiation can negotiators make use of it and help them to achieve the ultimate success more easily.

Keywords Business negotiation · New media · Impact

1 Introduction

Since ancient times, negotiation has been in our lives all the time, there are negotiations between countries, and there are negotiations between people. Through negotiation, the negotiating parties can resolve disputes, meet their respective interests or promote cooperative relations. From this point of view, negotiation has entered into various fields such as politics, economy, military, culture and diplomacy, and has become an indispensable tool for reaching consensus among different organizations. In all kinds of negotiation, business negotiation occupies an important position. At the same time, with the development of science and technology, human beings have gradually entered the era of new media. The Internet has greatly facilitated our lives and also changed the traditional way of negotiation. However, the previous articles have not analyzed and studied how new media affects business negotiation.

H. Wang (✉)
University International College, Macau University of Science and Technology, Macao 999078, China
e-mail: 1909853du011003@student.must.edu.mo

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_48

Therefore, this article will focus on analyzing the impact of new media on business negotiation in the Internet age. Next, this article will introduce the origin, definition and connotation characteristics of negotiation and new media, and on this basis, analyze the impact of new media on each process of business negotiation.

2 The Origin, Definition, and Connotation Characteristics of Negotiation

2.1 The Origin and Definition of Negotiation

As a conscious social activity, negotiation is a way to deal with interpersonal relations and resolve conflicts of interests. Negotiation is a new activity that arises when human beings interact with each other in order to resolve conflicts of interest, change mutual relations, transform nature and society, or communicate their views in order to exchange materials, energy and information, so as to reach agreement and reach a proper agreement (Jun 2014).

At the beginning of primitive society, human beings survived mainly by acquiring natural objects, such as fishing and hunting, gathering and so on, it was not until the middle and late stages that primitive agriculture and animal husbandry began. Due to the very low level of productivity, limited ability to conquer and transform nature, and the severe shortage of material wealth, conflicts occurred constantly, and both sides of the dispute, of course, had to state their reasons, which is the prototype of negotiation.

In modern times, negotiation refers to the dialogue between two or more individuals or groups, the purpose of which is to reach a beneficial result for all parties regarding one or more problems and conflicts that exist. Negotiation is an interactive process between entities that are eager to agree on issues of mutual interest while meeting their respective needs. Such beneficial results may apply to all parties involved, or only to one or some of them. Negotiators need to understand the negotiating process and other negotiators to increase their chances of reaching a consensus (Adnan et al. 2016).

2.2 Characteristics of Business Negotiation

Among the various kinds of negotiations, business negotiation occupies an important place. Buyers and sellers conduct business negotiations in order to facilitate transactions or resolve disputes, and through business negotiations, buyers and sellers can obtain their own economic interests. Business negotiation has the following characteristics:

To Obtain Economic Benefits As the Purpose. Different negotiators have different negotiating purposes. Diplomatic negotiation is about national interests; political negotiation is concerned with the fundamental interests of political parties and groups; military negotiation is concerned with the security interests of both hostile parties. Although the above-mentioned negotiations all involve economic interests to a certain extent, they are always carried out around other basic interests, and their focus is not necessarily economic interests. However, the goal of business negotiation is very clear. Negotiators take economic interests as their primary goal, and they will discuss other non-economic interests only after their own economic interests are satisfied. Compared to other types of negotiation, business negotiation focuses on economic benefits. For business negotiation, both parties are more concerned about the cost, efficiency and benefit of the technology involved in the negotiation. Therefore, people usually evaluate the success of a business negotiation by how good or bad it is to obtain economic benefits. Business negotiation without economic benefits loses its value and meaning.

Focus on Value. Business negotiation includes many factors, such as the needs and interests of the negotiator, but in most cases, value is the core of all business negotiations. This is because value and price can most directly reflect the interests of the negotiating parties. And the gains and losses of the interests of both parties in the negotiation can usually be converted into a certain price, which is reflected by the price rise and fall. It is worth noting that negotiators should not only take price as the primary goal and insist on their own goals, but also pay attention not to place too much emphasis on price. They should broaden their thinking and strive for the maximization of interests from different levels.

Focus on the Tightness and Accuracy of the Contract. An agreement or contract agreed upon by both parties reflects the outcome of business negotiations. Among them, the contract terms mainly reflect the rights and obligations of all parties, and the rigor and accuracy of the contract terms are the premise to ensure that both parties in the negotiation can obtain their due interests. Some negotiators in the business negotiations spent a lot of effort to obtain more favorable results, and the other party in order to get the contract, also had to make many concessions, then the negotiator seems to have won the negotiation, but if the contract terms in the signing of careless, do not pay attention to the contract terms of the strict, accurate, legal, complete, reasonable, legal, it is possible to fall into the trap of the other party, which will not only lose the benefits that have been obtained, but also lose more benefits. Such examples are very common in business negotiations. Therefore, negotiators cannot blindly trust verbal promises, but also pay attention to whether the terms of the contract correspond (Xiao 2017).

3 Definition and Connotation Characteristics of New Media

3.1 Definition of New Media

The international community defines new media differently, with UNESCO defining it as "new media is online media (Ji and Yong 2015)." This article will adopt this concept and discuss it in the context of what it describes.

3.2 Characteristics of New Media Compared with Traditional Media

Openness. In the Internet age, information resources are almost completely open, and any individual or organization can obtain any information they want on the network, and they can also publish information conveniently through the network (Yan 2017). Therefore, the network media has penetrated into people's economy, politics and life, and become an important way for people to exchange knowledge and information. The network has created more convenient conditions for the dissemination of new media information, and everyone can express their thoughts on the network in the new media era, and this openness is also the core of the new media. In the new media era, everyone can express their thoughts on the Internet, and this openness is the core of the new media. The dissemination of information in these traditional media is controlled by many factors. Therefore, information recipients can only passively receive information and cannot independently choose the information they want to read. The network media can break this limitation, so that people can receive information anytime and anywhere, completely free from the restrictions of time and place. The Internet allows global connectivity, so new media users can read the Library of Congress' collection without leaving home. This is not possible with traditional media.

Rapidity. New media is a product of the rapid development of modern communication technology, and one of the biggest advantages of the network is that information can be transmitted quickly (Yan 2017). Traditional media need to go through more processes to obtain information, and at the same time, there may be a lag in information release due to the limitation of airtime. The new media use the network platform to fully meet the effectiveness of news release and people can record video and write text in real time through cell phones, laptops, IPADs, etc., and report in real time and spread out quickly so that more audiences can receive it.

Interactivity. Compared with traditional media, the biggest advantage of new media is reflected in the interactivity of information dissemination through network media. Unlike traditional media, which spreads information to audiences in a one-way manner (Yan 2017). Under the new media environment, each network user can become a disseminator of information and realize two-way communication. Users

can participate in the release and dissemination of information, easily realize information feedback, and can participate in the process of reorganizing information in the network media. Therefore, the personalized characteristics of new media network communication are obvious.

4 The Impact of New Media on Business Negotiations

4.1 Comparison with Traditional Business Negotiations

In general, with the development of society, the forms of media are gradually becoming more diverse. This trend affects all aspects of our lives, as well as business negotiations. As a result of the development of new media, the volume of information has increased, the speed of information dissemination has increased, and there are more ways to disseminate information (Flew 2008). All these are undoubtedly changing the traditional mode of negotiation insidiously. Especially since the new crown epidemic in 2019, the influence of new media on business negotiations has begun to increase exponentially. Many business negotiations have shifted from offline to online. The location of negotiation is more casual, the time of negotiation is more flexible, and the occasions of negotiation are more diverse… Next, this article will further explore the development of new media, especially the impact of new media on traditional negotiation models after the new crown epidemic.

4.2 The Impact of New Media on Negotiation Preparation

First, an important and essential part of any business negotiation is preparation. Preparation includes conducting research, developing a negotiation plan and organizing the negotiation agenda (Li and Zhao 2007). Nowadays, with the development of the Internet and new media, news is spreading faster and faster, and access to information is easier. This can help us to better understand the information of the negotiation opponent and the negotiation environment. However, in the face of a large amount of information, how to effectively extract information and identify the authenticity of the information in the preparation stage of the negotiation has become a problem in business negotiations. If negotiators believe the wrong information on the Internet, it will affect the development of the negotiation plan and the success of the negotiation. Only by capturing the right information before the negotiation, negotiators can better formulate their strategies and determine their offers.

Second, with the gradual development of social media, negotiators can obtain personal backgrounds about their opponents from social media, including their biographies, beliefs, personalities, family members, interests, and so on. Through the understanding of their personal background, negotiators can take measures to

win the goodwill of the other party to a certain extent, such as using the other party's familiar ethnic music as the background during the banquet, etc., which will be more conducive to the smooth conduct of negotiations (Li and Zhao 2007). At the same time, in many cases, business negotiations between small businesses are the initial communication between the two principals through social media, so social media also influences the first impression of both parties. Therefore, making a good impression of the other party through social media and formulating relevant strategies for the other party's background will affect the outcome of the negotiation.

Third, the development of new media has had a huge impact on the organization of the negotiation agenda. The emergence of videoconferencing software has changed the timing and location of traditional negotiations. Through the online mode of negotiation, the time of negotiation will be more flexible, and the choice of location will be more relaxed. Very often, only a computer is needed for the negotiation to take place. This undoubtedly reduces the time and money costs of face-to-face negotiations. Therefore, the development of new media also brings more new options for negotiation methods.

4.3 The Impact of New Media on the Negotiation Process

Different from traditional business negotiation, although online business negotiation will make the negotiation more convenient during the negotiation stage, it will also bring greater challenges to the negotiators.

Advantages. The influence of external factors on the negotiation will be reduced. In cross-border business negotiation, online negotiation makes negotiating parties do not need to consider the physical and psychological discomfort caused by environmental changes, and both parties can negotiate with a good mental state and appearance, thus ensuring the smooth progress of the negotiation. More flexible negotiation time. Very often, negotiation time is shortened due to the high costs incurred in the negotiation process, such as commuting and accommodation costs (Crump 2011). But with online negotiations, these costs can be significantly reduced, giving both parties more time to negotiate. No need to consider the location of the negotiation. Depending on where the negotiations take place, they can be divided into home negotiations, away negotiations, and neutral negotiations (Thompson et al. 2010). If the negotiations are conducted online, the parties do not need to consider the location of the negotiations, and there is no home and away status for the parties in traditional negotiations.

Disadvantages. Negotiators can grasp the psychological state of their opponents from their verbal and non-verbal words (Liangqianyu 2022). In offline negotiation, some small actions of the negotiating opponent can reveal their mental state and emotion. For example, the hands keep rubbing together, or unconsciously touching the water glass. But if negotiators switch to online negotiation, these subtle body movements are hard to observe in the screen, so to a certain extent, it will also affect

the judgment of both sides of the negotiation. It increases the instability in the negotiation process. The quality of electronic devices and the stability of the network are unstable factors in the negotiation process. For example, fluctuations in the network and poor microphone sound quality can affect the fluency of business negotiations. Influence trust building between negotiating parties. People are reluctant to sign agreements with people they don't know or trust (Gunia et al. 2016). When dealing with a person they have never seen or heard of, people never dare to be careless, they are defensive before taking action, and try not to make promises easily during the conversation; on the contrary, if both parties have Once a certain level of trust is understood and established, the difficulty of negotiating will be greatly reduced, and the probability of success will be greatly improved. By negotiating online, the number of offline contacts between the negotiators will be reduced, which will affect the establishment of trust between the two parties.

4.4 Impact on the Final Outcome of the Negotiation

For multi-round negotiations, new media can have a huge impact on their final outcome. Very often, after each round of negotiations, the media will report on the results of both sides of the negotiations, and in the face of these news, people from all walks of life will express their opinions through social media or on the Internet (Curhan et al. 2010). Although these views may not be correct, when the number of supporters exceeds a certain number, it will affect the social opinion, which will further influence the judgment of the negotiating parties and even affect the negotiation strategy and negotiation goals of the next round.

Sometimes, after the negotiation is over, under the pressure of public opinion in the society, the negotiating parties may change their views on the outcome of the negotiation, from satisfaction to dissatisfaction, which leads to the collapse of the final cooperation. This situation is more common in distributive negotiation (Purdy et al. 2000). For example, after the negotiation is over and before the contract is signed, both parties may feel that they have gained an advantage from the negotiation, but when other people in the society give their different views, the party with the disadvantage in the negotiation may suddenly realize its own disadvantage and cancel the last cooperation.

5 Conclusion

In summary, first of all, in the preparation stage of the negotiation, the emergence of new media makes the place and time of the negotiation more flexible, which helps to formulate the negotiation strategy and affects the first impression of the negotiating parties. Second, in the process of negotiation, the development of new media has brought many advantages and disadvantages. Negotiators should learn to

use its advantages and overcome its disadvantages, so as to make the negotiation successful. Finally, in multi-round negotiation, new media may indirectly affect the final negotiation result, which requires negotiators to stay sober at all times, not to believe in public opinion, and not to be misled by public opinion.

In conclusion, whether in the preparatory stage of the negotiation, during the negotiation process, or between multiple negotiations, new media has a different degree of influence on each step of the negotiation. At the same time, it also imposes stricter requirements on the negotiating parties, and any small mistakes in each link may lead to the failure of the final negotiation. In other words, the details make or break. Therefore, negotiators need to fully understand how new media affects negotiation, and they need to learn to use new media to create favorable situations for themselves, while also eliminating negative factors about themselves. Only by giving full play to the role of new media can negotiators achieve the ultimate success more easily.

References

Adnan M, Hassan M, Aziz I, Paputungan IV (2016) Protocols for agent-based autonomous negotiations: a review. In: 3rd international conference on computer and information sciences (ICCOINS). Kuala Lumpur, Malaysia, pp 622–626

Crump L (2011) Negotiation process and negotiation context. Int Negot 16(2):197–227

Curhan JR, Elfenbein HA, Eisenkraft N (2010) The objective value of subjective value: a multi-round negotiation study. J Appl Soc Psychol 40(3):690–709

Flew T (2008) New media: an introduction, 3rd edn. Oxford University Press, UK

Gunia BC, Brett JM, Gelfand MJ (2016) The science of culture and negotiation. Curr Opin Psychol 8:78–83

Ji W, Yong Z (2015) Analysis of the concept of "New Media". New Media Res 1(16):6, 40

Jun QW (2014) Business negotiation: theories, techniques and cases, 4th edn. China Renmin University Press, Beijing

Li WW, Zhao YC (2007) Talking about the preparatory work before business negotiation. Econ Trade Update 5(9):100–101, 103

Liangqianyu S (2022) Analysis of language characteristics of business negotiation. China Bus Trade 1:126–128

Purdy JM, Nye P, Balakrishnan PS (2000) The impact of communication media on negotiation outcomes. Int J Confl Manag 11(2):162–187

Thompson LL, Wang J, Gunia BC (2010) Negotiation. Annu Rev Psychol 61:491–515

Xiao FZ (2017) The importance and skills of international business negotiation. New Bus Week 23:290

Yan W (2017) Research on the characteristics of information dissemination in the new media environment. Mod Soc 3:3–4

Body Language in Business Negotiation

Ruimeng Guo

Abstract As a pragmatic strategy in verbal communication, body language plays an important role in international business negotiation. This paper analyzes the information expressed by body language in business negotiation from facial expressions, body movements, and gestures, which can improve the skills of negotiators and promote the efficiency and success rate of negotiations. This paper looks into common body language that varies among countries and the universal acceptance of certain body language. Through real cases in business negotiation, this paper offers the positive and negative effects of body language in the procedure of business negotiation. This paper also analyses the usage of body language in cross-cultural business negotiation, thus offering guidance to negotiators. This paper finds out body language in business negotiation carries important information. Through the understanding of culture and exact movements, negotiators can infer the progress made in the negotiation. This helps them to create favorable conditions and make better decisions for their side.

Keywords Business · Negotiation · Body language

1 Introduction

With the development of the economy and technology, more and more people participate in business communication, and business negotiation is increasingly frequent in international economic activities. Body language, also known as body language, refers to the coordinated activities of the head, eyes, neck, hands, elbow, arm, body, crotch, foot, and other parts of the human body to convey the thought of the characters, vividly through the expression of a way of communication (Knapp 1978). The so-called business negotiation refers to a method and means by which buyers and

R. Guo (✉)
School of Foreign Studies, Central University of Finance and Economics, Beijing 102200, China
e-mail: 2019312201@email.cufe.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_49

sellers negotiate on issues of concern to facilitate transactions and meet the interests of both parties or to solve disputes between buyers and sellers, and obtain their economic benefits. The research of The British psychologist Argay shows that when the meaning represented by verbal and non-verbal signals is different, people are more willing to believe the meaning represented by non-verbal signals (Benjamin and Florence 2009).

Body language, as a special part of business negotiation, plays an important role in a business negotiation with its authenticity and unconsciousness, which is paid more and more attention by negotiators. Body language plays an incredible role in business negotiations, interpersonal communication, criminal trials, and other situations. In business negotiations, negotiators need to always pay attention to the changes in the body language of the other party, carefully analyze the internal relationship between each subtle movement change, and form an accurate judgment based on the negotiation situation at that time, the expression, behavior, and body of the other party's negotiators, and adjust the negotiation process accordingly. And through the effective body language of their personnel to influence the other party's views and views on their own, accept their negotiation propositions, achieve their negotiation objectives and appeals, and finally achieve the smooth negotiation and the conclusion of the contract.

Increasing research interests have been focused on body language in negotiation. Negotiation, as an important method in business, requires opposing parts including cooperation and competition (Nagendra 2018). Most of the time, negotiators stand in interests of their parties and seek agreement through negotiation. A successful negotiation both needs accurate verbal expression and appropriate body language. In earlier reviews, researches are mainly carried out in the verbal area and negotiation environment. Less has been done in the area of body language in negotiation. Some researchers were pointing out the negative impacts of different body language on negotiation but seldom has been mentioned the actual guidance to negotiators. Body language conveys useful expression, indicating the progress of negotiation, whether it is moving forward or backward.

This paper begins with the expression of body language, aiming to highlight the use of body language in business negotiations. This literature focuses on concrete cases, analyzing the real cases in negotiation. Through discussion of body language including facial expression, gestures, and body movement, the passage shows common and classic types of body language. Such emphasis is based on behavioral approaches and cognitive framing. Through the cross-cultural difference and similarities, this paper gives negotiators concrete evidence and models to rely on.

2 Interpretation of Body Language in Business Negotiation

2.1 Definition of Body Language

In commercial negotiation, normal body language includes gestures, body movements, and facial expressions. Gestures are obvious to capture. When crossing the arms, one means impatience and defense. Frequent changes of gestures can mean lies and nervousness or excitement according to different situations. Facial expression is the most direct non-verbal language. The subtle changes that happen on negotiators' faces are difficult to hide and always express whether he or she is favorable of the offer. Researches have shown that human has more than 250,000 facial expressions (Yi and Kyung 2019). Eyes are the most effective to transcend messages, which helps negotiators to know the attitudes and thoughts of the other part. In negotiation, when the frequency of eye contact is quite often, it can mean interest in the topic, or sometimes it has provocative meaning. When one side does not have much eye contact with the other side, it can show indifference to a certain topic. Many experienced negotiators wear tinted lenses. Body movements are the indication of the process and situation of the negotiation. A lean-back body means no interest and defense, a lean-forward body shows interest. If one changes his or her position at a high frequency, it should be checked whether the negotiation needs an interval.

In many cases, body language is carried out unconsciously. Compared with verbal language, they are more difficult to hide. Thus, the knowledge of body language helps the negotiators find the hidden meaning in negotiation. This can create larger benefits for their side. With the trend of globalization, cross-regional negotiation should also pay attention to the difference in culture that can lead to different habits of body language. Preparation should be taken into account to avoid misunderstanding. Research has shown that when there shows incoherence between verbal and body language, people tend to believe the body language. So the use and interpretation of body language are of great importance to the success of negotiation.

2.2 Case Analysis

Facial Expression. In a case of negotiation, the buyer was shrewd and was unwilling to counterbid the first offer (Varner and Beamer 2006). The client only showed a lot about personality, life experience, and an abundance of knowledge to raise the offer. After 3 times of offering, the buyer was noticed to have his eyes wide open for a second and the muscles at the corner of his eyes affected. Such signs clearly show satisfaction with the offer. Although it did not touch the bottom line of the seller, the sellers were unwilling to make the fourth offer. If the seller couldn't catch the subtle changes in the buyer's facial expression, then it would make an unnecessary loss to the seller. This is the application of facial expression in negotiation. Eyes reflect mentality. From the length of time of eye contact. The negotiator can judge

the feelings of the listener. In a normal negotiation, the time of sight that focused on the speaker's face should take up approximately 30–60%. If exceeded such a range, the listener tends to be especially interested in the topic. If the percentage is lower than this range, it can be seen as a sign of concealment and indifference. Also, a normal person blinks 6–8 times in one minute. If the frequency is higher, sometimes it indicates the feeling of being superior to the other side. On other occasions, it can mean hideous and dishonest. When a question is raised by one side, normally the other side would look directly into his eyes and answer the question. But if the other side avoids eye contact, it can be a misleading strategy or dishonesty. The frowning eyebrows and drifting eyes can convey a negative message and defense. The mouth is also an important way to observe people's psychological state. A tightly closed mouth often indicates strong will or serious thinking. Pouting means aggressive overtures or disapproval. When people bite their lips, they often show anxiety or guilt.

Body Movements. Only two levels of headings should be numbered. Lower-level headings remain unnumbered; they are formatted as run-in headings. In the course of bidding, investigator A is making a product introduction. At first, B is listening. In the process, B leans back on his chair, makes his legs cross, and put his hand on the armrests. Such body movements indicate the participant is losing interest in a certain topic. Continuing the topic can be the wrong choice. The change in interpersonal space also affects the feelings of negotiators. An example is that bosses and managers have a large office table which leaves a large room between the staff and the bosses. A larger space between the two sides can add potential pressure to the other side. It is a method to make negotiators more authoritative. Thus it benefits the negotiator to create more profitable offers. Shaking the foot or slapping the floor with the foot can be a sign of restlessness, helplessness, impatience, or a desire to get rid of some stressful situations. At the negotiation table, when the other side begins to show similar body movements, negotiators should consider whether the negotiation has been so long, in such occasions, the negotiation can be halted for a while to let both sides relax for a while, sometimes, it can mean the other side has been waiting too long and hasn't been offered the topics they truly care about. For negotiators, crossing their feet often means psychologically suppressing and even hiding their true emotions. For example, it can be a sign of holding back on some extremely favorable or unfavorable offers. In such cases, the negotiator should be aware of abrupt offers, for this movement shows vigilance or defense, or tries to suppress their nervousness or happiness. For negotiators, especially females, bringing knees together again indicates rejection or a defensive state of mind. This is often a subtle and tactful gesture. Sitting with legs wide open shows that the person is confident and willing to accept challenges. If the negotiator is sitting with one leg crossed over the other, it can be a habit. But sometimes it can mean unconsciously observing the other side and protecting the interests of their side. Frequent changes in leg posture can indicate emotional instability, restlessness, or impatience.

Gestures. In cases of selling, when the potential buyers are rejecting, while their verbal expression can be the same, their body language can show their true feelings (Ji 1999). While rejecting, the buyers who expose their palms to the buyer or even

show their palms while talking are believed to express the real reasons. But if the buyers hide their hands and avoid eye contact, they are believed to give excuses rather than true reasons. The changes in gestures can prove the validity or invalidity of their words. The knowledge of gestures can give sellers directions for their next move. If the buyer is pretending, they should alter to another area to find out their true interest. If they are speaking the truth, the two sides should explore agreement on the current topic. The hands and arms are the most flexible parts of the body that carry out a large number of movements. With the assistance of gestures and hand contact with the other side, negotiators can judge the psychological activity or state of mind of the other side. At the same time, information can be conveyed to the other side by these methods. A clenched fist is a sign of nervous tension. The clenched fist accompanied by a finger joint sound is a sign to the other side of the silent threat or sends a signal of attack. Clenching makes muscles tense, and people usually clench their fists in preparation for a threat or challenge from the outside (Ping 1994). Tapping the table with the finger or pen in the hand, or scribbling on the paper, often shows indifference to the topic of the other person, disapproval, or impatient consciousness, on the other hand, it also serves as a hint or reminds the other person's attention. Fingers crossed that making a shape of a steeple in the front of the chest is a common gesture in Western countries. It can be seen as a sign of expressing confidence. It is widely used when someone is giving a speech. In negotiation, it can show the negotiator is confident in the topic he is referring to. Such gestures have the effect of being authoritative and assertive and made the other side believe what the speaker is saying. If hands are crossed and placed in front of the abdomen. It is a reflection of modesty, reserve, or a nervous state of mind. In negotiation, this is often done when the negotiator is listening to the other side and still holds a conservative attitude to the offer. Crossing one's arms in front of the chest is often a sign of hostility and defense. Message can be conveyed by the movement of a handshake. The use of the handshake can be dated back to ancient times. When carrying out activities in hunting, ancient people often hold stones, sticks, or other weapons in their hands for defense (Zhong 2003). When two strangers meet each other, if they do not have malicious intentions, they usually put down everything in their hands and show their palms for the other to make palm contact, to show that they are friendly. Over time, the traditional habit passes on and evolved into today's handshake. The standard handshake is a slightly firm grip of the palm with the fingers, followed by a slightly firm grip of the palm for about one time. If the handshake is inconsistent with the standard posture, it has additional meaning beyond greetings and politeness. This often happens in negotiation. It mainly includes the following situations: if the palm of the other side is sweaty, it indicates that the other party is in a psychological state of excitement, tension, or emotional instability. If the other side shook hands firmly, it shows that the person has been very satisfied with the outcome of the negotiation. Also, it can indicate the negotiator's personality. People who make handshake in this way are often outgoing and passionate. This handshake is popular in the United States, which is largely due to its active nature of such kind of handshake. If you feel that the handshake is not hard, on the one hand, maybe the person's weak personality. On the other hand, it can be shown as a sign of being

arrogant and reserved in a negotiation. Staring at the other person for a moment before shaking hands, and then reaching out to shake hands, to some extent, this is trying to win the other person psychologically, in negotiation, people doing this are trying to put the other person at a psychological disadvantage of being stressful. Staring at the other person for a moment can mean examination and observation of the other side. This can give pressure on the other side, for they may wonder if the person is checking whether he is worth shaking hands with. Palm up to shake hands with the other side, often shows a weakness in status. It can show a passive, inferior, or supported by others situation. If the palm reaches down to shake hands with the other person, it is an attempt at strength and dominance. In other cases, palm down can also mean condescending. Clenching with both hands and waving them up and down are often used to express warm welcome and sincere gratitude to the other side, ask for help from others, or to affirm contractual relations and other meanings. In negotiations, this way of handshaking often appears at the beginning.

Culture Influence. Many commercial negotiations can be cross-regional. The differences in behaviors and ways of expression originated from the difference in history and culture (Edward 1999). By knowing the features of both cultures, negotiators can be better prepared for the possible misunderstanding. An excellent negotiator should be familiar with the fundamental interest of their side. By correct application of both sides' cultures, they show respect for the culture of the other side and confidence in the culture of their own. This can facilitate the negotiation. When negotiating, the negotiators should pay attention to cultural differences. This can lead to a contradictory result. When an American negotiator met with a Brazilian one, the whole procedure of the negotiation is successful. However, when they were to make a deal, the American negotiator used a gesture of 'OK', which was to round a circle using the thumb and index finger, to express his excitement. The Brazilian was immediately offended by such a gesture. While in American culture, such a gesture means agreement, it can mean offense and disrespect in Brazil. Many gestures have various meanings in different cultures. Similar examples like thumb up, which means agreement and approval in Chinese can mean negative in middle east countries (Portugal et al. 2014). Physical contact means communication through body contact. If used properly, physical touch creates feelings of warmth and trust. If used improperly, this can lead to distrust and even annoyance. Some cultures think physical contact is bad and offensive, while other cultures are familiar with physical contact. In Italy, Greece, Spain, and Portugal, people can see that men and women walk hand in hand or arm in arm. They are also more open-minded to physical contact in negotiation. But in some cultures, it varies according to gender. In Latin American countries, for example, contact between men is considered acceptable. The general rule is that older people or people of higher social status can actively carry out physical contact like a handshake or hug to someone who is young or of low social status. People from low-context cultures and people from high-context cultures have inconsistent attitudes toward touch. People are specific about how they behave. When these expectations are not met, they are confused. Sometimes the feeling of resentment and being ignored can arise. All people from different cultures bring their unique cultural baggage.

However, as people's understanding of another culture deepens, people should learn to adjust their expectations during business negotiations, and based on the different cultural backgrounds of negotiators adjust their behavior. Mutual respect's different living customs is the precondition of a successful negotiation.

2.3 Implications

The Principle of Equivalent. Although negotiators should learn the culture of the other side, excessively catering to their culture makes negotiators in an unfavorable situation. It can be sensed as a huge comparison in status. This can result in an unwanted offer by the other side. For example, people from western countries tend to carry out more body language. The Chinese tend to act in a mile and conservative way. In many situations, when verbal language fails to conduct meaning, the natural expression of body language can build mutual respect and trust. In negotiation, both sides should be based on fairness and equivalent rule. When they're sure exists a gap between two sides, the weaker side can make a concession. But the bottom line should always be kept in mind.

Listening Skills. First, a successful negotiator should spend more than 50% of the time used listening; Secondly, listen wholeheartedly, pay sincere attention, to listen respectfully. Such action makes the other party feel their subject status, is conducive to the completion of the transaction. In the process of listening, show respect, concern, and interest in what the other person has to say. Respond positively. Avoid showing signs of impatience. Don't interrupt the other person in the middle of his speech.

3 Conclusion

Above are the common action of body language and the information it can transmit in negotiation and communication. Interpreting body language should be analyzed by combining body movements and facial expressions as a whole, rather than judging the true thoughts of the other party by a single body movement or facial expression. In addition, some negotiators with professional body language training can control their body language and confuse the other party. As a pragmatic strategy in verbal communication, the use of body language will improve the skills of negotiators, promote the efficiency of negotiations, and help both sides to achieve success in negotiations, which is of great significance in international business negotiations. In business negotiations, the true acceptance and inner bottom line of the negotiating conditions of the other party are often not shown, but such deliberate suppression and concealment will be exposed by body language. It is difficult for human subjective consciousness to dominate body language. Body language can intuitively and quickly reveal the truest thoughts of the other person. By observing the subtle signs of changes

in the body language of the other party, we can infer the development trend and results of the whole business negotiation. Therefore, interpreting body language plays an important role in business negotiation.

These body languages are only in general terms. Different nationalities, different regions, different cultural levels, and personal cultivation can all result from different modes of their actions, gestures, and the information conveyed. Body language in a negotiation context should be treated differently in the specific environment. In addition, when observing the movements and gestures of the other party, body language should not only judge from an isolated and static movement or posture but should be analyzed and observed align with a series of movements and verbal language. Only in this way can the negotiators get more real, comprehensive, and credible conclusions.

In international business negotiations, negotiators should not only pay attention to the impact of cultural differences on language use but also take into account the cultural background and cultural differences of the same region when observing the behavior of the other party. This requires us to take a comprehensive consideration based on the cultural background while learning how body language reflects psychological emotions.

References

Benjamin V, Florence G (2009) The influence of Indian culture on negotiation from a French perspective. J Manage Dev 38(9):755–770

Edward H (1999) Understanding cultural differences, Los Angeles

Ji WB (1999) Intercultural nonverbal communication, 1st edn. Foreign Language Education & Research, Beijing

Knapp L (1978) Nonverbal communication in human interaction, 2nd edn. Holt, Rinehart and Winston, New York

Nagendra B (2018) The cultural negotiation: a shift of paradigm between first and second generation immigrants in Lahiri's the namesake. Prithvi Acad J 1(1):88–98

Ping Y (1994) A nonverbal communication review, 1st edn. Foreign Language Education & Research, Beijing

Portugal M, Li D, Rosa N, Ribeiro F (2014) Culture in international business research: a bibliometric study in four top IB journals. Manage Res 12(1):68–91

Varner I, Beamer L (2006) Intercultural communication in the global workplace. China Machine Press, Beijing

Yi FZ, Kyung K (2019) The individual on the move: redefining 'individualism' in China translation and interpreting studies. J Am Transl Interpreting Stud Assoc 15(2):161–182

Zhong XZ (2003) Principles and techniques of business negotiation. Southeast University Press, Nanjing

National Culture and Business Negotiation

Lisi Liu

Abstract The differences of national culture have been one of the main factors that need to solve in recent years. There are many people who come from the different countries, so they must have the different cultures, customs and habits. The business negotiation means that buyers and sellers achieve cooperation to obtain their respective benefits or solve disputes between them. As a matter of fact, with the development of the global economy, negotiators may meet many kinds of people from the other countries. This requires the negotiators that they not only need to consider the conditions and interests, they also need to pay attention to the opposite representative's national cultures and customs. The article mainly uses case analysis and literature research to explain the relationship between national cultural differences and business negotiations deeply. Through a series of analysis, there are five kinds of cultural differences that are language, etiquette, religious, customs and thinking differences could affect business negotiations. In conclusion, the negotiators should take measures to make some preparations in advance, only by control more details of ourselves and the opposite representative can they win the greatest interests.

Keywords National cultural differences · Business negotiation · Case analysis

1 Introduction

Business negotiation can be defined as the activity in which different subjects negotiate the conditions in order to reach a cooperation. Culture could be defined as the summary of heritage from human beings of historical development. According to the background that is the global economic connectivity, the cultures displayed by countries are very different. With the increasing of trade exchanges between countries, cooperation opportunities between companies that are from various countries

L. Liu (✉)
Xi'an University of Finance and Economics, Xi'an 710000, China
e-mail: 2016150229@jou.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_50

are also raising. Negotiation is the necessary process for companies to reach cooperation, so in order to get the greatest for themselves, they must understand each other details and master each other's culture. Although cultural exchanges are not complete, they find that socio-economic development is greatly hampered by not knowing the cultures of other countries (Tu 2021).

2 Negotiation, Culture and Analysis Model

2.1 The Business Negotiations' Definition and Characteristic

In the general framework of global economic integration, trade activities between countries become more frequent, commercial relations become increasingly complex, international business negotiations become an indispensable part of transnational trade exchanges (Yuan and Lin 2021). Business negotiations are a means for both parties to obtain benefits and reach cooperation. With the high level of economic exchanges, business negotiations have become a central part of business activities. It can be said that without business negotiations, companies cannot reach a deal and cannot grasp more market information. In addition, the principle to be followed in business negotiation include win–win principle, equality principle, legality principle, timeliness principle and minimum objective principle.

Business negotiation also has many effects. First, business negotiation could be the mean to achieve economic goals. Second, it is an important way to obtain market information for enterprises. Finally, it is the core strength of enterprises to explore the market. As for the characters of business negotiation contains that the purpose of business negotiation is to gain more profits. Different kinds of negotiation have the different points, for example the point of political negotiation is about party, and the point of military negotiations is about the safety of countries. Although these negotiations may all involve the economic profit force but they have their own core profit than the economy. However, the business negotiations have the most obvious purpose is for the economy interests. In the most extent, people often consider the number of interests they could get to evaluate the degree of success. Also, business negotiators consider the value negotiation as the core. In business negotiation, the manifestation of value is price. For many cases, the gains and losses of interests can be reflected by the price requirements of both sides of the negotiation. Negotiators pay more attention to the tightness and accuracy of the contract. The contract reflects the rights and obligations of both parties. Therefore, the safety of contract is the significant condition to ensure the interests of both sides to the negotiation.

2.2 National Culture's Definition and Characteristic

The meaning of culture is not only to cultivate the land, but also to take care of the land and raise animals, take care of people's lives that include dressing customs, decorating the body, care for friends and sacrificing ancestors. It also means living in towns or urban areas, and cultivating correct morality and mind. In the late middle-ages, culture began to refer to moral perfection and mental and artistic achievements. As for the characters of national culture, it originated from human beings, is a precious legacy of human development, and it has become a spiritual foundation unique to all regions of the world. Within the inconsistencies. In different countries, the culture of each region or ethnic group is very different. For example, many scholars have conducted in-depth discussions on whether different ethnic groups eat pork. Only when we fully understand the differences in thinking styles, concepts, values, background cultures, national characteristics, religious beliefs, etc. of different countries, can we formulate our own negotiation strategies in a targeted manner, grasp them as a whole, consider them as a whole, and better achieve the success of international business negotiations (Wang 2021).

2.3 Analysis Model for the Impact of National Cultural on Business Negotiation

Language Difference. Business negotiation is a communicative activity, and language is a tool for communication. Both parties to the negotiation need to use good language skills to express their respective positions and views clearly, and finally reach a consensus of opinions, and the good negotiation effect is fully reflected in the use of negotiation language, strategies and methods (Shanliang 2022). There are thousands of languages in the world, and the way of communication also varies according to cultural differences. For example, Americans handle affairs cleanly, so when negotiating with Americans, they should express. Their opinions are direct, and "yes" or "no" must be communicated directly. The Japanese are very euphemistic, and they rarely refuse. They think it's rude to reject it outright, which is a very inappropriate social etiquette. Therefore, when negotiating with Japanese people, negotiators should try to consider whether the other party will think more about their own words. They should also know that unfamiliarity cultural factors and the peculiarities of cross-cultural communication can lead to inappropriate costs and failures in foreign markets (Simeon 2022).

The impact of cultural differences on business negotiations is also reflected in nonverbal communication. Negotiators' understanding of body language varies greatly, and many times body language conveys the exact opposite message. For example, most countries nod their heads in agreement and satisfaction. In India and some countries, however, people shake their heads in approval. In addition, another example means "OK" gesture to Americans, which stands for "money" in the eyes of

the Japanese, but for Tunisians, it is a provocative act. The negotiations start from the conversation. In China, people often call other their family name and their occupation to show honor to other people, such as, Lawyer Zhang or Teacher Mei. However, they could not do like that in the areas of English. They should be called Mr. or Miss, Ms. Mei. However, in some countries, such as Germany, people attach great importance to job titles, so when people communicate with them that they should add the job titles. What's more, in western countries they could call their family members name directly, which is quite different from the traditional culture of Asia, China, Japan, South Korea and other countries. A good cross-cultural understanding can help with the percentage of success in the negotiation process. Cultural barriers such as when people communicate with others without language skills, the prejudice from others can decrease the speed of study negotiation process (Adelina et al. 2022).

Etiquette Differences. There are also obvious differences in etiquette culture in social intercourse and even international business negotiation, which has a great relationship with the historical development and civilization evolution of countries all over the world. Gentleman's speech and behavior will create a good image and a friendly atmosphere for business negotiation. In Asian countries, people attach great importance to etiquette culture. For example, Japanese businessmen are known for their calmness and preciseness. They not only pay great attention to their appearance, but also integrate the etiquette norms into their words and deeds. They pay more attention to the standing posture, sitting posture, kneeling posture and various bow angles, as well as the grasp of the distance between the two sides, this systematic code of conduct will leave a very good impression in business negotiations. Although the United States and some other western countries are not as strict as Japan, they also have etiquette of taking off their hats and shaking hands. Handshake is the most common etiquette, but when people facing a woman, they can't reach out actively, they should wait for the woman reach the hands firstly. This is called contact culture, and Chinese people usually keep a certain distance to give a certain sense of comfort (Liang 2017). In addition, in China, when a man shaking hand with other people, if the opposite representative is a woman, he needs to shake half of his hand. However, if the opposite representative is a man, he needs to hold his full palm.

Punctuality is also a kind of etiquette. It is worth nothing that people from different cultural backgrounds treat time differently. Western people attach great importance to the concept of time, especially Switzerland and Germany. They have a strong sense of time and will never be late. Asian countries, such as Japan, they are generally very strict requirements for work, very strict with the rules, excellent control of time, generally will arrive at the conference venue in advance to avoid being late. What's more, the negotiators in China usually do some preparing in advance to make the opposing representative feel respected. In addition, the preparation includes the study and analysis of the other party and attention to the context of the negotiation by collecting and organizing information (Hishan and Al-Sharea 2022). In contrast, people in Latin America are more casual. Although integrity is part of traditional

Chinese culture, people's requirements for time are relatively relaxed, and daily activities are relatively few. Their daily activities are relatively free and often late. Therefore, if negotiators do not understand the other party's cultural concepts in advance, they cannot largely forgive the situation, which will lead to conflict. This concept of time is also often reflected in business negotiations. For Americans whose time is money, efficiency and speed are everything. They have a strong sense of aggression and competition, while China pays more attention to building for a long-time relationship. According to this situation, mastering the necessary business etiquette is the basis and key to achieving win–win cooperation with foreign countries (Qi et al. 2020).

Religious Differences. Different countries have different religious beliefs, and there are also great differences in social communication and personal behavior. For some behaviors and ideas, different religions have different understandings, and these differences usually affect the behavior and habits of negotiators, thus causing inconvenience in international business negotiations. For example, Muslims in the Middle East do not drink alcohol and eat pork, and so on. If you do not know in advance during the business negotiation, you may offend the other party at some points. Religious activities often have fixed days, such as Christianity. In addition to some international festivals, festivals vary from country to country, even working hours. For example, Chinese traditional festivals, such as Spring Festival, National Day and Mid-Autumn Festival are different from those in other countries. The other factor is the working time system, there are some differences in the working system and length of time in various countries. This has a very significant impact on the specific plan and schedule of business negotiation. Therefore, comprehensive factors must be taken into account when formulating the plan.

Customs Differences. As an important part of culture, the influence of customs and habits on international business negotiations cannot be ignored, and negotiators should learn to think differently based on each other's cultural systems (Lin 2019). In the process of business negotiations in different countries, contradictions and misunderstandings often arise due to differences in customs and habits, which are usually related to the history of different countries (Wu and Guo 2021). The famous custom in China is table culture. Chinese people prefer the entertainment culture on the wine table. Drinking and eating have become a culture, which is a tradition left from ancient times. For Chinese people, you come and go, drink and eat, which can quickly close the relationship between people, and is also an effective means of communicating emotions. The same is true of some Asian countries. Western countries and even some non-western countries are more practical. They pay more attention to the event, as well as private time and space. Therefore, it is no fit for these situations. In western countries, the family, age and salary are all personal privacy, which is often ignored in communication and negotiation. A little greeting will cause each other's unhappiness. There will be different effect due to cultural differences of various countries on international negotiations.

In other aspect, the sense of equality is irreplaceable in people's hearts in America or other western countries. The concept of equality refers to the principle of maintaining fairness and justice in the process of international business negotiations. It likes to use data to explain everything, starting from the actual interests of both sides of the negotiation, in order to achieve win–win results.

Thinking Difference. The greatest difference between people is the mode of thinking. In the negotiation process, people's thinking mode has always played an important role. The mode of thinking is formed by the development of the surrounding cultural environment and is influenced by morality and values. These factors are different in the culture differences of various countries, which leads to the differences in the mode of thinking of negotiators. This difference is bound to have a certain impact on negotiators' skills, behavior and style, such as the China and western countries. Chinese people consider more about built a long-time relationship, that means that negotiators from a collectivist culture concentrate more on forming a relationship and they treat different to people between in-group and out-group partners, having strongly connection with the former and working hard for their collective interests during the negotiation process, an approach that can lead to higher joint profits (Sara et al. 2021).

Chinese culture grows in the inland environment. The special geographical environment of the east and south seas, the western mountains and the northern desert has formed a naturally closed survival system. Therefore, culture is in a relatively stable state. This stability is largely the result of running around the center of the circle. This circular culture makes Chinese people from a kind of curvilinear thinking. They are used to taking a circuitous and tactful way in daily communication and expression and like to express from the perspective of details and sides when facing problems, they sometimes avoid to directly cut into the main points. Western countries with cultural differences are different. Their linear thinking allows them to get straight to the point and directly enter the theme center in communication and negotiation. Chinese people pay attention to tactical strategies and will not easily let the other party perceive their intentions, and the negotiation expression is more euphemistic. Western people, such as Americans, have a warm and frank style of acting, speak frankly, and will not hide their interests, needs and purposes.

The perceptual thinking of Chinese people is a kind of fuzzy thinking, which makes it impossible for people to have a clear definition of things and conduct logical and organized analysis. On the contrary, westerns thinking can make them better face the essence of things, rather than focusing on the external performance of things. The difference between the two kinds of thinking will easily lead to the difference in the purpose of negotiation is not only for the terms, but also to lay the foundation for the future cooperation between the two sides. Western negotiators only focus on the negotiation task itself. They are more concerned about whether the negotiation is successful and whether the expected profit value is achieved.

3 Negotiation Case Analysis

3.1 Successful Case

The US prime minister Ford visited Japan in earlier years, the company (CBS) received the task to Broadcast all of Ford's activities in Japan to the United States. CBS negotiators arrived in Tokyo quickly to prepare the equipment needed for the meeting before Ford's visit to Japan. The representative of the US is an ambitious and young man, he put forward many exorbitant requirements, while the representative of Japan is silent. After the negotiations were concluded, the two sides failed to sign the contract. Two days later, a senior CBS executive apologized for the behavior of the CBS young employees. He then tells them that they can help as much as they can. The Representative of Japan accepted his apology, and the two sides quickly signed the contract. The story tells us that Americans' thinking is too straightforward, while Japanese thinking is more euphemistic. Americans pay attention to reality and have no enough patient. However, Japanese dislike too much pressure, they prefer to care about the qualification and status. Senior managers understand the cultural background and negotiation style of the Japanese and have made great contributions to the cooperation between the two sides.

3.2 Failed Case

A representative of a Brazilian company wanted to go to the United States to buy cheaper equipment, but the Brazilian negotiating team was delayed for a long time because of shopping on the street. When they got there, they were nearly an hour behind the scheduled start. U.S. company representatives were so angry that they accused the Brazilian representative of punctuality. In addition, during the course of the negotiations, the representative of the United States continued to mention the matter many times that caused the representative of Brazil was ashamed of it, and they had no intention to bargain with the Americans. They could not calm down to see the contract seriously, and then they hurried signed the contract. When the contract had been signed, Brazilian negotiators realized they had lost a lot of money, but it was too late. Different cultural backgrounds have different concepts of time. Americans are particularly strict about time, believing that time is money. However, some Asian countries have very relaxed requirements for time, they think that was unforgivable. The case shows that it is necessary to understand the culture of different countries in order to a better negotiation.

3.3 Cross-culture Cooperation Skills

Language is a major source of negotiation power. Most Americans only speak English. In various negotiations, language and body language are important factors affecting negotiations. Many time people in the same cultural background also have deviations in their understanding of language. Thus, when a person speaks another language, the deviation in meaning is certainly greater. Sometimes, language also determines culture, because different languages have their own unique ways of interpreting it. Multi-language speakers need to change their mindset frequently to suit the scenario they are in. As a result, cross-cultural negotiations will always face the necessary language barriers. As we know, business negotiations in general require hiring translators to ensure that their ideas are better relayed. Finally, before the negotiation, a negotiation team should be designed, which needs professional skills, the team members should have professional communication ability and cooperation ability. Negotiation team should evaluate the situation, determining the facts that need to be verified in the negotiation process and select the best time and strategy. The negotiators should master the operation of international business negotiation under the influence of cultural difference, they can remove the cultural barriers for enterprises to carry out transnational business negotiation (Si 2021).

In daily business negotiations, the behavior and habits of the object of any business negotiation are closely related to the cultural background, national customs, business habits and language habits of the country and nation in which is located. If you want to "Know each other and friends and be invincible in a hundred battles" in business negotiation is required to understand the culture, customs and business habits of different countries and nations. In this way, negotiation strategies and business reception can vary from person to person and avoid taboos. The concept of time also has an important impact on business negotiation. It affects people's behavior and communication effects. Some actions represent the idea of time and convey some important information about the idea of time. Therefore, when people from different countries are communicating, they should be deeply aware of this, avoid conflicts and obstacles caused by cultural differences in the concept of time. Negotiators also should understand the differences between Chinese and western concept of time, which is conductive to economic cooperation and exchanges between China and the West. Therefore, in the negotiation process, it is not only necessary to establish a correct cultural attitude, rationally use communication skills, strive to overcome communication barriers, but also to pay attention to the emotional maintenance in the later stage (Du 2020). In international business negotiations, negotiators should have extensive cultural knowledge and advanced speaking skills, effective negotiation methods, and a good understanding of the cultural background of the other party's country, so as to maximize the economic interests of both parties to reach consensus (Xie 2020).

4 Conclusion

Cross-culture negotiation is a kind of behavior of both sides people that they exchange their ideas and emotions on a certain thing or their interests in a specific occasion to reach an agreement. In the negotiation, both sides will have many different conflicts of interests. The negotiation may succeed or fail. On the one hand, the result depends on whether the conditions given by both sides that they can get enough interests from the opposite side. On the other hand, the result also depends on the attitudes of the negotiators, this usually shows as they can give enough respect to the opposite negotiator's national culture. Therefore, in the negotiation, negotiators should understand each other's advantages and weakness, and they should show their talents on the basis to achieve the goals of negotiation. Based on the different culture, there will be various effects on concepts and thinking systems of both sides. In a word, it is very important to understand the cultural differences and recognize the impact of the national cultural differences.

References

Adelina A, Apriyanto S, Triana Y (2022) Cross-culture negotiation of Indonesian students. Scaffolding: Jurnal Pendidikan Islam dan Multikulturalisme 4(1):405–413

Du L (2020) Analysis of cultural factors in international business negotiations. Modernization Mall 22:75–77

Hishan S, Al-Sharea M (2022) The influence of culture on international business negotiations. Asia Proc Soc Sci 9(1):265–266

Liang Q (2017) A study on the cultural differences between Chinese and Western interpersonal distances. Overseas English 20:176–177

Lin C (2019) Differences in customs and habits in intercultural international business negotiations. Mod Commun 8:86–88

Qi L, Cao P, Xiao X (2020) A study on the differences and countermeasures of Chinese and Western business etiquette from the perspective of cross-cultural communication: an analysis based on context. Office Bus 22:110–111

Sara B, Ogliastri E, Caputo A (2021) Distributive/integrative negotiation strategies in cross-cultural contexts: a comparative study of the USA and Italy. J Manage Organ 27(4):786–808

Shanliang Q (2022) Analysis of the linguistic characteristics of business negotiations. Chin Bus Theor 1:126–128

Si Y (2021) Strategic selection, influence and countermeasures of international business negotiation from the perspective of cultural differences. J Hubei Univ Econ 18(2):39–42

Simeon S (2022) Culture and intercultural communication in international business. Ikonomiceski i Sotsialni Alternative 1:95–110

Tu Y (2021) An intercultural comparison of negotiation styles between Taiwan and the United States. Acad Strateg Manag J 20(6):1–18

Wang B (2021) On cultural differences in international business negotiations. Modernization Mall 15:142–144
Wu P, Guo Y (2021) A study on the influence of differences in customs and habits in cross-cultural business negotiations. Enterprises Reform Manage 19:217–220
Xie C (2020) Cross-cultural barriers in international business negotiations and coping strategies. Modern Mark 3:40–42
Yuan M, Lin M (2021) Research on international business negotiation skills based on the perspective of cultural docking. Modernization Mall 20:110–112

Analysis of the Impact of Cultural Differences Between China and the United States on International Business Negotiations

Ruihan Jin, Jiahui Song, Qiyu Wang, and Yuanqing Wang

Abstract It is well-established that different areas have cultural differences, influencing people's communication and trade. The United States is the world's largest economic country and China's largest trading partner. Differences in concepts and habits formed in a specific cultural environment cause conflicts in business negotiations. The primary main object of this study is to survey the impact of cultural differences between China and the United States on talks. The paper analysis has included three parts between the China and America negotiation, The effect of cultural differences, The impact of differences in mindsets on words, and the result of the differences in values. In sum, it can contact those cultural differences between China and The United States affect business negotiations. For future studies, we are trying to research the strategy of cross-cultural research. These results suggest significant differences between Chinese and the United Stated cultures in various areas, which influenced the negotiation.

Keywords Cultural differences · Business negotiations · Intercultural communication

Ruihan Jin, Jiahui Song, Qiyu Wang and Yuanqing Wang are contributed equally

R. Jin
Knowledge-First Empowerment Academy, Missouri City, Texas 44004, USA

J. Song (✉)
School of Languages and Cultures, The University of Sheffield, Sheffield S1 4FD, UK
e-mail: JSong48@Sheffield.ac.uk

Q. Wang
Beijing Royal School, Beijing 102209, China

Y. Wang
Beijing Haidian Kaiwen Academy, Beijing 100195, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_51

1 Introduction

Negotiation is a decision-making process while two or more parties involved that both parties will find an acceptable way. The parties first offer their demands and then move toward an agreement through concession making or search for new alternatives. The process continues until both parties agree to a resolution. Giving and taking us involved in the negotiation means one party will win; however, the other should take process. Negotiate is from Latin. Although most people frequently bargain, if not every day, they find the process dreaded. Examples include haggling over the rent of an apartment, reviewing the details of a job offer with a recruiter, and negotiating a contract with a supplier. However, there are the less formal, more subtle discussions we engage in daily, such as persuading a young child to eat his vegetables, resolving a quarrel with a coworker, or persuading a cup of coffee to accept a late delivery. These are all part of the negotiation. All three of the modes of negotiation that we have described are highly relevant to language learning, though we have focused on the potential contribution of procedural negotiation to the language classroom. Learning to perceive and communicate meaning in a new language requires learners. A language class's communicative and social activity will include interactive negotiation, which involves discussing, checking, and clarifying meanings, as well as procedural negotiation, which entails coming to a decision. Importantly, all three of them are connected.

Researchers looking into the nature of conversational contact first used the term "negotiation" in our meaning here. Here, the negotiation is obviously social and takes place when people use language to either show that they understand, do not understand, or even believe what another person has said, or to change and reorganize their language to be more understandable. When Evelyn Hatch investigated how learning may genuinely result from the kind of interactions that learners may be involved in, she first realized the implications of this for language learning. This dramatic deviance from the conventional wisdom that the ability to communicate was a result of the necessary prior and explicit learning of the forms of language, which was consistent with the well-known claim made by Krashen that the main factor in determining language acquisition is the availability of comprehensible information for learners.

Economic integration makes international business contacts everywhere and all the time. If any country wants to develop and progress, it must carry out various forms of trade with other countries. In cross-country business negotiations, both sides need take necessary countermeasures to achieve the purpose of negotiation. At present, the economy and trade between China and the United States are developing rapidly, and the business negotiations between the two sides are becoming more and more frequent.

2 Cultural Differences Analysis Framework

2.1 Differences in Chinese and American Mindsets

It is widely observed that China, the world's biggest developing nation, and the United States have garnered increasing attention from each other, and even from the rest of the globe. As a result, business negotiation will be crucial in the advancement of economic exchange and commerce. However, cultural differences between China and the United States have a significant impact on economic discussions between the two countries. People who are not sensitive to cultural differences frequently lead to cultural conflicts by evaluating people's actions, views, and customs in another culture using their own cultural models.

Taking national culture as the focus of attention has severely hampered people's thinking and behavior throughout time. People often perceive other cultures through tinted lenses and compare two civilizations to assert that their own cultures are better to others. People must overcome cultural obstacles in order to conduct effective international commercial talks. As a result, regardless of whatever nation participates in the discussion, effective commercial commerce with the others is conceivable. In corporate talks, China and the United States must improve their cultural awareness and understanding of differences in ways of thinking, values, and negotiating methods. As a result, it may serve as a wonderful basis for achieving an agreement. To be more explicit, China and the United States vary in the primary schools of thought, logical processes, and dialectical methods that impact their respective nations. The major effect of culture is evident in various nations' morals and legislation, the ideologies that different countries accept, the manner they deal with matters, and the social hierarchy; Distinct negotiation styles, on the other hand, will have an impact on the trade process. We can tell from several aspects that China and the United States have different attitudes in negotiation, etiquette styles, expression techniques, and negotiating aims during commercial negotiations. Given the aforementioned contrasts, this study makes constructive ideas for Chinese and American negotiators that are favorable to harmonic dialogue from the standpoint of cross-country communication. Meanwhile, we will address how to appropriately deal with cultural differences between China and the US throughout the negotiating process, so that trade discussions between China and the US may progress easily and precisely.

2.2 The Chinese Mindset and Its Negotiation Strategy

To have viable business talks, it is fundamental to have a shared comprehension of one another's exchange styles, and social qualities and social shows have a huge part in characterizing discussion styles (Adler et al. 1992). This review will initially explore the ideal character that Confucianism endeavors to develop, then, at that point, it will exactly test its effect on Chinese exchange ways of behaving and outcomes. So the

lessons of Confucius can impart profound quality and appropriate conduct in each individual so they can become respectable men with ideal character and equipped for administering with moral sense and verifiable insight, this study will initially explore the ideal character that Confucianism endeavors to develop. This study will utilize Western hypotheses of character to break down the unique character structure that is hidden inside Confucian guidance and its impact on Chinese business haggling techniques. The motivation behind this study is to show that Confucianism altogether affects how Chinese business is directed. Broad exploration has been directed on Confucianism as well as Chinese culture; be that as it may, very little consideration has been devoted to the Confucian ideal character and what it means for discussions about business.

At the point when it came to passing on his insight, Confucius was basically worried about helping his understudies in developing ethically. The way of thinking of Confucianism puts serious areas of strength for an on the improvement of one's maximum capacity. Everybody needs to have the objective of turning into a "wonderful man," otherwise called a "Junzi," as per Confucianism. A Junzi is somebody who has the qualities of a holy person, a researcher, and a fighter all simultaneously. Benevolence, astuteness, and dauntlessness are the three crucial qualities that make up Junzi's origination of the ideal Confucian character. Individuals ought to be educated in the "six expressions," as per Conscious Confucius, so that "the splendid have no perplexities, decent individuals have no nerves, and bold individuals don't fear" (Barry and Friedman 1998). As an immediate consequence of this, Confucian Junzi has the appeal of a logician, the responsiveness of a humanist, and the grit of a bold champion. Since old times, the ethical norm for all Chinese individuals has been Confucius' ideal character for a Junzi, which has saturated the country's social customs as well as its feeling of public personality.

This examination will focus on two particular styles of arranging ways of behaving: integrative and cutthroat. The utilization of lose or aggressive systems, like dangers, guarantees, position, responsibilities, and enticing arrangements, as well as other very unbending methodologies, to pressure different gatherings into making concessions, now and again to the detriment of the enemies, has been broadly concentrated on in the exchange writing (Bazerman et al. 2000; Blackman 2001). It is described by a way to deal with critical thinking that underscores joint effort and the trading of data, as well as a fixation on tending to and fulfilling the prerequisites and tendencies of the two players (Bloomberg News 2022). Assuming you are ready to change your position and quest for arrangements in which everybody benefits, then, at that point, you are exhibiting integrative way of behaving.

This exploration investigates whether the Confucian ideal character impacts the methodology of making a first proposition (Brislin 1986). First offers, otherwise called opening offers, frequently contain fundamental data and may consequently establish the vibe for resulting dealings. In any case, there is a cutoff to how much achievement can be accomplished by utilizing extreme offers. For example, recommendations that are stunning to such an extent that they bring into question the

believability of the individual who caused the proposition or that run the expectations of the opposite side to the direct that they toward consider leaving are less fruitful.

The primary essential part of the Confucian ideal character is consideration, which involves adoring one's kindred man while additionally captivating in struggle with one's enemies while keeping a cool head and discretion. Since Confucius upheld "reimbursing harm with equity and generosity with consideration," an individual with the Confucian ideal character is urged to cherish everybody, except for their rivals. This is on the grounds that Confucius had confidence in "reimbursing hurt with equity and generosity with graciousness." As an outcome of this, the kindness part of the Confucian ideal character is bound to lead moderators to take part in cutthroat way of behaving and to make high beginning offers while managing their foes in light of the fact that their enemies are viewed as untouchables, rivals, or even adversaries.

Empathy requires a specific arrangement of abilities, including the ability to keep a cool head and withdraw from a circumstance. As indicated by what has been shown up until this point, the most excellent instances of character types are those that radiate a quiet and dispassionate methodology. They are less inclined to partake in integrative exercises, for example, framing associations with different mediators and discussing fair data with them because of the assumptions that have been placed on them. Then again, they are more disposed to partake in serious ways of behaving, for example, rivaling different gatherings and keeping a stone-like face before them. Moreover, graciousness as a part of limitation is connected to being fastidious, reliable, and exhaustive, all of which typically aid the course of cooperative critical thinking and may subsequently advance integrative way of behaving and make one less ready to take a firmly cutthroat disposition during dealings. As per the discoveries of this exploration, close to home serenity is associated emphatically with cutthroat ways of behaving and the primary proposition, however adversely with integrative way of behaving. Then again, restriction is related adversely with cutthroat ways of behaving and decidedly with integrative way of behaving.

2.3 American Way of Thinking and Negotiation Strategy

Research in political psychology has shown that individuals in the East and West think differently. For millennia, the East and the West have had quite different ways of thinking about the world. Worldview and the thinking process are intertwined; social behavior develops the worldview, which in turn influences the thinking process. As a result, the mentalities of persons from various cultural backgrounds vary greatly. Social psychologists (particularly in the West) first realized and empirically verified this distinction at a very late stage.

People in the West for a long time believed that everyone else thought like them. That everyone had the same fundamental cognitive processes, that cultural variations were based on beliefs rather than on differences in processes, and that the reasoning

process followed rigorous logical norms and was independent of the subject matter. A psychologist at the University of Michigan, Richard Nisbett, has discovered this and investigated it. In a book on reasoning, he and a co-author called it Reasoning in Man rather than Reasoning in the West, despite the fact that their subjects were mostly Westerners or American university students. That everyone sees and thinks alike is profoundly ingrained in Western culture, according to him. After being challenged by a Chinese student, he was able to shift his own perspective on the matter. That's what he heard from this pupil "What you and I have in common is that I believe the world is a circle, and you believe it is a straight line." The Chinese see the world as a continuous cycle of change and return to a starting point. The Chinese believe that comprehending the whole is more important than understanding the pieces, thus they concentrate on a broad variety of events and examine the connections between them. As a result, Westerners have a tendency to see the universe in terms of discrete items or individuals rather than as a whole, leading them to believe that they have some degree of influence over the course of events since they are familiar with the laws that regulate the behavior of these objects." Experiments on social psychology demonstrate considerable distinctions between Asian and Western thinking, says Nisbet. For the most part, the contrasts between Chinese and American thinking are similar to the differences between Asian and Western thinking in terms of four primary areas: dialectical thinking, relational thinking, analogical thinking and internalized vs externalized thinking. It's impossible to overlook the consequences of these four discrepancies for the outcome of China-US discussions. We need to understand the American mindset in order to build a "new kind of great power relationship" between our two countries, rather than pushing our ideals on them in a wishful fashion, from the Chinese side.

3 The Impact of the Differences in Values Between China and the United States on Business Negotiations

3.1 Differences in Strategic Negotiation

The dialectical way of thinking commonly used by the Chinese has had the greatest influence on their process of understanding problems and is evident in the way they view contradictions. Americans view the world from the perspective of its relative stability, believing that it is possible to extract individual things from a larger context and make judgements about what is right or wrong. This way of looking at contradictions leads the Chinese to resort more to negotiation when dealing with them, whereas the Americans resort to rules and laws. The Chinese concept of dialectic consists of three principles: the theory of change, the theory of conflict and the theory of neutralization. Unlike the Chinese, Americans believe in Aristotle's formal logic, which emphasizes the unity, non-contradiction and neutrality of the world. People influenced by this way of thinking believe that a proposition cannot

be right or wrong at the same time, that it is either right or wrong, and that there is no middle ground. For the Chinese, the most obvious manifestation of this simple epistemology is the 'middle way' of Confucianism, which has been internalised over thousands of years and has even become a character trait of the Chinese people. Values are the standard to measure people's behavior and culture. They affect the way people understand problems and also bring strong emotional impact to people. In different countries' cultures, there will be great differences in values. Meanwhile, those conditions may happen that an appropriate behavior or word in one culture may be considered immoral in another.

3.2 Differences Between Morality and Law

The first is the value differences between morality and law in China and the United States cultural relations. Great progress has been made in the construction of the rule of law in China, but due to the profound influence of values, people still tend to judge right and wrong by moral standards first, and then by laws and regulations in daily life (Ferraro 1995). However, for Americans, the order of these aspects is exactly the opposite. Chinese people tend to think ethically and prefer to use their interpersonal relationships to solve problems, even though these problems could have been solved in a normal way. Americans will use some legal method and rarely take private ways other than normal ways to solve problems (Liu 2021). When problems arise, they will resolve differences and disputes in accordance with the law. Therefore, they will spend more time and energy on the formulation and implementation of the contract (Nystrom 1990).

3.3 Differences in Dealing with People and Affairs

The values of Chinese culture in interpersonal relations emphasize tolerance, approachability, kindness. The core of all these concepts is to achieve interpersonal harmony. In order to live in harmony society, Chinese people will take an indirect way in words and deeds to avoid offending problem. In Chinese culture, people are more concerned about what others think of them (Zhao and Yu 2017). When doing things, Chinese people should first consider the ideas of others, and often regulate our behavior according to others' evaluation standards. Americans pay attention to competition, emphasize freedom and independence, and often express their views frankly in conversation. Therefore, Americans will hardly give up freedom of speech. In the visions of Americans, debate is not only to express personal views, but also to help solve problems. Differences of opinion will not affect interpersonal relationships.

3.4 Differences in Society Hierarchy

Fourth, the difference in values between the upper-level employees and lower levels employees of China and America. Chinese culture pays attention to ethics, and the hierarchical relationship between people. Chinese people's hierarchical relationship theory is based on the points that is talked by Confucius, which are benevolence, righteousness, courtesy, wisdom and faith. Therefore, in China, the relationship between superiors and subordinates has been alienated. Meanwhile, the qualifications elder people and authority superiors are also respected by the subordinates and younger. As far as we know, Chinese people are usually affected by collectivism, they focus on the group they belong to, and the ability of the leaders. Therefore, the final decision is made by the leaders. In America, interpersonal relations generally show that both sides of communication are equal, and the superior and subordinate are just one position. Everyone can have their own ideas for communication and exchange, so there is no principle about low status listening to high status.

4 Conclusion

The Chinese value a comprehensive way of thinking. Americans, on the other hand, tend to have a linear mindset, which has been shaped by the evolution of their philosophical thinking. The linear way of thinking that focuses on the analytical anatomy of things and the study of individuals is the main characteristic of the American mind. Influenced by the linear way of thinking, the emphasis is placed on the logical relationship between things. The emphasis on authority affects the autonomy of Chinese negotiators. It often leads to the delay of negotiation time and arouses the dissatisfaction of the other party. What's worse, sometimes this little time can cause huge economic losses. A strong sense of individuality has formed the American "dogmatic" negotiating style. Influenced by the concept of equality in the United States, the two sides of the communication are equal, and the negotiators are also equal in business. However, since the negotiating party is Chinese, their prominent personal role may put a lot of pressure on the other party, which may make the opponent very uncomfortable and lead to a deadlock in the negotiation.

Chinese people's values—collective-based thinking. He has formed a character of being kind to others and taking into account the overall situation. He is more considerate in dealing with problems, has a strong human touch, and rarely has a face-to-face, extreme or emotional approach. The Chinese give priority to humanity and friendship in negotiations, and then to laws and rules. The Chinese are reserved and polite, rarely raise objections in person, show a moderate attitude when expressing their opinions, and are ambiguous in their speech and actions, which makes the other party unable to negotiate without knowing why. American Values—Personalism. Individualism is at the core of American values, believing that a fair competition is the best way to motivate, and this value makes them more accustomed to dealing

with affairs alone, solving problems arbitrarily, being brave in expressing and recommending themselves, and rarely by covering up their emotions, they can express their feelings naturally, even in public. However, these will affect Chinese negotiators to a certain extent during negotiations and may cause unnecessary conflicts.

References

Adler N, Brahm R, Graham J (1992) Strategy implementation: a comparison of face-to-face negotiation in the people's republic of China and the United States. Strategy Manag J 13(6):449–466

Barry B, Friedman RA (1998) Bargainer characteristics in distributive and integrative negotiation. J Personal Soc Psychol 74(2):345–359

Bazerman MH, Curhan JR, Moore DA, Valley KL (2000) Negotiation. Annu Rev Psychol 51(1):279–314

Blackman C (2001) China business: the rules of the game. Allan and Unwin, St. Leonards

Bloomberg News China to Bring 'New Ideas' to Managing Foreign Reserves. http://www.bloomberg.com/news/2012-03-12/china-to-bring-new-ideas-to-managing-foreign-reserves-1-.html. Last accessed 20 Jul 2022

Brislin RW (1986) The wording and translation of research instruments. In: Lonner WJ, Berry JW (eds) Field methods in cross-cultural research. Sage Newbury Park, pp 137–164

Ferraro G (1995) Cultural anthropology. In: An applied perspective

Liu TF (2021) Research on the differences and countermeasures of Sino U.S. economic and trade negotiations. BCP Bus Manag 14:23–229

Nystrom PC (1990) Differences in moral values between corporations. J Bus Ethics 9(12):971–979

Zhao HX, Yu GF (2017) Study on the differences of business etiquette between China and America from the perspective of cultural dimensions. US-China Foreign Lang 15(3):1–5

World Medical Economy Development: The Covid-19 Self-Testing Kits and Qualified Medical Manufactories

Zhixuan Rong

Abstract Time has passed for two years since the COVID situation happens. While few countries' economies have begun to recover, others are still facing economic recession. Most of such situations are caused by the lack of workers, which may be due to the unqualified medical equipment and effective detection methods. This passage combines the latest policies and generally analyzes the chances and stock choices for the investors in the American stock market under the current covid situation. Throughout the research, the article finds out that the government policies and rules for insurance companies have led to an enormous shortage of the COVID 19 self-testing kits. Even though various manufactories produce the self-testing kits related products, only some of them have been granted by the FDA and are allowed to enter the US markets. Such long and strict evaluation processes have caused a shortage in medical regions and even affect public health safety. While the FDA not only has to face the COVID situation, it is also concluding from its failure and publishing large amounts of demands in future medical equipment to prevent similar situations. Therefore, the passage prefers the investor can deliberate to invest in firms that produce COVID-related products in short term and in enterprises that produce professional armamentariums in long term. Such investment chances are also providing opportunities for the public to focus on the US medical circumstance and guide them to avoid those unqualified medical products in the market.

Keywords Unqualified self-testing kits · Government policies · FDA's movements

Z. Rong (✉)
College of Arts and Sciences, Lehigh University, Bethlehem, PA 18015, USA
e-mail: zhr223@lehigh.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_52

1 Introduction

1.1 Background

As the top three countries with confirmed cases of COVID-19, the United States overconfidence led to the wide spread of novel coronavirus in the country. With the increasing number of confirmed cases in China, it has become unrealistic for the U.S. government to control the spread of the virus through vaccines. Therefore, Biden's administrations want to reach the same consequences through increasing testing efforts in developing countries. In September 2021, the U.S. government allocated $2 billion to purchase self-testing kits. Since then, the government's purchase of antigen detection kits has been increasing. The low price and convenient detection of antigen detection kits can allow everyone in the United States to do tests at home. The large-scale implementation of self-testing kits can quickly detect patients with Covid-19 so that relevant departments can prepare in advance to control the spread of the virus more quickly.

1.2 Related Research

Serge et al. use methods such as face-to-face meetings, paper-based tests, semi-structured organizations, and self-administrated questionnaires to test the appropriate use of COVID-19 self-testing kits. Through such research, the authors found out that the use of self-test kits among the general public is available and highly satisfied to face the situation under the critical context of the COVID-19 epidemic (Tonen-Wolyec et al. 2020). Guang et al. use binary classification and multimodality experiments to improve the accuracy of COVID-19 tongue tests. The authors found out that both experiments demonstrate how tongue image can be an excellent discriminative method to test the symptom of COVID-19. Such a novel solution will contribute to large-scale tests for the general public (Zhang et al. 2022). Ashraf et al. constructed observational and controlled experiments for patients aged greater than 18 years old people to examine the accuracy of COVID-19 tests. The authors identified various rising diagnostics parameters of COVID-19 relative to disease advancement and fatality, which concluded that alternative testing would be the best method to ensure the treatment (Ashraf et al. 2022).

Padgett et al. used controlled experiments to find out the best method to transport a self-collecting kit for SARS-CoV-2 testing. They design various environments and finally find out that nasal swabs are stored in desiccative collection tubes which offer a robust and economic self-collection method for the COVID-19 viral load testing, which can allow more people in rural areas to test at home (Padgett et al. 2021). Mariah et al. apply the control programs to discuss minimizing the need for personal protective equipment for the public during the COVID-19 test and how the self-collection kit helps control the COVID situation. They conclude that people are

willing to accept the self-specimen collecting procedure and improve the gathering of shipping process (Valentine-Graves et al. 2020). Adrianna et al. compared the effect of antigen detection and qPCR on the detection of SARS CoV through experiments and found that there was no difference between the results of antigen detection and qPCR, but the antigen detection was more convenient, the time to obtain the test results was shorter, and the price was cheaper (Klajmon et al. 2022).

Serra-Garcia and Czech. Studied the willingness of individuals in the United States to carry out antibody testing and found that most people are unwilling to carry out antibody testing because of the high cost. Although some other factors lead to this result, the price factor is the fundamental reason why people are unwilling to test (Serra-Garcia and Szech 2021). Through antigen detection, Charles and Maria found that antigen detection has a high value in detecting Streptococcus pyogenes, Streptococcus pneumonia, and Legionella pneumophila. It can not only detect Covid-19 but also diagnose various infectious diseases (Pavia and Plummer 2021).

Matthew believes that to control the development of covid-19, we need to establish a perfect detection system, which can quickly detect the virus so that relevant institutions can quickly diagnose and make relevant decisions (Binnicker 2020). Arkhipova et al. believed that the 2019 COVID-19 epidemic will greatly impact the global economy. If the development trend of the epidemic is not controlled in time, the development of the world economy and society will be greatly hit (Arkhipova et al. 2021).

1.3 Objective

In the context of the global epidemic, the U.S. government has increased investment in self-testing kits to control the development of the epidemic. This paper mainly analyzes the market prospect of self-testing kits in the United States and predicts that the market scale will gradually increase to $10 billion in the next few years, to find that the future of the U.S. detection kit market is still worthy of attention. The self-testing kits Market in the United States is currently a blue ocean market, but there are also many problems. This paper puts forward relevant solutions on how to solve the problem of large-scale product shortage and the proliferation of unqualified products.

2 Market Prospect and Scale of Covid-19 Antigen Detection

Since the FDA approved the first OTC antigen detection product in February 2021, the demand for OTC antigen detection in the United States has increased significantly. As of October 2021, the seventh enterprise has obtained FDA approval and plans to at least double the supply of antigen self-test reagents in the United States in the next few weeks, to achieve a reagent production capacity of 100million copies a month.

2.1 Advantages of Antigen Detection Over Nucleic Acid Detection

Both nucleic acid detection and antigen detection can directly detect the virus, but compared with nucleic acid detection, (1) the time of antigen detection is shorter, and the results can be obtained in 10–20 min: (2) the cost of antigen detection is lower, which saves time and labor cost; (3) antigen detection is more convenient and simple. In the context of the epidemic situation, everyone can't go out, antigen detection allows people to self-check at home, And you can know the test results only by distinguishing the color. Through antigen detection, people who are quarantined or have detection needs can do antigen detection without leaving their homes, avoiding crowding and reducing the risk of virus infection between people.

2.2 Market Prospect of Antigen Detection

According to the data from the U.S. Department of health, the number of nucleic acid tests was 720,000 on August 2, 2021, which was significantly reduced from the peak of last year. At present, the number of nucleic acid testing has decreased compared with last year, which also shows that the use of antigen self-test reagents in the United States is gradually improving and gradually replacing nucleic acid testing.

The market potential of antigen detection in the United States is huge. As a developed country, the United States hopes to achieve comprehensive immunization through vaccination, but this idea is impossible in the short term. (1) According to the survey, about a quarter of Americans are unwilling to be vaccinated. (2) Due to privacy protection, the United States cannot require citizens to directly disclose their vaccination status. Moreover, due to the uncertainty of vaccine effect, the possibility of disease recurrence is high. Therefore, the demand for low-cost, convenient, and fast antigen detection will increase significantly.

2.3 Market Size of Antigen Detection

At present, the antigen detection market in the United States is the blue ocean market, and only 14 enterprises have obtained the antigen reagent approved by the FDA EUA. The U.S. antigen market is in short supply. On January 4, 2022, the U.S. government announced that it would sign 500 million antigen testing procurement contracts; On January 13 of the same year, the U.S. government announced that it would purchase an additional 500 million copies of self-testing kits. The subsequent market size is expected to exceed that of Europe.

It can be seen from Fig. 1 that the U.S. self-testing kits market is expected to increase rapidly in the short term. It is expected that the market size will be $4.5

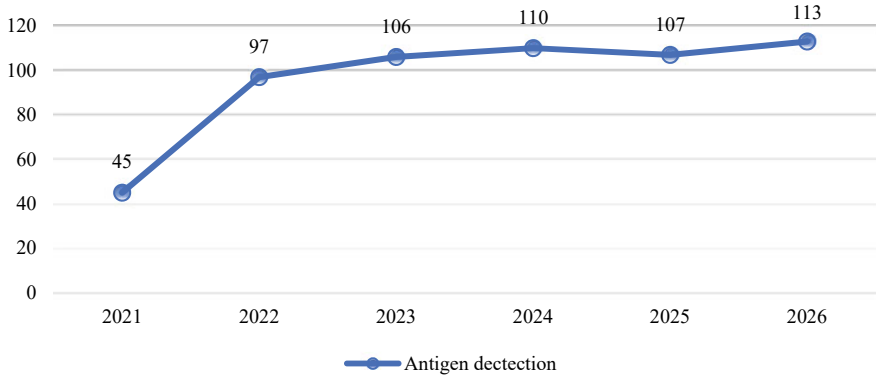


Fig. 1 US antigen detection market size (the US $100 million) forecast

billion in 2021, double in 2022, and then stabilize at about $10 billion. Therefore, the prospect of the antigen market in the United States is still very promising.

3 The Shortage and Future Trends for Covid-19 Self-Testing Kits

According to the data in New York Times, the daily increased number of COVID new cases in America is 136,289, and an average number of 128,676 till the cut-off date of July 13, 2022.

3.1 The Extreme Shortage and Unqualified Products in America

In November 2021, the COVID-19 self-testing kit was in extreme shortage in America. These kits usually have an average price of 20 dollars, but the severe demand has quadrupled their prices to 80 dollars. Since the omicron situation has become worse since January 2022, many manufacturers are illegally producing unqualified self-testing kits to fulfill the highly profitable and vacant market. To deal with such an uncontrollable situation, the US Food and Drug Administration had warned the public and hospitals to avoid using the self-testing kit produced by Acon Laboratories, Colelltrion, and SD Biosensor. These products will not only provide the wrong testing results but also cause the patients to face severe infectious diseases or even death due to unsanitary. At the same time, the FDA was also recalling various types of self-testing kits on the markets.

All these results are caused by the US government policies. When COVID-19 happened, the researchers from BCC Research estimated that the financial market for COVID-19 will reach 60.3 billion dollars in the year 2020 and keep increasing during the following periods. When the time comes to 2027, they even predict that this market will finally approach the market value of 195.1 billion dollars. Aiming for such a huge cake, the US government decided to publish the COVID fast testing plan at the beginning of 2022. Such action strongly stimulates the import and manufactory markets. To reduce the pressure of public testing, America requires more self-testing kits that are examined by FDA and published to the pharmacies. Nevertheless, the standard for importing relative products to the American market is very strict compared to that in European markets. There are lots of companies that can produce qualified kits but lack the certifications from US pharmacies.

3.2 The Convenience of Covid-19 Self-Testing Kits, Underserved Markets, and Profitable Future

According to research done by Doctor Serge and his colleagues, they found that the COVID-19 self-testing kits are highly satisfactory among the public in order to face the severe situation in the urgent context of the current situation. Since most laboratories had discovered the best environment to protect patients' saliva, such self-testing kits could be published in rural regions, providing the residents there the same and accurate chance to check their symptoms at home. They no longer have to spend more costs and afford the high risk to test in the hospital. Such equal treatment is giving them more convenient and safe experiences to get the results through COVID-19 self-testing kits.

On January 14, 2022, the US government agreed to spend 1.3 billion dollars to buy COVID test kits from iHealth Labs Inc., 340 million dollars from Roche Diagnostics Corp., and 306 million dollars from Abbott Rapid Dx North America. For the past year, the stock price for Roche Diagnostics Corp. has increased from $37.88 to $53.86 per share. According to the data from yahoo finance, the Beta for this stock is 0.30, which means that it contains a relatively low risk and high potential to rise in the future. The same situation and stock trends have occurred in the other two stocks and relative industries.

While the FDA is still working on those illegal self-testing kits, the US market is largely demanding qualified products. Therefore, the COVID self-testing kits will not quit the financial market shortly. Those companies that gained the certifications from FDA will keep producing products, these vacant markets are also requiring more imported products at the same time. The FDA needs to provide more authorization for those qualified manufactories and demands their self-testing kits. As the current most economic and reliable examining methods, the market for self-testing kits is still profitable.

4 Solution

4.1 Short in Covid-19 and Long in Epidemic Disease

To solve the issues of unqualified self-testing kits and medical shortages, the American government pressingly demands relative products. As US president Biden had announced on December 21st, 2021, the American government had decided to distribute 500 million shares of free self-testing kits to the public to combat COVID. According to CNBC, most private insurance companies are required to monthly provide eight times free family COVID tests at the same time. Under such policies, each American citizen can at most get four free tests per month. Currently, America has a population of 332 million, which means that the US government has to dispense at least 2.656 billion self-testing kits to the public. If the procurement price for each kit remains at 5 dollars as released, then there is a market holds for 13.28 billion dollars.

Under such circumstances, the investment in medical pharmacy will be considerable, especially for the companies that have already gained the licenses from FDA and EUA which allow them to sell these products in American markets. Instancing the Chinese company "Siemens Healthineers", their product "Clinitest" is one of the earliest qualified self-testing kits. Their early access to the global market has allowed them to become a winner in the financial market. Investment in such a mature company will be a relatively stable choice.

Nevertheless, while the US government and FDA will keep authorizing various industries and firms to enter this financial market, the stock price for the current companies will reduce in the future due to the increment in supplies and those "unicorn" companies with unique products may become more competitive. In the meantime, there is also a large number of corporations that remain in the process of FDA examination. Even though these companies may begin to profit after passing the verification, the examination will last for months and may further lead to the bankruptcy of some of these small companies that do not have sufficient monetary support.

According to the latest reports from the United States Department of Health and Human Services, which is also known as the HHS, the American government is preparing for future epidemic disease situations. They believed that one of the main reasons for COVID to become such severe is the shortage of medical equipment, which causes many people not to have the chance to examine their health at the beginning of COVID. The lack of devices has hampered the efficiency of controlling viral transmission. Therefore, the US government has decided to invest more in developing national personal protective equipment and durable medical equipment. While the market for COVID self-testing kits is becoming smaller in the future and blocking new investors out of this market, the investment in PPE and DME-related industries or the supplement chains are also worth investing in in the long term.

4.2 Solutions for the Proliferation of Unqualified Products and How Enterprises Can Quickly Pass the FDA Audit

As a developed country, the United States wants to solve COVID-19 by developing vaccines, but this method is not feasible. On January 15, 2022, the U.S. government officially implemented the covid-19 rapid detection program, which greatly stimulated the purchase demand for antigen detection products. However, there are only a few antigen detection production enterprises approved by FDA EUA. Facing such a large demand, it is difficult to quickly solve the current market demand by relying on only a few enterprises. Therefore, FDA must speed up the review of various enterprises.

It is Necessary to Correctly Meet the Audit Standards of the Current New Crown Situation. Most enterprises hesitate to apply for FDA certification. They worry that even if they spend a lot of money on clinical practice, they still cannot get FDA approval. This is related to FDA's review standards. They believe that the use of inaccurate and ineffective detection reagents will pose a threat to the lives of Americans. Therefore, FDA should increase the recruitment and working hours of employees and issue incentive policies. The more auditors, the higher the efficiency and the relevant commissions can be obtained, improve the audit speed, enable more enterprises to obtain certification, and solve the problem of toolkit shortage.

FDA Should Actively Address the Influx of Illegal Kits. Due to the huge market demand, a large number of unauthorized test kits have entered the U.S. market. These unapproved products are difficult to identify, and some illegal manufacturers will provide false documents to confuse the public. These unapproved products enter the market without formal inspection, which poses a great threat to the American people's safety and will disrupt the testing kit Market in the United States. Therefore, FDA should issue relevant reward policies for successful reporting and increase the publicity of the harm of illegal products to the human body. As long as people report illegal products and capture successful reward dollars and issue certificates of meritorious prosecution. Lectures were held in schools, hospitals, and other public places to let the public know the dangers of illegal products. The above methods will solve the problem of illegal products.

5 Conclusion

This paper analyzes the market prospect and scale of antigenic test kits and finds that the current U.S. test market is a blue ocean market with great market potential, but in the long run, the new crown test market is not optimistic. Moreover, there are a large number of unqualified illegal products and only a dozen enterprises that can pass FDA certification in the market today, which can not support the strong demand for testing kits in the United States. This paper gives reasonable solutions to these problems. (1)

FDA should increase the efficiency of employees' audit of enterprises by increasing incentives, and increasing the publicity of the harm of unqualified products, to reduce people's purchase of unqualified products. (2) The U.S. government and FDA should focus on the development of unicorns and the localization of the production process in the short term and should focus on the investment and development of personal medical facilities and professional elite diagnostic devices in the long term.

References

Arkhipova AN, Turkova VN, Kuznetsova ON (2021) World economy development forecast during the covid-19 pandemic. IOP Conf Ser: Earth Environ Sci 751(1):012132 (6pp)

Ashraf AI, Ali S, Rahman N, Ali A, Hamidullah (2022) Estimation of emerging diagnostic parameters for coronavirus disease 2019 patients' severity and fatality. J Pakistan Med Assoc 72(7):1384

Binnicker MJ (2020) Emergence of a novel coronavirus disease (COVID-19) and the importance of diagnostic testing: why partnership between clinical laboratories, public health agencies, and industry is essential to control the outbreak. Clin Chem 66(5):664–666

Klajmon A, Olechowska-Jarząb A, Salamon D, Sroka-Oleksiak A, Brzychczy-Włoch M, Gosiewski T (2022) Comparison of antigen tests and qPCR in rapid diagnostics of infections caused by SARS-CoV-2 Virus. Viruses 14:17

Padgett LR, Kennington LA, Ahls CL, Samarasinghe DK, Tu Y-P, Wallander ML, Cooper SD, Elliott JS, Rains D (2021) Polyester nasal swabs collected in a dry tube are a robust and inexpensive, minimal self-collection kit for SARS-CoV-2 testing. PLoS ONE 16(4):e0245423

Pavia CS, Plummer MM (2021) The evolution of rapid antigen detection systems and their application for COVID-19 and other serious respiratory infectious diseases. J Microbiol Immunol Infect 54(5):776–786, ISSN 1684-1182

Serra-Garcia M, Szech N (2021) Understanding demand for covid-19 antibody testing. In: VfS annual conference 2021 (virtual conference): climate economics

Tonen-Wolyec S, Dupont R, Batina-Agasa S, Hayette M-P, Bélec L, Landay A (2020) Capillary whole-blood IgG-IgM COVID-19 self-test as a serological screening tool for SARS-CoV-2 infection adapted to the general public. PLoSONE 15(10):e0240779

Valentine-Graves M, Hall E, Guest JL, Adam E, Valencia R, Shinn K, Hardee I, Sanchez T, Siegler AJ, Sullivan PS (2020) At-home self-collection of saliva, oropharyngeal swabs, and dried blood spots for SARS-CoV-2 diagnosis and serology: post-collection acceptability of specimen collection process and patient confidence in specimens. PLoS ONE 15(8):e0236775

Zhang G, He X, Li D, Tian C, Wei B (2022) Automated screening of COVID-19-based tongue image on Chinese medicine. Bio Med Res Int, NA

New Oriental Hedging Strategy Analysis

Zhaoyang Xue

Abstract As a leader in the education industry, New Oriental has created numerous plans. Before the "double reduction" policy, the business volume of New Oriental was also gradually increasing. However, the "double reduction" policy was issued on July 24. After this policy was issued, the industry suffered a huge blow. New Oriental's revenue also took a big hit, with "layoffs" and "business transformation" also trending searches. In the face of challenges, New Oriental did not choose to wait but actively chose corresponding hedging strategies to resist risks. This paper first introduces the general situation of New Oriental and then analyzes its financial data. In view of the current situation, New Oriental adopts the hedging mode of expanding the university business division and developing new businesses to lower the risk. In conclusion, New Oriental uses the business of college students and live broadcasting as a hedging strategy to deal with the current challenges.

Keywords New oriental · Hedging strategy · Financial analysis

1 Introduction

Since the outbreak of COVID-19, the audience for "online teaching" has surged, and the education and training industry has attracted more and more capital. In 2020, 111 cases of financing for online education in China alone, with a total amount of 53.93 billion yuan, exceeded the total financing of the previous four years (People's Daily 2021). Among them, the K12 online education platform, Monkey Guidance, and Homework has received up to 38.01 billion yuan in financing (Wu and Han 2021). In order to compete in the market, major education and training companies have taken a series of measures, with advertising and marketing being the first to take the lead. In the first nine months of 2020, a total of 5.5 billion yuan was spent on advertising and sales by the three companies—Yuxingtuan, Yujibang, and Xueersi

Z. Xue (✉)
The University of Manchester, Manchester M13 9PL, UK
e-mail: zhaoyang.xue@postgrad.manchester.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_53

online School—more than double the amount in the same period of 2019. Online education has become the third largest advertiser of mainstream platforms after e-commerce and games (Xinhua Net 2022). Hot words such as “high demand”, “high loss”, “high financing”, “high valuation” and “high income” also frequently appear on the Internet to describe the education and training industry. It can be seen that before the “double reduction”, with the expansion of market scale, the competition between institutions also became fierce (Wen 2022).

Shaun Jian policy was issued on July 24, 2021, by the official committee of the Chinese government aiming to reduce the pressure of homework and off-campus training for primary students and secondary students. After the policy is issued, a nationwide comprehensive inspection of all kinds of training institutions should be launched, and institutions with comprehensive procedures should be re-examined and approved in accordance with the new regulations. For institutions that fail to meet the examination and approval procedures, the original record registration and operation license shall be canceled. For non-disciplinary training institutions, relevant local governments should categorize them into three categories, namely sports, culture, art and science, and technology, identify corresponding supervision departments, formulate management standards and subject them to strict examination and approval. Off-campus institutions that do not have corresponding qualifications or conduct training without approval shall be strictly dealt with in accordance with the law, and capitalization of institutions shall be strictly prohibited (Central People’s Government of the People’s Republic of China 2021).

The double reduction policy has dealt a fatal blow to the originally booming K12 education industry. According to media reports, in the fiscal year 2021, New Oriental reported revenue of $4.277 billion, up 19.5% from the same period last year. Since 2017, the revenue of primary and secondary schools in New Oriental contributed more than 50% of the total revenue, and after-school tutoring and other services of primary and secondary schools have accounted for 80% of new Oriental’s revenue in the fiscal year 2021. Downsizing of hedging strategies to meet this challenge. Yu Minhong, the founder of New Oriental, announced at a recent executive meeting that new Oriental will gradually close its primary and junior high school subject business in communities below the GRADE B campus after the end of the autumn course, and each city will also gradually close the teaching sites. Yu also said the company planned to cut 40,000 jobs by the end of August, out of an overall workforce of about 100,000 at the start of 2021 (Liu 2021). In addition to reducing the staff, New oriental also employed numerous methods and hedging strategies for maintaining the company’s profit. The subsequent essay will discuss those issues.

In Sect. 2, the article will first introduce the general situation and financial status of New Oriental. Then, the article will introduce the hedging strategies adopted by New Oriental to overcome the current challenges. Finally, the paper also points out the shortcomings of this research.

2 Firm Description

2.1 Back Ground Information

New Oriental Education and Technology Group is one of the largest education groups in China. Its primary business primarily focused on English education. The group was established in 1993.

It has a number of development platforms such as a short-term training system, cultural communication system, consulting service system, and science and technology industry system. As one of the most successful Chinese education groups, New Oriental is the first Chinese company to list on the New York Stock Exchange in the US, in addition to its huge scale at home. In the subsequent development process, the influence of New Oriental continued to expand, at the same time, the movie "American Partners in China" was shot with new Oriental as the background. In 202 oh you press November, New Oriental listed in Hong Kong Stock Exchange secondary (New Oriental Official Website 2022).

2.2 Business Areas

New Oriental, headquartered in Zhongguancun, Haidian District, Beijing, is a comprehensive education group and training institution. New Oriental offers a wide range of services, including TOEFL, IELTS and other language training, K9 and K12 training, online preschool education, overseas consulting, and book publishing. New Oriental also includes a number of well-known sub-brands, such as Bubble Children's English, Future Study Abroad, and so on. New Oriental was listed on the New York Stock Exchange in 2006, the first Chinese educational institution to list overseas. In July 2012, New Oriental Group was investigated by THE US Securities and Exchange Commission due to the VIE structure adjustment, and its share price was greatly affected. In 2016, New Oriental Education Group entered into a strategic partnership with a well-known Chinese Internet company, with Tencent investing 320 million yuan to develop New Oriental Online, which can offer more online courses to customers. And New Oriental Online will be listed in China, and New Oriental Group will not lose control of new Oriental Online (New Oriental Education and Technology Group 2022).

2.3 The Financial Situation

New Oriental announced that it received revenue of 1.967 billion dollars in 2021, this number for last year was1.874 billion, and thus we can see an increase in the revenue. The net loss was 876 billion dollars and a net profit of $229 million in the

Table 1 Income statement of new oriental

Income statement	New oriental			
All numbers in thousands (dollar)				
	TTM	2021/5/30	2020/5/30	2019/5/30
Total revenue	3,793,209	4,276,539	3,578,682	3,096,491
Cost of revenue	2,085,311	2,036,875	1,588,899	1,376,269
Gross profit	1,707,898	2,239,664	1,989,783	1,720,222
Operating expense	2,655,330	2,090,604	1,590,780	1,418,315
Operating income	−947,432	149,060	399,003	301,907
Net non operating interest income expense	–	134,764.00	111,490.00	95,915.00
Other income expense	−139,735.00	31,153.00	−22,657.00	−81,973.00
Earnings from equity interest net of tax	−55,068	−1368	1385	−2289
Net income common stockholders	−1,043,885	334,414	413,333	238,065

same period last year. According to the official data, New Oriental's current cash and cash reached 1.027 billion dollars in total.

Moreover, the half-year operating costs and administrative expenses for New Oriental were 2.7 billion dollars, this figure for the last year was 1.755 billion dollars. the company's half-year general and administrative expenses amounted to $1.292 billion, compared to $587 million in the same period last year.

The general manager in New Oriental indicated that, due to the "Shuang Jian" Policy, the frim market value of New Oriental dropped by 90%, and the operating income decreased by 80%. New Oriental Group has already laid off more than 6g0,000 workers and spent nearly 20 billion yuan to demobilize them and pay for leased land (Hong Kong News 2022) (Tables 1, 2 and 3).

3 Hedging Strategy

3.1 Potential Risk

Risks Related to Our Business.

- The People's Republic of China has exerted a significant influence on the development of the education industry. In particular, the promulgation of the double reduction policy has exerted a significant negative influence on the subsequent development of New Oriental. The business, financial condition, and operating results of New Oriental are all subject to great uncertainty, and the country may

Table 2 Balance sheet of new oriental

Balance statement		New orential	
All numbers in thousands (dollar)			
	2021/5/30	2020/5/30	2019/5/30
Total assets	10,151,053	6,556,885	4,646,559
Total liabilities net minority interest	5,132,877	3,687,074	2,121,462
Total equity gross minority interest	5,018,176	2,869,811	2,525,097
Total capitalization	5,210,906	2,851,176	2,457,143
Common stock equity	4,913,275	2,733,295	2,360,686
Capital lease obligations	1,864,662	1,462,162	–
Net tangible assets	4,821,196	2,636,646	2,260,732
Working capital	3,102,710	1,277,056	1,460,018
Invested capital	5,210,906	2,851,176	2,457,143
Tangible book value	4,821,196	2,636,646	2,260,732
Total debt	2,162,293	1,580,043	96,457
Share issued	1,690,082	1,588,017	1,588,017

Table 3 Cash flow of new oriental

Cash flow		New oriental		
All numbers in thousands (dollar)				
	TTM	2021/5/30	2020/5/30	2019/5/30
Operating cash flow	−100,5305	1,130,085	804,455	805,648
Investing cash flow	1,148,375	−217,7639	−1,256,370	−574,712
Financing cash flow	−180,737	1,654,084	−17,862	266,649
End cash position	1,548,525	1,632,127	919,424	1,418,227
Free cash flow	−1,441,653	693,737	494,907	528,770

continue to issue policies and provisions unfavorable to the development of the education industry.

- At present, a very key problem is that the promulgating of adverse policies in the education industry reduces the number of our new users. If the number of new users cannot be guaranteed, our profits may be significantly affected, so our profitability may be affected under the influence of such adverse conditions.
- The brand of New Oriental has suffered a major blow under the influence of macro policies. We need to maintain our brand and attract new customers through brand influence so as to increase profits.
- Although the whole education industry has suffered a huge impact, it does not mean that we can reduce our service quality. On the contrary, we need to improve the quality of teaching to maintain our brand and enhance the core competitiveness of the whole group.

- The traditional education industry has been severely hit, so we need to find a new industry as a breakthrough for business transformation and new profit points as soon as possible (Annual report of New Oriental 2021).

3.2 Two Strategies Were Implemented to Copy the Risk

With the gradual landing of the "double reduction" policy, K12 business in the industry is facing substantial adjustment. According to media reports, Yu Minhong, founder of New Oriental, announced at a recent executive meeting that new Oriental will gradually close its primary and junior high school subject business in communities below the GRADE B campus after the end of the autumn course, and each city will also gradually close the teaching sites. In August 2019, New Oriental Online announced its first annual report after going public. During the reporting period, The revenue of Oriental Unicast reached 56.9 million yuan, accounting for more than one-third of the total revenue of its K12 business. In terms of paying student visits, The number of paid students attending New Oriental's online K12 courses increased 188.3% year on year, while the number of paid students attending Oriental's ONLINE K12 courses increased 316.1% year on year. In the fiscal year 2021, New Oriental's revenue from K12 after-school tutoring, exam preparation, and other courses was $3.667 billion, accounting for 85.8% of the total revenue, and the proportion increased for three consecutive years. Other services, such as kindergarten and primary and secondary schools, textbook development and distribution, study abroad consulting, and overseas study Tours generated $399 million, less than a tenth of the total.

Expand the Business Scale of the Undergraduate Business Division. Yu Minhong said at the New Oriental University Student Learning and Development Center's brand upgrade conference, "Many people think that this is a transformation of New Oriental because the university business is an encouraging project, but in fact, we think this is a perseverance and return." It is reported that this time, New Oriental will comprehensively upgrade the existing 4th and 6th-grade projects, postgraduate entrance examination projects, overseas examination projects, teaching fund projects, and accounting projects. In the future, it will also expand education and training projects such as computer grade examinations and judicial examinations. In terms of the number of students, its financial report shows that more than 90% of the students enrolled in the primary and secondary tutoring courses, while the number of applicants for the test preparation courses and language training courses only accounted for 9.2% of the total number. Specifically, about 390,000 students have registered for test preparation courses, including 198,000 overseas test preparation courses and 193,000 Chinese test preparation courses; about 5000 students have registered for adult English courses.

Build New Business Through Webcast. Recently, "Oriental Selection", an English teacher's studio, has gone viral on WeChat. At the same time, the fire also spread

to the stock market. Hong Kong stock New Oriental Online shares soared for two consecutive days, June 13 intraday doubled to 12.5 Hong Kong dollars/share, new Oriental online parent company also rose more than 25% on that day. According to data, the number of viewers of "Oriental Selection" reached 12.746 million on June 11, and GMV reached 21.043 million on that day, making it into the live broadcast room. The account currently has 3.39 million followers. Shares of New Oriental Online soared for two days in a row, up nearly 40% on June 10, and up nearly 100% on June 13. By the end of the market, New Oriental line at hk $8.72/share, up 39.97%. Meanwhile, on June 13, Hong Kong stock New Oriental also soared after the opening of the day, intraday up more than 20%. At the close, New Oriental was up 13.13% at HK $14.48 per share (STCN 2022).

4 Conclusion

The education industry as a sunrise industry has attracted lots of capital, so there are a lot of problems in this industry. For example, anxiety about trafficking and uneven quality of training undermine the fairness of education to a large extent and make many parents complain bitterly. After China enacted the double reduction policy, the education industry suffered a major blow. Taking New Oriental Education Group as an example, its business income decreased by more than 80%. However, in the face of the industry table, New Oriental Group actively sought ways to carry out reforms to hedge the huge risks brought by the industry by taking advantage of its own size.

At present, there are two main hedging policies adopted by New Oriental. First of all, New Oriental Group is expanding the business scale of the University Student Division. From the perspective of macro development, this decision is in line with the national policy. In the next few years, the state will vigorously promote the employment ratio of domestic students. At the same time, in the foreseeable future, the state may also promulgate corresponding replication policies to Make it easier for more graduates who study in China to find jobs in domestic companies. Secondly, the recent live broadcast also brought New Oriental back to the public's field of vision again. The product salesmen in "Oriental Selection" have also become the hottest Internet celebrities recently, and the sales have also exceeded 500 million yuan. In the future, New Oriental may also be The idea of developing new businesses through the Internet to help farmers is also a way to hedge risks.

Due to information access and time constraints, we don't have much more detailed internal data. A more comprehensive investigation is required to receive more conclusive suggestions and detailed results.

References

Annual report of New Oriental (2021) [Online] 16 Jul 2022. Available: https://investor.neworiental.org/zh-hans/news-releases/news-release-details/xindongfangxuanbutijiao2021cainian20-fniandubaogao

Central People's Government of the People's Republic of China (2021) The general office of the CPC Central committee and the state council issued opinions on further reducing the Burden of homework and off-campus training for students receiving compulsory education. [Online] 24 Jul 2021. Available: http://www.gov.cn/xinwen/2021-07/24/content_5627132.htm

Hong Kong News (2022) New oriental reports $876M loss in H1 Fiscal Year 2022. [Online] 23 Feb 2022. Available: https://pandaily.com/new-oriental-reports-876m-loss-in-h1-fiscal-year-2022/

Liu W (2021) New oriental "U-turn" strategic adjustment to return to the university business. [Online] 9 Oct 2021. Available: https://baijiahao.baidu.com/s?id=1713097576027693429&wfr=spider&for=pc

New Oriental Education and Technology Group (2022) Overview. [Online] 14 Jul 2022. Available: http://www.neworiental.org/english/who/201507/8213540.html

New Oriental official website (2022) About new oriental. [Online] 10 Jul 2022. Available: http://www.neworiental.org/profile/about.html

People's Daily (2021) People's daily four asked the chaos of off-campus training: is it for education or business [On-line] 8 Jul 2021. Available: https://baijiahao.baidu.com/s?id=1694522635562322824&wfr=spider&for=pc

STCN (2022) About new oriental live hot share price new oriental online once up 100% [Online] 14 Jun 2022. Available: https://m.gmw.cn/baijia/2022-06/14/1302996114.html

Wen Z (2022) Analysis on the prospect of education and training industry under the pattern of "double reduction." Service Econ 4:117–119. https://doi.org/10.19699/j.cnki.issn2096-0298.2022.08.117

Wu J, Han Y (2021) Online education under the vortex of capital [Online] 18 Jan 2021. Available: https://www.ccdi.gov.cn/toutiao/202101/t20210118_234020.html

Xinhua Net (2022) New oriental bilingual live with goods "fire out of the circle" educational institutions to transform each brilliant [Online] 13 Jun 2022. Available: https://baijiahao.baidu.com/s?id=1735480229228747531&wfr=spider&for=pc

Analysis of Billiard Hedging Strategies

Yuchu Zhang

Abstract Hedging is a financial term that refers to an investment that purposely reduces the risk of another investment. It is a way to reduce business risk while still making a profit on an investment. Generally, hedging is the simultaneous execution of two transactions that are correlated, opposite in direction, equal in quantity, and offsetting in profit and loss. A correlation is the unity of the market supply and demand that affects the price of two commodities, and a change in supply and demand will affect the price of both commodities in the same direction. The opposite direction means that the two transactions are bought and sold in opposite directions so that no matter what direction the price changes, there is always a profit and a loss. Of course, in order to offset the profit and loss, the size of the two transactions must be determined according to the magnitude of the respective price changes, so that roughly the same amount. The article mainly adopts an example-based argument for the relevant hedging study. This article will first analyze Bilili's overall corporate structure and business strategy, then explain the hedging tools used by Bilili to face risks in the context of the company's current situation, analyze Bilili's problems, and finally make relevant hedging recommendations.

Keywords Hedging · Supply · Demand · Financial analysis

1 Introduction

The importance of a hedging strategy is to remove a risk that we don't want to get. In this case, the stability of the investment will be greatly increased, and the company will get more stable profits, making the operation smoother. Shu Qun defined a financial strategy that provides investors with a competitive advantage (Shu 2000). Shelumiel Ryan Abapt thought hedging is a method of managing financial risk through financial instruments (various Financial derivatives) (Ryan 2018). It

Y. Zhang (✉)
Wuhan University of Technology, Wuhan 430000, China
e-mail: 1415188733@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_54

involves the designation of one or more financial instruments as a buffer for potential loss. Piuesh Daga credit risk issues in the hedging process must be taken into account (Daga 2012). These days, John D Ciorciari put the fact that The concept of "hedging" is gaining prominence in international relations discourse (Ciorciari 2019). Justin Grossbard thought the purpose of a forex hedging strategy is to reduce the volatility and overall risk of trading results.

In order to hedge effectively, traders consider how other currency pairs or financial products related to the underlying strategy (Grossbard 2011). Hitesh Singhi put the fact that hedging is generally done using derivative products such as futures and options (Singhi). But, For the firm, Timothy B. Folta argues that instead of buying and selling financial securities to hedge, the manager of the firm making strategic hedges makes choices around real assets (Timothy). Ian H. Hedging should not be a risk-taking tool for gamblers but should always be used as a way to minimize risk and minimize costs. (Giddy 2019). Hedging strategies should not be used in isolation but in combination with other investment approaches to improve the analysis of securities through a diversified portfolio (Yates 2013). The CFI team suggests that strategies are diverse, and each is unique (Treanor et al. 2014).

This work analyzes the hedging strategy of BiliBili based on internal analysis and external analysis. The market location, business environment, power consumption, and fluctuation of stock prices are analyzed in the context of domestic and foreign environments. The paper also gives some suggestions for BiliBili's future development.

The remainder of the article is organized as follows. In Sect. 2, the work presents the corporate description for BiliBili. Analysis of hedging strategies is conducted in Sect. 3. The article summarizes the paper in the last Section (Fig. 1).

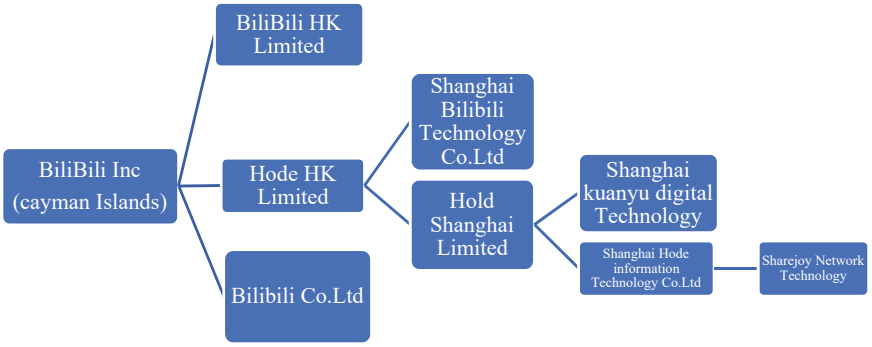


Fig. 1 Business structure of BiliBili

2 Corporate Description

2.1 Internal Analysis

BiliBili (NASDAQ:BILI; HKEX:9626), known as BiliBili or B-site for short, is a cultural community and video platform for China's young generation, founded on June 26, 2009 and affectionately known as "B-site" by netizens. On 28 March 2018, BiliBili was listed on the NASDAQ in the United States. On 29 March 2021, BiliBili was officially listed for the second time in Hong Kong. In its early days, BiliBili was a video site for the creation and sharing of ACG (animation, comics, games) content. After more than a decade of development, it has built an ecosystem around users, creators, and content to produce a constant stream of quality content. It has won first place in the "Gen Z Favored App" and "Gen Z Favored Pan-Entertainment App" lists by Quest Mobile Research Institute and was selected as one of the top 100 most valuable Chinese brands in the "BrandZ" report 2019. In February 2022, BiliBili Live will go live with the pre-broadcast face authentication feature to ensure that the person starting the broadcast is the same as the person with the real name authentication, with a subsequent gradual opening in each division. In March, BiliBili announced its financial results for the fourth quarter and fiscal year 2021. 2021 financial total net revenue was RMB 19.4 billion, up 62% from 2020.

2.2 External Analysis

Market Environment. BiliBili is very competitive in the Chinese movie and television entertainment industry. Its main competitors include IQ Inc, Tencent, Tek tok, Acfun, fast hands, and more.

At the beginning of its founding, founder Xu Yi, the current president, proposed a goal of sharing the largest 2D ACG (animation, comic, game) content creation and video website. But the problem was the first decade of the twenty-first century, and the Chinese anime, cartoon, and game industry did not rise to a large scale. Most anime, cartoons, and game products are guided by the government to make products suitable for children (under 12 years old). They are short of domestic products for power consumption (teenage aged to 24) teenagers. Most consumers tend to animation, comics, and game products from Japan, Europe, and the United States. Therefore, BiliBili successfully failed in commercialization.

In 2011, Chen Rui formally joined BiliBili's activities as an angel investor. After the BiliBili has been listed, commercial operation directions emerge from the ACG cultural circle and gradually approach to popular users or "generation Z" for the purpose of collecting more traffic and achieving higher business benefits and stock prices.

China's online video users reached 579 million in 2017, including 549 million mobile online video users, and 72 accounts.9% of mobile Internet users. But, the

industry's top 4 video sites have reached a share of 77.27 belonging to the oligopoly market. The video website industry has been shuffled several times. BiliBili rapidly rises with the expansion of the ACG subculture group when iqiyi, Youku, Tencent video and Tik tok occupy much of the market share. In 2017, the total size of secondary users in China has reached 4.4 million, the number is increasing year by year, and the consumption capacity is improving, which is a point of new growth.

Company Position and Current Situation. In 2011, Chen Rui officially participated in the activities of BiliBili as an angel investor. While ensuring the cultural web site of the two-dimensional ACG, he actively committed broadcasting rights and copyrights for ACG products in Japan and abroad and promised to create domestic ACG products, movies, video sharing, live broadcasting, and other products and services to figure out the young market. At the same time, more types of videos have gradually gathered middle-aged elderly customers.

Chen Rui said in a number of public speeches as chairman and CEO. Billiard's goal is not only China's YouTube but also the biggest video site at the same time, CO maintains and develops a virtual community for friendly exchanges between video creators and viewers. And, BilliBili also buys and watch movies and movies, provide live broadcast promote electronic sport, and become the most prominent Internet audiovisual entertainment place.

The main content that can be promoted by BiliBili is referred to as the main content that can be driven by billiards called "the main content that can draw user's attention" and "the main content that can be produced by the billiard". Second, BiliBili's other core business—Mobile Gaming agents and producers benefit from the interaction of live flows with host hosts and audiences, both domestic and abroad. Mobile games, however, account for 80% of BiliBili's total operating income. Single operation modes and poor structures are also why they were not optimistic.

Negotiating Power of Suppliers. On the scale of the current platform, BiliBili is certainly a large video website company and it allows for the gaming business, so there is a greater demand for network technology support and network broadband services. As for the content, most Japanese anime companies choose BiliBili for cooperation in expanding their business in China because BiliBili is the largest ACG website in China. This indicates that BiliBili's suppliers are not very strong.

Stock Price Analysis. Billiard shares have risen steadily since 2018. But a bigger drop in BiliBili's stock began to start in 2021.It shows that the creation had great potential for the growth of BiliBili and had a good ability to raise money. However, as problems continue, many problems and difficulties arise, leading to a change in stock prices (Fig. 2).

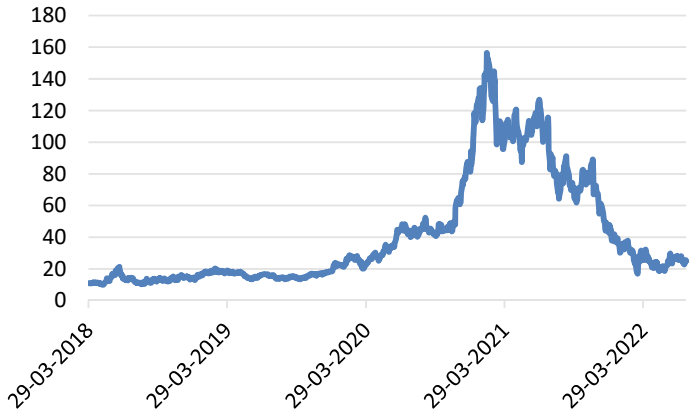


Fig. 2 2018–2022 BiliBili stock price K-line

3 Analysis of Hedging Strategies

3.1 Potential Hazard Analysis

Competitor Threat. Watermelon video is now the biggest challenger to BiliBili and its most direct rivals in China. Through the events of the new year's "troublesome Mom", watermelon video has owned a total of 200,000 Paid Membership and got 13 million profit from there. Besides, watermelon video has begun efforts from the external market and the old market, there will be a lot of competitive pressure on BiliBili. Further development should be viewed from the sink market because BiliBili now has a large user scale.

Consecutive Losses. Although the B station's profitability has improved, the loss is still expanding to a net loss of $565 million in 2019 while growing to a net loss of one dollar. The market is now bullish at BiliBili, but after the experience of two black swan events, lucky and new crown plague, the capital market should be gradually cautious, the current B station needs to compete with the time to give a satisfactory answer to the capital in the next two years.

If the losses continue to grow, this could lead to an eventual crisis of confidence in the company which would ultimately cause the stock market to plummet.

Game Business Slow Growth. BiliBili's game business revenues have been sluggish by 2018 yuan, 2017 million in 2019, boasts an increase of 22%.Chen RII claims that the B station currently has more than 30 games in reserve, However, it is not clear how much sustainable revenue these games will generate. You know, now that BiliBili's game interests are basically not FDA and blue root support to support two games, you have not immediately found the third amazing game, but the bounty game business revenue may not increase too.

Table 1 2019Q2-2019Q4 change in revenue of BiliBili's game business

	2018Q2	2018Q3	2018Q4	2019Q1	2019Q2	2019Q3	2019Q4
Revenue from handheld games (million)	790	744	710	870	920	930	870
Revenue share (%)	78	69	62	64	60	50	43
Year-on-year growth (%)	61	24	14	27	16	25	22
Ringgit growth (%)	15.00	−5.82	−4.57	22.54	5.75	1.09	−6.45

3.2 Hedging Strategies

Diversification of Investment. Diversified investment means that billibili can conduct investment business in different fields and industries, or invest in the same industry to produce different products. Diversified investment is the way the corporate group increases revenue opportunities and diversifies business risk, and it is also a trend in modern corporate management development. Diversified investments can help them hedge some of the risk well because the current business item of the B site is too single.

Simultaneous Gaming and Live Streaming Industry. As for the game, the game revenue ratio of the B station is still the largest, and the gross profit of the game business rose from 70,000 yuan of Q4 2018 to 870 million yuan of Q4 2019, but the profit ratio fell from 62% of Q4 2019 to 43% of Q4 2019. This shows that the growth of the game business gradually peers, while the profit structure of B station is diversified and rationalized. In the future, the B station game business must be mainly increased. While the game is a BilliBili strong project, the live industry belongs to another emerging industry to increase the investment of independent benefits projects to enhance better effects and hedging conditions (Table 1).

Due to the continued rise in short-form video sites and the emergence of many new video sites, there is a rapid loss of users if BiliBili does not start effective and innovative activities. In terms of content, the video production threshold increases, but it also corresponds to the screening of bad quality content, but continues to increase video playback of all types. It also holds all kinds of IP linkage activities such as the original "corpse mad competition". As for video production, you can think about how to engage a general audience in the video production of the up master.

4 Conclusion

The actual structure and evolution of BiliBili were analyzed. Then, a series of problems such as market location, business environment, power consumption, and fluctuation of stock prices were analyzed in the context of domestic and foreign environments. Based on this criterion, a series of analyses of risk liabilities are like competitive pressures, ongoing losses, and bottlenecks to growth. Finally, a corresponding hedge strategy has been proposed based on these problems. Based on these issues, investing in the game industry will invest in the live industry to reduce the corresponding risk and achieve hedging. Combined with the overall analysis of the article, there is no doubt that BiliBili is a very good new generation company that has experienced so many difficulties in its ongoing travel toward maturity, but its future is still very much as long as it maintains the risk forecast and makes the risk forecast possible.

The article also exists some limitations. The detailed statistical analysis method is lacking in the article, and the author does not conduct an empirical study for examining the impact of the hedging strategy. In the future, the article would collect more data and investigate the results based on the quantities method.

References

Ciorciari J (2019) Hedging in international relations: an introduction. Int Relations Asia-Pacific 19(3):367–374

Daga P (2012) The development, evolution, and status of hedge. Financ Leader 01:16–17

Giddy I (2019) Corporate hedging: tools and techniques. New York University Stern School of Business University

Grossbard J (2011) Forex hedging strategies. Int Financ Account 04:55–59

Ryan S (2018) What is currency hedging. Hedg Syst 2:13–14

Shu Q (2000) The use and widespread of Chinese hedging. Chinese Enterprise 11:64–65

Singhi H, Status and prospects of research on the hedging. Am Bus 16:93–94

Timothy B, Hedging strategies. Hedging Strategies. In: Augier M, Teece D (eds) The Palgrave encyclopedia of strategic management. Palgrave Macmillan, London. The Palgrave encyclopedia of strategic management 120:978–979

Treanor SD et al (2014) Does operational and financial hedging reduce exposure? Evidence from the U.S. airline industry. Financ Rev 49(1):149–172

Yates T (2013) Analysis and enlightenment of the financial hedging. Hedging Risk Study 04:65–68

Rethinking Online Travel Agency: Dealing with Public Health Emergencies

Ziyi Yang

Abstract The role and influence of OTA companies as tourism market players in achieving high-quality development in the new era are growing. At the same time, the OTA market has the problem of severe homogenization. This paper uses a single case study approach to analyze Ctrip's approach to public health emergencies through an analysis of the OTA market as a whole, an analysis of OTA competitors, and a balanced scorecard approach. In this way, to explore the way forward for OTA companies in the face of global health emergencies.

Keywords Online travel agency · Balance scorecard

1 Introduction

The tourism industry has entered a fiercely complex and competitive stage (Kim et al. 2020) with a pronounced focus on customers and the market. Thus, online travel agencies (OTA), a new business model based on Internet information technology, the travel e-commerce platform has been gaining attention from investors. Online travel agency is intermediaries that sells offline travel services, and the industry is characterized by "low frequency and high unit price" (Stangl et al. 2016). The OTA companies optimize the customer experience, reduce the cost of soliciting customers, improve the booking process's overall efficiency and complete the travel industry's value transfer process (Chang et al. 2019). These online travel agencies, namely Ctrip, Expedia, Booking etc. do not own any hotels but run websites that attract customers with great hotel information, price comparisons, discounts, and reviews (Masiero et al. 2020).

However, the global tourism industry has been hit hard by the impact of Covid-19. The rapid spread of the epidemic, the wide range of infections, and the difficulty of control have profoundly impacted the global economy, social development, and

Z. Yang (✉)
Soochow University, Suzhou 215000, China
e-mail: zyyangyzy@stu.suda.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_55

people's lives. And the tourism industry is more vulnerable to external circumstances and emergencies due to its comprehensive and sensitive nature. Therefore, this article will take Ctrip as an example to analyze how OTA companies can survive in the midst of global emergencies.

2 OTA Business Model

In the travel industry, OTA is considered as a commonly used and a major distribution channel for facilitating customers to make reservations (Gao and Bi 2021). There are three main types of revenue streams for OTAs: Agency model, Merchant model, and Advertising model (Ţierean 2018). Agency model: OTAs earn revenue as commission agents, and OTAs do not own the goods as intermediaries. (2) Merchant model: OTA buys the commodity and then sells it at a markup price. (3) Price model: OTA charges for advertising. The ownership of the merchandise lies with the OTA. Most OTA companies use the agency model as their main profit model. There is no single profit model available to OTAs, and generally, OTAs can choose one model as their primary profit model or a combination of models (Weigert 2018) (Fig. 1).

In the agency model, the OTA is treated as a platform to link consumers with suppliers by acting as an intermediary between the two, helping merchants sell individual travel items or packages while helping consumers find targeted items for a percentage of the commission. In this model, the actual transaction takes place between the merchant and the consumer, with ownership of the goods never falling on the OTA. The agency model is widely used for airline bookings as airlines have a strong voice, while hotel and other bookings are available in both agency and wholesale models, but the agency model dominates.

In the merchant model, the OTA buys out a portion of the service (e.g. airline/hotel/travel products) and sells it to the consumer at a mark-up. the OTA buys out the inventory and assumes the operational risk, and ownership of the goods is transferred from the merchant to the OTA. This is a high-reward, high-risk model compared to the agency model, and it also has a high level of OTA involvement. In

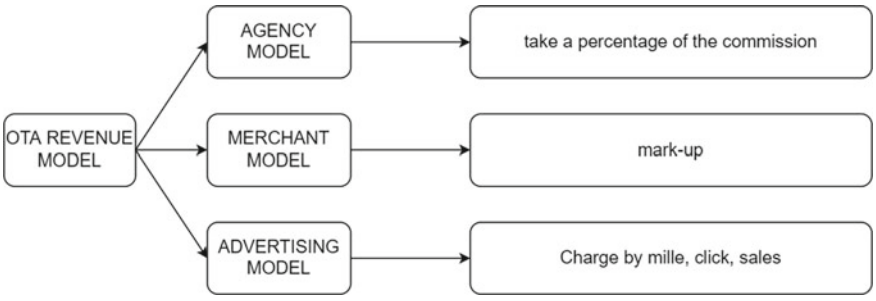


Fig. 1 OTA revenue model

the process, the OTA earns revenue from the price difference and ties up the user's money, so the returns are higher. However, losses can be incurred if user demand is misjudged at that stage and the demand does not cover the hoarded goods.

The advertising model is aimed at businesses with high demand for customers, and OTAs provide them with a platform for marketing. Airlines, hotels and travel agencies that are under pressure to attract more customers choose to advertise on OTA websites or mobile platforms in order to attract more effective customers. OTAs earn advertising revenue by charging advertising fees for results. Currently, OTAs account for the smallest proportion of advertising revenue.

3 The Competitive Landscape of OTAs in the Chinese Market

3.1 Overall Competitive Landscape

Ctrip is a dominant player and Meituan is expected to break the game. In October 2015, Ctrip acquired Qunar.com in a share swap, making Baidu the largest shareholder of Ctrip. With the monopoly attribute of the OTA industry, Ctrip has changed the original situation of many strong players in the Chinese market to one super strong OTA market (Fig. 2).

The threat of Meituan is the greatest among Ctrip's rivals, and the future may form a three-way situation between Ctrip, Ali and Meituan. YL.com is an intra-system competition, mainly using the customer resources of Tencent and the business resources in Ctrip, so the threat is not significant. However, Meituan, with its broader coverage of the ground marketing team, has been able to break through in

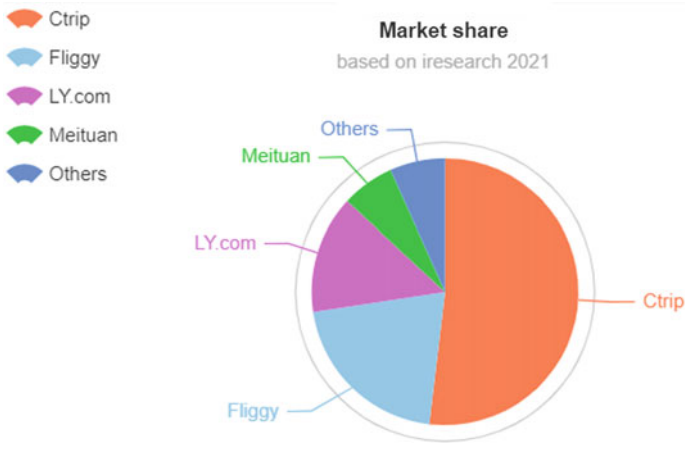


Fig. 2 Market share of OTA

lower-tier cities as a late entrant. What's more, backed by Ali's customer basis, the company focuses on the "standard airfare + high-rate hotel discount coupons + B&B" ecosystem. At present, the biggest threat is the impact of Meituan, which will have enough business travel users along with user iterations, and will then be able to push the resource end.

In the long run, the OTA market is expected to be divided among Ctrip, Ali and Meituan.

3.2 LY.Com Analysis

Tongcheng Yilong (YL.com) is one of the earliest OTA companies in China, formed by the merger of two OTA vendors, Tongcheng and Yilong. In 1999, YL.com was founded as a hotel booking business, and in 2004, Tongcheng Network was founded as an online business card distributor. In 2017, Tongteng was separated from its offline travel business and eventually merged with YL.com in 2018, resulting in a successful listing in Hong Kong. "Tongcheng + Yilong" complemented each other's resources, strengthened the scale effect and consolidated the market position of OTA.

YL.com has transformed and upgraded from OTA to ITA, optimizing user experience and improving its operational efficiency. The hundreds of millions of users accumulated by the WeChat small program form the basis of the strategy, and nearly 2000 employees in the IT department has already built up business-side automation, with 94% of the total number of users in the business. The company has already automated its business side, with 94% of airline tickets and 75% of accommodation nights processed automatically. In the future, the company will focus on smart travel innovation, transforming the industry chain and customer behavior, providing customers with a full process of companion butler service, and realizing the transformation from OTA to ITA. In the future, the company is expected to strengthen its scale effect and further consolidate its position in the OTA market through joint technology development and marketing promotion (Fig. 3).

3.3 Meituan Analysis

Meituan entered the OTA hotel market late but has risen rapidly with the support of the Group's LBS platform. In 2012, Meituan first entered the hotel business as a group purchasing company, and officially entered the hotel booking market in 2013. Then, with the support of the group's LBS platform, it achieved a rapid rise in the mid-to low-end hotel market. In 2016, it promoted its high-star hotel strategy, and in 2017, it launched the new "Meituan Travel".

In the early stages of development, Meituan competed with Ctrip in a staggered manner, tapping into local demand in lower tier cities and implementing an "open-source, cut-back" strategy. Unlike Ctrip, which caters to the high-end hotel needs of

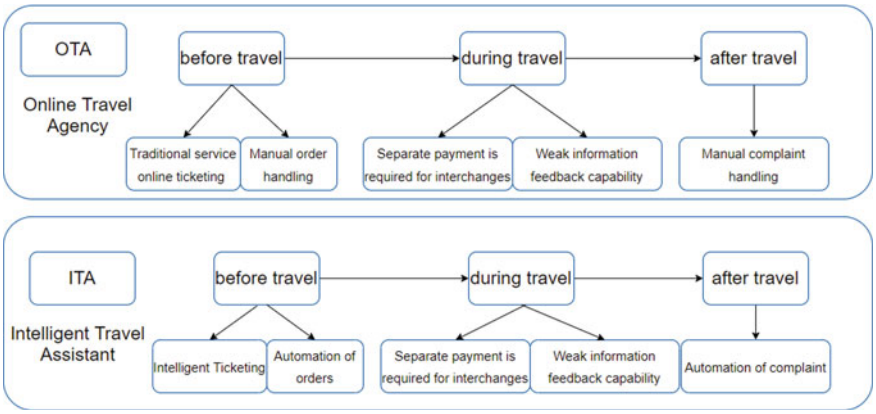


Fig. 3 OTA and ita

business travelers, Meituan mainly covers the local low-end hotel needs of young travelers, cultivating the incremental market in low-tier cities. This is an "open-source" strategy on the Customer-suite, cultivating the incremental market in low-tier cities. This strategy has enabled Meituan Hotels to achieve "stable mid-week demand and significant weekend peaks", and "no slowdown in low season and more prosperous in high season". In addition, Meituan also empowers hotel merchants, helping them to achieve autonomous and efficient operations, thus achieving the goal of "cutting costs" on the Business-side. By refining its operations through "cutting costs and reducing expenses", Meituan has quickly captured the incremental market of local low-end hotels, laying the foundation for its next expansion.

3.4 Fliggy Analysis

Fliggy Travel, formerly known as Ali Travel, is a platform-based model to create a new travel ecosystem. Ali was first involved in the travel market in 2009, the company launched Taobao Travel and its travel services, and in 2014, the two were merged and upgraded to launch Ali Travel. Ali Travel was further upgraded to "Fliggy" in 2016, as an atypical OTA, mainly in a platform mode to provide air tickets, B&B. In the future, a new tourism ecosystem will be created through the New Travel Alliance (Fig. 4).

Backed by the Ali ecosystem, Flying Pig receives a range of support from traffic and payment to technology and experience. Fliggy is embedded into the travel channels of Taobao and Alipay respectively, taking full advantage of Ali's super customer, and is also supported by Ali Cloud in many ways, providing security for its rapid expansion. Since its inception, Fliggy has experienced rapid growth, jumping to

Fig. 4 Ali business cycle

second place in the industry in terms of the transaction value for standard airline tickets and a rapidly growing high-end hotel discount voucher business.

Unlike the traditional OTA agency commission model, Fliggy adopts the Taobao platform model, in which merchants sell on their own after being stationed, with lower commission rates, and Fliggy is only responsible for the construction of the portal, which results in lower operating costs. The Taobao platform model empowers merchants to achieve rapid expansion of their standard product business.

4 Ctrip Analysis Based on Balancing Scorecard

4.1 Balancing Scorecard

The balanced scorecard is a performance measurement system driven by strategy and includes performance measures in the following areas: financial, customer, efficiency, and innovation (Frigo and Krumwiede 2000), which is widely used in management performance. In fact, Gartner Group predicted that at least 40% of Fortune 1000 companies will be using the balanced scorecard by the end of 2000 (Eldenberg and Wolcott 2005). Given its widespread acceptance and use by practitioners, the BSC is well-entrenched in the management accounting literature (Hilton et al. 2007).

Considering that OTA platform is involving kinds of dimensions of work, thus this article chooses a balancing scorecard (BSC) as the evaluating model.

4.2 Financial Aspect

Financial indicators should be used as one of the key points of performance appraisal, which can visually evaluate business performance and is a key part of the assessment for measuring Internet companies. The analysis of the financial dimension of the balanced scorecard can reflect the strategic objectives of the company and their achievement, and thus provide an accurate grasp of the company's own business situation (Merchant 1982).

In this dimension, this article chooses EPS, the proportion of operating expenses and price strategy as standard performance indicators to analyze Ctrip's financial performance.

Basic EPS and Diluted EPS (Fig. 5).

The EPS index can reflect the distribution of the operating profit of a company, as well as the overall performance of the company for the year. As the index is directly linked to the distribution of profits it can therefore be used as an important indicator for investment and also for financial evaluation. The main difference between Basic EPS and Diluted EPS is that Diluted EPS takes into account the number of potential shareholders of convertible bonds, and a comparison of the two shows the willingness of the company's creditors to invest, thus reflecting the overall performance of the company.

The table of statistics shows that the EPS index falls off a cliff from 2019 to 2020 as a result of the epidemic. It can be seen that the overall profits of the companies have fallen and are struggling to return to their pre-epidemic levels, even if the companies' eps index remains below 0 by 2021. Moreover, the data from the companies' annual

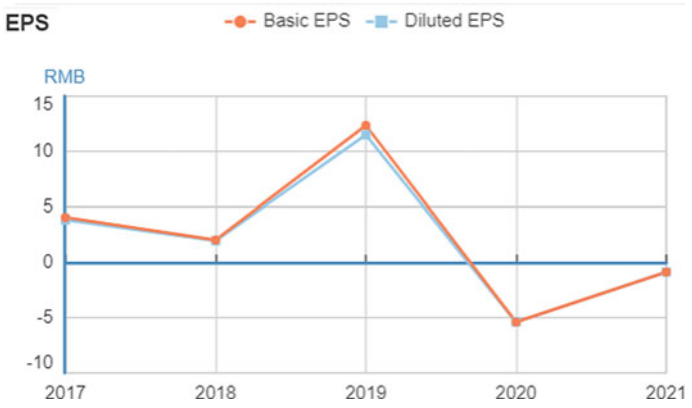


Fig. 5 EPS situation

reports show that the companies' basic eps and diluted eps remain flat in 2020 and 2021, indicating that the companies' original bondholders are not optimistic about the companies' future expectations and are not willing to convert convertible bonds into shares to become shareholders of the companies. Therefore, the survival of OTA companies in the face of public health emergencies is the key research question in this piece of writing.

Proportion of Operating Expenses

Product development expenses are mainly used for the development and maintenance of B-side merchants and technology investment, which are expected to be maintained in the future. Sales and marketing expenses are mainly used for C-side customer acquisition and promotion, mainly including C-side APP download and brand advertising (Fig. 6).

Looking at the statistics of the Ctrip business for the five consecutive years from 2017 to 2021, 2020 is a significant point in time for the distribution of corporate expense ratios, i.e. the outbreak of the New Crown epidemic brings about a change in the overall corporate strategy of the business. Prior to the onset of the epidemic in 2020, the overall operating expenses of the enterprise are mainly distributed on the marketing side, and the development of the C-terminal customer market is where the overall OTA enterprise's competitive point lies.

And after 2020, it is evident that the marketing end of the business has shrunk significantly, from over half of the previous operating expenses to less than one-third in the later years, which can be seen in the reduction in the flow of customers from the C-suite affected by the epidemic quarantine policy in the general environment. It is due to the limitations of offline tourism in the local market that Ctrip enterprises have placed their corporate development goals on broadening the overseas market and the sinking market in local cities while increasing innovation and research and development for tourism products. As can be seen in the statistics table, after 2020, product development is a major expense in terms of daily running costs. A good

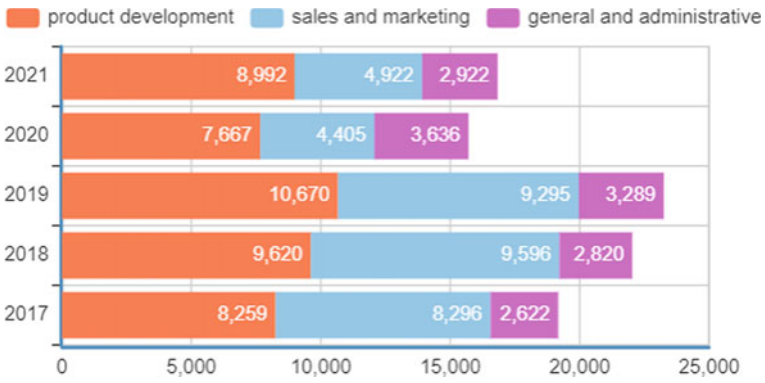


Fig. 6 Operating expense

foundation is being laid for the accumulated travel demand of the public in the post-epidemic era.

Price Strategy

Price Discrimination. Price discrimination is a common pricing strategy in economics. Ctrip maximizes its profits by using the information it holds to accurately differentiate between users and price differentials. This is a new way of implementing price discrimination in the era of big data, built on cloud computing technology and data mining techniques.

OTA has the innate advantage of getting first-hand initial information and building its own database. By filtering, analyzing and summarizing information, the information is quantified into data, which is constantly crossed and collected in a constant stream, eliminating the information limitations of the previous travel agency model. Computer algorithms, and cloud computing technology, can be used to ladder consumers with data, By using data, it can deduce information that affects consumer behavior, while grasping consumer psychology and guiding consumers to passively choose goods; while accurately predicting consumers' maximum willingness to buy and their maximum price tolerance, so that they willingly spend the most money to consume. The price is not the sum of costs and profits in line with the principle of supply, but rather the highest price that consumers are willing to pay.

Price War (Penetration). Ctrip, with its well-established financial resources from the early days, has been able to suppress the growth of other OTAs by expanding its market share through price wars, increasing the stickiness of existing customers and continuously exploring potential customers.

4.3 Efficiency

Daily Operations. As the domestic landscape became more stable, Ctrip took the lead in accelerating the pace of internationalization, acquiring SkyTour and Trip.com in FY16 and FY17 respectively, as the company's main platform for the European and Asia Pacific markets, realizing the internationalization of its brand.

With the growth in first-tier cities slowing and online customer acquisition costs high, Ctrip has chosen to expand into lower-tier cities by expanding offline franchises. The company invested in PepsiCo in 2016, and 5500 PepsiCo experience shops landed in 2017, while Ctrip and Qunar.com also increased their shop expansion. At present, the contribution of offline shops is relatively limited, but the company has used this to achieve a low-cost position. The cost of acquiring customers from offline shops is only half of the cost of acquiring customers from online APPs, and through offline shops, the company has gained more than 80% of new customers.

Emergency Measures. At the beginning of the new epidemic in 2020, Ctrip executives said that "the travel experience does not only come from the travel itinerary, it runs through the whole process from the purchase decision to the end of the trip, and the loss of refunds and changes is also part of the travel experience, and the loss of

prepayment before the trip is made is a very bad experience for travelers. In order to give travelers the best possible experience and to meet the overall needs of national epidemic prevention and control, Ctrip is willing and should bear these losses". Under this guiding principle, Ctrip took the initiative to assume responsibility for non-destructive refunds, 48 h earlier than the national non-destructive refund policy, and any losses incurred during these 48 h were borne by Ctrip.

There are more than 8000 suppliers on Ctrip's platform, and with the new pneumonia epidemic, these suppliers have suffered huge losses on the one hand, but still have to comply with the overall national anti-epidemic policy and cooperate with tourists to refund and change their tickets on the other.

As a "platform governor", it is an important goal of Ctrip's social responsibility governance to regulate the socially responsible behavior of the platform's bilateral users and maintain the standard operation of the platform. During this epidemic, Ctrip repeatedly encouraged and called on platform users to fulfill their social responsibility. After the introduction of the regional refund policy, Ctrip invested a lot of manpower in communicating and coordinating with suppliers, and launched the "Peace of Mind Cancellation Guarantee Agreement" and "Health Guardian Alliance" for hotels around the world, requiring businesses to have the necessary anti-epidemic health conditions in place to ensure guest safety. "We have also launched many supportive policies, allocating hundreds of millions of dollars in marketing funds, launching tens of thousands of dollars in support funds, and labeling hotels that are actively fulfilling their responsibilities with the title of 'Caring Hotel' to help stop and cushion the losses of platform merchants. Only when all merchants on the platform survive will there be hope for the industry to recover". While ensuring supply chain stability, Ctrip has exerted its platform influence to guide suppliers to fulfill their social responsibility and strengthen national policy advocacy for public crisis management.

4.4 Innovation

According to the data table, it can be seen that Ctrip's expenses on product development have remained relatively stable overall (except for 2020 when it was affected by the epidemic). Travel products are easily imitated in terms of service design and travel package combinations, with the problem of serious homogenization and high substitutability. Therefore, comprehensive and rich travel information can attract more tourists and effectively improve the stickiness of travel websites and tourists' loyalty (Fig. 7).

At the same time, high-end customized tourism is currently an important breakthrough point for OTA products. In this regard, Ctrip has specifically set up a private customization module, including the development of travel itineraries, the display of exclusive special programs, and CEO-recommended routes, which not only provides high-end professional services for tourists but also promotes product marketing. As such, Ctrip develops unique and distinctive high-end customized travel itineraries

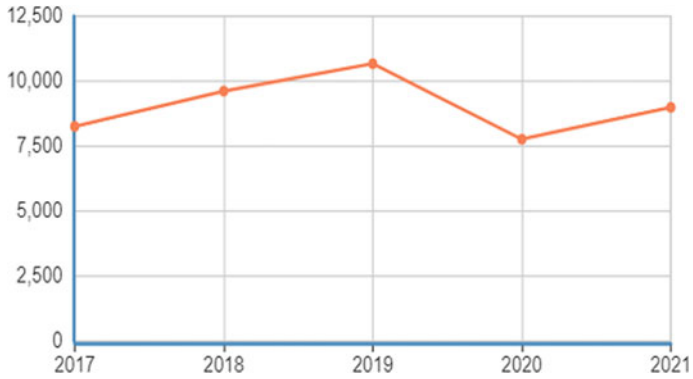


Fig. 7 Development cost

and supporting services, attaches importance to grasping the individual needs of tourists, provides a wide range of travel product materials, and processes them into individual travel products for potential tourists to combine and design personalized travel itineraries according to their individual travel needs, and develops the OTA platform business into a vertical field.

4.5 Customer

Ctrip has relied on its financial strength since its IPO to win various domestic traffic battles and has expanded its international users through the acquisition of Sky Tour. To ensure service experience and enhance user stickiness, Ctrip has built the largest and most extensive call centers in the industry, and these call centers ensure high user stickiness. Ctrip users have a repeat rate of 40–50% once a year, and 80% of the company's total transactions come from repeat customers.

5 Conclusion

The article has the following conclusion. Platform enterprises encourage bilateral users within the platform business ecosystem to participate in social responsibility governance and jointly promote the solution of social public issues, which transcends the limitations of a single responsibility-fulfilling subject and reflects the coupling of responsibility-fulfilling subjects. As the social responsibility behaviors of bilateral platform users have a great impact on the reputation and responsible image of platform-based enterprises, platform-based enterprises need to regulate and govern the social responsibility of other platform users, to regulate the responsible behavior of platform users by constructing platform trading rules and social responsibility

governance mechanisms, to minimize the emergence of social responsibility heterogeneity, and to maintain the normal order of platform operations in the event of a public crisis.

In the event of a public crisis, the normal order of the platform's operation is maintained. It can be considered that platform-based enterprises strengthen the motivation of platform users to fulfill their social responsibility by providing information channels for social responsibility fulfillment, financial compensation and reputation incentives, and enhance their awareness of their responsibility as co-responsible subjects of corporate social responsibility. The governance of social responsibility in the platform ecosystem is based on coupling and shared governance. The stronger the coupling between the social responsibility subjects of the platform ecosystem, the higher the intensity of social responsibility fulfillment.

In the wake of the new epidemic, Ctrip has launched the "Same program, providing 1 billion yuan of support funds and 10 billion yuan of small and micro loans to the platform's partner suppliers. The program involves financial support, resource tilting, fee waiver, security guarantee, and resource sharing in five areas. It also launched the "Holiday Recharge" learning program, which provides nearly 2000 online courses for partners to reinforce their internal strength for the resumption of growth after the epidemic. These initiatives have not only provided the platform with the necessary resources to support its growth but also provided its partners with the best online courses. "These initiatives will not only provide a platform for suppliers not only provide some financial support to platform suppliers for the losses caused by the implementation of the refund policy funding but also incentivize platform suppliers' sense of social responsibility".

A sound crisis management mechanism is an important guarantee for timely and effective response to public crisis management. In an uncertain development environment, enterprises should incorporate crisis management into their regular management and establish a regular mechanism for crisis management, which will not only enhance their ability to respond to crises but also motivate them to stay calm in times of crisis and better fulfill their social responsibilities in public crises.

Ctrip has always attached importance to crisis management since its establishment, and as early as 2005, it set up the travel industry's first major disaster travel experience guarantee fund, putting RMB 1 million into the guarantee account each year to deal with sudden crises. After the outbreak of the New Crown epidemic, Ctrip, on the one hand, launched a crisis alert and set up an emergency command team for the New Crown epidemic, and on the other hand, quickly launched a major disaster protection fund and proposed free refunds and changes ahead of the national policy.

The fulfillment of social responsibility cannot be achieved without long-term financial investment by enterprises. In academia, many scholars have used stakeholder theory, transaction cost theory, and, social contract theory to analyze the impact of CSR on corporate financial performance at both the theoretical and empirical levels, and they believe that achieving the unity of financial objectives and social responsibility is an important issue facing enterprises today and that enterprises must focus on the consistency of financial objectives and social responsibility in order to

achieve joint development of the company and society. Therefore, it is necessary to make financial investments in social responsibility in the business process, to enhance the ability of enterprises to fulfill their social responsibility, and to realize the harmonization of economic benefits and social responsibility objectives in the long term.

The Ctrip Major Disaster Travel Experience Guarantee Fund has been in existence for 15 years, with RMB 1 million put into the Guarantee Fund account every year to preserve and increase its value through the operation of the fund, which is used to fulfill social responsibility in major disaster management. During the New Crown epidemic, the total payout from the Ctrip Safeguard Fund reached RMB 200 million. In addition, Ctrip also established the Ctrip Charity Platform in 2019, providing RMB10 million in charity funds to support the development of charity projects by suppliers and the community. In the future, the firm would develop quickly based on the above analysis.

References

Chang YW, Hsu PY, Lan YC (2019) Cooperation and competition between online travel agencies and hotels. Tour Manage 71:187–196

Eldenberg LG, Wolcott SK (2005) Cost management: measuring, monitoring, and motivating performance. Wiley, New York, NY

Frigo ML, Krumwiede KR (2000) The balanced scorecard. Strateg Financ 81(7):50

Gao GX, Bi JW (2021) Hotel booking through online travel agency: optimal stackelberg strategies under customer-centric payment service. Annals Tour Res 86:103074; Mauri AG, Minazzi R (2013) Web reviews influence on expectations and purchasing intentions of hotel potential customers. Int J Hospital Manag 34(6):99–107

Hilton RW, Maher MW, Selto FH (2007) Cost management: strategies for business decisions, 4th edn. McGraw-Hill Irwin, Burr Ridge, IL

Kim J, Franklin D, Phillips M et al (2020) Online travel agency price presentation: examining the influence of price dispersion on travelers' hotel preference. J Travel Res 59(4):704–721; Bennett MM, Lai CWK (2005) The impact of the internet on travel agencies in Taiwan. Tourism Hospital Res 6(1):8–23

Masiero L, Viglia G, Nieto-Garcia M (2020) Strategic consumer behavior in online hotel booking. Ann Tour Res 83:102947

Merchant KA (1982) The control function of management. Sloan Manag Rev (Pre-1986) 23(4):43

Romanian ŢO, Hotel managers' perspective on revenue management. Bull Transilvania Univer Brasov. Econ Sci. Series V 11(2):57–70; Zeng G, Cao X, Lin Z, Xiao SH (2020) When online reviews meet virtual reality: effects on consumer hotel booking. Annals Tourism Res 81, Article 102860

Stangl B, Inversini A, Schegg R (2016) Hotels' dependency on online intermediaries and their chosen distribution channel portfolios: three country insights. Int J Hosp Manag 52:87–96

Weigert M (2018) Jumia travel in Africa: expanding the boundaries of the online travel agency business model. Tour Rev

Research on the Relationship Between Executive Compensation and Firm Performance: A Case Study of Panel Data of Chinese Firms

Mingtao You

Abstract Senior executives play an important role in corporate governance. By analyzing the samples of listed companies from 2014 to 2019, this paper finds that the improvement of enterprise performance cannot be separated from the decision-making of senior executives. How to use compensation to motivate senior executives to actively create new value for the enterprise and safeguard the interests of the enterprise, so as to improve the operation efficiency and profitability of the company, is of great significance to the development of the company. Therefore, when exploring the relationship between salary incentive and enterprise performance, we should pay attention to the study of the external monetary form of salary incentive to explore its impact on the company's performance, and explore whether it is correct to argue that there is a significant positive correlation between executive compensation incentive and the company's performance, that is, the more compensation is given to executives, the company's performance will be improved accordingly.

Keywords Salary incentive · Regression analysis · External currency

1 Introduction

Executives play a role in corporate governance, enterprise performance cannot leave the executive decision, how to use compensation incentive executives, stand in the position of the enterprise, actively create new value for the enterprise, safeguard the interests of the enterprise, so as to improve the enterprise efficiency and company profitability, it is of great significance to the development of the company.

As for the form of compensation, previous studies mainly divided compensation into money, equity and debt. Smith and Watts believe that the form of compensation can be wages or restricted stocks and options (Wentao et al. 2021) and Zhang

M. You (✉)
Northwest A & F University, 3-2-4, Yard 35, Northwest 1st Road, Lianhu District, Xi'an City, Shaanxi Province, China
e-mail: 460282594@nwafu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_56

Xingliang believes that in addition to the above two, there are also debt compensation, for which companies will pay compensation for executives in the form of pensions, etc.

For the form of compensation incentive, the research generally believes that there are two main forms, namely, the internal form of giving spiritual satisfaction and the external form of monetary expression. A large number of corporate data show that there is a positive relationship between executive compensation and corporate performance. Higher compensation can urge managers to stand in the enterprise position and work more actively, confirming the optimal compensation contract theory. Sheng Mingquan found that there is a positive correlation between executive compensation and corporate performance, and higher compensation can urge managers to stand in the company's position and work more proactively, confirming the theory of optimal compensation contract. China Entrepreneur Survey System By tracking the external environment in 2011–2018, it was found that the business environment plays a vital role in promoting entrepreneurship. Xie Zhong and Zhang Jie Empirically concluded that the business environment is the guarantee for the cultivation of entrepreneurship, and a good business environment helps to strengthen the role of entrepreneurship in promoting the performance of real enterprises. Sun Rong (Zhu 2021) empirically shows that a good business environment helps entrepreneurs to innovate and allocate entrepreneurship to productivity, thereby indirectly promoting economic growth.

This paper mainly investigates the influence of salary incentive on company performance in the form of external currency.

In summary, the existing literature on the role and influence of executives in corporate governance is mainly focused on the spiritual level, and there is a lack of research on external activities. This paper explores the impact of compensation incentives in the form of external currencies on corporate performance.

2 Methods and Data

2.1 Methods

Methods are to first determine the dependent variables of the overall data: earnings per share (EPS), independent variables: executive compensation incentives (LNPAY), regulatory variables: equity balance (CR) and control variables: equity concentration (ECD5), enterprise size (SIZE), capital structure (LEV), operating capacity (CLR), corporate growth (NEG) (Xianan et al. 2021); After confirming the variables of the data, combined with the assumptions proposed in the theoretical analysis of the previous article, the regression model is constructed as follows:

$$EPS = \beta(0) + \beta(1) * LNPAY + \beta(2) * CR + \beta(3) * SIZE + \beta(4) * LEV + \beta(5) * CLR + \beta(6) * NEG + \varepsilon \quad (1)$$

Finally, a descriptive analysis and regression analysis were carried out to verify that, other things being equal, the executive compensation incentive was significantly positively correlated with the company's performance, that is, the more compensation was given to the executives, the company's performance would increase accordingly (Pan 2021).

2.2 Data

Through the Guotaian database, the article selected the A-share listed companies from 2014 to 2019 as the research object, considering the accuracy of the study, excluded the PT, ST, financial industry and missing data samples in the data collation, and finally obtained 9846 observations and carried out tailing treatment (Bing et al. 2021).

3 Results and Discussion

3.1 Descriptive Analysis

From the descriptive analysis, we can see from Table 1 that, on the whole, the financial performance of enterprises varies greatly and the total income level is low, the minimum EPS is only −1.64, which indicates that the company has suffered serious losses, the degree of dispersion of LNPAY is low, and the average earnings per share (EPS) is only −1.64, the average is 14.5, with a higher real compensation given the Logarithm, and the ratio of equity checks and balances (CR), with a maximum of 2.7 and a minimum of 0.03, varies widely between companies. In addition, for the control variables, the ECD5 has a maximum value of 87.9 and a minimum value of 19.7, indicating that the degree of ownership concentration of listed enterprises is quite different, and the SIZE of listed enterprises is mostly concentrated at about 22, with a concentrated distribution, the average value of capital structure (Lev) is 0.44, and the maximum value is 0.93. It can be seen that the financial risk of the sample companies is quite different, and the overall level of debt is high. The maximum value of operating capacity (CLR) is 5.8, and the minimum value is 0.11, the average value of company growth (Neg) is 0.18, and the overall growth rate of enterprises is slow and uneven (Balogh et al. 2020).

Table 1 Descriptive statistical analysis of variables

Variables	Mean	SD	Min	Max
EPS	0.281	0.497	−1.639	2.043
LNPAY	14.54	0.691	12.99	16.58
CR	0.712	0.59	0.0291	2.694
ECD5	51.83	14.95	19.7	87.9
SIZE	22.43	1.291	19.97	26.38
LEV	0.444	0.207	0.0592	0.929
CLR	1.261	0.982	0.112	5.805
NEG	0.178	0.465	−0.575	2.966

3.2 Correlation Analysis and Multicollinearity

According to Table 2, the correlation Coefficient between earnings per share (EPS) and LNPAY is 0.295, which is positive to a large extent, that is, the more executives are paid, the better the company's performance. There is also a significant correlation between the control variables and the dependent variables, and except the asset-liability ratio is significantly negative correlation, the others are all positive correlation, which is in line with the economic reality, indicating the rationality of the selection of the control variables in this paper, they can have a certain impact on corporate performance. In addition, the correlations of the control variables were all below 0.5, and most of them were low to moderate degree (Zheng and Zhang 2020). The VIF values of the control variables were all lower than 10, so there was no Multicollinearity problem.

Table 2 Correlation analysis and collinearity test of variables

	EPS	LNPAY	ECD5	CR	SIZE	LEV	CLR	NEG	VIF
EPS	1								
LNPAY	295***	1							1.32
ECD5	226***	074***	1						1.13
CR	−0.043***	098***	−0.129***	1					1.06
SIZE	251***	451***	269***	−0.091***	1				1.86
LEV	−0.148***	114***	0.013	−0.120***	497***	1			1.41
CLR	113***	080***	107***	−0.065***	154***	129***	1		1.05
NEG	195***	033***	067***	069***	039***	0.001	110***	1	1.02

3.3 Executive Compensation Incentive Regression Analysis

In this paper, we use Stata16.0 to explore the impact of executive compensation incentive intensity on eps. Huasman test shows that the P value is significantly 0.

From Table 3, the MODEL-1 has good explanatory power for dependent variables through f-test, and the goodness of fit of the modified multiple regression model is 0.571, indicating that the model-1 can explain 57.1% of the dependent variables, and the goodness of fit is good (Xiaowei et al. 2020).

According to the results of multiple regression, the β Coefficient of LNPAY to EPS is 0.081, which is significantly positive correlation at the level of 0.01, this suggests that compensation incentive can effectively promote the increase of enterprise performance, the reason may be that increasing the level of executive compensation means that the executives get the attention of the company, which provides the guarantee for their future development in the company, once the business situation of a company is closely related to its own interests, it will prompt the executives to think from the standpoint of the company and strive for the maximum benefit of the company more actively, to make more favorable decisions for the enterprise, thereby improving the operating profits of the enterprise and increasing the value of the enterprise. The

Table 3 Multiple regression analysis

Variables	Model
LNPAY	0.081***
	−5.2
CR	
CR*LNPAY	
ECD5	0.004***
	−5.13
SIZE	0.189***
	−12.26
LEV	−1.333***
	(−21.19)
CLR	0.088***
	−7.13
NEG	0.140***
	−13.19
Variables	Model
Constant	−4.895***
	(−14.18)
r2_a	0.571
F	151.1
F test	0

above regression results confirm that, other things being equal, executive compensation incentive has a significant positive correlation with corporate performance, that is, the more executive compensation is given, the corporate performance will improve accordingly (Chen 2019).

4 Conclusion

In this paper, we choose the sample of listed companies from 2014 to 2019 to study the impact of executive compensation incentive intensity on earnings per share, executive Compensation Incentives and corporate performance are significantly positive correlation, that is, the more executive compensation, the company's performance will improve accordingly. In particular, the more external money given, the more obvious the incentives for senior executives, although some companies will be high because of the fixed external currency of senior executives will lead to their own laziness, lack of progress, but most companies show a positive correlation, suggesting that, in general, the more executives are paid, the higher the company's performance (Rababah 2019). In the analysis, we can also see that the equity check and balance has a negative moderating effect in the relationship between executive compensation incentive and enterprise performance, it is necessary for the enterprise to make scientific and reasonable arrangement and weigh the situation of the company in an all-round way, so as to improve the motivation of the executives and promote the increase of the performance of the enterprise, only then can give full play to the salary incentive function.

References

Balogh G, Sipos N, Rideg A (2020) An empirical study of the internal factors influencing the application of compensation incentives in SMEs. Compet Rev Int Bus J 31(3)

Bing Z, Meng LY, Cheng SF, Guo ZZ (2021) Executive compensation incentives, risk level and corporate innovation. Emerg Markets Rev 47(prepublish)

Chen L (2019) Research on the influence of executive compensation incentive on company growth. Acad J Eng Technol Sci 2(3)

Rababah NM (2019) CEO-TMT exchange, TMT psychological empowerment and firm performance: the moderating effects of TMT incentive pay. Turk Turizm Arastirmalari Dergisi 2(1)

Wu P (2021) A summary of researches on the governance of non-state-owned shareholders, executive compensation incentives and earnings management. Sci J Econ Manag Res 3(7)

Xianan Y, Hua M, Jing C, Xinzhong B, Daqing G (2021) Could executive compensation incentive enhance the efficiency of enterprise resource allocation? An empirical study from China. Discr Dyn Nat Soc 2021

Xiaowei L, Ya S, Jiexiang W (2020) The influence of executive compensation incentives on R&D investment: the moderating effect of executive overconfidence. Technol Anal Strat Manag 32(10)

Zheng S, Zhang Z (2020) Research on employee compensation incentive mechanism. Int J Innov Manag Technol 11(5)

Zhu W, Shen W, Di Y, Wang Y, Qiu J (2021) Research on the salary incentive of accounting firms—taking a accounting firm as an example. Int J Soc Sci Educ Res 4(11)
Zhu Y (2021) The relationship between executive incentives and company innovation investment. World Sci Res J 7(12)

Hedging Strategy Case Analysis—Southwest Airlines

Boao Yu

Abstract Hedging is a typical method for companies to avoid risks. A good hedging strategy could help the firm to deduce the temporary risks and losses caused by the fluctuation of their financial determinants. The main purpose of this paper is to represent the importance of hedging strategy for a company by analyzing the hedging strategy used by Southwest Airlines in 2021—a typical example of a firm that used hedging strategies a lot in the real life. In this paper, a financial analysis would be made based on the firm's general background information, financial situation, and historical stock price. Based on that information, specifically, the hedging strategies for fuel with a long call option, short call option, and short put option would be analyzed. This paper could provide a reference for airline companies as well as the firms which have high fluctuation in their inputs.

Keywords Fuel hedge · Financial analysis · Hedging strategy

1 Introduction

As explained by Siew Hoon Lim and Yongtao Hong, airlines use financial instruments and contract as tools to prevent expenses from the impact of rising fuel costs (Lim and Hong 2014). According to the annual report of Southwest airlines for 2021(Southwest Airlines Co 2021), The cost of jet fuel and oil is the second largest expense for the company. The price of jet fuel has taken a decisive role in the profits of Southwest Airlines, also any other firm whose outcomes are highly reliant on oil products. Southwest Airlines is always seeking ways to operate the firm with a good fuel price, otherwise, the firm would face a heavy loss and other forms of economic distress, for the reason that jet fuel and other oil products are necessities for an airline company, which could not be avoided. According to Dave Carter, "Airlines that want to prevent

B. Yu (✉)
University of Calagry, 3330-24Ave NW, Calgary, AB, Canada
e-mail: boao.yu@ucalgary.ca

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_57

huge swings in operating expenses and bottom line profitability choose to hedge fuel prices" (Carter et al. 2004).

The paper would firstly start by giving an introduction to the firm's profile, which are respectively the firm's background information, the firm's financial status, and share price. In the next part, the hedging strategy of Southwest Airlines would be analyzed specifically. The temporary existing risks, which could lead to a huge loss for the company, will be figured out, such as the risk that can still affect the firm, the impact of the Covid-19 pandemic on the hedging strategy for the firm on the oil products, as well as the possible problems which could be brought by externalities. Next, the hedging strategies used by the firm would be explained in detail. The firm, 2021, used many hedge derivatives to reduce the possible loss which could be brought by the fluctuating oil price. There will be three examples used in this paper, which are the long call option, short call option, and short put option.

In this article, Sect. 2 presents the firm description and Sect. 3 introduces the hedging strategy analysis for Southwest Airlines. Finally, the paper conducts the conclusion in the last Section.

2 Firm Profile

2.1 Background Information

Southwest Airlines is operated by South West Airlines Co. Southwest Airlines is one of the major airlines of the United States and the world's largest low-cost carrier. Like the information introduced by Krista Richard, Southwest Airlines' low pricing strategies made them succeed in early 1990 when the whole airline company was experiencing a heavy decline (Richards 2009). It is a private own firm which is founded in 1967, and headquartered in Dallas, US. By the end of 2021, Southwest Airlines has a total asset of 36.3 billion US dollars. The airline currently has approximately 60,000 employees and operates 4000 departures a day. On December 31, 2021, Southwest had a total of 728 Boeing 737 aircraft in its fleet and 121 destinations in 42 states, the District of Columbia, the Commonwealth of Puerto Rico, and ten near-international countries: Mexico, Jamaica, The Bahamas, Aruba, Dominican Republic, Costa Rica, Belize, Cuba, the Cayman Islands, and Turks and Caicos.

2.2 The Financial Situation

According to the annual report of Southwest Airlines for 2021, the company had an operating income of 1721 million dollars, a net income was 977 million dollars, and the net income per share is 1.61 million dollars.

The firm also suffered a significant impact due to the pandemic of Covid-19. In March 2020, the World Health Organization classified the novel coronavirus, COVID-19, as a pandemic. The COVID-19 pandemic had an abrupt and rapid impact on the U.S. economic landscape, outlook, and particularly on the travel industry. This had a severely detrimental effect on travel demand, revenues, and bookings throughout 2020.

2.3 Share Price Analysis

As described by HANS R. STOLL, the level of put and call options is highly determined by the expected share price change during a chosen time period (wiley online library n.d.). Before January 2012, the share price has slight fluctuation, but in general, have a flat trend, and the share hit a local maximum of $22.35 per share in October 2000 as can be seen in Fig. 1.

After January 2012, the share price started to increase exponentially. The share price quadrupled in only two years and reached a price of 42.32 in October 2014. In the following two years, the share price experienced some moderate fluctuation, but was still considered stable overall, and kept on the same price level. After January 2016, the share price started to increase fast again, and finally hit the highest price in its history in October 2017. Subsequently, the price was kept in the same price range by some fluctuation, without significant changes until October 2019. With the influence of the Covid-19 Pandemic, the airline industry suffered a serious attack. The share price of Southwest Airlines dropped dramatically from 53.98 per share in October 2019 to 34.18 in April 2020. After that, the share price experienced large

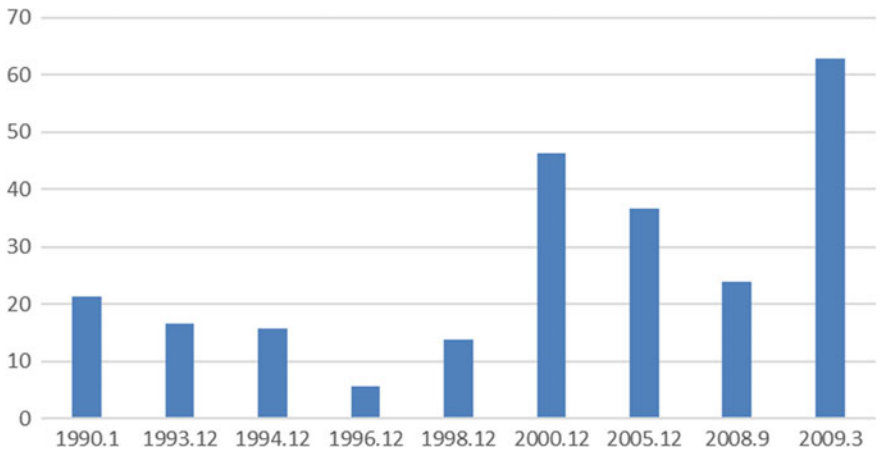


Fig. 1 The historical share price of Southwest Airlines

fluctuations, and the pandemic of Covid-19 is still keeping affecting the share price now.

3 Hedging Strategy Analysis

3.1 Temporary Risks

The Covid-19 pandemic gives the firm one of the most obvious effects on financial situations and hedging strategies. As the pandemic is serious enough to make the public officials to appeal people to take necessary epidemic to prevent practices. For instance, in the United States, the government from federal, state, and local established various policies such as self-quarantine, imposing tests, vaccination requirements, etc. Those policies highly restricted people's travel actions, which, at the same time, substantially decreased the firm's business operations. Also, people had to change their plans for international travel, which lead to the result that the demand for international air travel significantly decreased a sudden.

The function of Airlines are tremendously depends on energy, hence, are influenced by increasing energy price. Furthermore, jet fuel and oil are routinely one of the largest operating charges for airlines. The company always try to purchase the fuel by as less much of money as they could, and also reduce the fluctuation on the expenses of fuel by using fuel hedging programs. As a matter of fact, there are limited chances to take a fuel hedging program which is longer than about 24 months into the future for the reason that jet fuel is not a good that traded widely throughout different industries, and therefore a big part of jet fuel hedging program is entered in short-term timeframes (Table 1).

From 2020 to 2021, with the significant decrease in the demand of airlines, the demand for jet fuel and oil for the firm also experienced a humous decrease. And this could cause the firm to be in the situation of "over-hedged" for the three-forth of the year 2020 and the whole year of 2021.

Table 1 The expenses on fuel and fuel energy costs for Southwest Airlines

Year	Cost (million dollor)	Average cost per gallon	Percent of operating expense (%)
2017	4076	1.99	23
2018	4616	2.2	24.60
2019	4347	2.09	22.30
2020	1849	1.45	14.40
2021	3310	1.98	23.50

3.2 Hedging Strategy

The cost of jet fuel is one of the most expensive expenditures for an airline company, also they are determined by many factors which are not easy to be predicted. The work done by Antonio S. Mello and John E. Parsons emphasized the use of different kinds of hedges to lower the actual expenditures of the firm's financial constraints (Mello and Parsons 2015). Hedging is perhaps the easiest and most common approach for firms to reduce the arising risks, said John Cotter and Jim Hanley (Cotter n.d.). As emphasized by Donald Lien and Y.K.Tse, Hedging is a widely used tool, future hedging is playing an important role in risk management (Lien 2002). Took If the Jet fuel price increase even only a little, the annual expenditure for a firm will increase by a huge figure. For instance, according to the annual report of Southwest Airlines, around about 1.9 billion gallons of jet fuel are expected to be purchased in 2022. According to this predicted consumption, a tiny change in the jet fuel price, for example, 1 cent per gallon, would lead to an increasing in fuel expenditure for the firm for about 1.9 billion dollars. The purpose of hedging for Southwest Airlines is to avoid the risk that the oil price increase sharply, which is unexpected. And hence, the uncertainties for the firm brought by the unpredictable price of the oil could be reduced. Tanking the hedging used by Southwest airlines in 2021 as examples. The hedging strategies that the firm used during 2021 are call and put options, collar structures, call and put spreads, and fixed price swap agreements in the portfolios. Gurdip Bakshi, Charles Cao, and Zhiwu Chen described the different use of long and short put options and their importance (Bakshi et al. 2000). According to Robert C. Merton, Myron S. Scholes, and Mathew L. Gladstein's research, the option strategies could be used by investors to create a return that the strategies of combining stocks with fixed-income securities (Merton et al. 1982). The example of a long call option, a short put option, and a short call option would be represented in this paper.

A short call option allows the asset holder to sell the underlying asset at a specified price (strike price) before the option is expired. In this case, the firm is going to consume 1.9 billion gallons of Jet fuel in 2021 (Table 2).

The strike price of the call option is from $1.51 to $1.98/gallon. If the Jet fuel price goes above $1.98 per gallon, Southwest Airlines would face a loss of fuel price-$1.98 times 1,900,000,000. If the situation is that the price is between $1.51 and $1.98/gallon, then the firm could earn the option premium.

Next, for the short put option, the firm will have to purchase the underlying asset if the but option buyer exercises the put option (Table 3).

Table 2 Data for short call option

	Min	Max	Total gain/loss
Strike price (above max)	1.51	1.98	(Fuel price-1.98) x $1.9 billion
Strike price (in the range)	1.51	1.98	The option premium

Table 3 Data for short put option

	Strike price	Total gain/loss
Current price exceeds the strike price	1.51/gallon	Option premium
Current price below the strike price	1.51/gallon	(1.51-market price) x total volume

Table 4 Data for long call option

	Strike price min	Strike price max	Total gain/loss
Market price > max strike price	1.51	1.98	(Market price-1.98)x total volume
Min strike price < market price < max strike price	1.51	1.98	No gain or loss
Market price < min strike price	1.51	1.98	Option premium

In this case, Southwest Airlines signed a short put option with a counterparty and the strike price is $1.51 per gallon. If the Jet fuel price exceeds this strike price, the counterparty would not exercise this option, and hence the firm could an option premium. Vice-versa, if the price is below this strike price, which is lower than $1.51 per gallon, then the counterparty would access this option, and Southwest Airlines would have to purchase the Jet fuel from the Counterparty with a price of $1.51 per gallon. In this situation, Southwest airlines would face a loss of $1.51-the market price of Jet fuel.

The Last is about the long call option. A long call option allows a firm to buy an asset at the strike price in the future. However, the long call option is different from a short call option because, for a long call option, the firm also has the authority to purchase the asset ahead at a cheaper price. In the case of Southwest Airlines, the strike price is between $1.51 and $1.98/gallon (Table 4).

The firm would choose to execute this option if the fuel price is greater than the maximum strike price, which is $1.98/gallon. The total profit would be the fuel price minus the maximum strike price. If the price is between the range of the strike price, no matter whether the firm chooses to exercise the option or not, it will face a loss which is equal to the option premium. If the price goes below the minimum strike price, the firm would choose not to exercise this option, and the total loss would equal the option premium.

4 Conclusion

Oil derivatives are the major target to use hedging for Southwest Airlines because the price of oil products is highly unpredictable and significantly fluctuating all the time.

The application of hedging strategies for Southwest Airlines is playing a decisive role in the firm's annual income.

In this paper, firstly, the basic firm's financial information, the economic situation, and the share price were introduced.

In the next part, the importance of hedging for Southwest Airlines was elaborated on, which described the fact that the hedge that Southwest airlines used for the oil products has made significant effects in reducing the risks that are brought by the oil price, and proved that the hedging strategies are necessary for the firm.

Finally, the risks are possibly existing are described in the third part, and then three specific examples with corresponding data were analyzed in detail, which could give the reader a more clear understanding of the hedging strategy that the firm used.

As a result, by analyzing the factors mentioned above, this paper concludes that the Hedging strategy could be an ideal approach for firms who are facing huge risks regarding the necessary materials that the firm uses for their goods. When hedging is used on the right track, that could have a significant effect on reducing the risks that the firm is aiming to reduce. However, a wrong hedging strategy could also make the firm worse off, as the 'over hedge' example mentioned in the Couvid-19 pandemic situation. This paper could be a general reference that can help firms to determine their hedging strategies and the possible existing risks.

Last, the hedging examples that are used in this paper are the long put option, short put option, and short call option. Further possible hedging strategies, such as collar structures, spread options, and the mixture of call and put options are not mentioned in this paper. Therefore, further research could focus on other types of hedging strategies that are not mentioned here, which could give the readers more specific and useful references for the hedging strategies in the real life.

References

Bakshi G, Cao C, Chen Z (2000) Pricing and hedging long-term options. J Econ. Retrieved 18 Jul 2022

Carter DA, Rogers DA, Simkins BJ (2004) Fuel hedging in the airline industry: the case of Southwest Airlines

Cotter J (n.d.) Reevaluating hedging performance. Wiley Online library

Lien D (2002) Some recent developments in futures hedging. Weliy Online Library

Lim SH, Hong Y (2014) Fuel hedging and airline operating costs. J Air Transp Manag. Retrieved 17 Jul 2022

Mello AS, Parsons JE (2015) Hedging and liquidity. OUP academic. Retrieved 18 Jul 2022

Merton RC, Scholes MS, Gladstein ML (1982) The returns and risks of alternative put-option portfolio investment strategies. J Bus 55(1):1–55

Richards K (2009) The effect of Southwest Airlines on U.S. Airline Markets. Res Transp Econ. Retrieved 18 Jul 2022

Southwest Airlines Co. (2021) Annual report to shareholders. (n.d.). Retrieved 15 Jul 2022

The relationship between put and call option prices—Wiley online library. (n.d.). Retrieved 18 Jul 2022

Green Finance Policy Promotes Corporate Green Innovation

Diao Junchen and Zhang Guosheng

Abstract To encourage green innovation and accomplish green development, green financing is a key motivator. Based on the data of A-share listed manufacturing enterprises from 2014 to 2020, This study investigates how a place-based green finance policy in China, pilot zones for green finance reform and innovations, affects corporate innovation. The research shows that the policy can encourage the overall green technology innovation ability of businesses to a certain extent, and the results are stable. This policy is more obvious for the promotion of green utility model patents of enterprises in the pilot area, and the results are still significant after the first lag. Further research found that for different types of enterprises, policy implementation differently promoted green innovation activities. government agencies should fully consider the variety of regulated firms when drafting pertinent rules and offer tailored and unique measures to carry out green policies.

Keywords Green finance policy · Corporate green innovation · Differences-in-differences

1 Introduction

Promoting the coordinated development of the economy and environment is a common problem and challenge worldwide. In the last few years, China has made proactive and positive efforts to play a substantial role in fostering the conclusion of the Paris Agreement, and ecological civilization construction has achieved remarkable results. But the imbalance between the economy and ecology is still prominent. It has proven challenging to adapt the conventional industrialization model to the needs of high-quality development. Low pollution and emissions as the characteristic of an environmentally friendly economy will become the inevitable trend of Chinese economic development (Zhigang et al. 2022). strengthening green creation

D. Junchen (✉) · Z. Guosheng
Beijing Wuzi University, Beijing, China
e-mail: 13041277133@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_58

is the inherent necessity to build an environmentally friendly circular development economic system and promote the coordinated development ecological environment.

In June 2017, China issued the "Overall Plan for Building Green Finance Reform and Innovation Pilot Zones" to build green finance reform and innovation pilot zones with their characteristics and focuses in Zhejiang, Guangdong, Jiangxi, Guizhou, and Xinjiang. The five pilot areas have different levels of economic development, natural endowments, and geographic locations, which provide fertile ground for practical testing of green finance innovation concepts suitable for different situations. So, does the green finance policy of pilot zones promote the innovation of green innovation in enterprises, thereby accelerating industrial transformation? Further, is there a significant difference in the impact effect of the policy between the pilot areas and the non-pilot areas? This paper takes the green finance policy of pilot zones as the starting point, explores the implementation effect of the policy from the standpoint of green creation, and analyzes the heterogeneity and influence mechanism of the policy affecting the green creation of businesses.

2 Literature Review

Despite the fact that the concerned agencies have published a number of guidelines on environmentally friendly finance and green creation, how to successfully combine them is still a problem that has to be explored. Studies found that green finance policies adjust the opportunity cost of environmental pollution by changing the investment and financing channels of capital allocation and they succeed in guiding industrial change through capital allocation and environmentally friendly development. Government-sponsored green loan subsidies can enhance the quality of the environment by helping businesses use less energy, thereby raising the level of green creation (Li et al. 2018). Meng et al., based on corporate data from China, confirm that green credit significantly boosts corporate green technology research and development (Meng et al. 2014). Chen Guojin et al. incorporated green finance policies into the Capital asset pricing model and studied that the guarantee category policy reduces the financing costs of enterprises by influencing the credit spread of green bonds, thereby promoting green innovation and transformation of brown enterprises (Guojin et al. 2021). Enterprise innovation is inseparable from R&D investment, and a large part of the lack of corporate R&D is due to corporate financing constraints (Lerner and Wulf 2007). The R&D activities of enterprises require a large and continuous injection of funds, part of which is used for capital investment in the process of independent research and development, while the other part of the funds is used for enterprises to implement mergers and acquisitions or purchase patents at appropriate times to obtain innovation resources to support enterprise innovation (Becker 2011). Green credit policies make green innovation activities in industries where green credit restricts more active, and the strengthening of environmental enforcement and intellectual property protection will enhance the effectiveness of innovation (Xin and Ying 2021). Green finance policies adopt punitive high-interest loans or

refuse to issue loans, prevent enterprises from listing, and collect higher premiums for polluting enterprises by providing low-interest loans, giving bond issuance and listing facilities, and providing more preferential premiums, which greatly alleviates the financing constraints of environmentally friendly businesses (Yang 2011). They narrow the external financing channels of polluting enterprises, thus helping to increase the innovative development of eco-friendly businesses and forcing polluting ones to upgrade and transform (Ying and Yao 2021).

In summary, the existing research mainly focuses on the implementation influence of environmentally friendly credit policy and its impact on the financing behavior and investment of businesses and has drawn relatively rich and meaningful conclusions. The following are some potential minor additions of this paper to the body of literature. Taking the green finance policy of pilot zones of China as an example, we evaluated the policy effect of the five Pilot Zones from the standpoint of enterprise technological creation, and the influence of the policy on the innovation of different types of enterprises, as well as the dynamic time-varying and regional differences of policy effects.

3 Model Construction and Data

3.1 Model Construction

This paper mainly studies whether China's green finance policy can promote the environmentally friendly innovation of businesses. Referring to the existing literature, this paper divides listed businesses into two parts from the provincial level, with enterprises in Guangdong, Zhejiang, Guizhou, Jiangxi, and Xinjiang as the experimental group, and enterprises in other provinces as the control group, quantitatively evaluating the policy effective from the standpoint of eco-friendly creation. We constructed the following dual difference model:

$$\begin{aligned} lnPatent_{ijt} = {} & \alpha_1 Treat_j * Time_t + \alpha_2 Treat_j + \alpha_3 Time_t \\ & + \gamma X_{it} + \delta_{jt} + \mu_i + \lambda_t + \varepsilon_{ijt} \end{aligned} \tag{1}$$

Among them, the explanatory variable $lnPatent_{ijt}$ indicates enterprise green innovation. The explanatory variable is $Treat_j * Time_t$, including the time virtual variable and the experimental group virtual variable. X_{it} is the enterprise control variable matrix, including the enterprise scale, asset-liability ratio, enterprise profitability, cash flow level, growth ability, enterprise age and other financial indicators. δ_{jt} is the per capita GDP, industrial structure and other macroeconomic indicators at the provincial level. μ_i is the individual fixation effect and λ_t is the time fixation effect. ε_{ijt} is a random perturbation term.

In the benchmark analysis, Formula (1) focuses on the coefficient α_1 of the DID term $Treat_j * Time_t$, which reflects the influence of the establishment of the policy

on the difference between the environmentally friendly innovation ability of the businesses in the pilot area and the enterprises in the non-pilot zone, if α_1 is significantly greater than 0, it indicates that the policy promotes the eco-friendly creation ability of the businesses in the pilot area, and vice versa, there is no obvious promotion effect.

3.2 Data Processing

This paper takes the A-share listed manufacturing enterprises from 2014 to 2020 as the initial sample and selects the corresponding enterprises' green patent data, financial data, and provincial economic data as the research indicators. We processed the data as follows: Exclude the sample companies with an asset-liability ratio greater than 1 and less than 0. Exclude the sample companies whose main variable data is missing and whose data has been continuous for no more than three consecutive years; 3. Exclude the companies that are listed unless they are listed in normal transactions (including ST, ST*, and PT).

4 Empirical Analysis

4.1 Benchmark Result Analysis

As mentioned above, the logarithm of the number of eco-friendly patent applications plus 1 is used as the dependent variable, and the provincial level and policy time point in the pilot area are used as dummy variables to explore the influence of the policy on the eco-friendly innovation capacity of enterprises. Estimated results are presented in Table 1. Columns (1), (4) are the estimated results of the whole sample, and columns (2), (5) and (3), (6) are the estimated results of green invention patents and green utility model patents, respectively. Columns (4)–(6) are the regression results with one lag period.

As shown in Table 1, the DID term coefficients are all significantly positive at the level of 1%, indicating that the establishment of pilot zones to a certain extent has facilitated the green technology creation of businesses. Continuing to delay the implementation of the policy by one period, it can be seen that pilot policy's beneficial effects on the three have persisted over time, demonstrating that the policy continues to have an impact on the technological innovation of green utility model patents.

Table 1 The impact of the policy on the number of green patents in enterprises

Variables	(1) lnpatent	(2) lnpatent1	(3) lnpatent2	(4) lnpatent	(5) lnpatent1	(6) lnpatent2
Treat * time	0.0853***	0.0609**	0.0699***	0.0496**	0.0556**	0.0703***
	(0.0306)	(0.0249)	(0.0236)	(0.0288)	(0.0253)	(0.0241)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−1.63	−2.306**	−0.318	−1.794	−2.350**	−0.138
	(1.174)	(0.968)	(0.96)	(1.173)	(0.978)	(0.993)
Observations	10,382	10,382	10,382	10,382	10,382	10,382
R-squared	0.032	0.016	0.047	0.031	0.017	0.048
Number of id	1628	1628	1628	1628	1628	1628

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2 Robustness Check

Parallel Trend Test. Before analyzing the empirical results, this article firstly runs a parallel trend test on the eco-friendly creation indicators of businesses. Figure 1 demonstrates that, prior to the pilot policy's introduction, the number of eco-friendly patent applications in pilot areas and non-pilot areas maintained a parallel trend. After the policy was promulgated, the level of eco-friendly patent applications in pilot areas began to significantly exceed non-pilot areas Before the implementation of the policy. There was a considerable trend change in the number of eco-friendly patents of businesses in the pilot area relative to the number of eco-friendly patents of businesses in the non-experiment area. The results of two groups show that nothing has changed from the year before the implementation of policy, and the parallel trend assumption of the DID model is supported.

Placebo Test. In order to further test that the regression results of the benchmark DID model are not affected by other unobservable factors, and to verify that the research findings presented in this work are attributed to the policy, a placebo test is required. The findings in this research can withstand a placebo test, and the full-sample regression results in the benchmark analysis are robust.

4.3 A Subsection Sample

Heterogeneity of Property Rights. The property rights of an enterprise usually have various effects on its R&D investment and technological creation. The sample in this study is split into groups of state-owned and non-state-owned enterprises, (Hereinafter referred to as SOE and non-SOE) according to the nature of property rights,

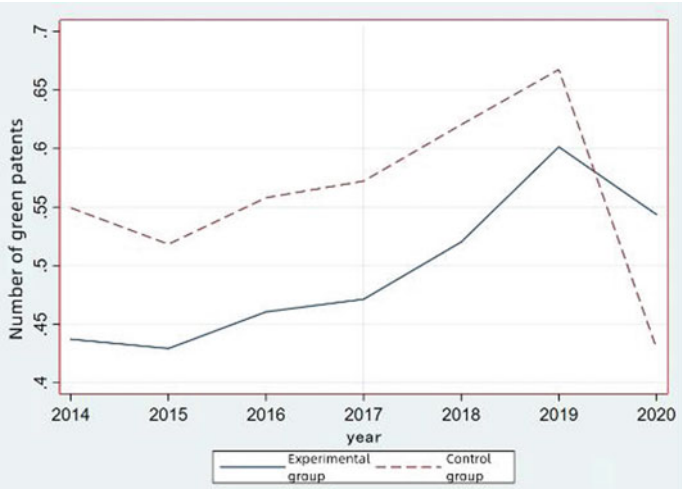


Fig. 1 Parallel trend test

in order to compare the varying effects of the introduction of the policy on green technology creation of businesses with different property rights. As presented in columns (1) and (2) in Table 2, the coefficient of the DID term is a favorable impact in both the SOE and non-SOE subsamples, but significant levels vary. The green financial policy can further promote the green technology innovation of SOE. One theory is that state-owned businesses respond to the policy with blatant rigidity. In addition to pursuing economic interests, state-owned enterprises also undertake the government's environmental governance goals, and the dual externalities of green technology innovation make non-state-owned enterprises that have long been discriminated against by credit lack of innovation investment, reducing their motivation to innovate (Fig. 2).

Table 2 Enterprise heterogeneity

Variables	(1) State-owned enterprise	(2) Non-state-owned enterprise	(3) Large-scale enterprises	(4) Small-scale enterprises	(5) Heavily polluting enterprises	(6) Non-heavily polluting enterprises
Treat time	0.127	0.0877	0.0861	0.0846	0.0112	0.111
	(0.0716)	(0.0347)	(0.0475)	(0.0356)	(0.0524)	(0.0368)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.818	−3.548	−1.181	−1.522	1.402	−2.764
	(2.4)	(1.345)	(1.679)	(1.538)	(2.395)	(1.353)
Observations	3040	7111	5474	4908	2842	7540
Number of ID	509	1177	830	798	459	1202
R-squared	0.047	0.031	0.043	0.029	0.04	0.034

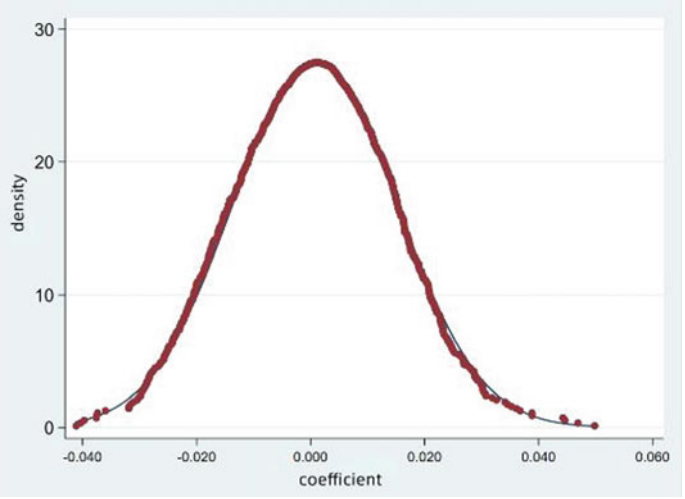


Fig. 2 Placebo test

Scale Heterogeneity. There is heterogeneity in the R&D investment and technological innovation capabilities of enterprises of different sizes. In this paper, the scale is measured according to the natural logarithm of the average value of the total assets of the enterprise, with the median as the quantile, and the enterprises are divided into relatively large-scale and small-scale enterprises to test the establishment of the pilot zones. Differential impact of green technology innovation in enterprises of different scales. As presented in columns (3) and (4) in Table 2, the coefficient of the DID term for large-scale firms and the one for small-scale firms both are significantly positive, but the significant levels vary. This suggests that there is less heterogeneity between the two.

Industry Heterogeneity. Industry heterogeneity. Due to the significant differences in pollution discharge and technological composition between heavily polluting enterprises and non-heavy polluting enterprises, the influence of the policy on environmentally friendly technology creation of firms in the two types of enterprises is also different. Drawing on the study of Ailing et al. (2019), this paper constructs an industry pollution emission intensity index to verify the differential influence of the policy on eco-friendly technology creation of businesses of different natures. As shown in columns (5) and (6), the coefficient of the DID term for the heavily polluting businesses is positive but insignificant, while the one for the non-heavy polluting enterprises is strongly favorable. This finding demonstrates that the policy plays a substantial role in fostering the green creation capabilities of non-heavy polluting businesses, while the promotion effect on heavily polluting ones is not obvious. Since the policy has a financing penalty effect on the debt financing of the heavily polluting businesses, the debt cost of the highly polluting manufacturing enterprises will rise, which will not have a substantial effect on promoting green

Table 3 Regional heterogeneity

Variables	East region		Central region		West region	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat time	0.0808	0.0767	0.107	0.0878	0.0516	0.09
	(0.0365)	(0.0343)	(0.11)	(0.1)	(0.0767)	(0.0813)
Control	Yes	No	Yes	No	Yes	No
Constant	−1.634	0.555	−8.476	0.607	0.0863	0.494
	(1.707)	(0.0187)	(5.434)	(0.036)	(3.693)	(0.0382)
Observations	6970	7241	1600	1655	1346	1409
R-squared	0.033	0.031	0.059	0.048	0.034	0.023
Number of id	1096	1096	248	248	212	212

R&D creation. It is simpler to acquire financial support in terms of policies, and more green innovations are in turn more conducive to obtaining loan concessions and green compensation. Thus, the green creation capabilities of non-heavy polluting manufacturing businesses have been significantly improved.

Regional Heterogeneity. In the green financial pilot zones, the five provinces have different levels of economic development. The five provinces are located in different regions, so there may be differences in policy effects. For this reason, this paper conducts a heterogeneity analysis of the differences in regional economic development levels.

The regression results of the heterogeneity analysis are presented in Table 3. The results present that the coefficient in the eastern region is strongly favorable at the level of 5%, while the coefficient of the DID term in other areas is positive but insignificant. It suggests that the policy has a favorable impact on the environmentally friendly growth of the eastern region and that the pilot policy's incentive influence in the middle and western regions is less clear. The reason is that due to different geographical locations and levels of economic development, the policy focus of different regions is different.

5 Research Conclusions and Policy Recommendations

As an important intermediary of resource allocation and a key link to the ecological environment, eco-friendly finance is a considerable issue in the process of advancing the construction of ecological civilization. This paper discusses the effects of eco-friendly financial policies from the standpoint of green innovation. This study takes the green finance policy of pilot zones of China in 2017 as the entry point, based on the panel data of Chinese manufacturing companies, and uses DID to study the impact of the policy on the eco-friendly innovation of manufacturing businesses.

The research found that: First, the policy can promote the overall eco-friendly technology innovation capability of businesses, and the results are still significant after a lag period. Second, the implementation of the policy has more strongly facilitated the eco-friendly innovation activities of state-owned businesses and non-heavy polluting ones. Thus, financial institutions and government agencies should fully consider the variety of regulated firms when drafting pertinent rules and offer tailored and unique measures to carry out green policies (Xiuhua et al. 2021). To ignite the passion of non-state-owned firms to cut carbon emissions, it is vital to properly take into account the ownership character of businesses when developing performance rating indicators for manufacturing firms. Government agencies should advise financial institutions to increase green financial support for non-state-owned businesses and assist those qualified to issue green bonds. Additionally, local governments should encourage heavily polluting businesses to increase the added value of their products and market competitiveness through technological innovation, such as upgrading and production process transformation, in addition to increasing subsidies for environmental protection projects of them. Third, the more developed the economic development level is, the more obvious the green financial policy will enhance the green innovation ability of businesses. In order to availably direct the flow of funds to green businesses and increase the efficacy of green financial investment, local policies should be deeply affiliated with the real economy and coincide with the characteristics of economic growth, industrial structure characteristics, and corporate needs (Rongrong et al. 2021). Relevant departments should not only hasten the convergence of green financial product standards and improve the function of standards and norms in directing the development of new eco-friendly financial services and products, but also achieve regional development In line with the development of various regions.

References

Ailing P, Xin L, Jinlong Q, Yu S (2019) Can green M&A of heavy polluting enterprises achieve substantial transformation under the pressure of media. China Ind Econ 174–192

Becker RA (2011) Pollution abatement expenditure by U.S. manufacturing plants: do community characteristics matter? Contributions Econ Anal Policy 3(2)

Guojin C, Saijie D, Xiangqin Z, Xiaoyu J (2021) China's green finance policy, financing costs and firms green transition: a Central Bank collateral framework perspective. J Financ Res 75–95

Lerner J, Wulf J (2007) Innovation and incentives: evidence from corporate R&D. Rev Econ Stat 89(4)

Li Z, Liao G, Wang Z, Huang Z (2018) Green loan and subsidy for promoting clean production innovation. J Clean Prod 187

Meng XH, Zeng SX, Shi JJ, Qi GY, Zhang ZB (2014) The relationship between corporate environmental performance and environmental disclosure: an empirical study in China. J Environ Manag 145

Rongrong D, Aoxiang Z, Ming C (2021) Impact of high-speed rail on urban ecological efficiency in the Yangtze river economic belt: empirical analysis based on DID and SDID. East China Econ Manag 1–11

Xin W, Ying W (2021) Research on the green innovation promoted by green credit policies. Manag World 173–188

Xiuhua W, Jinhua L, Yaxiong Z (2021) Effectiveness measurement of green finance reform and innovation pilot zone. J Q Tech Econ 107–127
Yang L (20111) Green policies and jobs in china: a double dividend? Econ Res J 42–54
Ying S, Yao M (2021) Green finance policy and green technology innovation——Evidence from the green finance reform and innovation pilot zone. Fujian Tribune 126–138
Zhigang C, Yuqi Z, Haisen W, Xiao O, Yuxi X (2022) Can green credit policy promote low-carbon technology innovation? J Clean Prod 359

Green Engineering Management of Photovoltaic Technology Under Climate and Terrain Differences

Ruiheng Hu

Abstract As the Photovoltaic Technology (PVT) System has become one of the most popular technologies around the world, the green managerial methods for sustainable management of the PVT has been promoted to the miscellaneous industries. The Green Engineering Management (GEM) applied to the PVT can maximize the effectiveness of converting the solar energy into electricity. And the sustainable characteristics of the GEM will drive the companies to put the cyclic utilization of it into practice and derive the splendid profits. This paper investigates the special and unique GEM methodology to manage the PVT System in different regions and embodies the beneficial influences of environmental management. In the rest of the paper, we elaborate the background of the PVT and the advantages of the sustainable management. We analyze the management method from two aspects and generalize the corresponding GEEM. Moreover, the paper summarizes the contributions and the drawback of analysis and outlook the appropriate research and investigation about the appropriate managerial methods of the PVT in the near future.

Keywords Photovoltaic technology · Green engineering management · Managerial methods · Environmental recycling

1 Introduction

Nowadays, the imperative energy shortage problems and the serious contamination of the Thermal Power Generation (TPG) has become a thorny hassle. To avert the bafflement of energy deficiency and severe pollution, the increasingly mature PVT is gradually superseding the traditional TPG industry. With the development of the PVT, more and more scientists, researchers and engineers implement deep research on creating the brand new versatile Photovoltaic Systems and apply the advanced PVT to various realms and domains to realize sustainability.

R. Hu (✉)
University of Dayton, 300 College Park, Dayton, OH 45469, USA
e-mail: hur006@udayton.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_59

There are many newly-invented types of PVT that have sprung up in the past few years. According to Han et al. (2014), Browne et al. (2015), two published papers focused on the analysis of the management of the optimal Photovoltaic Technology. However, the study will first put more emphasis on describing how to utilize the different kinds of technologies to appropriately monitor and control Photovoltaic Technology. The published paper (Gonzalo et al. 2020) demonstrated some useful technologies and sustainable methods to superintend the PVT and prevent them from being corroding or disrupting by the complicated factors. So, It is essential to further elaborate on other attractive technologies to supervise and master the situation or the condition of the photovoltaic system and embody the gist of fantastic Green Engineering Management (GEM). Moreover, the study will underscore the best GEM to manage the photovoltaic system in different regions and buildings. Rezk et al. (2020) claimed that they paid attention to a single region of the application of the unique PVT. While different places have different advantages and flaws. In accordance with the intricate environment, the most important thing is to figure out the optimum management to handle the changeable situation. For instance, complicated conditions like the bumpy terrain, the unpredictable weather, the extreme weather, the mountainous area, the skyscrapers, the city and urban area will greatly have a formidable and massive impact on the management. Even the tiny changes can influence the entire management plan. The integration of the recycling PVT and different regions will broaden our holistic horizon and expand our viewpoint of the management of the PVT. So, some analysis about what kinds of management is adaptable to different unique specific regions will be discussed. PVT is absolutely a prospective and promising technology. The advantages of the PVT like the controllable and low cost, the fabulous sustainable character and the less by-product make the PVT become one of the most popular and concerned technology in the future society. Rationally managing the PVT will give full play to the function of PVT, improve its working efficiency and obtain more benefits and profits.

The rest parts of the paper are made of a short literature review associated with the PVT and GEM and three detailed perspectives showing the optimal green engineering management to manage the PVT. The challenges and some further discussions will be made in the fourth part and the conclusion will be summarized at the end of the paper.

2 Literature Review

2.1 Photovoltaic Technology

As a new energy technology, the PVT is undoubtedly becoming one of the most popular sustainable technologies in the world. According to Parida et al. (2011), the author claimed that the PVT is an efficient technology that can convert solar energy into electricity energy. Because of its specialty that can increase the low

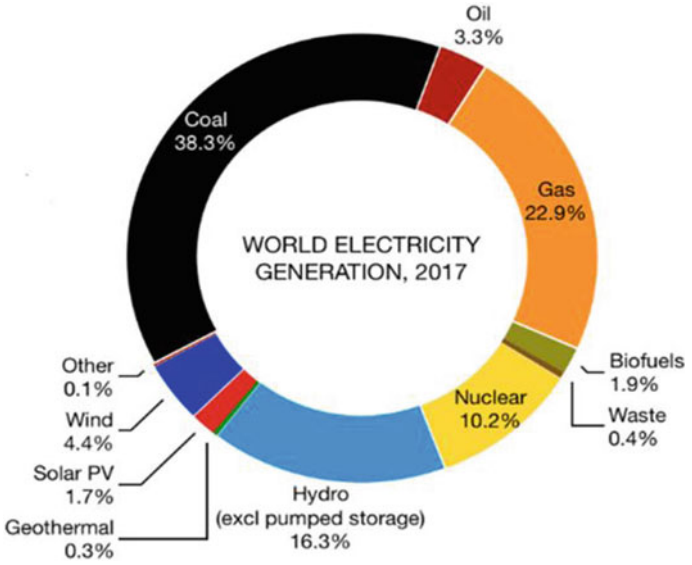


Fig. 1 World electricity generation 2017 (Tawalbeh et al. 2021)

power generation into the high output power and the supreme advantages from its superior maintenance, the PVT has been applied to various sustainable industries. The statistic shown in Fig. 1 suggests the ratio of the PVT electricity generation.

The history of PVT in the last century was devious but magnificent. Joseph (1993) proposed that the PVT feasibility was first manifested by three journal papers in 1954. Three authors believed that the PVT had the crucial potential to increase the transferring magnitude of energy conversion which can be realized by the advanced PVT cell. From then on, many laboratories began to do deep research on the PVT. With the development of the PVT, the PVT was then utilized in the space realm. The driving force of satellites and other space shuttles were made of the PVT solar system which opened a brand new era. In the 1970's, the controversy between nuclear energy and PVT was reputed for a long time. However, the USA government still gave the plentiful resources for laboratories to create the PVT and the epoch came into the Terrestrial realm and the transferring efficiency was changed from the 10% into the 28% in 1990. In accordance with (Ghosh and Yadav 2021), from 2008, the PVT developed apace and the cumulative capacity of the PVT was increased 6200 times in 2020. The commonly-used material like the crystalline stuff was substituted by the exquisite material like the passivated emitter and rear contact (PERC) Cells and the Shingled Cells. The newly-invented modules were implemented to improve the efficiency of the PVT as perfectly as possible and the management of energy wastage are becoming controllable and mature. Furthermore, Joseph (1993) pointed out that the PVT had an unerringly fantastic future and the experts will pay more attention to the creation of recycling methods and promote the economic development of PVT.

2.2 Green Engineering Management

The GEM is a sustainable development based on the principle of Triple Bottom Line (TBL). The TBL consists of economic effects, environmental effects and social effects. The GEM integrates two factors: economic effects and environmental effects realizing the principle of Sustainability. Moreover, powerful specialty is its classic character and the GEM can be managed by the sustainable modules. The analysis of the GEM will be discussed in three aspects. The first aspect is the management of the PVT. According to Purnomo et al. (2021), several gallant attempts on creating marketing strategy revolution and emerging technology tracking technology has been practically done by many companies. The birth of Green Supply Chain Management evolved the economic factor of the GEM which was to a great extent the reduction of wastage, the diminishing cost and the incremental production. Besides, the benign environmental factor of the GEM sufficed the gratification of companies income which will propel the investment of new inventions and renovate the obsolete technologies. The second aspect is the investigation of the GEM in accordance with the different unique regions or scenarios. The related study (Lu et al. 2013) focused on the GEM corresponding to the novel Green Building. Authors illustrated the reason why the governors and companies paid more attention to expand and increase the functional value of the Green building and the crucial requisites of intensifying the useful GEM. This paper will not emphasize the singular GEM of one region. However, the paper will extend the ranges of regions and expound more special GEM according to the different scenarios. The third aspect is the relative policies of the GEM. Loknath and Azeem (2017) proposed that the GEM's objective of the policies is to realize the responsibility of society, curtail the unnecessary waste and procure the advantageous profits. The GEM also gives regard to the sustainable tenet and constructs the specific strategies to ensure the environment and marketing goals. Each three aspects exposes the typical concept of the GEM and expresses the functionality of its different effects. But to the extent of the GEM, the companies should lay emphasis on the economic effects and the environmental effects and formulate the appropriate strategies like the study (Lozano et al. 2018) attained the achievements that ensuring the sustainable development of the environment under the economic yield of the project target.

3 Management Modules

3.1 Managerial Adaption Based on Climate Differences

Different regions differentiate the usage and the management of the PVT. The natural traits like the meteorological conditions, the terrain factor and the climate prerequisite can have a great impact on the types of PVT and adjust the corresponding

management. So, this paper will exert a comparison of the usage and the management of PVT in ubiquitous different regions elucidating the optimum plan to manage the PVT efficiently and rationally.

The first comparison objective is the discrepancy between the cold region and the hot region. Weather conditions and climate prerequisite are the considerate aspects of the management of PVT. The cold region weather is frigid and freezing in high latitude generally. Especially when the temperature is typically under zero, the extreme weather like the snowstorm will trespass the PVT panel and the strongly adhesive snow may adhere to the surface of the PVT panel. The degradation of solar energy conversion efficiency and the snow cleanliness have become serious problems. The adjustment of tilted slope of the PVT panel announced by Awad et al. (2017) and the several simple cleaning solutions given by Borrebaek et al. (2020) will keep the PVT panel ultra clean and better realize sustainable usage. Besides that, the integration of green energy with the PVT System optimizes the management structure. According to Kavian et al. (2020), You et al. (2021), the mixed utilization of the geothermal energy and the PVT system promoted the circulation of energy usage and reduced the discharge of CO_2. The cost of the mixture new system is lower than the pure PVT System. In cold regions or architecture, we also can utilize the heat generated by the geothermal system to keep the PVT panel warm and ensure the proper functioning of the PVT System to reuse the premium energy and suffice the needs of citizens.

While in hot regions such as the tropical area and dessert, because of the high temperature and intense solar radiation, the management of PVT in hot regions is different from the management in cold regions. To resolve the scorching condition of the PVT panel, engineers will set up the coolant system to cool down the surface temperature. Dida et al. (2021) claimed that exerting the passive coolant system like the most basic utensil and infrastructure include the constructed cooling fin and the simple rough Burlap cloth. The companies will not invest more money in taking the initiative to provide innumerable water to cool down the temperature and it is easier for companies to supervise and maintain the initial cooling fin and cheap cloth because cooling fin is the basic part in the PVT System factory and can facilitate the conversion effectiveness of solar energy. In addition, similar to the situation in cold regions, in hot regions it is essential to clean the annoying dust on the panel surface. Kazem et al. (2020) proposed that there were many ways to eradicate the dust on the PVT panel surface. The newly-invented technology like nanotechnology with less cost and powerful functionality will help companies to manage the PVT System readily. Moreover, in accordance with the (Garni et al. 2018), various tracking software and mechanisms have been developed to superintend the PVT system. The effective supervising capability and low cost investment improve the operation efficiency of the PVT and the extraneous generated electricity can be reused to propel the tracking module. Besides, to achieve the objective of sustainability, the related paper (Tawalbeh et al. 2021) suggested that the material of the PVT like the copper metal and silver can be recycled to compensate for the scarcity of the semiconductor material of the PVT. The result is the curtailment of the material resources, the evolution of material circulation and the promotion of the environment.

3.2 Managerial Approaches Based on the Terrain Differences

Moreover, the terrain differences will also affect the management of PVT. The topography of the plain, the mountainous area and the water region will be discussed.

Most of the PVT installations are equipped in the spacious plain regions. These regions have the large area of space and land to set up the large number of PVT installations. Besides, the solar radiation there is actually very high and will give full play to the PVT System. In accordance with the (Vrînceanu et al. 2019), large area settlement of PVT In Romania plain brings countless profits and benefits to civilians and residential places. But in some PVT gears, the material stuff is still the poisonous substances and chemical element and the non-ideal material will damage the soil quality and give rise to the severe ordeal like crop failure in the plain terrain. The starvation problem may become serious. So, the recycling of harmful gadgets is imperative. According to Shahariar et al. (2020), we can recycle the abandoned stuff and reuse it to construct more PVT panels augmenting the scale of the PVT System in the expansive plain. For ease of management and control, Vrînceanu et al. (2019) recommended the specific plan that settled the PVT manufacturing locale beside the major road or path. This optimal plan will reduce the cost of material transmission, protect the environment and make it easy to monitor the product's quality. In addition, the capacious plain area renders the inherent advantages of the naturally environment wind energy. Jones and Olsson (2017) expounded that the provision of continuous natural wind resources can motivate the PVT to generate more electricity, lessening the cost of converting transition installation and making it easy to manage.

In mountainous areas, because of the rugged terrain, it is difficult to install the PVT panel. The changeable weather conditions can also influence the construction of PVT infrastructure. The unavoidable landslide or avalanche casualty will disrupt the entire PVT system and give rise to the underestimated losses. Chuitturi et al. (2018) Claimed that the best place to brace up the PVT panel is at the top of the mountain near the skiing court and attraction site. The manager can easily check out the problem of the PVT panel supported by the fixed supporters and save cost from the construction consumption of the cable transmuting the electricity from the power plant in the plain area. Furthermore, soil erosion in the mountainous area obstructs the development of the PVT. This thorny problem has perplexed the government for a long time. Tan et al. (2021) enumerated some methods to stop the phenomenon of soil erosion. The effective methods will increase the stability of the PVT panel and realize the sustainability.

On the earth, almost 80% of the region is water. Therefore, several PVT infrastructures are set up in the water region. Figure 2 show the capacity of the floating PVT construction.

The floating type of the PVT panel is popular in the water and humid region because it can prevent the water from massive evaporation and its better conversion power in accordance with (Liu et al. 2017). To improve the working efficiency of the PVT panel, the related paper (Zahedi et al. 2018) announced a sustainable strategy that reuses the water resource to cool down the PVT panel. It is a self-cleaning system.

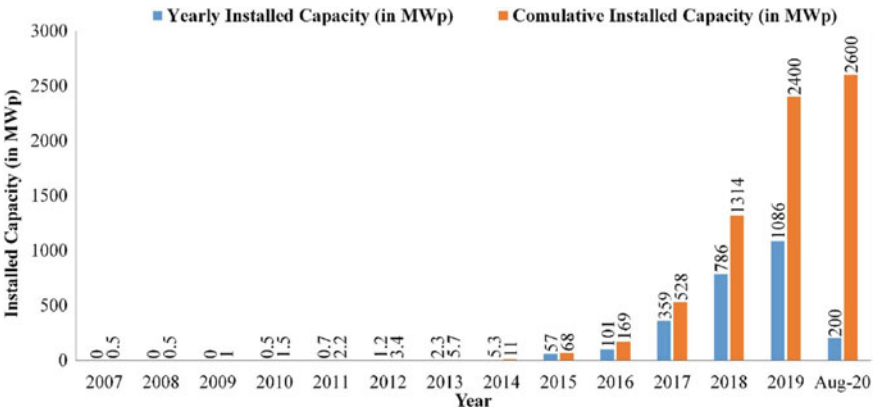


Fig. 2 The increasing floating PVT capacity (Kumar et al. 2021)

Besides, It is evident the floating penal is exposed to the water resources. We can source clean water to completely clean the penal. This method can sharply reduce the cost of maintaining the panels and save the labor cost. In addition, Kosciuch et al. (2021) pointed out that it is essential to enact the plan to protect the biodiversity beside the PVT System regions. Constructing a rational layout of the PVT penal can beautify the surrounding environment. The inhabitant of the animals and the birds will improve the environmental quality and be beneficial to fulfill the idea of sustainability and the GEM.

4 Discussion and Conclusion

This paper offered some environmentally effective management modules and methods to efficiently manage the promising PVT in the context of the wide use of PVT Systems in the world and the tendency of utilizing the sustainable GEM on a large scale. To specifically explain the specific and the important usage of the reliable GEM, the article demonstrated the different green engineering management modules to handle different circumstances. The third section of the paper was classified into two typical frameworks including the climate conditions and the terrain situations. The research put some incisive insights into further discussing two climate conditions and three topography types. Most importantly, the impressive recycling and reusing methodology of the GEM will completely facilitate the PVT System construction and achieve a win–win situation for nature and the companies. Besides, the management measurement proposed by this paper can be applied to more technology, society and industry realms, and deepen the recognition of the GEM.

However, there are still some constraints and constrictions to this study. The entire paper just discussed the special GEM methods according to some typical climate situations and normal terrain conditions. With the development of the PVT,

the situation of more extreme weather and complicated terrain should be further investigated and researched. Similarly, the more efficient way of optimization of the management should be concerned considerably because the GEM of the PVT still has many defects and imperfections. Moreover, in the future study, we can lay more emphasis on the implementation of the management and ameliorate the management techniques and improve the technologies to improve the GEM effectiveness. More researches about how to integrate the GEM into the companies rapidly and procure the personnel's agreement need to be considered and probed. So, with the rises of the management methods, the application of the GEM into the PVT industry will definitely upgrade the industry chains and make the countries' connection more tightly in the near future.

References

Awad H, Gül M, Emtiaz Salim KM, Yu H (2017) Predicting the energy production by solar photovoltaic systems in cold-climate regions. Int J Sustain Energy. https://doi.org/10.1080/14786451.2017.1408622

Borrebæk P-OA, Jelle BP, Zhang Z (2020) Avoiding snow and ice accretion on building integrated photovoltaics–challenges, strategies, and opportunities. Solar Energy Mater Solar Cells 206:110306

Browne MC, Norton B, McCormack SJ (2015) Phase change materials for photovoltaic thermal management. Renew Sustain Energy Rev 47:762–782

Chitturi SRP, Sharma E, Elmenreich W (2018) Efficiency of photovoltaic systems in mountainous areas. In: 2018 IEEE international energy conference (ENERGYCON). IEEE

Chowdhury MS et al (2020) An overview of solar photovoltaic panels' end-of-life material recycling. Energy Strat Rev 27:100431

Dida M et al (2021) Experimental investigation of a passive cooling system for photovoltaic modules efficiency improvement in hot and arid regions. Energy Convers Manag 243:114328

Garni A, Hassan Z, Awasthi A, Ramli MAM (2018) Optimal design and analysis of grid-connected photovoltaic under different tracking systems using HOMER. Energy Convers Manag 155:42–57

Ghosh S, Yadav R (2021) Future of photovoltaic technologies: a comprehensive review. Sustain Energy Technol Assess 47:101410

Gonzalo AP, Marugán AP, Márquez FPG (2020) Survey of maintenance management for photovoltaic power systems. Renew Sustain Energy Rev 134:110347

Han J et al (2014) PLC-based photovoltaic system management for smart home energy management system. IEEE Trans Consum Electron 60(2):184–189

Jones LE, Olsson G (2017) Solar photovoltaic and wind energy providing water. Global Challeng 1(5):1600022

Kavian S et al (2020) Exergy, economic and environmental evaluation of an optimized hybrid photovoltaic-geothermal heat pump system. Appl Energy 276:115469

Kazem HA et al (2020) A review of dust accumulation and cleaning methods for solar photovoltaic systems. J Clean Prod 123187

Kosciuch K et al (2021) Aquatic habitat bird occurrences at photovoltaic solar energy development in Southern California, USA. Diversity 13(11):524

Kumar M, Niyaz HM, Gupta R (2021) Challenges and opportunities towards the development of floating photovoltaic systems. Solar Energy Mater Solar Cells 233:111408

Liu L et al (2017) Power generation efficiency and prospects of floating photovoltaic systems. Energy Procedia 105:1136–1142

Loferski JJ (1993) The first forty years: a brief history of the modern photovoltaic age 1(1):67–78. https://doi.org/10.1002/pip.4670010109
Loknath Y, Azeem B (2017) Green management–concept and strategies. In: National conference on marketing and sustainable development, vol 13
Lozano FJ et al (2018) New perspectives for green and sustainable chemistry and engineering: approaches from sustainable resource and energy use, management, and transformation. J Clean Prod 172:227–232
Lu M, Pei YL, Li F (2013) The study on the green building's values and it's crucial factor-green engineering management. In: Advanced materials research, vol 671. Trans Tech Publications Ltd
Parida B, Iniyan S, Goic R (2011) A review of solar photovoltaic technologies. Renew Sustain Energy Rev 15(3):1625–1636
Purnomo A et al (2021) A study of green management literature through bibliometric positioning during four decades
Rezk H et al (2020) Optimization and energy management of hybrid photovoltaic-diesel-battery system to pump and desalinate water at isolated regions. IEEE Access 8:102512–102529
Tan W et al (2021) Study on the allocation of soil and water conservation measures for photovoltaic power station in rocky desertification mountainous area of Guizhou province. In: IOP conference series: Earth and environmental science, vol 831, no 1. IOP Publishing
Tawalbeh M et al (2021) Environmental impacts of solar photovoltaic systems: a critical review of recent progress and future outlook. Sci Total Environ 759:143528
Vrînceanu A et al (2019) Impacts of photovoltaic farms on the environment in the Romanian Plain. Energies 12(13):2533
You T et al (2021) Hybrid photovoltaic/thermal and ground source heat pump: review and perspective. Renew Sustain Energy Rev 151:111569
Zahedi R et al (2021) Cleaning of floating photovoltaic systems: a critical review on approaches from technical and economic perspectives. Energies 14(7):2018

Hazards and Management of Covid-19 Nucleic Acid Detection Kit and Management

Runqi Zou

Abstract Since the outbreak of the COVID-19 epidemic worldwide in 2020, nucleic acid testing has gradually become a major need in people's lives. At present, the huge number of nucleic acid tests has brought serious environmental problems, that is, the contamination of nucleic acid test kits. This paper proposes some treatment methods by analyzing the structure of related products and possible contamination. First, start with the analysis of the components of the nucleic acid detection kit, draw relevant conclusions to prove the corresponding contamination, and finally try to analyze the possible treatment methods. In the future, relevant research and discussions on sustainable development will continue. In reference to previous studies, this paper summarizes some possible pollution and some policy treatment methods, at the same time, it is intended to thoroughly find out the prevention and control methods suitable for nucleic acid testing related environmental pollution problems, and achieve a reasonable outlook. In accordance with the principle of sustainable development, more scientific and reasonable means (such as centralized recycling, etc.) should be adopted to treat the pollutants generated by nucleic acid testing based on the policy of referring to the existing data box processing methods. This paper analyzes the current hot topics and issues related to human environmental protection from the perspectives of environmental science, environmental engineering and social development.

Keywords Nucleic acid test · Waste management · Sustainability · Hazards

1 Introduction

Since December 2019, a number of pneumonia cases of unknown cause with a history of exposure to seafood markets in South China have been detected in some hospitals in Wuhan, Hubei Province, which have been confirmed as acute respiratory infections caused by Novel Coronavirus infection. On 11 February 2020, Director-general

R. Zou (✉)
The High School Affiliated to Renmin University of China, Beijing 100080, China
e-mail: 16011010317@stu.suse.edu.c

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_60

Tedros of the World Health Organization (WHO) announced in Geneva, Switzerland that the novel coronavirus pneumonia has been named "COVID-19". The Committee stresses the need to maintain public health and social measures to protect vulnerable groups and to maintain the capacity to scale up public health and social measures as the epidemiological situation changes. In addition, the Committee stressed the need for continued international cooperation and coordination of surveillance and reporting in a timely and robust manner to various global systems, such as the Global Influenza Surveillance and Response System, in order to inform national, regional and global responses (www.who.int).

At present, the situation of epidemic prevention and control is grim and complex. The importance of covid-19 test for epidemic prevention and control is self-evident. Nucleic acid detection is an indispensable part of covid screening. With the continuous variation of the virus, its infectivity and concealment are becoming stronger and stronger, which will lead to the increasing demand for nucleic acid detection reagents. The Chinese government will enhance the capacity of epidemic prevention and early detection, quickly and early detection of infected persons and the epidemic situation, so as to identify and extinguish each other, cut the chain of transmission, and eliminate the number of infected persons. Some of the existing research is more on nucleic acid detection itself. For example, how to identify the corresponding virus, how to determine under what circumstances a patient needs to be counted as positive, how to find virus variants, and so on. However, the lack of research in society is about some treatments of nucleic acid detection kits. Although certain policies and decrees have made general regulations, there is still a lack of targeted corresponding considerations. At the same time, the current research also lacks a systematic analysis of the possible contamination of nucleic acid detection.

This article intends to investigate and sort out the possible contamination of all nucleic acid detection kits, and to make assumptions and judgments on certain treatment methods. This article is divided into "Introduction to the components of nucleic acid kits", "Introduction to the possible garbage generated by nucleic acid detection", "Introduction to pollution caused by related wastes", and "Corresponding treatment methods".

2 Material Analysis and Possible Impacts

2.1 Structure of Testing Kits

In order to achieve a more comprehensive epidemic prevention and control and early diagnosis, the Chinese government has organized large-scale nucleic acid testing to achieve this goal. The daily nucleic acid testing capacity has reached 57 million tubes per day. Such mass testing can also result in large quantities of testing reagents and accompanying medical waste. The disposal of medical waste and nucleic acid testing kits is one of the environmental issues needing attention at present. The

issue is about sustainable development (mainly in terms of public health and public resources). Among the 17 SDGs, The Goal 3: Ensure healthy lives and promote well-being for all at all ages and Goal 12: Ensure sustainable consumption and production patterns relevant to our subject, the most relevant of these is Goal12. Because of the large number of nucleic acid tests, each test requires a lot of reagents and human resources. This will put a strain on the country economically.

In this year, a huge scope nucleic corrosive testing has been directed in China, principal gear of Coronavirus testing packs is for the most part including testing swab, extraction tubes, recognition fluid and exceptional trash container, which can be found in the accompanying chart (www.medical-swab.com). This unique trash container is utilized for gathering clinical squander that can't be halfway treated. Notwithstanding, this report will fundamentally zero in on the initial two testing packs, testing swab and extraction tubes, on the grounds that these two units are not just the main piece of nucleic corrosive location, yet additionally the made materials out of those two testing units can cause incredible ozone harming substance discharge.

Moreover, the constituent material of detection liquid contained in the extraction tubes are significant to be tested. However, this report is discussing about the material of constituent kits, the detection liquid is more declined to biology, which would not be discussed here.

2.2 Hydrocarbon Components in Petroleum

In normal testing kits, testing swab and extraction tubes consumed a lot of plastics and the constituent material of those two parts are both polymers, which has been widely used. Therefore, testing those two kits components material will be meaning to environment.

Polymers are extensive chain compounds made out of monomers. A monomer is a particle that can be clung to other indistinguishable atoms. Polymers are fundamentally colossal particles made with an enormous measure of more modest, indistinguishable particles. Polymers have an unexpected physical and synthetic cosmetics in comparison to their monomers, and all the more particularly, their properties can be custom-made relying upon their primary reason. There are a few kinds of polymers. Expansion polymers are shaped when the monomers structure twofold bonds with the given carbon molecules. Buildup polymers are created when two monomers are joined and the water particle is taken out. There are like-wise normally happening and manmade polymers.

For testing swab, which can be divided into two parts: nylon staple fiber fleece and medical ABS plastic. the upper head of swab is made of nylon, which is used for taking samples and leaving these samples on its surface for testing. Another part of it is consisting of medical ABS plastic, which is composed of three monomers, including Acrylonitrile, butadiene and styrene (Wikipedia 2021). In addition, the ABS polymers combine the properties of those three materials, which are the main reason why people choose to use it. These properties are first, it is a non-toxic

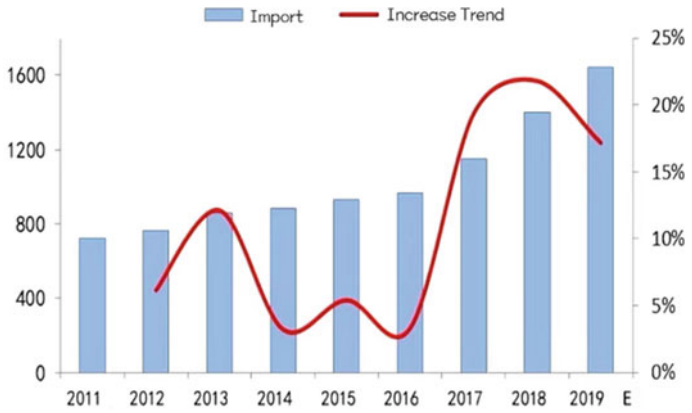


Fig. 1 Polyethylene consumption in China from 2010–2019 (m.dyhjw.com)

and odorless material, and which is insoluble in water. In addition, it has thermal insulation property, which can ensure that the ABS material is not easily deformed. Therefore, depending on these three characteristics above, we can know that the swab for nucleic acid detection would not cause harm on human body, besides, it would not easily be deformed when taking sample. Another important constituent material of nucleic acid detection is the material of extraction tube, the main constituent material is polyethylene (Pi et al. 2020). The large-scale nucleic acid testing in China has consumed a lot of polyethylene in recent year (Fig. 1).

In addition, polyethylene is not only a material for medical extraction tubes, but also a common and widely used material in many chemical factories and daily life, such as plastic bag and boxes, according to the diagram below, the polyethylene consumption in China is increasing year by year, therefore, it is significant to avoid contamination from polyethylene.

2.3 Possible Environmental Problems and Solutions

White Pollution. The supposed "white pollution" alludes to the ecological contamination brought about by non-degradable plastic waste in metropolitan and rustic trash or dispersed wherever whenever. It essentially incorporates plastic sacks, plastic bundling, dispensable polypropylene cheap food box, plastic silverware cups and electrical machines to fill froth stuffing, plastic drink bottles, yogurt cups, frozen yogurt skin, and so forth. Dealing with the undeniably difficult issue of white contamination, individuals desire to track down an option in contrast to the ongoing plastic presentation, and don't cause white contamination plastic substitutes, biodegradable plastic, this sort of new utilitarian plastics, its trademark is after arrive at a specific life squander, in specific ecological condition, because of its conspicuous

changes in synthetic construction, Cause a few exhibition misfortune and appearance change and debasement, innocuous or less damage to the regular habitat. The starch filled plastic, for instance the starch in a brief timeframe by soil organisms, most importantly, discharge amylase rapidly break down and create void, bringing about a decrease in film mechanical properties, simultaneously the equation to add the deoxidant respond with metal salts in the dirt to produce superoxide, make polyethylene chain burst and corruption into little sections of handily consumed by microorganisms was given by the common habitat, simultaneously to work on the job of soil (FCY 2020).

During nucleic acid testing, cotton swabs are used. Except for the contaminated and unusable or scattered cotton swabs that have been used for accounting and testing purposes, the products with problems from the factory will no longer be subject to strict management and treatment according to the standard of medical waste. And the knowledge is put into the ordinary garbage can, do a good job of not remaining in the environment, garbage classification, corresponding to processing, recycling and reuse. In this research on material, the discarded polyethylene is generally treated through landfill and combustion. Some researchers have found that it needs to take around 500–700 years to break down polyethylene (Meir 2020). In addition, the emitted gas after burning polyethylene contains a lot of methane and ethylene, which will increase the climate change and some other toxic gases would do harm on people health and organisms (University of Hawaii at Manoa 2018). Therefore, the suggested sustainable method to treat the used polyethylene is through recycling, which can prevent greenhouse gas emission and be recycled as new application. Some possible recycled polyethylene applications are: First, utilize the recycled polyethylene as marina, because plastic lumber is a good technology product to resist rot, corrode or decay in harsh environment. Second is fences, because normal fence is built by wood or metals, this material will need to be maintained frequently or easily break down, if use recycled polyethylene to build the fence, the maintenance cost would be decreased and will bring benefits to economy and environment. The final application suggested is landscaping, nowadays, many projects are built outdoor, which means the material used need to stand wind, heat and could, and polyethylene matches all these features, building outdoor landscaping by using recycled polyethylene will be a good idea.

Cotton Swabs. The Chinese government has made some changes to the scope of medical waste, and some items are no longer counted as medical waste. Cotton swabs, cotton balls and infusion stickers are not managed according to medical waste. The Catalogue (2021 edition) provides for some non-risk or low-risk medical waste, which can be exempted according to the provisions of the ex-emption content if the corresponding conditions are met (National Hazardous Waste List 2020). Among them, cotton swabs, cotton balls and infusion stickers were used by patients to press for hemostasis but not collected in medical waste containers, and the whole process was not in accordance with medical waste management. Sealed medicine bottles, ampoule bottles and other glass medicine bottles can not be collected by sharp tool box.

3 Treatment and Disposal Methods

3.1 Testing Requirements

Requirements for medical waste management at sampling sites (Ha 2020).

1. Medical waste includes: discarded testing and medical supplies such as cotton swabs, protective suits, masks and gloves used by testing personnel and medical personnel; The water bottle holding hands on the collection platform belongs to medical waste, and the water bottle pours out the water and puts it into the medical waste garbage bag; Protective equipment for volunteers, transit personnel and other workers. Special attention: rest room food leftovers, water bottles are household garbage, do not put medical waste garbage bags.
2. Medical waste delivery requirements: Medical waste should be put into a small yellow medical waste trash can at the detection site, which must be covered with a special yellow bag for medical waste.
3. Medical waste packaging bag requirements: The medical waste packaging bag shall be a special yellow polyethylene (PE) bag with the required thickness. Double packing, double tying and double disinfection should be done in goosenior-neck style to ensure that the packing is tightly tied, without leakage, rupture and perforation, and then placed in the yellow recycling box of medical waste. If the packaging bag is damaged or medical waste is scattered, it is necessary to disinfect the packaging again.
4. Requirements for medical waste transfer: The medical waste from all sampling points shall be transported to the medical waste collection point along with the production, and the volume of medical waste packaging shall be reduced as much as possible to increase the volume of medical waste transfer. Transport personnel should take good protection, handle with care, to avoid throwing, throwing and other actions caused by damage of garbage bags medical waste overflow risk. During transportation, airtight and leak proof measures should be taken.
5. Temporary storage requirements for medical waste: In principle, medical waste should be placed in a closed room with a yellow revolving box. Open-air storage and direct landing of medical waste are strictly prohibited.
6. It is strictly forbidden to mix with household garbage.

Collection of medical waste requirement.

3.2 A Subsection Sample

Collection point setting requirements: The location of the collection point should be convenient for medical waste transport vehicles to enter and pass. It can be installed in the room on the first floor of the building to ensure that the ground is hardened and the ground is protected from wind and rain and snow. It is recommended to install

it in the temporary storage room of medical waste in the community health service center.

Medical waste packaging bag requirements: The medical waste packaging bag shall be a special yellow polyethylene (PE) bag with the required thickness. Double packing, double tying and double disinfection should be done in goosenior-neck style to ensure that the packing is tightly tied, without leakage, rupture and perforation, and then placed in the yellow recycling box of medical waste. If the packaging bag is damaged or medical waste is scattered, it is necessary to disinfect the packaging again (Li 2021).

Handover requirements for medical waste: Each collection point shall designate a special person to manage medical waste, and a special person shall be responsible for handover with the medical waste disposal unit or emergency fleet. Reduce the packaging volume of clinical waste as much as possible to increase the transshipment volume of clinical waste.

Among the above types of medical waste treatment and disposal technologies, incineration technology can dispose infectious, pathological, damaging, pharmaceutical and chemical medical waste, that is, there is no requirement for the types of medical waste (Tangent 2018). Besides, incineration can treat large quantities of medical waste thoroughly. Non-incineration technology has the characteristics of low operation cost, strong adaptability, less secondary pollution and no dioxin generation, but this kind of technology is only applicable to the treatment of infectious, injurious and part of pathological medical waste.

There is a big gap between urban and rural areas in China, and environmental protection facilities in remote areas are backward. However, there is no difference in the epidemic prevention goals of Chinese governments at all levels. As incineration is more likely to be widely used, considering the huge consumption of nucleic acid detection kit and the firming determination of Chinese government in preventing the spread of Covid-19, we suspect that incineration is widely used in the treatment and disposal of Covid-19 nucleic kit in China.

3.3 Suggestions and Prospects

Nucleic acid detection kit belongs to solid waste, and its treatment and disposal need to follow the principle of "Waste Minimization, Waste Valorization and Environmentally Sound Management". Minimizing the amount of nucleic acid detection kit is the best treatment and disposal measure, which is not only beneficial to its terminal management, but also can reduce the energy consumption and pollutant emissions in the production process. It is a good measure to change the sampling method from single person single detection to multi person mixed detection. 'Environmentally Sound Management' is the core of nucleic acid detection kit treatment and disposal, which has 2 meanings: eliminating the infectivity of used nucleic acid detection kit and treating the kit with environmentally friendly methods. Reducing the pro-portion of incineration facilities and replacing disinfection pretreatment can

ensure the treatment effect and reduce the production of persistent organic pollutants (ZZ et al. 2022).

Recycling the used nucleic acid detection kit has always been a topic that cannot be mentioned in China, which is mainly caused by the epidemic prevention policy formulated by the Chinese government and the aversion and fear of the Chinese people towards Covid-19. A good example of recycling testing kit has been mentioned in part2, the extraction tube after sterilization can be recycled into many applications, where matches its properties. In the view of the huge consumption of nucleic acid detection kit and the extremely low survival rate of coronavirus, we believe that more feasibility study on the waste valorization of nucleic acid detection kit is needed. In a word, when we face the new source of pollution, the main consideration is to use sustainable idea to convert them into renewable energy.

4 Conclusion

In the context of nucleic acid detection waste disposal, for environment, the disposal of waste should comply with the corresponding environmental laws and regulations, it is necessary to used environmentally friendly and preferential treatment method to deal with the available waste, such as recycling and reuse. For economy, the production of covid-19 test kits can bring benefits, but in other aspects, such as the harm caused by disposing used equipment, they may also be socio-economic losses. Therefore, in this study, using sustainable method to deal with plastic is our main goal. For society, ensure that public health and building a good relationship with nature is an important factor in maintaining social stability. Therefore, the following conclusions are drawn through the study. In order to better shorten the nucleic acid test pollution treatment problems faced by people in cities and suburbs, as well as more in-depth research on nucleic acid test kit waste disposal. In accordance with the principle of sustainable development, more scientific and reasonable means (such as centralized recycling, etc.) should be adopted to treat the pollutants generated by nucleic acid testing based on the policy of referring to the existing data box processing methods. In the future, we should consider waste disposal methods from a more scientific and sustainable perspective.

References

FCY (2020) Law of the People's Republic of China on the prevention and control of environmental pollution by solid waste. Available at: https://www.mee.gov.cn/ywgz/fgbz/fl/202004/t20200430_777580.shtml. Last accessed 26 May 2022

Ha (2020) Notice on the publication of the catalogue of clinical waste classification, 2021 edn. Available at: http://www.nhc.gov.cn/yzygj/. Last accessed 26 May 2022

Li W et al (2021) Study on the effect of emergency disposal of medical waste in MSW incinerator on slag and flue gas emission. Environ Sanitation Eng. Available at: http://www.srhj.org.cn/CN/abstract/abstract692.shtml. Last accessed 26 May 2022

m.dyhjw.com (n.d.) Tesla (TSLA.us) has started selling test drives of display cars at some stores in the United States. [online] Available at: http://m.dyhjw.com/gold/20191223-20834.html

Meir B (2020) Why does it take plastic so long to break down? Available at: https://davidson.weizmann.ac.il/en/online/askexpert/why-does-it-take-plastic-so-long-break-down. Last accessed 20 May 2022

National Hazardous Waste List (2020) Management of solid waste and chemicals. Available at: https://www.mee.gov.cn/xxgk2018/xxgk/xxgk02/202011/t20201127_810202.html. Last accessed 26 May 2022

Pi L et al (2020) Polyethylene/TiO_2 medical tube with comprehensive mechanical performances via bio-mimic multiscale helical structures. J Vinyl Add Tech 26(4):405–412. https://doi.org/10.1002/vnl.21755

Tangent (2018) How to dispose of HDPE PLASTIC: productive uses for recycled plastic material. Available at: https://tangentmaterials.com/productive-uses-for-recycled-plastic-material/. Last accessed 20 May 2022

University of Hawaii at Manoa (2018) Degrading plastics revealed as source of greenhouse gases. ScienceDaily. Available at: cn.bing.com. (n.d.). Bing. [online] Available at: https://cn.bing.com/images/search?view=detailV2&ccid=W586TYQg&id=7618F1D9DC10624517EEB83D923E8CF0B4AF41D2&thid=OIP.W586TYQgVcMPFcDuJSmFNgHaEc&mediaurl=https%3a%2f%2fshijin-img.oss-cn-chengdu.aliyuncs.com%2fblog-img%2ff32d7eb4278547a19be1ed2bbebde00e.jpeg&exph=420&expw=700&q=.https://www.sciencedaily.com/releases/2018/08/180801182009.htm. Last accessed 26 May 2022

Wikipedia (2021) ABS. Available at: https://zh.wikipedia.org/wiki/ABS%E6%A0%91%E8%84%82. Last accessed 20 May 2022

www.medical-swab.com (n.d.) Nucleic acid test Nasal swab What are pharyngeal swabs made of?—Shenzhen Medic Bio-medical Technology Co., LTD. [online] Available at: https://www.medical-swab.com/article-item-1282.html

www.who.int (n.d.) Statement of the eleventh meeting of the international health regulations (2005) emergency committee on the COVID-19 pandemic. [online] Available at: https://www.who.int/zh/news/item/13-04-2022-statement-on-the-eleventh-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-coronavirus-disease-(covid-19)-pandemic

ZZ et al (2022) Revision ideas and implementation suggestions on technical specifications or disinfection centralized treatment engineering of medical waste. Chinese J Environ Eng 16(4):1068–1073

Health Monitoring and Maintenance of Bridges

Boyuan Wang

Abstract According to the research status of bridges in recent years, this paper conducts a literature review on bridge maintenance, and sums up the prevention and maintenance methods for different damages on bridges made of various materials. This paper introduces the common damages of wooden bridges, steel bridges, and reinforced concrete bridges caused by environmental and human factors and their prevention and maintenance methods. How to prevent corrosion, prevent fire, and improve structural strength of reinforced concrete structures is studied and summarized.

Keywords Conservation · Health monitoring · Reinforced concrete bridge · Steel bridge · Wood bridge

1 Introduction

Nowadays, bridges play an important role in transportation. However, when the bridge is in use, some damages will inevitably appear, which will disrupt the transport. It is very important to master their maintenance methods, which can not only ensure the daily transport, but also ensure the safety of people's lives and property. In this paper, steel bridges, wooden bridges, and reinforced concrete bridges are selected. Their maintenance strategies are introduced.

2 Maintenance of Wooden Bridges

With the development of society, people's awareness of environmental protection is gradually enhanced, and wooden bridges with the advantages of strong environmental

B. Wang (✉)
Tianjin University of Technology, Xiqing District, Tianjin 300384, China
e-mail: 18610358713@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_61

protection, energy saving, and renewable ability gradually enter people's field of vision. Laminwood has been widely used in bridge engineering because of its light weight and good seismic performance. Taking laminwood arch bridge arch bridge as an example, although it has the advantages of light weight and good seismic performance, the waterproof, fireproof, and anticorrosion of wood structure and compression resistance of arch are still common problems.

2.1 Strengthening of Bearing Structure of Wooden Bridge

Glued wood is suitable for middle and small span tie-rod arch system. In the structure of glulam tie-rod arch, the arch is glulam, which is mainly under pressure, and the horizontal metal cable is mainly under tension, giving full play to the performance advantages of two different materials.

Taking a wooden bridge as an example (Sun et al. 2020), the displacement meters are arranged at 1/4, 1/2, and 3/4 of the arch ribs respectively, and the experimental results of the mid-span position of the bridge deck are as follows Fig. 1:

Under full-span load, the maximum deformation of the main arch occurs in the main arch span, and the maximum deformation value is 12 mm.

Under the action of half-span load, the maximum deformation of the main arch occurs at the 1/4 position of the full span, and the deformation curve is S-shaped, with the maximum deformation value of 18 mm (Sun et al. 2020).

Under eccentric load, the maximum deformation of the main arch occurs in the mid-span, and the maximum deformation value is 6 mm. The maximum deformation of the whole bridge occurs in the bridge deck span, and the maximum deformation values are 22 mm, 18 mm, and 13 mm respectively (Fig. 2).

The bearing capacity and stiffness of glued wood beams can be improved by vertically embedding CFRP. In the reinforced wood beam, the compression zone is compressed by wood, and the tension zone is pulled by CFRP and wood. According to the different sizes and numbers of CFRP plates, the wood beam will have some failure, such as tensile failure of wood, yielding of wood in the compression zone, and peeling of laminate and wood beam. According to the different forces of the bridge, CFRP plates are used for reinforcement, and epoxy resin carbon fiber plate glue is used for bonding with the wooden beams. Compared with the unreinforced wood beam, the flexural capacity of the reinforced wood beam is significantly improved.

2.2 Anticorrosion of Wooden Bridges

Wood is a natural organic material, which is easily damaged by fungi, insects, and decays. There are three kinds of common fungi in wood: mold, discolored bacteria, and decayed bacteria. Among them, mold and color-changing bacteria only change the color of wood and affect its appearance, but not its strength. Rotten bacteria do

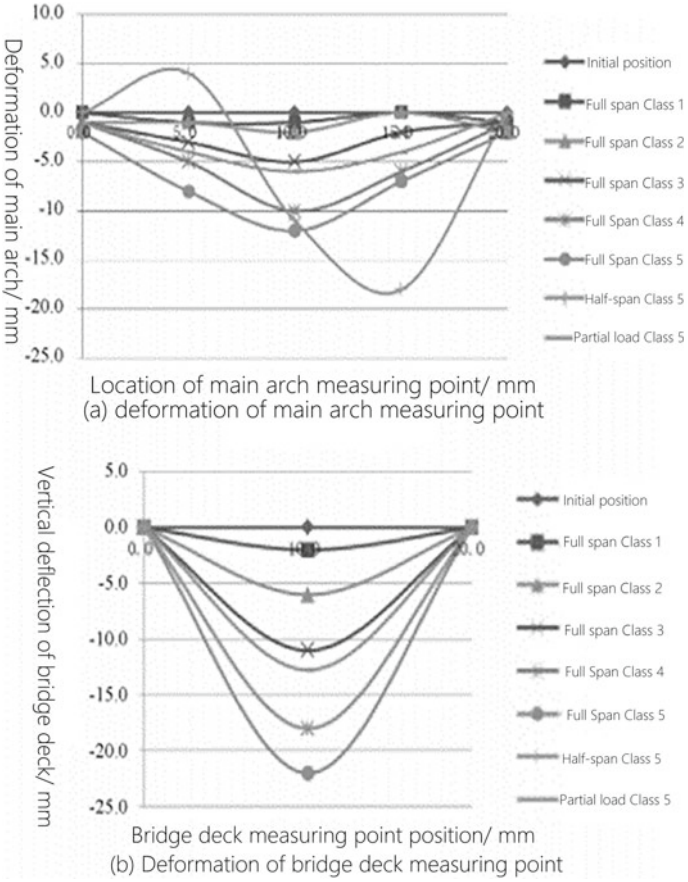
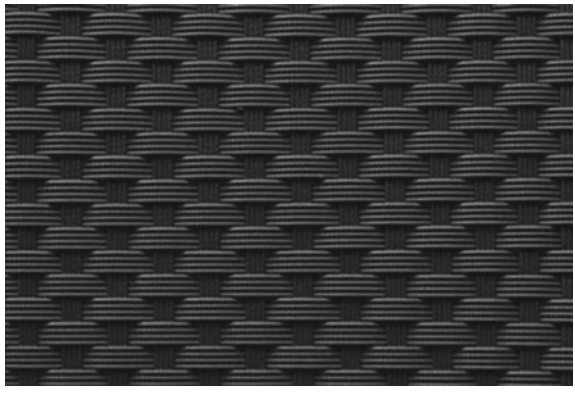


Fig. 1 Compression experiment of a wooden bridge

Fig. 2 CFRP



serious harm to wood, and they use lignin as their nutrient. By secreting enzymes, cellulose and hemicellulose in wood cell walls are decomposed, which makes wood decayed.

The reproduction and survival of aquatic fungi must have three conditions: suitable temperature, sufficient air, and appropriate humidity. Therefore, wooden stakes struck underground or in water are not easy to rot. However, when subjected to repeated wet and dry action, it will accelerate the process of decay. When the temperature is higher than 60 °C or lower than 5 °C, the moisture content of wood is lower than 25% or higher than 150%, or the air is isolated, the growth and reproduction of fungi will be inhibited or even stopped.

The wood boards used in glued wood components are relatively dry, and the moisture content of the wood boards is usually less than 15% (Zhu et al. 2020), and the glued wood structures made from them are not easy to be cracked or twisted. Before the production of glued wood, dry the wood, control the moisture, make the wood-rotting bacteria difficult to grow, do a good job of cleaning at ordinary times, and keep the surface of the wood clean without leaving dirt (Fig. 3).

Wood wax oil paint can be used for nursing (Zhu et al. 2020), because wood wax oil can penetrate into wood and deeply moisturize and maintain the wood; Wax can be closely combined with wood fiber to enhance surface hardness and prevent water and pollution. Therefore, this gold combination can provide the best beautification and protection for wood. Wood will not only be corroded by fungi, but also eaten by insects. For example, termites, longicorn beetles and beetles. They live and reproduce in bark or xylem, which leads to the decrease of wood strength and even the collapse of wood structure. Chemical agents can be used to spray or soak or inject into wood, so as to inhibit or kill fungi and insects and achieve the purpose of anticorrosion. The water-soluble preservatives mainly include sodium fluoride, borax, sodium arsenite and so on, which are mainly used for the preservation of indoor landscape wooden bridges. The preservatives mainly include creosote (also

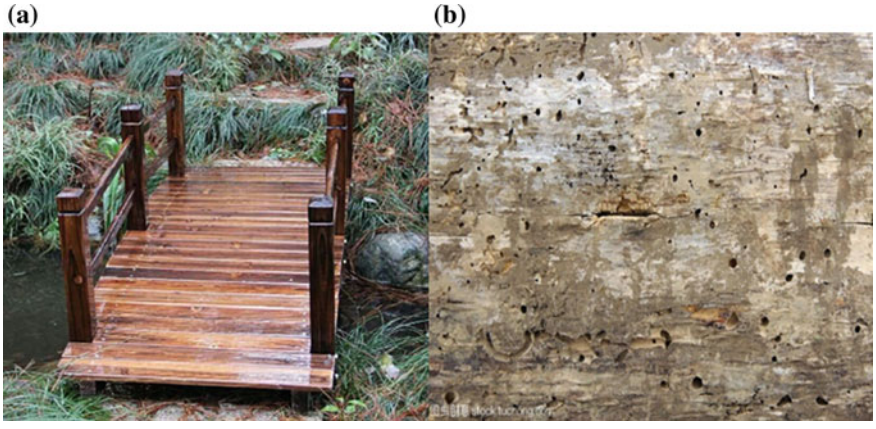


Fig. 3 **a** Photo of bridge care with wood wax oil, **b** timber

known as creosote), creosote-coal tar mixture, etc. These preservative have strong toxicity and long-lasting toxicity, but have pungent odor. After being treated, the surface of wood surface is black. The main varieties of composite preservatives are boron phenol mixture, fluorine chromium phenol mixture, fluorine boron phenol mixture, etc. This kind of preservative is highly toxic to bacteria and insects, less toxic to people and animals, and has lasting efficacy, so its application is expanding day by day. Or use phenolic resin adhesive or resorcinol formaldehyde resin adhesive with strong water resistance.

2.3 Fire Prevention of Wooden Bridge

Flammability of wood is its main disadvantage. The purpose of wood fire treatment is to improve the fire resistance of wood and making it difficult to burn. Or when the wood is on fire, the flame will not spread quickly along the surface of the material. Or when the flame is removed, the flame on the surface of the wood will be extinguished immediately. The common fire prevention method is to paint or cover the surface of wood with flame retardant materials and impregnate wood with fire retardant. Commonly used fireproof coating materials include inorganic coatings (such as silicates, gypsum, etc.) and organic coatings (such as tetrachlorophthalic anhydride resin fireproof coatings, intumescent acrylic latex fireproof coatings, etc.). The fire retardant used for impregnation includes phosphorus-nitrogen series, boride series, halogen series and amino phosphate resin series with ferric phosphate as the main component.

3 Maintenance of Reinforced Concrete and Steel Bridges

3.1 Strengthening and Anticorrosion of Steel Structure by Alloy Elements

The basic components of steel are iron and carbon. And the carbon content of steel is less than 2.11%, in addition to other alloy elements. According to chemical composition, it is divided into carbon steel and alloy steel. Carbon steel is divided into low carbon steel (carbon content $\leq 0.25\%$), medium carbon steel (0.25 ~ 0.6%) and high carbon steel (> 0.6%). Alloy steel is divided into low alloy steel (total content of alloy elements $\leq 5\%$), medium alloy steel (5 ~ 10%) and high alloy steel (10%). In addition, adding different metal elements to steel can improve the performance of steel in varying degrees (Figs. 4 and 5; Table 1).

Most of the large bridges being built and planned in China are located in economically developed coastal areas. The content of SO_2 in the atmosphere of these areas is increasing day by day, and the coexistence of SO_2 and Cl—has become the norm,

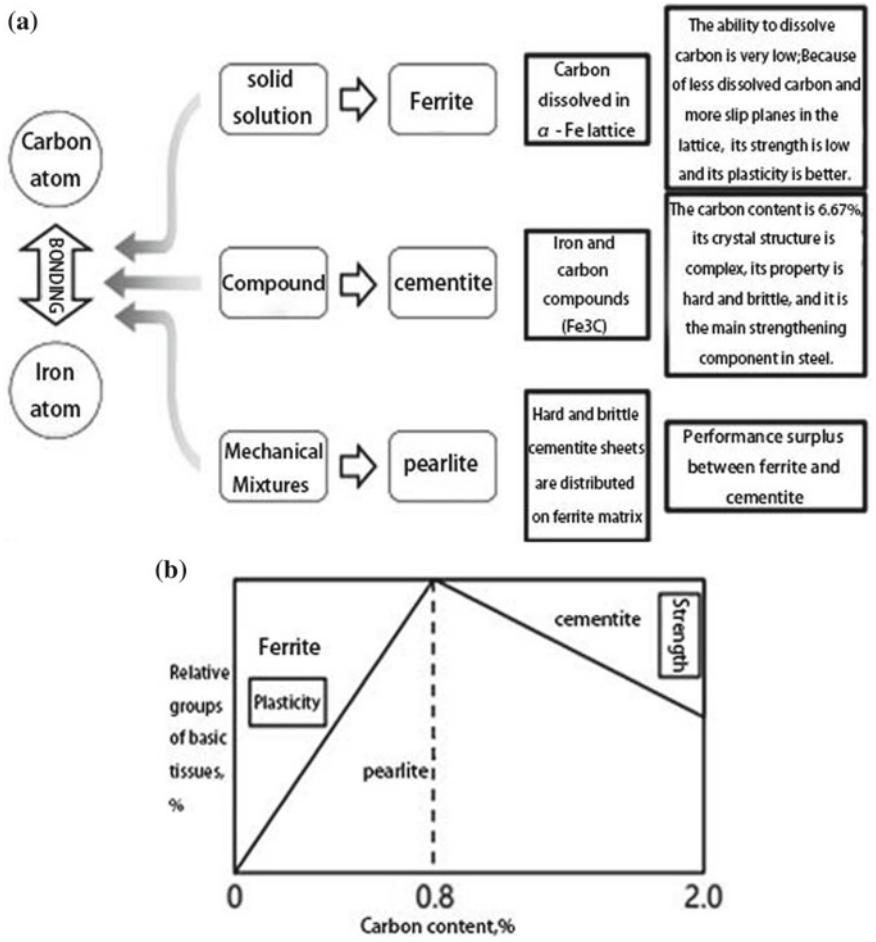


Fig. 4 **a** Basic structure of steel structure. **b** Influence of basic structure of steel structure on its strength and plasticity

which poses a great threat to the safe service of bridges and will greatly shorten their service life. The marine atmospheric corrosion resistance of steel is generally improved by increasing the Ni content in steel. However, due to the high price of Ni and the great fluctuation of the market, how to replace part of Ni with Al and develop low-cost bridge steel containing Al and resistant to marine atmospheric corrosion has gradually become the focus of future bridge steel research and development (Hai et al. 2019).

In the smelting process, aluminum is mainly used as deoxidizer, but if the content of aluminum is too high, a series of problems such as increased inclusion and blockage will often occur. However, aluminum has great potential in improving the weather resistance and reducing the cost of steel. It is considered that adding a small amount

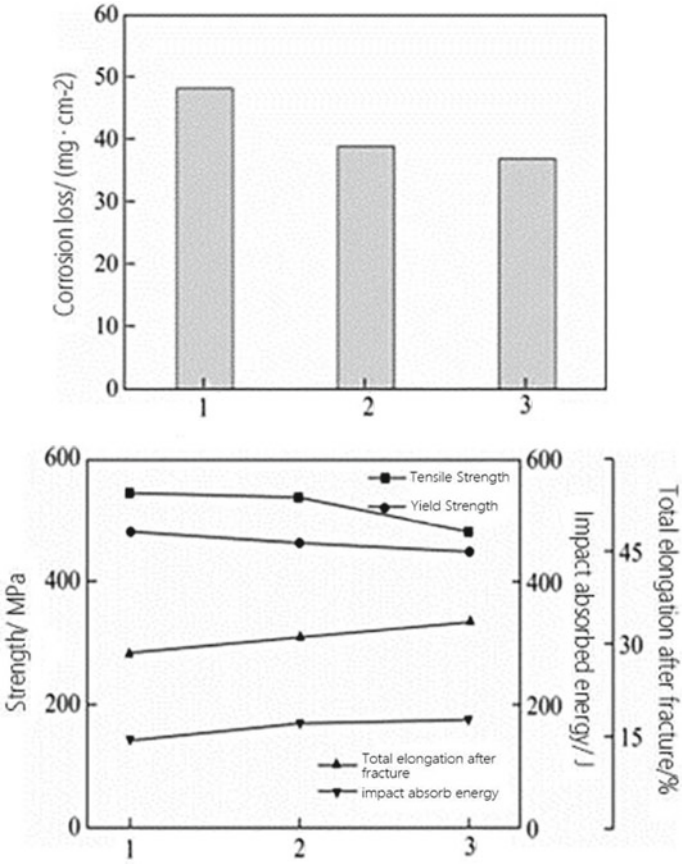


Fig. 5 Experiment on improving strength and corrosion resistance of weathering steel by adding Al element

of aluminum will improve the weather resistance of low carbon steel. Under the condition of marine atmosphere after adding aluminum, fine spinel oxide $FeAl_2O_4$ will be formed on the surface of low alloy steel, which will enhance the barrier effect of rust layer to corrosion medium and moisture. With the increase of aluminum content, the weathering resistance of steel is improved. It is found that Al has the advantages of strengthening ferrite, inhibiting the crystallization of corrosion products, and promoting the formation of fine-grained oxide film with protective effect. It is beneficial to improving the corrosion resistance (Hai et al. 2019) of steel.

Compared with weathering steel without Al, the grain size of weathering steel with Al addition is obviously coarsened, and the grain size of weathering steel with 0.23% Al is 3 times larger than that of weathering steel without Al addition (Hai et al. 2019). With the increase of Al content in steel, the grain coarse further and the ferrite content increases obviously. The average grain size of ferrite in Al-free

Table 1 Influence of alloy elements on steel properties

Alloying agent	Function
Si (less than 1%)	Improve strength without reducing plasticity and toughness
Mn (content 1 ~ 2%)	Improve strength, eliminate hot brittleness of sulfur and oxygen, and improve hot workability
Ti	Enhance strength, improve toughness and weldability, reduce aging tendency, and slightly reduce plasticity
V	Improve strength, reduce aging tendency and improve welding
Ni	Improve strength
S	Cause hot embrittlement
P	Improve strength, significantly reduce plastic toughness, reduce weldability, and cause cold brittleness
O	Reduce mechanical properties, especially toughness
N	Improve the strength, significantly reduce the plastic toughness, reduce the weldability, aggravate the aging tendency, and cause cold brittleness
H	Causing hydrogen embrittlement and white spots

steel is about 6 μm and the volume fraction of ferrite is about 78%. The average grain size of ferrite of 25% Al weathering steel is about 12 μm, and the volume fraction of ferrite is about 92%. The average grain size of ferrite in weathering steel containing 0.75% Al is about 20 μm, and the volume fraction of ferrite is about 95%. The structure of weathering steel is mainly ferrite, and there is limited ferrite in weathering steel without adding Al. With the increase of Al content, the bainite content gradually decreases. The addition of Al can obviously increase the ferrite content in weathering steel, which is mainly due to the role of Al in strengthening ferrite and inhibiting the transformation from ferrite to austenite. Compared with weathering steel without Al addition, the strength of weathering steel with Al addition decreased slightly, while the elongation and impact energy absorption after fracture increased. According to the Holpage formula, under the condition of external load, the deformation of every grain in weathering steel is restrained by the surrounding grains, so the room temperature strength of weathering steel always decreases with the coarsening of grains (that is, the reduction of the total grain boundary area), which leads to the increase of the effective distance of dislocation slip, plasticity and impact energy absorption. With the increase of Al content, bainite content in steel decreases and ferrite content increases. As a result, the strength of steel decreases and the elongation after fracture increases. In addition, with the increase of Al content, the corrosion weight loss gradually decreases. Compared with the weathering steel without Al addition, the corrosion weight loss of weathering steel with Al addition decreases by 25%, indicating that the addition of Al not only improves the strength of weathering steel, but also improves its corrosion resistance (Hai et al. 2019).

3.2 *Other Common Anticorrosion Measures of Reinforced Concrete*

The anti-corrosion measures of reinforced concrete include improving the compactness of concrete, ensuring the thickness of protective layer, limiting halogen additive, adding antirust agent and so on. In addition, it is particularly important to ensure a reasonable mixture ratio of concrete, and pay attention to the reasonable particle size of coarse and fine aggregates. A reasonable water-cement ratio and sand ratio; The vibration method is accurate; Avoid segregation during casting; Especially, when using string pipes, the nozzle height should be reasonable.

The corrosion causes of steel include chemical corrosion, electrochemical corrosion and stress corrosion, among which electrochemical corrosion is the main form of steel corrosion. The anti-corrosion measures for steel structures mainly include mechanical isolation measures, i.e., coating the surface of steel structures with inert materials and isolating corrosive media such as water and oxygen to achieve the anti-corrosion purpose. According to the principle of electrochemical corrosion, these two methods are to artificially increase the potential of steel structure members and make them at the pole with higher potential, thus achieving the purpose of protection.

Among them, steel bridge coating is usually a comprehensive anti-corrosion system (Ma 2020) composed of primer, intermediate paint and top paint, which has good corrosion resistance, weather resistance and construction performance.

The anticorrosion coating system for metal steel structures in the atmosphere mainly adopts the antirust primer (metal spraying or zinc-rich primer), intermediate sealing paint and top paint with anti-ultraviolet aging as its main function. The primer on the outer surface of steel box girder of the coastal steel bridge is basically sprayed with metal (aluminum or zinc-aluminum alloy). The top coat is basically acrylic polyurethane top coat or fluorocarbon resin. The inner surface primer basically adopts inorganic zinc-rich primer and epoxy zinc-rich primer (see Table 2).

Metal spraying Zn-Al alloy has a good protective effect, but the construction cost is high. In addition, a large amount of noise, arc light and metal dust are generated during spraying, resulting in poor environmental protection performance. At present, it is mainly used in parts of steel members which are difficult to repaint under severe service environment, such as the outer surface of steel box girder. The protective effect of epoxy zinc-rich primer is slightly inferior to that of metal spraying, but the construction cost is less. The construction requirement for steel surface is low and the tolerance is high, which is mainly used in easy maintenance parts such as the inner surface of steel box girder. In addition, limited by objective environment and conditions in maintenance painting, it is generally impossible to use the same sandblasting and shot blasting treatment, and the primer can be a coating with low requirements for surface treatment and good adhesion, such as an epoxy zinc-rich primer.

Acrylic polyurethane finish and fluorocarbon finish are commonly used in anticorrosion coating of bridge steel structures. Compared with polyurethane paint, fluorocarbon finish paint has better light and color retention and durability, and its protective

Table 2 Painting methods of steel structures at different parts (Dai 2018)

Location	Coating materials	Number of passes/channel	Thickness/μm
Surface in contact with concrete	Sand blasting and derusting		Sa2 1/2, Rz 40 ~ 80 μm
	Inorganic zinc-rich bottom	1	20
Other surfaces (arrange dehumidifier, relative humidity not greater than 50%)	Paint sand blasting for rust removal		Sa2 1/2, Rz40 ~ 80 μm
	Inorganic zinc rich primer	1	20
	Low surface finish epoxy paint	1	125
High-strength bolt friction surface	Sand blasting and derusting		Sa3 1/2, Rz 40 ~ 0 μm
	Arc spraying aluminum	1	120 ± 20
	Inorganic zinc-rich shop primer	1	40

effect is better than polyurethane finish paint. However, the fluorocarbon topcoat has a higher VOC content and contains isocyanate. Great impact on human health and environment. However, polyurethane coating and its supporting coatings still occupy an important position in heavy-duty anticorrosion coating of special parts of bridge steel structures due to their relatively excellent cost performance and workability (Ma 2020).

At this point, the overall anti-corrosion coating system can be designed as follows (Dai 2018).

Epoxy zinc-rich primer + epoxy micaceous iron oxide intermediate + fluorocarbon topcoat (conventional standard system), or inorganic/epoxy zinc-rich primer + epoxy micaceous iron oxide intermediate + polyurethane topcoat.

Auxiliary components anticorrosion coating steel bridge auxiliary components include crash barriers, high-strength bolts, etc. Corrosion diseases are common in actual operation. Within the scope, the reinforced epoxy powder coating is adopted for anticorrosion, and cathodic protection measures at the expense of anode are adopted.

3.3 Concrete Pavement Maintenance

The main types of diseases are fine cracks and oil pollution erosion, pits formed by loose mixture and scratches during vehicle running (Fig. 6).

The main diseases are pits and cracks (including transverse cracks, longitudinal cracks, chicken-claw-shaped cracks, etc.), among which the number of cracks accounts for 76.5% of the total number, and 90% of the cracks are about 4.0 m away

Fig. 6 Crack of concrete pavement

from curbs. In view of the cracks, adopt sealing treatment to prevent water infiltration; Pits are repaired with hot mix asphalt mixture. The repair area is limited to the surface SMA repair. In addition, the structure of traditional asphalt-based materials, such as crushed stone seal, mist seal and micro-surfacing, has problems of high temperature stability. The interface bonding with thermosetting epoxy asphalt pavement is a big problem.

The application of high toughness resin coating can reduce the stress of the original pavement structure and delay the pavement cracking. Considering the traffic flow of long-span bridges, we should pay attention to the following three points during maintenance construction: ① The traffic pressure is high after closure, so the construction curing time should be short to ensure that the traffic can be opened quickly; ② The construction operation time should be long to avoid premature reaction after mixing rubber materials; ③ It is required that the epoxy resin should have a low initial viscosity, which is convenient for construction. Experimental results Ye et al. (2020) of workability of epoxy resin are as follows:

1. the viscosities of high-permeability resin and permeable resin are 1.5 Pa.s and 0.6 Pa.s respectively.
2. Both of them have long operable time, which is about 30 min and about 60 min respectively.
3. The curing time is short, and the high toughness resin can be cured in 4 h at normal temperature, while the permeable resin can be cured in 6 h, which can meet the requirements of maintenance on the same day and open traffic on the same day.

The resin overlay should have high deformability to cooperate with the deformation of steel bridge deck pavement. The tensile strength and elongation at break of the permeable resin and the high-permeability resin at room temperature 23 °C are 21.20 MPa and 10.84 MPa respectively, and 95% and 125% respectively. Both have high crack resistance and good deformability.

The experimental result Ye et al. (2020) shows that the crack resistance of the mixture is obviously improved by using the high toughness resin cover, the flexural strength is increased by 2–4 times, and the ultimate failure strain is increased by 2–3 times, which can restore the structural strength of the pavement and prolong the service life of the pavement for more than 3 years. The trabecular bending strain at low temperature − 10 °C can reach more than 30,000, and the bending failure strength can reach 72 Mpa (see Table 3).

The high-toughness resin thin-layer overlay structure is composed of a high-permeability epoxy resin sealing layer and a high-hardness resin wearing layer, with a total thickness of about 3–5 mm, which basically does not increase the dead load of the bridge deck. It can effectively inhibit cracks on the pavement surface, and has certain strength, deformability and higher bonding performance, which not only provides higher crack resistance of the resin itself. It also ensures the deformation ability of the steel bridge deck pavement, and is not easy to peel and delaminate under the load (Fig. 7).

In addition, epoxy asphalt concrete belongs to suspension dense mixture, and the pavement surface has low structural depth and poor anti-sliding performance. The structural depth of the resin cover is about 1 mm, which makes it difficult to form

Table 3 Deformation ability of high toughness resin overlay at different temperatures

Test temperature	Plan	Ultimate strain	Bending and tensile strength
15 °C	No cover	55,655	10.0
	High toughness resin cover	93,766	48.94
− 10 °C	No cover	9049	25.32
	High toughness resin cover	35,688	72.37

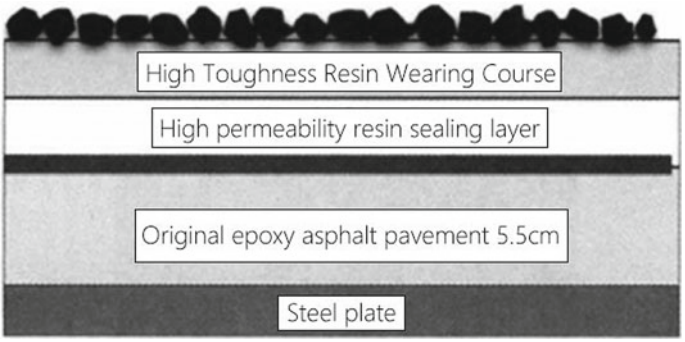


Fig. 7 Asphalt pavement (Ye et al. 2020)

Shui Piao and fog when driving on rainy days. The pendulum friction coefficient can reach more than 80BPN, which can greatly improve the anti-sliding performance, thus shortening the braking distance and improving the traffic safety. Moreover, the resin cover has a certain anti-freezing effect, and the exposed and evenly arranged gravel on the surface forms stress concentration points under the action of load. In rainy and snowy weather, the paved surface is not easy to accumulate snow and ice, which has a certain degree of guarantee for driving safety in rainy and snowy weather (Ye et al. 2020).

4 Conclusion

The application value of glulam structure in wooden bridge engineering is relatively high. In view of the problems in the use of glulam, fire prevention, anti-corrosion, compression resistance and tensile testing and maintenance work should be carried out. CFRP plates can be vertically embedded to increase their strength, and external coating can be used to achieve the purpose of fire prevention and anti-corrosion.

Steel structures in reinforced concrete bridges and steel bridges can increase their strength by adding other metal elements to the steel. Developing low-cost bridge steel containing Al and resistant to marine atmospheric corrosion has gradually become the focus of future bridge steel research and development (Hai et al. 2019). In addition, aiming at the anticorrosion of steel structures, most bridges choose to spray with anticorrosion coatings. In the future, we will mainly explore new coatings with low pollution, low cost and low energy consumption.

The concrete in steel–concrete structure needs to improve the compactness of concrete, ensure the thickness of protective layer, limit halogen additive, add antirust agent and ensure reasonable mix ratio to achieve the purpose of anti-corrosion.

For the maintenance of concrete pavement, the coating effect of high toughness resin thin layer is good, paving cracks and pits are effectively closed, and crack propagation is delayed. The anti-sliding and wear resistance of the surface is greatly improved (Ye et al. 2020).

References

Dai R (2018) Long-term anticorrosion coating for steel bridges. Coat Ind 8(12):74–79

Hai X, Sha X, Meng J, Fan L, Wang W, Wang Z (2019) Effect of Al on microstructure and mechanical properties of weathering bridge steel. Shanghai Metal 41(4):45–48

Ma X (2020) Anticorrosion protection and painting of steel structure bridges along Zhejiang coast. J Zhejiang Inst Commun Technol 21(1):25–30

Sun X, Qu Y, Liu W, Lu W, Liu X (2020) Structural design and analysis of a wooden landscape bridge. Highway 2:79–84

Ye L, Yang W, Wen J, Zhang H, Fu X (2020) Study on the application of high-toughness resin thin-layer cover in the preventive maintenance of epoxy asphalt pavement on steel bridge deck of sea-crossing bridge. 1:9–14

Zhu J, Jin Y, Fu N, Yan P (2020) Discussion on inspection and maintenance methods of glued wood structures. Green Sci Technol 8:136–142

Hedge Analysis of ZTE

Yinghui Zhang

Abstract Under the reform of the RMB exchange rate and Global trade, how China's multinational companies control their foreign exchange risks has become an important topic. Although many foreign scholars have conducted in-depth research on companies using financial derivatives, there is still little research on Chinese companies as a sample. Due to the derivatives speculation and the 2008 financial crisis, Chinese scholars have been controversy about the role and nature of financial derivatives. This paper selects ZTE as a case company analyzes its statement content and its risks in detail, and finally summarizes the methods that ZTE uses in foreign exchange risk management.

Keywords Multinational · Exchange rate

1 Introduction

Chinese companies began going global in the early twentieth century. The Southeast Asian financial crisis in 1997 caused the depreciation of exchange rates in Asian countries, which also attracted the attention of Chinese enterprises to foreign exchange risk management. But because the Chinese government's effective control of the exchange rate has long kept the renminbi roughly stable, it is conducive to the import and export trade of Chinese enterprises. In July 2005, with the reform of the exchange rate system, the Chinese government began to implement a floating exchange rate system based on market supply and demand and adjusted with reference to a basket of currencies. In August 2015, China introduced an intermediate quotation mechanism for the exchange rate of the RMB against the US dollar. According to the external development, the government chooses several major currencies to form the currency basket. The intermediate quotation mechanism is the closing exchange rate plus the exchange rate change of a basket of currencies. This reform makes the RMB

Y. Zhang (✉)
Xiamen University, Xiamen 361000, China
e-mail: 17420182200846@stu.xmu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_62

no longer affected by the single exchange rate of the US dollar, and the formation mechanism of the RMB exchange rate is more international and market-oriented. This is a huge challenge for Chinese multinationals to operate.

ISDA, based on a study of the world's top 500, found that 88% of companies used foreign exchange derivatives. A large number of theoretical studies have proved that hedging is beneficial to companies. Smith and Stulz demonstrated that hedging can reduce expected tax expenses and the cost of financial distress (Smith and Stulz 1985); Froot et al. demonstrated that hedging can reduce underinvestment when the company's cash flow is unstable and the cost of external financing is high (Froot et al. 1993; Siallagan and Prijadi 2020; Wei 2020; Kristjanpoller and Concha 2016).

There are now more than 10,000 multinationals in China, and their subsidiaries are posted globally. Despite mastering many first-class technologies, the composition of sales revenue is diverse. Therefore, it is very important for multinationals to have corresponding exchange rate risk management and professionals, which determines whether multinationals can reasonably avoid the risks brought by exchange rate fluctuations (Glauben et al. 2022; Cheng et al. 2022). ZTE is one of the earliest multinational enterprises in China to carry out financial derivatives (Li et al. 2020). In recent years, it has gradually formed its exchange rate risk management mechanism. With the marketization of China's exchange rate system, ZTE uses more frequent financial instruments to hedge risks. Through the case of ZTE, this paper analyzes the impact of exchange rate on multinational corporations and summarizes effective exchange rate risk management methods, so as to provide a reference for multinational enterprises.

2 Company Background

Founded in Shenzhen in 1985, ZTE Corporation (hereinafter referred to as ZTE) is China's largest publicly traded telecommunications equipment company, formerly known as ZTE Semiconductor Co., Ltd. In 1997, ZTE A shares were listed on the Shenzhen Stock Exchange. In December 2004, ZTE, as the first A-share listed company in mainland China, was successfully listed in Hong Kong (Lim and Hong 2014; Jouamaa et al. 2020).

As ZTE pursues excellence and spends huge scientific research costs, it has set up 18 R&D centers around the world, located in different countries in the country, and has nearly 3 W domestic and foreign researchers. After a long effort, ZTE has become the world's fourth largest phone maker. ZTE integrates "design, development, production, sales, service" and other production processes, with "operator network, government enterprise business, consumer business" as its main business. At the same time, the company not only develops steadily in China but also vigorously develops overseas business and successfully enters the international market. ZTE is admired by China's three biggest telecom operators for its high-quality services and products. ZTE provides innovative technology and product solutions to 180 countries around the world, such as data, wireless broadband, wired broadband, and so on.

As the main business income of foreign countries accounts for 40% of the total income, in order to avoid the foreign exchange risk of the group company, ZTE has set up foreign exchange management centers and fund swap platforms on the mainland. In 2008, the company passed the resolution of the shareholder's meeting to hedge financial derivatives within a certain limit, so as to avoid the foreign exchange risk of enterprises. These businesses mainly involve foreign exchange forward, structural forward, foreign exchange options, and foreign exchange swaps.

The chart shows that ZTE's share price has been fluctuating. In early 2020, ZTE's share price rose sharply due to the global popularity of 5 g technology and the popularity of 5 g among the public. The highest share price reached 55.11 yuan. But the boom did not last long, and ZTE's share price, which has been slowly falling because of frequent epidemics and economic downturns around the world, is now only two-thirds of its original high.

3 Analysis of Financial Indicators

This paper selects the financial statement data of ZTE from 2019 to 2021 to analyze the current situation of ZTE's operation from a financial perspective (Table 1).

Table 1 Key financial indicators

Account\Time	2019	2020	2021
Net profit (yuan)	5,147,877,000	4,259,752,000	6,812,941,000
Year growth rate of net profit (%)	173.71	− 17.25	59.94
Gross operating income	90,736,582,000	1.01451E+11	1.14522E+11
Operating income growth rate (%)	6.11	11.81	12.88
Basic each income (yuan)	1.22	0.92	1.47
Rate of net profit to the sales (%)	6.37	4.65	6.14
Gross profit margin (%)	37.17	31.61	35.24
Operating cycle (day)	248.47	222.53	222.41
Inventory turnover (rimes)	2.16	2.26	2.12
Inventory days (day)	166.4	159.24	169.92
Turnover fate of the receivable payment (day)	82.07	63.29	52.5
Current ratio	1.19	1.44	1.63
Quick ratio	0.78	0.87	1.06
Debt rate (%)	73.12	69.38	68.42

Fig. 1 Share price of ZTE

3.1 Solvency Analysis

Theoretically, the current ratio and quick ratio are more reasonable around 2 and 1 respectively. As can be seen from the table below, ZTE's quick ratio is close to 1, but ZTE's current ratio and quick ratio are generally declining. Therefore, the company's short-term solvency is slightly insufficient.

In addition, ZTE's asset-liability ratio is relatively high. But in recent years, the addition of capital has gradually reduced the asset-liability ratio. Low asset-liability ratios make it easier for companies to deal with emergencies as they develop and expand, and not to be passive (Fig. 1).

3.2 Profitability Analysis

As can be seen from the above table, ZTE's gross profit margin and net profit margin of sales in the past three years are very stable and have not fluctuated much. From 2019 to 2021, the average gross profit margin of sales was 34.67%, indicating that ZTE's profitability was relatively stable. In addition, its operating income increased steadily almost every year.

Net profit has increased year by year, and the gross profit margin of sales has steadily increased. Although net profit fell in 2020 compared with the previous year, in part because of the covid-19 epidemic spreading around the world. Generally speaking, the company's profitability is good, which shows that the profitability of information technology is improving.

3.3 Capacity Analysis

As can be seen from the above table, ZTE's inventory turnover rate has been reduced, indicating that the company's sales capacity has declined, and there are certain risks in inventory turnover and management. The reasons for the above results are inseparable from the epidemic in 2020 and the sanctions imposed by the United States on ZTE. The decline in the turnover days of accounts receivable shows that the company has a fast collection speed, short average collection period, less bad debt losses, fast asset flow, and strong solvency. All these show that ZTE is still in a difficult business situation.

4 ZTE's Sources of Foreign Exchange Risk

4.1 From Revenue Composition

Economic risk mainly refers to the risk that exchange rate fluctuations affect the profits of enterprises by affecting specific businesses in the process of enterprise operation. As a multinational enterprise in China, ZTE achieved an operating income of 114.55 billion yuan in 2021, an increase of 12.9% over the same period last year. The group's net profit attributable to ordinary shareholders of listed companies was 6.81 billion yuan, an increase of 59.9% over the same period last year, and its basic earnings per share were 1.47 yuan. Among them, the domestic market realized a business income of 78 billion 70 million yuan and the international market realized a business income of 36.45 billion yuan. As can be seen from the table, the proportion of the company's overseas revenue is close to 35%, and the amount of business income is still increasing. In 2021, Asia accounted for 12.56% of revenue, Africa for 4.31%, and Europe and Oceania for 14.96%. Based on this analysis, a conclusion is drawn. ZTE's operating income calculated in foreign currency accounts for a large proportion. The following table shows ZTE's domestic and foreign revenue.

Combined with the company's annual statements and related announcements, the economic risks of ZTE mainly come from domestic business, export business priced in local currency, import and export business priced in foreign currency, and foreign currency business of overseas subsidiaries. As the fluctuation of the exchange rate is difficult to predict, ZTE will face greater exchange rate risk. The following table is obtained through the sensitivity analysis from 2019 to 2021. We can find that the impact of US dollar exchange rate fluctuations on ZTE's profits is gradually narrowing, which may depend on the implementation of hedging policies in recent years, but there are still losses caused by exchange rate fluctuations. ZTE should pay attention to the economic risks brought by the fluctuation of the US dollar exchange rate and euro exchange rate at the same time, and improve its exchange rate risk management (Tables 2 and 3).

Table 2 Proportion of ZTE's domestic and foreign revenue

Region|year	2019 (%)	2020 (%)	2021 (%)
China	64.16	67.08	68.17
Asia (excluding China)	14.53	14.52	12.56
Africa	5.86	4.75	4.31
Europe, the United States and Oceania	15.45	13.65	14.96
Total	100	100	100

Table 3 ZTE's domestic and foreign business income unit: RMB million

Region|year	2019	2020	2021
China	58,217.00	68,051.20	78,066.50
Asia (excluding China)	13,180.30	14,729.30	14,379.50
Africa	5316.10	4822.60	4937.80
Europe, the United States and Oceania	14,023.20	13,847.60	17,137.80
Total	90,736.60	101,450.70	114,521.60

4.2 From Short-Term Borrowings

ZTE has a variety of short-term loans for all kinds of business operations, mainly in US dollars, RMB and euros. Although the total amount of short-term borrowing is declining year by year, high short-term borrowing in foreign currencies will be affected by fluctuations in the exchange rate of the US dollar and the euro, which may bring exchange losses to ZTE. The specific data of short-term loans can be seen in the following Table 4.

Table 4 Short-term borrowings

		Equivalent to RMB Unit: thousand yuan		
		2019	2020	2021
Credit loan	RMB	10,928,990	4,631,452	2,872,000
	USD	5,169,096	3,468,509	2,455,012
	EUR	1,001,869	1,009,251	185,513
	YTL	417,220	236,282	152,848
Bill discount loan	RMB	4,195,791	748,180	271,562
Letter of credit loan	RMB	4,783,000	300,000	3,000,000
Pledged loan	RMB	75,000	30,000	10,000
Guaranteed borrowings	RMB	10,000	20,000	–
Mortgages	RMB	65,000	115,486	–
Total		26,645,966	10,559,160	8,946,935

5 Hedge Strategy Analysis

5.1 Foreign Exchange Derivatives Investments

ZTE and its subsidiaries in order to reduce the impact of exchange rate fluctuations on the company's assets, liabilities, and profitability. Since 2010, it has been actively using financial products provided by financial institutions to carry out foreign exchange derivatives investment business. Although the use of foreign exchange derivatives reduces ZTE's foreign exchange risk and reduces the sensitivity of its net profit to changes in exchange rate risk. Although foreign exchange derivatives investment accounted for 15% of net assets (see Table 5). Although the company earned 426 million yuan on derivatives investments in 2021, it lost 200 million yuan on derivatives in 2019. Foreign exchange derivatives such as foreign exchange forwards, foreign exchange options, and foreign exchange swaps should still be actively used to reduce risks.

The first is foreign exchange swaps. A department of ZTE received a notice from the superior department that the company will need a short-term foreign exchange fund based on the three-month LIBOR interest rate in three months. This is a three-month foreign exchange swap that ZTE can sign. ZTE bears a fixed interest rate (depending on the interest rate difference between the two sides), which may be higher than LIBOR, but the counterparty bears exchange rate risk and volatility.

Secondly, foreign exchange forward can be carried out. Suppose you need $100 at the beginning of the period and return it three months later. The spot exchange rate of the US dollar against the RMB after three months is 671.4, and the Bank of China's three-month forward exchange rate is 672. The swap cost is 672 – 671.4 = 0.6. That is, it lost 0.6 yuan and avoided the risk of the exchange rate. If the dollar continues to appreciate after three months and the dollar reaches 672 against the RMB. Without purchasing foreign exchange forward, the company's borrowing cost will be much greater than that of purchasing foreign exchange forward now.

Finally, we can continue to purchase foreign exchange options by signing contracts with banks. By the maturity date, it determines whether to exercise the right compared with its exchange rate price, and it is possible to obtain more profits.

5.2 Multinational Diversification

By setting up branches in multiple countries, ZTE can use the concept of decentralized investment to transform the fluctuation of RMB against a single currency into the fluctuation of RMB against multiple currencies. In an accounting cycle, although currency an appreciated against the RMB, currency B depreciated against the RMB. The two currencies can be effectively hedged to eliminate the impact of exchange rate fluctuations on the company's net profit. ZTE also makes full use of this principle,

Table 5 Investment in foreign exchange derivatives Unit: RMB 10,000

	Start date	Termination date	Opening amount	Purchase amount	Amount sold	Closing amount	Proportion of investment amount to net assets at the end of the period	Actual profit and loss amount during the reporting period
2020	2020/3/11	2021/12/30	1,449,815	1,531,660	2,301,693	679,782.3	15.70%	(19,798.11)
2021	2021/1/28	2022/12/30	671,521.5	2,658,943	2,601,474	728,990	14.17	42,549.43

mainly participates in seven overseas companies, and continues to expand the scale of overseas subsidiaries with an expansion strategy.

5.3 Reasonable Combination of Creditor's Rights and Debts

ZTE's mobile phone business has a large market share in the United States, and its revenue is related to fluctuations in the exchange rate of the US dollar. The exchange rate of the US dollar against RMB on April 1, 2022, is 6.3415, and the exchange rate of the US dollar against RMB on April 31, 2022 is 6.6085 Short-term exchange rate fluctuations were 4.21%. Faced with short-term exchange rate risks, ZTE adopts a combination of creditors' rights and debt to avoid risks. Because the company has more assets measured on the basis of US dollars, the company uses the same amount of US dollar liabilities as far as possible to effectively avoid exchange rate risks and reduce exchange gains and losses.

5.4 Establishment of Relevant Management Institutions and Their Accountability Systems

Foreign exchange risk management is very important business assistance, which requires the personnel of management institutions to fully understand the knowledge of foreign exchange and the existence of related circumvention. Conduct due diligence when hedging by the company, and analyze the risks, returns, feasibility, and necessity of the financial derivatives invested. In the medium term, derivatives should be monitored at any time to control their risks. And strict risk control, the company will allocate responsibility to individuals, so as to avoid liability loopholes.

6 Conclusion

With the globalization of trade, ZTE has reasonably avoided some foreign exchange risk exposure by investing in financial derivatives, avoiding the impact of exchange rate fluctuation risk on the company's net profit level. Because the hedging period of derivatives is longer, it is not only less than one year. The negative fair value of derivatives in 2020 does not mean that ZTE's use of financial derivatives is unreasonable. In addition, derivatives bring good returns to the company. Therefore, ZTE avoids the exchange risk of multinational business through diversified means and risk management methods such as financial derivatives, improves the company's assets and profitability to a certain extent, and enhances the value of the enterprise.

References

Cheng Y et al (2022) A CEEMD-ARIMA-SVM model with structural breaks to forecast the crude oil prices linked with extreme events. Soft Comput 1–15

Froot KA, Scharfstein DS, Stein JC (1993) Risk management: coordinating corporate investment and financing policies. J Financ 48:1629–1658

Glauben T, Svanidze M, Götz L, Prehn S, Jaghdani TJ, Đurić I, Kuhn L (2022) The war in Ukraine, agricultural trade and risks to global food security. Intereconomics 57(3):157–163.https://doi.org/10.1007/s10272-022-1052-7

Jouamaa MA, Mekki AAE, Boubrahimi N, Harbouze R (2020) Grain imports risk hedging in morocco. Int J Food Agric Econ 8(4):381–394

Kristjanpoller WD, Concha D (2016) Impact of fuel price fluctuations on airline stock returns. Appl Energy 178:496–504

Li W, Cheng Y, Fang Q (2020) Forecast on silver futures linked with structural breaks and day-of-the-week effect. North Am J Econ Finan 53:101192

Lim SH, Hong Y (2014) Fuel hedging and airline operating costs. J Air Transp Manag 36:33–40

Siallagan SD, Prijadi R (2020) The impact of operational and financial hedging to the airline operating performance. In: International conference on economics, business and economic education 2019, vol 2020

Smith CW, Stulz RM (1985) The determinants of firms' hedging policies. J Financ Quant Anal 20:391–405

Wei J (2020) Aviation fuel hedging, is it "hedging" or "protection". Large Aircr 04:64–67

Hedging Strategy Analysis of Southwest Airlines

Xiao Han

Abstract Hedging jet fuel is important for airlines because oil prices often fluctuate wildly. Southwest's low-cost strategy owes much to its excellent hedging strategy. We perform financial analysis based on the company's basic background, financial position, and share price. On this basis, this paper focuses on four hedging strategies adopted by Southwest Airlines to deal with fuel price risks. The four hedging strategies that Southwest Airlines adopted are call options, collar structures, call spreads, and put spreads. In addition, this paper also compares the hedging strategies of Southwest Airlines and other airlines and explains the important reasons why Southwest Airlines can achieve the success of hedging. Finally, this paper also explains the impact of COVID-19 on the effectiveness of southwest Airlines' hedging strategy and its performance in financial statements. This paper can provide suggestions for other airlines to develop hedging plans in the future and avoid inappropriate hedging strategies.

Keywords Fuel hedging · Oil price fluctuation

1 Introduction

As the most important energy in the world, the fluctuation of oil prices affects the production and operation activities of many enterprises. For airlines, jet fuel cost is not only a rigid expense but also the largest part of operating costs. Although the main business of airlines is to provide air transport services, when oil prices are low for a long time, some airlines will lock in oil prices to lock in costs and obtain long-term, stable income from their main business. At this point, the aviation oil hedging business has become the choice of airlines. Aviation fuel hedging refers to a financial derivative tool that airlines use to maintain and increase their aviation fuel

X. Han (✉)
The University of WAIKATO Joint Institute, Zhejiang University City College, Hangzhou 310000, Zhejiang, China
e-mail: 31911134@sttu.zucc.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_63

in the future in order to cope with operational risks caused by the fluctuation of oil prices. Airlines lock in costs by buying or selling forward aviation fuel contracts. If airlines buy call contracts and oil prices rise, they can offset the increase in operating costs caused by the rising cost of jet fuel, thus hedging jet fuel. Berghofer and Lucey (2014), similar to the study of Treanor et al. (2014), analyzed the impact of financial derivatives on reducing jet fuel price risk exposure. In addition, Siallagan and Prijadi (2019) found that hedging has a significant impact on the financial performance of companies from both operational and financial aspects.

Founded in 1971, Southwest is the only U.S. airline to have been consistently profitable since 1973. Some world experts believe that the southwest has been able to remain profitable because of the use of derivatives to hedge. As can be seen from the financial statements of Southwest Airlines over the years, the proportion of jet fuel costs is much lower than the industry average, which is attributed to the successful implementation of the jet fuel hedging strategy (Wei 2020). In 2007 southwest insured a percentage of its fuel for 2012 for up to five years. On July 11, 2008, the price of Brent crude oil in London peaked at $146.77 per barrel, which directly led to the rapid rise in airline costs. In 2008, southwest airlines were profitable even though most airlines were losing money, as it took precautions to hedge jet fuel through financial derivatives such as futures, options, and forward contracts before oil prices rose.

This article analyses the hedging strategy of Southwest Airlines and compares the hedging strategy of Southwest Airlines and other airlines. In addition, this paper also explores the impact of COVID-19 on southwest Airlines' hedging strategy and hedging effect.

2 Firm Description

2.1 Background Information

Southwest Airlines is an American airline company, founded on June 18, 1971, headquartered in Texas, USA, and listed on the New York Stock Exchange on June 27, 1977. Southwest Airlines is the second largest airline in the United States and the originator of the low-cost airline business model in the civil aviation industry. Southwest wins market share with a low-cost strategy that keeps prices low while maintaining good service.

2.2 Business Area

Southwest mainly provides point-to-point service, rather than the "hub-and-spoke" service offered by most major U.S. airlines, with no long-haul flights or international

flights. It has the characteristics of short time and intensive flight. Hub-and-spoke is when airlines concentrate most of their operations in central hub cities and serve most destinations either by providing one-stop services or through hub connectivity services. Because it does not operate centrally through central transshipment points, Southwest's point-to-point route structure provides more direct routes than hub-and-spoke services.

2.3 Financial Situation

We can see that in 2020, due to the impact of COVID-19, the net profit of the company was negative, while ROA and ROE were negative. The negative net profit was mainly due to higher fixed costs. Because a large portion of a company's costs is fixed, especially in the short term, the reduction in operating expenses resulting from reduced business is not enough to overcome the sharp decline in revenue (Table 1).

In terms of short-term solvency, Southwest's liquidity and quick ratios have increased significantly because it has a lot of cash on hand. In terms of the leverage

Table 1 Key financial indicators for southwest airlines

	2019A	2020A	2021A
Revenue ($billion)	22.43	9.05	15.79
DuPont analysis			
Gross margin (%)	26.70	− 20.90	26.10
Net margin (%)	10.30	− 34.00	6.20
Asset turnover (times)	0.86	0.30	0.45
ROA (%)	8.80	− 10.20	2.80
Financial leverage	2.65	3.23	3.68
ROE (%)	23.40	− 32.90	10.10
Liquidity indicator			
Current ratio (%)	66.70	202.10	196.80
Quick ratio (%)	60.80	196.60	191.00
Leverage indicators			
Debt/equity	1.65	2.23	2.68
Operating efficiency indicators			
Inventory turnover	33.20	23.20	24.60
Accounts receivable turnover	61.20	73.60	142.00
Operating cycles (days)	94.40	96.80	166.60
Shareholder indicators			
EPS (USD/share)	4.27	− 5.44	1.61

ratio, the company's debt ratio has increased significantly. In terms of asset utilization ratio, we can see that the company's inventory turnover has decreased since the epidemic, but accounts receivable turnover has increased.

2.4 Stock Price Analysis

The company's share price began to fall in early 2020. Due to the impact of the epidemic in the early stage, investors had pessimistic expectations on the capital market, and the company's valuation was undervalued. Given Southwest's lower costs, limited debt burden, unrivaled brand and culture, industry-leading domestic preferences, and unique market positioning, these advantages translate into advantages for the company in the post-pandemic era. Southwest has the strongest balance sheet of any U.S. airline. Starting in the second half of 2020, Southwest's stock price began to recover and gradually recovered to pre-pandemic levels.

We can see that Southwest's stock price has moved in the opposite direction to the price of oil during this period. Kristjanpoller and Concha (2016) say that we can predict the impact of oil prices on airline stocks, which means that if oil prices rise, airline stock prices will fall.

3 Analysis of Hedging Strategy

3.1 Fuel Price Risk

Airlines operate by nature on energy and are therefore exposed to changes in fuel prices. In addition, jet fuel and fuel is usually one of the biggest operating expenses for airlines. The aviation industry is a highly competitive market and values customer loyalty, with at least 291 airlines registered as members of the International Air Transport Association (IATA 2019). Due to the fierce competition in the American aviation industry, Southwest Airlines does not have the ability to raise ticket prices alone, so it cannot reduce the negative impact of high oil prices by raising prices (Zong 2011). As a result, the company strives to obtain jet fuel as cheaply as possible and to reduce the volatility of fuel charges through fuel hedging programs. Although the company can trade short-term jet fuel derivatives on a regular basis, opportunities for direct hedging of jet fuel are limited for two years because jet fuel is not widely traded on organized futures exchanges and has very low liquidity. So the company uses derivatives of other commodities, such as WTI crude oil and Brent crude oil to help reduce the risk of jet fuel price volatility, which creates basis risk because the price of crude oil and jet fuel may move in different ways.

3.2 Fuel Hedging Strategy

To deal with jet fuel price risk, Southwest mainly uses OTC futures options and complex option structures. Southwest airlines primarily use four kinds of hedging strategy, which is call options, collar structures (which include both a purchased call option and a sold put option), call spreads (which include a purchased call option and a sold call option), and put spreads (which include a purchased put option and a sold put option).

Among them, call options have a wide range of protection and retain the benefits of oil price decline, but the cost is high. A call spread is executed by buying a low price of the call option plus selling to build a high strike price of the call, while a put spread is done by buying a low price of the put option and selling a high strike price of the put to build. These two hedging strategies both sell options at the same time as buying options to save portfolio costs and retain the benefits of falling oil prices. However, the upside range of the protection of these two options is limited by the short option part. Collar structures, in which a call is bought and a put is sold, also save costs, but the put position is sold at the expense of potential gains from lower oil prices.

All of the hedging strategies are profitable when oil prices rise, so as to hedge the increased cost of jet fuel and play a role of hedging. When the oil price falls, the above option strategy combined with airlines' demand for spot purchase, the total position has no risk exposure and still meets the hedging requirements. The main reason is that Southwest Airlines strictly controls risks while reducing costs and avoids selling too many options.

Southwest's hedging strategy has a big advantage over others. On the one hand, Southwest Airlines has always insisted on hedging for the purpose of not speculative trading. After entering the options market with the idea of using derivatives to stabilize jet fuel costs, many airlines began to try to increase additional returns through options trading, gradually shifting from hedging strategy to speculative strategy. Most of these airlines use trinomial options, a hedging strategy that doubles potential risks while saving costs. Some companies cannot implement effective process control and risk hedging strategies by using complex structural tools for hedging, which will lead to a loss of profits (Zhou 2010).

Southwest airlines, on the other hand, has hedged not only the fuel it needs now but also a certain percentage of its future jet fuel. However, due to a lack of sufficient funds, many airlines do not have a long-term hedging plan like Southwest Airlines, but only carry out short-term high hedging, resulting in limited hedging income.

Hedging has both advantages and disadvantages. Lim and Hong (2014) said that if airlines did not hedge, they would face the risk of higher fuel spot prices, while if they hedged, airlines would be exposed to the risk of lower fuel prices in the near future and suffer losses on fuel hedging contracts.

Oil prices in 2020 were affected by the pandemic and OPEC production cuts. Oil prices have fallen since the outbreak began earlier this year. In the global outbreak of serious march and April, oil demand fell sharply due to disease blockade measures,

Table 2 Unhedged and hedged fuel and oil expense

	2020
Fuel and oil expense, unhedged	1810
Add: premium cost of fuel contracts designated as hedges	64
Deduct: fuel hedge gains included in fuel and oil expense, net	(25)
Fuel and oil expense, as reported	1849

but OPEC + is playing this time the price war, Saudi Arabia and Russia lead the price cut, to grab market share, leading to global oil supply in the short term are increased, the oil market is an excess of history had ever seen, cause prices to slump. Oil prices didn't recover until OPEC + began enforcing a new production cut agreement in May. Since then, Opec + has maintained a high implementation rate of production cuts. Despite repeated outbreaks in Europe and the United States, the impact on oil prices has been limited, and oil prices have continued to rise.

During 2020 and 2021, Southwest Airlines' fuel purchase and consumption projections 2020 and 2021 declined significantly due to the sharp decline in demand for air travel caused by the COVID-19 pandemic (Southwest Airlines Co. 2020). Because the company will hedge its fuel needs for the next two years, so covid-19 cause the Company to be in an "over-hedged" position in 2020 and 2021. As a result, the Company eliminated certain fuel hedges related to these periods and incurred losses.

In the future, the company may be also affected by unexpected events such as the recurrence of COVID-19, so it is difficult to accurately predict fuel demand and determine the number of derivatives to buy (Table 2).

It can be seen that in 2020, the hedging return of Southwest Airlines is positive but not enough to offset the premium cost of derivatives, and the fuel and oil expense after hedging is higher than the expense without hedging. Although the hedging effect of 2020 is not ideal, it reduces the risks faced by the company.

4 Conclusion

Oil prices in 2020 have fluctuated dramatically due to the pandemic and OPEC production cuts. In the face of such huge fluctuations in oil prices, Southwest Airlines' hedging strategy is particularly important.

Through research, we find that Southwest Airlines has adopted four hedging strategies, namely, call option, collar structures, call spread, and put spread. Through the combination of four hedging strategies, Southwest Airlines can well avoid the risk of jet fuel price. In addition, compared with other airlines, Southwest was able to insist on not speculating with derivatives and hedging its future jet fuel requirements. That gives Southwest a good handle on its jet fuel costs. In addition, the

paper found that the COVID-19 pandemic and the oil price volatility caused by the production cut agreement had a significant impact on Southwest Airlines. In 2020, Southwest Airlines was in the situation of over-hedging, which caused great losses to the company.

There are some deficiencies in the hedging strategy research of Southwest Airlines in this paper. First of all, this paper does not provide the data on the specific strike price of the option signed by Southwest Airlines. Secondly, this paper does not focus on the changes in southwest Airlines' hedging strategy during the epidemic and its performance in financial statements.

References

Berghofer B, Lucey B (2014) Fuel hedging, operational hedging and risk exposure—evidence from the global airline industry. Int Rev Financ Anal 124–139

IATA (2019) IATA members. https://www.iata.org/about/members/Pages/airline-list.aspx. Access on 6 July 2019

Kristjanpoller WD, Concha D (2016) Impact of fuel price fluctuations on airline stock returns. Appl Energy 178:496–504

Lim SH, Hong Y (2014) Fuel hedging and airline operating costs. J Air Transp Manag 36:33–40

Siallagan SD, Prijadi R (2020) The impact of operational and financial hedging to the airline operating performance. In: International conference on economics, business and economic education 2019, vol 2020

Southwest Airlines Co. LTD (LUV) (2020) Annual report

Treanor SD et al (2014) Does operational and financial hedging reduce exposure? Evidence from the U.S. airline industry. Financ Rev 49(1):149–172. https://doi.org/10.1111/fire.12029

Wei J (2020) Aviation fuel hedging, is it "hedging" or "protection". Large Aircr 04:64–67

Zhou J (2010) Case analysis of hedging tool selection. Bus Account 07:15–17

Zong H (2011) Hedging strategies of aviation Industry—taking the United States as an example. J Henan Inst Sci Technol 01:17–20

How Brand Storytelling is Changing to Target the Generation Z in the Digital Age

Xiyu Zhang, Han Jiang, Wenzhen Li, and Wanmin Zheng

Abstract In the digital age, Generation Z is one of the emerging customer groups in all industries. Here comes a question: to target those young generations, what changes in advertising should be done? In the history of advertising, storytelling has always been one of the most powerful tools that marketers can use. This paper proved the new generation has shifted storytelling to new levels by using the focus group approach and the case study of Disney's new storytelling strategies. Which concluded that storytelling changes in content, advertising channel, and the company's role to cater Generation Z under the digital marketing background.

Keywords Storytelling · Generation Z · Digital marketing · Content marketing

1 Introduction

Brands have been telling stories for a long time. Initially, they borrowed characters from famous stories, like Nike, which the name originated from a goddess of ancient Greek, personifying victory (Mathews and Wacker 2007). Subsequently, rather than retelling stories from the legend, firms innovated by creating their own character, aiming to enhance engagement and communication with customers.

X. Zhang (✉)
Department of Economics, University of Warwick, Coventry CV4 7AL, UK
e-mail: julie_zhang2002@outlook.com

H. Jiang
Faculty of Business and Economics, University of Melbourne, Melbourne 3010, Australia

W. Li
Department of Plant Protection, Shandong Agricultural University, Tai'an 271018, China

W. Zheng
Department of Business and Management, Singapore Institute of Management, Singapore 188065, Singapore

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_64

For a long time, the channels for brands to tell stories were limited, companies typically used traditional advertising channels like billboards, newspapers, or TV commercials. Yet, these didn't allow for rich storytelling, especially when businesses try to convey emotion. Nowadays, brands are facing new opportunities, due to the averagely high level of technology adoption among new generations (Selig 2020). Customers and businesses are closely connected by cyber environments. Brands no longer tell stories unilaterally, rather, customers are willing to share their own stories via social media. To better engage with the customers, brands are motivated to actively analyze consumer behavior and preferences.

This paper is going to review the trends that affect brands' ability to tell their stories, some key developments in brands connecting with their customers, and discuss how this adapts to the preferences of Generation Z specifically.

2 Literature Review

Pereira (2019) claims that storytelling is an important strategy to increase the intensity of messages in communication and raise customer participation. It's a process to clarify the brand's essence in an emotional and narrative way. The audience may be unconsciously immersed, even attempt to match the plot, then ignore brands attributes on product promotion (Escalas 2004).

In the past two decades, with the rapid development of the information channel, the influence of many traditional platforms such as television and billboards are diminishing, especially among Generation Z. Kapil and Roy's research (2014) has proven the technology's essentialness in Gen Z's growth, which they are exposed to all kinds of electronic devices and social media during the childhood. Previous research has claimed that compared with the other groups, Gen Z is more active in building the collaborative spirit and social activities (Ozkan and Solmaz 2015). They are keen to express their personality and avoid becoming stereotypes (Francis and Hoefel 2018).

Businesses found it easy to appeal to the sentimental feeling of this generation by using truthful stories and a brand's "emotional DNA" (WARC 2018). Fundamentally, storytelling helps reduce their psychological resistance to direct promotion. Changing together with the target audience, stories evolved step by step, from the adaptive predisposition of daily monitoring to imagination exceeding the boundaries of reality (Boyd 2018).

Though plenty of studies tried to explain the usefulness of storytelling as an emotional promotion tool for brands and its rapid development, inadequate focus is placed on consumer-specific preferences and responses. While Generation Z gradually dominates the customer force, the following research aims to address the gap from this perspective.

3 Focus Group Analysis

We carried out interview by focus groups and effectively collected 38 results from participants born between 1996 and 2004, majoring in different fields. Discussions are mainly around Gen Z's perspective of advertising in terms of common channels, changes, and future expectations (see Appendix A.1).

3.1 Social Media Popularity Impacts

It is not surprising to find out that 84.2% of participants claim that social media and other digital platforms are the most common advertising channel for them (see Fig. 1). Just as the statistics demonstrated, total internet users have reached 4.95 billion by January 2022, with 4.62 billion active social media users (Johnson 2022). This provides a clear guideline for businesses to reach those young generations. We have to admit that we are experiencing an era of explosive online information.

Meanwhile, brands nowadays are no longer telling stories unilaterally. Instead, customers started to participate in this process. For instance, they are willing to share personal stories with the brand worldwide on Instagram. KOL like cyber influencers has even developed this activity into their job. By testing all kinds of products and sharing their comments, influencers and brands have reached a win–win situation, in which brands can observe a significant increase in sales revenues and exposure to the public and influencers can gain a strong attention base to receive more promotion demand.

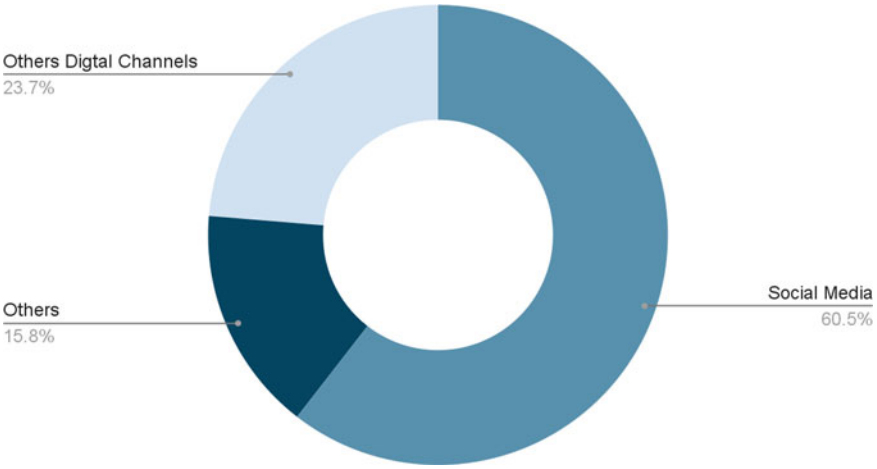


Fig. 1 The most common advertising channels for generation Z

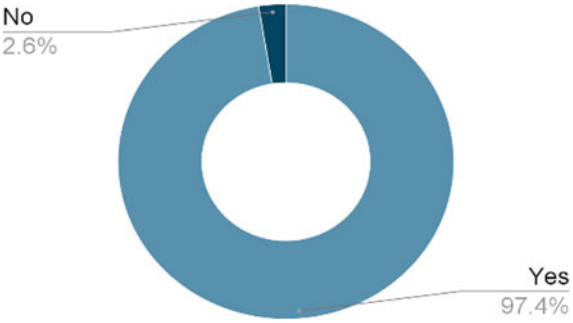


Fig. 2 Percentage of participants source

However, we have discovered some interesting facts from our focus groups about story sharing (see Figs. 2 and 3). Even though more than 97.4% of the participants agree that they will source previous users' experiences via various channels, they are less willing to share their own stories with the public. Albeit this frequency will rise when their attitudes reach the extreme states of preference, like aversion. Moreover, due to Gen Z's fast adaptability, overloaded recommendations or content about certain products will give rise to Social Media fatigue, which Technopedia (2017) defined this phenomenon as the withdrawal from media due to overwhelming redundant content. Young customers nowadays are cautious when it comes to purchasing. They are more likely to hesitate for the reliability of overspreading commercials for fresh launches, wondering about capital-driven force. Scholars believed it is largely due to the saturation point that customer have with social networking or the disconnecting objectives between brands and customers (Bright et al. 2015). Therefore, the polarized outcomes from our focus group are understandable, where most people proposed 50% higher changes after sourcing comments but the others questioned the authenticity of massive recommendations from influencers (see Fig. 4).

3.2 Gen Z's Focus on Advertising Evolvement

Furthermore, the spotted differences suggested by our participants between advertising in twenty-two years could indicate their shifting focus. There are two significant discoveries in advertising content (see Appendix A.2): The antipathy towards excessive description and the noticeable increasement in similarity. Our participants have demonstrated their disapproval of these changes, which confirm the necessity for advertising concision and uniqueness. Domanska (2021) believes these perspectives as the keys for great marketing companies. Besides, it's convincing that the increasing corporate social responsibility is no longer limited in companies, participants welcome this change as well. Petro (2021) has observed that generation Z prefers shopping with sustainable brands and firms benefit from more inelastic prices. Therefore, showing CSR in advertising is an efficient way to get in touch with this segment group.

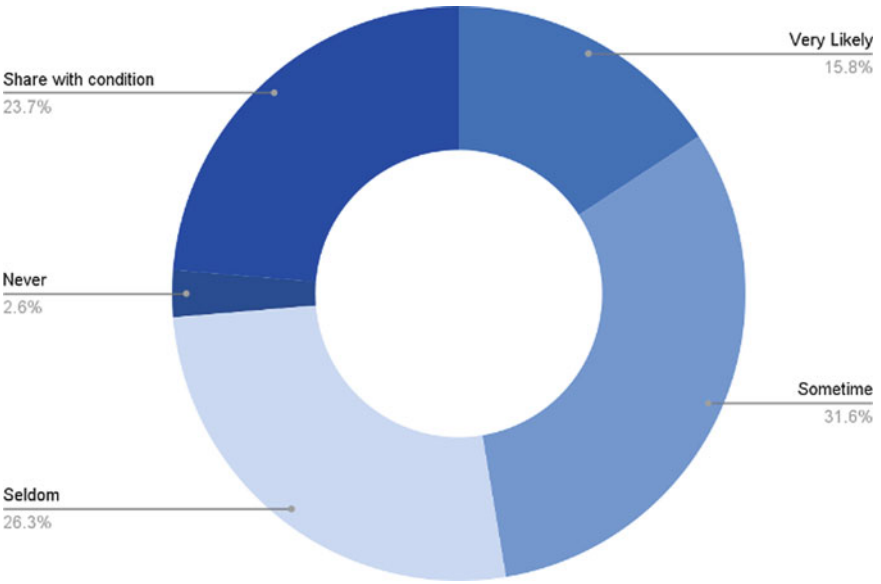
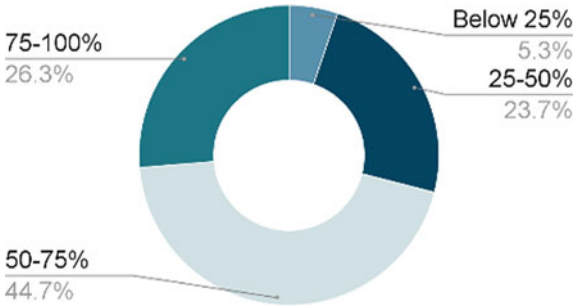


Fig. 3 Percentage of participants for experience before purchase experience after purchase

Fig. 4 Effect of other's experience towards participant's purchase



3.3 Consumer Expectation and Preference for New Storytelling

In order to find out the overlap between Gen Z's ideal advertising strategy and the employment of storytelling, we have designed 6 questions separated into two sections. Firstly, we asked participants to point out their touchpoints for all kinds of ads, then listed the characteristics of storytelling they believed are inspired.

During the interview, we introduced two distinct types of advertising to the participants and asked for their preference between a striking-titled poster and a storytelling video. As Fig. 5 demonstrates, 84% of them indicated that they felt engaged and connected with the brand due to the compelling story. Stronger expectations and

imagination arise for the real user experience. Meanwhile, the rest were frustrated about what the product was promoting at the very start of the video and whether the story is practical or not. Widrich (2012) has presented an explanation of the science behind storytelling: When we are listening to plain text, Broca and Wernicke areas of the brain are activated, which are used for language decoding. But for stories, more parts of the brain are activated just as experiencing real events. "The stories told in a business setting might not be quite as dramatic, but nevertheless can be more impactful than data alone" (Peterson 2017). Hence, this has corroborated the comparative advantage that storytelling has, within building emotional bonding with clients and beneficial in long term brand image. However, the comparison group is not perfect, it fails to control the same format. The result could be enhanced by comparing a storytelling video with an informative video.

Since storytelling is a strong persuasive tool in marketing but carries the risk of misunderstanding, it's time to consider what kind of brand stories are most motivating to Gen Z. By analyzing our interviewees' responses (see Fig. 6) we can divide the key factors into theme selection, plots written, and form of presentation. A 20-year-old participant said that she is motivated by stories focusing on daily and social issues which are close to our life, for example, aging problems. These enable her to feel positive and inspired while reminding her of her family.

As for the plot, what Phillips (2017) mentioned in his TEDx Talks about the spirits of storytelling are building suspense, evoking empathy, and raising emotion, which thus stimulates the hormones. We believe that Gen Z is creative, sensitive, and diversified. Though different contents bring different feelings to the audience,

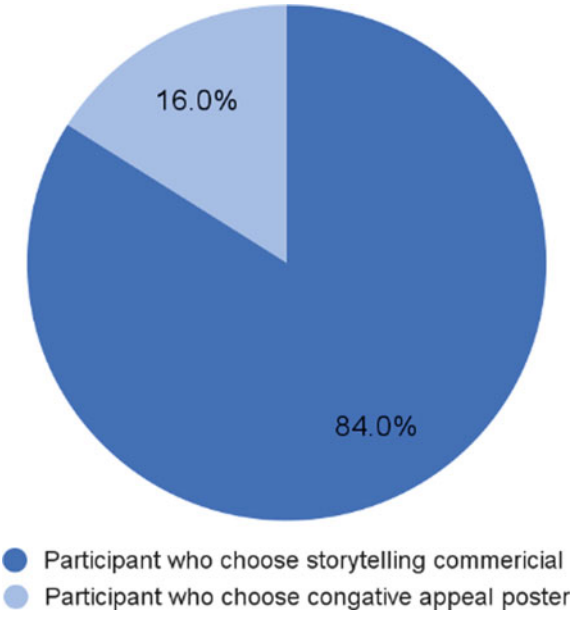


Fig. 5 The audience preference between storytelling and evidence

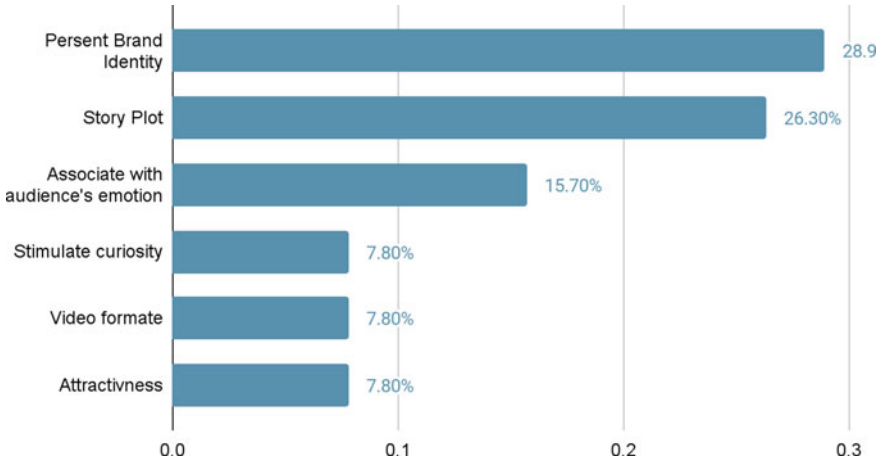


Fig. 6 Top 6 memorable characteristics from storytelling

passion and impulses will lead to similar purchasing desires. An interesting example mentioned by focus groups is the Vlog for "shu uemura lipsticks", in which the influencer characterized three girls with lipstick colors, introducing their stories of stepping out of their comfort zones. Hundreds of comments below presented that they are motivated by the girl's power to become who they want to be.

Besides, the sensory impression is useful in attraction at once. participants have mentioned keywords like "attraction" or "visual impact" as the essential elements of commercials (see Appendix A.3). Similarly, scholars concluded a strong positive correlation between music added and purchase intent variables (Morris and Boone 1998). Hence, striking sensory compositions like color or music would play strong roles in storytelling.

Above all, it's important to know that all stories are meant to personify the brand and creativity should never go beyond the brand image. Although the generation for creating a miserable background and simply advocating for dreams has gone, business must continue to explore their core spirit pragmatically and align the promotional strategy with it.

4 Case Study of Disney

Case study is useful to discuss storytelling from business perspectives. Since Disney has been committed to creating and adapting creative fairy tales for long, it's a perfect company to study. As Disney entered the twenty-first century, they started to redefine the traditional fairy tales while creating interactive storytelling experiences, to accommodate the new generation.

4.1 Diversification of Characters and Setting

In Disney's traditional storytelling, the protagonists portrayed were mostly one-dimensional. For example, in films such as Snow White, both the princess and the evil queen are shaped with monotonous characteristics, which audience can easily distinguish between kind and evil. These flat characters hardly appealed to Generation Z who grew to enjoy a profound understanding of individuals and the surrounding world. In the twenty-first century, Disney has delved deeper into the analysis of character image and to create characters with profound connotations, such as Moana, from a rebellious and curious teenager, grows into a courageous and responsible character through her step-by-step exploration of the world. The depiction of princess in the new era is no longer the role to be saved by the prince (Malka 2017). Meanwhile, it shows the independence of women, who can rely on themselves to achieve their goal (OSU 2018).

Generation Z from many cultures appears to be embracing feminism as a positive thing (Spiers 2019). By integrating Gen Z's social focus, such as gender equality, with the movie, Disney steadily redefined the traditional cartoons and fairytales, moving away from their stereotypes. They indeed benefit from this strategy by doubling its revenue in the entertainment and media sector from 2019 to 2020 (Navarro 2018).

4.2 Let Consumers Do Storytelling Marketing

LinaBell is a little pink fox created by Shanghai Disneyland in September, 2021. Once released, explosive popularity beyond everyone's expectation. 960 million people searched for "LinaBell" on Weibo, with 6.908 million discussions by April 25, 2022. Related products are sought after by consumers. Sales and prices are soaring, and the degree of brand premium is astonishing. Compared with traditional characters like Winnie Pooh who originated from films, LinaBell only has a simple setting of identity, leaving more space for audience to imagine. It can be said that the LinaBell is Disney's new attempt.

In the era of marketing 4.0, the interaction between consumers, brands, and products is an important factor affecting Gen Z's willingness to pay (Dash et al. 2021). The emergence of LinaBell in the pandemic has also brought vitality and energy to Gen Z. Disney makes consumers feel psychologically intimate through the real interaction between dolls and tourists, making it easier for them to accept the IP image.

On the other hand, Disney uses UGC to enhance their storytelling strategies. Consumers are encouraged to share their experiences on social media after interacting with LinaBell in Disneyland. Videos on TikTok with the tag "LinaBell" have been viewed 3.76 billion times by April 25, 2022. The high-frequency exposure in turn encourages more young adults to visit Shanghai Disneyland. In short, most customers

got to know her through the internet and the characteristics of LinaBell that we believed are shaped by continuous interaction.

Born within the digital age, Gen Z are mostly well educated and more accessible to global information (Francis and Hoefel 2018). To meet their diversity, Disney not only creates more characters with independent ideas, but also stimulates deeper discussion of the story themes. In this way, Disney gradually dominates the modern IP industry among young generation, accounting for 51% of the Top 50 films at the global box office in history (Zhao 2022). Besides, Gen Z is proficient in using a variety of social platforms and is the main creator of "user experience stories" in these platforms. All of these are important reasons for the success of Disney's changing storytelling among Generation Z.

5 Conclusion

The goal of the passage is to provide some intuition for brands of using storytelling effectively to target Generation Z. From the above analysis, we can conclude that today's generation pays significant focus on the marketing contents. Themes like discussing daily life or social issues found more engaged with customers. Stories that evoke sympathy might be an advisable option for brands, accompanied with build suspense or sensual appeal. Besides, Disney examples suggest that businesses who pay attention to the modern trend and bilateral interaction could attract higher attention. Those might motivate the managers to consider the effectiveness of storytelling under various circumstances.

Above all, storytelling is only a promotional tool, playing its role in personifying the brand characteristics in a more alluring way. The priority of all tools adopted is to align with the brand image, mutually reinforcing the design concepts, rather than simply performing an interesting story. We have discovered some interesting findings during the interview, for example the change of preference from straightforward to extensive and back to original. Though investigating the trends is not our major focus in this research, some insights might be useful for future evaluation.

Appendix A

A.1 Interview Question List

1. Do you think every brand has their own identity?
2. What is the most common advertising channel for you?
3. For generation Z just like you, what kind of advertising attracts you more?
4. Have you ever heard about storytelling as a promotional strategy? What characteristics does it have?

5. Which brand first comes to your mind when mentioned about storytelling?
6. When you judge the following two commercials, which one will push you to buy the product? A or B

A Disneyland® Paris—The little duck, 2018 (YouTube 2018)

B Service advertisement

(Chmielewski-Raimondo 2021)

7. How does it make you feel when watching commercials like the A above?
8. According to you, what kind of brand story will motivate your desire to purchase?
9. Is there any clear distinction between how brands convey their characteristics now and in the past? For example, plots, background, methods, presentation
10. When you are considering purchasing something, will you source other people's experience via various channels?
11. To what extent will this affect your purchasing decision?
12. To what extent are you willing to share your experience when you use a product?

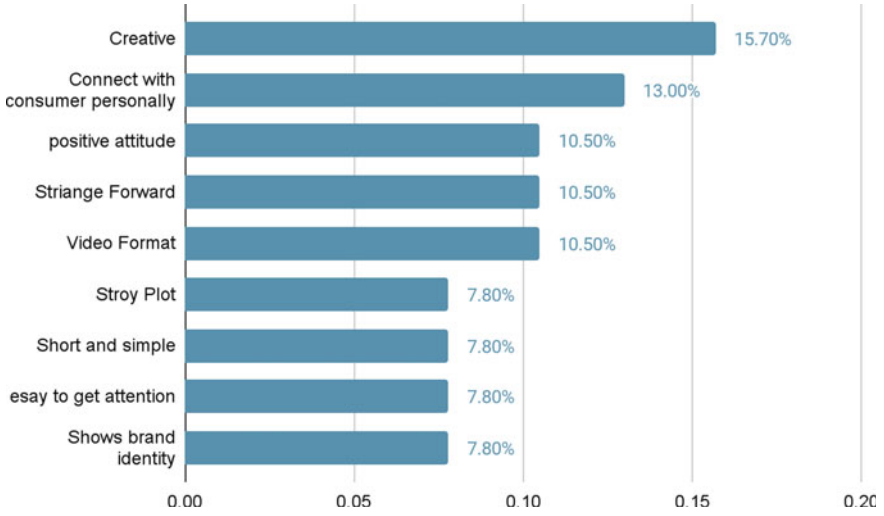
Very likely Sometimes Seldom Never

A.2 Table of Frequently Mentioned Changes in Advertising Content

Past	Current
Product oriented: the advertising will more close to the actually product performance	Promotion oriented: overrate product
Focus on express brand, to increase brand equity	Show brand's Corporate Social Responsibility (CSR):including sustainability, human rights etc
Most in traditional media channels: TV, billboard, magazine and so on	Leaning into digital channels: social media, website pop up etc
Most use their own brand jingle	Using trendy music
Mainly target existing consumer group: persuasive advertising	Expanded audience group to public: informative advertising

Source focus group research

A.3 Top 9 Favorable Advertising Elements for Generation Z



(source: focus group research)

References

Boyd B (2018) The evolution of stories: from mimesis to language, from fact to fiction. WIREs Cogn Sci 9. [Online]. Available at: https://doi.org/10.1002/wcs.1444

Bright LF, Kleiser SB, Grau SL (2015) Too much Facebook? An exploratory examination of social media fatigue. Comput Hum Behav 44:148–155. [Online]. Available at: https://doi.org/10.1016/j.chb.2014.11.048. Accessed 8 May 2020

Chmielewski-Raimondo D (2021) Week 3_MKTG30010_s2 2021_Buyer behaviour (CPM) and ethics (lecture slides) [pdf]. University of Melbourne. https://canvas.lms.unimelb.edu.au/courses/108561/files/8650700?module_item_id=3121179

Dash G, Kiefer K, Paul J (2021) Marketing-to-millennials: marketing 4.0, customer satisfaction and purchase intention. J Bus Res 122(2021):608–620. [Online]. Available at: https://www.sciencedirect.com/science/article/pii/S0148296320306688. Accessed 28 Apr 2022

Domanska A (2021) Marketing reimagined: world's most innovative marketing companies redefine the storytelling experience. Ind Leaders Mag 50–73

Escalas JE (2004) Narrative processing: building consumer connections to brands. J Consum Psychol 14(1&2):168–180

Francis T, Hoefel F (2018) 'True Gen': generation Z and its implications for companies. McKinsey & Company. [Online]. Available at: http://www.drthomaswu.com/uicmpaccsmac/Gen%20Z.pdf

Johnson J (2022) Global digital population as of January 2022. Statista. [Online]. Available at: https://www.statista.com/statistics/617136/digital-population-worldwide/. Accessed 28 Apr 2022

Kapil Y, Roy A (2014) A critical evaluation of generation Z at workplaces. Int J Soc Relevance Concern 2(1):10–14. [Online]. Available at: https://ijournals.in/wp-content/uploads/2017/07/IJOURNAL_CAMERA_READY.pdf

Malka N (2017) Why Moana is important. Introduction to gender and women's studies blog. Available at: https://gwst1501.wordpress.com/2017/03/12/why-moana-is-important/. Accessed 27 Apr 2022

Mathews R, Wacker W (2007) What's your story?: storytelling to move markets, audiences, people, and brands. Financial Times Prentice Hall

Morris JD, Boone MA (1998) The effects of music on emotional response, brand attitude, and purchase intent in an emotional advertising condition. Adv Consum Res 25(1):518–526

Navarro JG (2018) The Walt Disney Company: gross revenue 2018. Statista. [Online]. Available at: https://www.statista.com/statistics/273555/global-revenue-of-the-walt-disney-company/

OSU (2018) Why Moana is the best representation of a Disney princess|speaking the truth. u.osu.edu. [Online]. Available at: https://u.osu.edu/larsonblogposts/whymoana/#:~:text=Moana%20is%20a%20stepping%20stone%20for%20Disney%20films. Accessed 27 Apr 2022

Ozkan M, Solmaz B (2015) The changing face of the employees—generation Z and their perceptions of work (a study applied to university students). Procedia Econ Finance 26:476–483

Pereira G (2019) Brand storytelling: a three-dimensional perspective. J Brand Strategy 8(2):146–159

Peterson L (2017) The science behind the art of storytelling. Harvard Business Publishing. Available at: https://www.harvardbusiness.org/the-science-behind-the-art-of-storytelling/. Accessed 19 Apr 2022

Petro G (2021) Gen Z is emerging as the sustainability generation. Forbes. [Online]. Available at: https://www.forbes.com/sites/gregpetro/2021/04/30/gen-z-is-emerging-as-the-sustainability-generation/?sh=68101d688699. Accessed 18 Apr 2022

Phillips DJ (2017) The magical science of storytelling|David JP Phillips|TEDxStockholm. YouTube. Available at: https://www.youtube.com/watch?v=Nj-hdQMa3uA

Selig A (2020) Generation influence: reaching gen Z in the new digital paradigm. WP Engine. [Online]. Available at: https://wpengine.com.au/resources/gen-z-2020-full-report/. Accessed 28 Apr 2022

Spiers E (2019) Why generation Z is embracing feminism. Pacific Standard. [Online]. Available at: https://psmag.com/ideas/why-generation-z-is-embracing-feminism#:~:text=In%20many%20cultural%20contexts%2C%20Generation%20Z%20appears%20to

Techopedia (2017) What is social media fatigue?—definition from techopedia. Techopedia.com. [Online]. Available at: https://www.techopedia.com/definition/27372/social-media-fatigue. Accessed 18 Apr 2022

WARC (2018) Gen Z's influence on grocery purchases|WARC. origin.warc.com. [Online]. Available at: https://www.warc.com/newsandopinion/news/gen-z-influence-on-grocery-purchase/40351. Accessed 30 Mar 2022

Widrich L (2012) The science of storytelling: what listening to a story does to our brains. Buffer Resour. Available at: https://buffer.com/resources/science-of-storytelling-why-telling-a-story-is-the-most-powerful-way-to-activate-our-brains/. Accessed 19 Apr 2022

YouTube (2018) Disneyland® Paris—the little duck. [Online] Available at: https://www.youtube.com/watch?v=G4qMqbL9ACo. Accessed 9 Apr 2022

Zhao LY, Zhang LY (2022) Looking at Disney's hundred-year management from the perspective of Lina Belle: in-depth report on theme park industry. SWS Res

How to Alleviate the Aging Problem in China? Accessibility Building Strategies and Smart Accessibility Community

Haiyue Zhang

Abstract The problem of aged tendency of population is receiving considerable attention worldwide. Despite the vast research on old-age measures and security, little is known about the barrier-free environment construction strategy of the whole society and the realization of social value of the elderly. This study aims to determine how to build a barrier-free environment and what can China do at present. For this purpose, literature on psychology, sociology, landscape design and architectural design was consulted and analyzed. By comparison, this paper finds that there is still a large gap between China and developed countries in barrier-free construction. China can draw lessons from this in light of its own situation. Finally, this paper summarizes the barrier-free environment construction strategy in accordance with China's national conditions. Guided by this strategy, China can carry out the construction of intelligent barrier-free community first. In the barrier-free community, residential areas, office areas and centralized service areas within a stride of 500 m can be set up.

Keywords Remission of aging · Barrier-free environment construction strategy · Barrier-free community · China's national conditions

1 Introduction

In recent years, especially since the release of the results of the seventh population census, the proportion of the elderly population in China has continued to rise. Population aging is one of the most prominent development realities facing China in the new era. At present, the proportion of Chinese population aged 65 or above has reached 13.5%, up 4.63% points compared with 2010. If this trend continues, China will soon enter a moderately aging society. In the context of aging society, the labor market will be greatly impacted, and the burden of social pension will be

H. Zhang (✉)
Tai Cheng Road, Yangling District, Xianyang City, Shaanxi Province, China
e-mail: 842987339@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_65

unprecedentedly heavy. How to effectively alleviate the aging problem has become a very urgent problem.

The normal life of the elderly requires more convenient facilities and designs. Barrier-free living circle can make the life of the elderly more convenient, bring more choices to their life, and even enable them to realize their own value. Therefore, building barrier-free living circle will be an important way to alleviate the aging problem. However, at present, there is little consideration for the elderly in China, and the construction of barrier-free environment still needs a lot of improvement.

This paper compares the situation of barrier-free construction at home and abroad to find the barrier-free construction method in accordance with China's national conditions. The research suggests that an ideal aging society needs to create a nationwide barrier-free living circle with a cross-city concept, so that the elderly can live, work and travel across regions without barriers. However, China's barrier-free environment construction is still difficult to achieve such a high level. So we need an intermediate transition zone with Chinese characteristics, which means starting with a barrier-free community. In this community, the entertainment, work, medical, sports and other needs of the elderly can be maximized to meet. To achieve such a state requires solid barrier-free facilities as the foundation, such as barrier-free toilets, barrier-free seating. This paper discusses the problems faced by the aging society and the research on barrier-free living circle by referring to the literature, and further compares the present situation of barrier-free environment construction at home and abroad. At the same time, the psychological needs of the elderly and China's social status quo are analyzed, and the barrier-free community in line with China's national conditions is summarized.

2 Literature Review

2.1 Problems and Solutions of the Aging Society

Many studies have been addressing a number of topics including aging society. According to the classification criteria set in Population Aging and Its Socio-economic Consequences, a country or region is aging when the number of elderly people aged 65 and above accounts for more than 7% of the total population.

The research of Du Peng and Li Long points out that the scale of China's elderly population has been the largest in the world for a long time, and the proportion of elderly population has gradually stepped into the forefront of Asia and even the world (Du and Li 2021). Lu et al. from Peking University found that the current aging problem in China is severe, and proposed that China can alleviate the aging problem by encouraging the elderly to find jobs again (Lu and Gu 2022). In the 2019 study, scholars further pointed out that since the new era, it is not only urgent but also very important to innovate the community home care service model under the

new form of the old society. In order to effectively respond to the policy arrangement of the downward shift of pension service focus and the practical needs of the elderly, it is necessary to focus on the construction of community pension community in the new era (Lu and Huang 2022). Zhao Lixin and Zhao Lihong proved in their study that compared with simple family pension institutions, community home care has significant advantages: on the one hand, it can meet the psychological demands of the elderly holding traditional pension concepts and enhance their sense of security and family connection; On the other hand, it is convenient to mobilize and explore community resources, so that the elderly can get adequate care in a familiar environment, enhance their independent choice, and save economic costs (Zhao 2004).

Due to the circumstance of slow construction of elderly care in China, community home care will be the best choice for aging society in China.

2.2 Research on Barrier-Free Environment

Sun Guang and Zhang Zihan from Tianjin University of Technology compared and analyzed cases and found that accessibility could be a bridge to improve the problems of an ageing society. This bridge enables older people to discover their self-worth and the meaning of a secure old age. At the same time, it can improve the social problems of aging, such as insufficient labor force and large investment in old-age care (Sun and Zhang 2019). The research of Qian Siming et al. analyzed the problems in the setting and use of barrier-free facilities in cities, combined with the analysis of the characteristics of the travel behavior of the blind, clarified the norms, refinement and intelligent improvement principles of barrier-free facilities, and proposed the popularization and standardization of barrier-free facilities construction. The improvement strategies and suggestions from the four aspects of design refinement and intelligence, strengthening the management of barrier-free facilities and developing intelligent facilities for the blind provide reference for guiding and improving the design and management of barrier-free facilities in cities (Qian 2019).

3 Barrier-Free Community Construction Strategy

3.1 Compare the Construction Status at China and Foreign

The United States is the first country in the world to formulate accessibility standards and has the most complete accessibility laws. In 1976, the United States officially passed the law of barrier-free design, which was reviewed and enforced by the urban planning management department. If accessibility is not considered on the design drawings, construction cannot be carried out. If a building has been built but does not

meet the design requirements for accessibility, it will not be issued a certificate of use. Those who use it without a license may file a lawsuit and collect the money. The bill also stipulates that each apartment building with less than 20 units must have one barrier-free house, and each apartment building with more than 20 units must have one barrier-free house. In the United States, a great deal of research and experiment work has been carried out in the process of formulating and implementing the laws and regulations on barrier-free design technology. For example, some universities have set up special projects on barrier-free technology basic data testing funded by the government. In order to provide the basis for the formulation of standards and further amend the existing laws and regulations, the Department of Architecture of the State University of New York in the United States was engaged in this research work in the early 1970s, and has a special laboratory and teaching and research group. In the U.S., there is no room for leniency if you park in an accessible parking space, get fined, go to jail, or do volunteer work in the community. Whether by car, by plane or visiting shopping, disabled people have special access or can enter in advance. The airport has a set of special service procedures, and there is a special person to pick up the passengers, the disabled will be assigned to the seat nearest to the toilet, so that the implementation of barrier-free bring into full play.

In 1964, Japan set the direction of housing construction as living space, buildings and public parks for the elderly. People with visual disabilities in Japan can use haptic maps to follow their way through guide sounds, tactile signals, geographical indications, changing lights, graphics and special guiding devices. The construction of welfare towns in Japan began to boom in the 1980s. Its guiding idea is: whether physically disabled or able-bodied, whether the elderly or children can ease into a convenient life. In the 1990s, Japan vigorously promoted the love building law, aiming to build an environment that is convenient for everyone, including the elderly, the disabled and infants. Moreover, Japan's infrastructure is in place. For example, all intersections in Japan are all slope; Major road crossings are equipped with blind crossing audio indicators; Wheelchair access to all public facilities; All stations are equipped with lifts with braille buttons; Each MTR train has a special carriage with wheelchair seating; The blind road runs from the ground to the subway platform.

Britain's barrier-free infrastructure construction is relatively complete. Road junctions are basically slope, set up a warning blind road. Barrier-free buses are popular in cities. 90% of buses in Edinburgh are barrier-free low-chassis buses. Edinburgh has imposed a fine ranging from 30 to 60 pounds for occupying a disabled parking space. Low urinal, low writing table, low small table, low elevator button, low wash basin. The buses are equipped with lifts and wheelchair fixtures. Subway stations are generally equipped with lifting platforms. Sound and video cues work for the blind and hearing-impaired at the same time. Fixed wheelchair positions are arranged in the carriages. The elevator is designed specifically for the disabled. The elevator is wider and the button is so low that it is easy to reach in a wheelchair.

Barrier-free facilities for science and technology: in order to satisfy the disorder to the desires of the family friend said, British people on the telephone design try, the way the airport not only operates in a wheelchair can dial the telephone, low smoothly and convenient deaf man with a fax machine public phone call, it is said

that also has to language disabilities with a keyboard to communicate with normal telephone, the phone can be Keyboard input text into sound, so that the other side of the receiver to hear the sound of peace. The introduction of policies and decrees in the UK lags behind the actual construction of barrier-free environment. Although the Chronically Ill and Disabled Act of 1970 in the UK dealt with accessibility, it was made mandatory in 1995. Anti-discrimination against Persons with Disabilities Act: This law was introduced later than China's first law on barrier-free construction in 1990, the Law of the People's Republic of China on the Protection of Persons with Disabilities.

In many areas of China, great efforts have been made to build barrier-free facilities, but due to inadequate supervision and management, these barrier-free facilities cannot be fully utilized in reality. In some areas, blind roads and barrier-free channels are occupied by vendors' vehicles; Barrier-free toilets and elevators are closed all year round and restricted to use. In addition, there is also a shortage of training on the use and maintenance of barrier-free facilities for relevant staff, who do not understand the proper use and maintenance of barrier-free facilities. Taking public transport as an example, although some buses are equipped with barrier-free pedals, the relevant bus service personnel have not mastered how to use them, and some barrier-free pedals have become rusty and difficult to open due to the lack of daily maintenance. For the visually impaired, the bus station indicator is their eyes, but some buses are not open to use the voice system or damaged, causing great trouble for the visually impaired people. Failure to timely repair and replace damaged barrier-free facilities will not only affect the use of barrier-free facilities, but also cause secondary injuries to users. If the handrails of barrier-free toilets are loose and not repaired and replaced in time, when people with mobility difficulties rely on handrails to help them, it will cause the users to fall down and other serious situations. 3.4 Conclusion There is still a big gap between China's barrier-free facilities and foreign countries, so it is impossible to achieve truly barrier-free travel. There is a long way to go in terms of legislation, construction, maintenance and use of facilities. However, China can learn from the US barrier-free law, Japan's intelligent barrier-free system and the UK's barrier-free facilities to achieve intelligent barrier-free facilities in a small area.

3.2 Conclusion of Comparison and Targeted Strategies

There is still a big gap between China's barrier-free facilities environment and that of foreign countries. There is still a long way to go in terms of legislative facilities construction, maintenance and use. However, China can learn from the Accessibility laws of the United States Japan's intelligent barrier-free system and the UK's barrier-free facilities are the first to achieve intelligent barrier-free facilities in a small area. The unsatisfactory situation of China's barrier-free facilities construction is caused by many factors in addition to the lack of relevant laws and regulations. In addition to the problems of insufficient economic input and follow-up research, the lack of comprehensive planning in accordance with China's national conditions is also a

key factor hindering the construction of barrier-free facilities. Inspired by the idea of "negative planning", this paper puts forward a conforms to China's national conditions barrier-free building strategy, through the analysis of the demand of the elderly and active area, find out about barrier-free environment has strategic significance of key areas, such as hospital, on these small regions to achieve barrier-free again by point and the surface gradually developed to the municipal barrier-free overall environment, Finally, the construction of trans-municipal environment is realized. At present, the most important thing is the construction of small areas. This paper sets these small areas as intelligent barrier-free communities, and discusses their components and organizational structure in detail in the next part.

4 Smart Barrier-Free Communities in Line with China's National Conditions Under the Strategy

4.1 Components and Facilities

Residential Area. According to Chinese tradition, the elderly usually live together with their children, and a simple community for the elderly is not in line with the living habits of the elderly in China. However, the pace and concept of life of young people are quite different from that of the elderly, and living together is easy to intensify conflicts. At the same time, it is common for the younger generation to work across provinces, and there is no way to take care of the elderly. Based on the above situation, it is urgent to build a flexible barrier-free residential area.

Barrier-free residential areas should be mainly for the elderly to set up living units, and equipped with young people around the living space. Barrier-free residential areas should be equipped with corresponding facilities according to the movement status of the elderly. More intelligent and accessible equipment will be introduced, such as the intelligent toilet named "smart toilet" (Shi 2014) that can detect urine composition and record health status in real time, the multi-functional sports rehabilitation spa tank of Gentry Bathroom that can recheck exercise when taking a bath, and the open-door bathtub for the elderly with inconvenient legs and feet, etc.

Office Area. Create a barrier-free workplace. Some old people think that to undertake family work is to realize self-value, while some old people think that to return to society and participate in social work can realize self-value. The return of the elderly to work in the society, on the one hand, can make the elderly feel the improvement of self-value, on the other hand, also make contributions to the increasingly insufficient labor force. The building of barrier-free office space should meet the most basic points.

Accessible ramps, wall handrails, accessible elevators or seats, accessible restrooms, accessible signs, and all doors should be accessible. When suitable for

wheelchair access width requirements, etc. Suitable for the aging of the office environment, the construction of barrier-free facilities in the office can make the elderly in a more secure. Full and comfortable environment to give play to waste heat and contribute value.

Centralized Service Area. In the past, the pension center usually sets the entertainment area, sports area and medical care area in different areas, which leads to the physical consumption of the elderly is too large, and the activities are not smoothly carried out. The centralized service area will concentrate the main social life of the elderly together, reducing the operation difficulty and facilitating the elderly to reach quickly.

4.2 Organization Mode

The distance between each area is controlled within 500 m (Yi 2019), the maximum is not more than 1000 m. It is within 5 km of a large hospital. Pay attention to the connection between the elderly and the outside world, and form an open system to attract people outside the community.

5 Conclusion

This paper compares the state of barrier-free environment construction at home and abroad, and finds that there is still a big gap between China and foreign countries. Through the analysis, this paper points out the places that can be learned from, including foreign facilities construction, legislation and intelligent system. Then draw lessons from the idea of reverse planning and put forward the overall strategy of building barrier-free communities at key points, and finally cross-district and cross-province. Furthermore, the construction strategy of intelligent barrier-free community is put forward based on China's national conditions, that is, a residential office area with a stride of less than 500 m can be set up in barrier-free community.

There are some limitations to this study, which could lead to further studies and recommendations for future directions. This study is only theoretical analysis and lacks practical verification. It gives a general direction in construction strategy, but it is not specific enough. Consequently, there is still much to be done to unify theory building and verification in building an intelligent barrier-free community. Although the findings are context-specific to the role of barrier-free construction strategy in line with China's national conditions, the abilities of building strategies for barrier-free environments can be generalized.

References

Du P, Li L (2021) Prediction of long-term trend of population aging in China in the new era. J Renmin Univ China 35(01):96–109

Lu J, Gu Y (2022) The characteristics of American population change since 1950s and its enlightenment to China. Popul J 44(01):46–57

Lu J, Huang Y (2022) Theoretical and practical exploration of constructing community endowment community in the new era. Acad J Jinyang (02):40–47

Qian S (2019) Urban barrier-free facilities improvement planning and design strategy and suggestions. Planners 35(14):18–23

Shi Y (2014) Intelligent toilet design for aging. Artistic Sea (12):131–133

Sun G, Zhang Z (2019) Barrier-free facility application design based on aging society. Packag Eng 40(18):108–111

Yi R (2019) Research on the design of pension industrial park under the mode of combining medical care with nursing care. Hunan University, Master's thesis

Zhao l (2004) On community construction and home-based community endowment. Popul J (03):35–39

Insight into International Trade Law Mechanism: What is the Future for the WTO

Shiyun Liu, Yiqi Yu, Zhongqi Lou, and Yuhan Liu

Abstract As Globalization continues to grow, conflicts between member countries in the World Trade Organization (WTO), one of the most important global trade organizations, grow in the same pace. Disputes arise in several areas, including international intellectual property rights, the paralysis of the current WTO Appellate Body, intensifying regionalization and growing influence of RTAs, and the outbreak of trade war between the US and China. Therefore, this paper aims to investigate how these problems occurred and how such deficiencies are influencing the efficiency of the WTO, which failed to solve the US-China trade war in 2018. This paper also proposes several solutions to the current paralyzed WTO and how to strengthen, while at the same time limit, its global influence in the member states.

Keywords Intellectual property · Dispute settlement · The WTO · The appellate body · Dispute settlement mechanism (DSU) · Regional trade agreements · Transparency mechanism · US-China trade war

1 Introduction

The current interactive mode has its rather obvious trend that countries are becoming more reluctant to appeal to the WTO mechanism, while regional trade agreements

S. Liu
Faculty of Law, China University of Political Science and Law, Shanghai 102249, China

Y. Yu (✉)
International Relations, Mount Holyoke College, South Hadley 01075, US
e-mail: yu38y@mtholyoke.edu

Z. Lou
School of Humanities and Social Sciences, University of Science and Technology Beijing, Beijing 100083, China
e-mail: zhongqi_lou@163.com

Y. Liu
Qingdao No.2 Middle School, Qingdao 266061, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_66

(RTAs) are mushrooming. However, WTO has already brought to us, or what is likely to be offered by the WTO in the future needs further research, while the reflection on which may give a deeper insight into the US-China trade war.

In Part 2 of this article, a conclusion has been drawn that the WTO has its innate responsibility to actively make the procedure more convenient and to avoid dispute settlement mechanism failure. An introduction will be given on the international intellectual property disputes concerning the nature of disputes over IP rights, defects in current dispute settlement mechanism. To illustrate this point better, the case of the US-China IP dispute will be used, combing with the current challenges the WTO is facing. It is recommended that the WTO need to be more robust and more active to meet the original expectation of all members in case of deliberate or frustrated mechanism evasion and provide anticipated legal aids as a legal adviser serving to make sure the whole organization based on the common will of its members works well.

In Part 3, an analysis will be given on the appellate body of the WTO and challenges it is facing as well as possible solution for it to better "fix" the mechanism. The Appellate Body nowadays is still paralyzed. Although this paralysis indicates a failure of the WTO to prevent itself from ruling by power, rather than ruling by law, it offers a path for countries to rethink about the current global trading system, as well as regulations governing such huge organization. From this aspect, reforms that lead the all the WTO members to a greater future is underway.

In Part 4, insights are provided into different regional trade agreements as well as the future trend of international organization and what the WTO can learn from this tendency. The emergence of the wide-reaching RTAs illustrates that countries are moving toward regional groupings as political conflicts making it difficult to reach a consensus on global agreements. Reasons behind RTAs are advantages brought about by their regional feature, which also determines that RTAs have a limited negative impact on world trade and the WTO while strengthening regional economic ties. In the long run, the implementation of RTA may create a practice-based foundation for the new content of the global trade agreement, which requires WTO to use the existing mechanism and take positive action.

Part 5 of this article analyzes the composition, causes and impacts of the US-China trade war to explore the possible reforms of WTO and the alleviation of the world economic slowdown by regional trade agreements. The lack of WTO in its effectiveness leads to a series of international disputes that cannot be solved timely and effectively through WTO. This has led governments to become disillusioned with the WTO and made some conflicts more intense and difficult to resolve. If governments on both sides fail to negotiate an effective settlement, it will slow economic growth on both sides of the conflict and globally. One of the most widely watched and influential events in recent years has been the US-China trade war. The impact of US-China trade war cannot be ignored in the world, and this serious economic friction also reflects a series of problems under the current WTO system.

2 Reflection on IP Disputes Settlement Mechanism Inside the WTO

2.1 Introduction

The International frame and mechanism of intellectual property (IP) protection have evolved several times, from less powerful and more self-autonomous World Intellectual Property Organization (WIPO) system to the stringent WTO/the Trade Related Aspects of Intellectual Property Rights (TRIPS) featuring its relatively high execution ability, from TRIPS system to a milder consultation approach combined with greater discretion as well as different regional arrangements. However, the core of this topic never changes, and that is how to protect transnational IP application in a more effective and more encouraging way to promote creation and communication of societies. In consideration of the ever-changing and complicated forms and issues of IP disputes, what the WTO needs to do is no longer acting as a passive arbitrator waiting for claims and requests from its parties, but rather an active legal adviser serving to provide a systemic and foreseeable procedural recommendation and adequate aids for relief. The WTO has its innate responsibility to actively make the procedure more convenient to avoid dispute settlement mechanism failure especially when the process of evidence collection and legal application, as well as enforcement of decisions become harder for its members.

The WTO is a mechanism launched passively after a dispute happens and parties request for relief on their initiative. What measure can be taken is totally based on specific request from the party no matter what stage of litigation they are in. There's a jet lag between actual investigation and participation of the WTO into disputes and its potential empowerment which may impact parties. Considering above problems, what if the WTO can actively enter into the dispute at early stage with the mutual consent of both parties to make the procedure feasible and efficient for them? The WTO can serve as an adviser in procedure issue and legal helper of relevant information collection to solve difficulty of proving and legal identification for the ag-grieved party, suggestions of which will not have any legal binding force. Also, if necessary, a rather fixed relief procedure can be designed to make the whole process transparent and foreseeable. In this conception, the WTO is more like a neutral serving agent than an arbitrator with legal binding force. Combing with the concerns on appointing new appellate body members of the WTO, the WTO is also recommended to actively activate its emergency mechanism, for example establishing an interim alternate committee on its initiative.

2.2 Doubts on IP Disputes Settlement Mechanism

To better conceive the mechanism, the first question needs to be considered is why the core seems unchanged while the mechanism different countries recognize unanimously and resort to is changing ever so? On the one hand, the application in practice of these mechanism does not always meet signatory countries' anticipation, let alone the legislation gap between different countries within their own territory and different degrees of state commitment to ensuring compliance. On the other hand, the nature of the IP right dispute varies greatly which means the stipulation of TRIPS, which mainly provides minimum standards and general principals, cannot completely cover all circumstances. When there is complaint on application of TRIPS, broader discretion is left to the country. Just as what happened in Canada Pharmaceutical Patents Case, the Panel relied on the respondent country's interpretation of its statute without evidence of actual discrimination in the application of its laws (Panel Report 2000).

Defects of the Mechanism Itself. The failure of mechanism application may be closely related with methods of application and function of the WTO system and is rooted deeply in the agreement countries consent on ever since TRIPS system was constructed. Besides, more practice than theory matters and is connected with different attitude of countries towards recognition of IP protection, as well as the specific types of claims on a violation. Yoshifumi Fukunaga has once pointed out that TRIPS disputes are classified into three groups based on the type of violation that constitutes a complaint: statute, application, and ineffectiveness of domestic remedies (Fukunaga 2008). The former origins from a systematic construction which may be involved in the nature of IP rights dispute. Thus, when discussing international IP protection, the nature and types of IP rights disputes and their respective challenges are crucial if countries choose to settle disputes through WTO DSM, as well as countries filing strategy when facing different kinds of disputes.

Besides, appellate body concern is also a main obstacle for members to enter into the dispute settlement mechanism when facing IP dispute. While the severity of the situation worsens with each passing month according to the European Union, the US is said to be sticking to its position that it is "not in a position to agree" to the proposal (William New 2018). Though there are members trying to introduce a proposal that request establishing a Selection Committee for appointing new Appellate Body members, the US stands out claiming the issue of former Appellate Body members working on cases after their mandates have expired has not been addressed yet. This part will be discussed in detail in Part III of this article.

Diversity and Complexity of IP Disputes Claims. International IP disputes mainly focus on whether a state makes its laws appropriately in conformity with the obligation under international law, such as TRIPS. This means a conflict between a state's commitment to enforcement and its scarcity of resources to be put into a series of domestic protection system, which usually hap-pens because of huge economic gap between developing countries and developed countries. Statutes of a state shows whether the country's attitude is consistent with the former when joining relevant agreement, which is a rather easy and obvious way to judge if a violation exist and

is comparatively objective and accessible. However, just as Professors Dreyfuss and Lowenfeld have argued, (Dreyfuss and Lowenfeld 1997) the distinctions between ideas and applications may provide a means of evading the TRIPS Agreement's obligations. Legislation may appear to be conforming, but it may be devoid of all bite. As a result, it is almost unavoidable that disagreements will arise over whether a state that has passed conforming legislation has still failed to provide meaningful protection to innovators. For example, there is no agreed-upon international standard of absolute novelty, and developing countries may, within limits, choose from among the various approaches recognized in domestic patent laws, (Mansfield 1993; Maskus and Konan 1994; Carlos 1994) allowing oral prior art to defeat novelty, and reluctant to provide any novelty grace period. By this method, the field of inventions patented in developed countries which will continue to be available for local exploitation without royalties is enlarged (Samuelson 1997).

2.3 Issues Playing Out in the US-China IP Dispute

A Debate emerged in 2018 at the WTO is between the U.S and China over new U.S actions targeted at China's purported failure to protect IP rights fairly under domestic and international law mainly on manipulated technology transfer, discriminatory licensing restrictions and cyber intrusions, concerning both statutes stipulation failure and application failure. China expressed concern about the United States' unilateral action against it and argued that Section 301 of the United States Trade Act of 1974, based on which the U.S make the unilateral determination, is unjustifiable, and the U.S take action where dispute procedures have not been exhausted (William New 2018).

Apart from the illegal measures taken by the U.S to retaliate with self-help and make unilateral determination against the so-called violation, which is forbidden by the DSU obligation, pursuing a claim within legal framework while imposing unilateral tariffs jeopardizes the procedural legitimacy of justifiable claims (Garvey 2018).

Nature of the Disputes. Take a closer look at the very nature of the dispute, and two main factors can be found. One is the degree of discretion in the U.S domestic law both in application and interpretation, and another is method of assessing whether a non-developed country's gradually stable and complete IP protection establishment meet the fixed standard stipulated in its international agreement. Early researches have pointed out that China "has pursued to centralize judicial authority, build judicial professionalism, and create case uniformity within the IP adjudication system" (Weightman 2020). However, whether that is enough for China to fulfill its commitment remains controversial. It is hard to examine whether a country has fully applied its statutes concerning IP protection to judicial practice, for the difficulty of collecting evidence and interpretative authority of a country over its own domestic laws.

Lack of Adequate Instruction for Elements of a Violation in Proving Process. According to the Art. 42 of the TRIPS, when a country fails to effectively apply

its IP laws, it violates its TRIPS obligations (Agreement on Trade-Related Aspects of Intellectual Property Rights 1994). Civil mechanisms must allow for effective action against any act of infringement, as well as remedies that both prevent future infringement and provide future deterrence (Agreement on Trade-Related Aspects of Intellectual Property Rights 1994), which cannot be judged solely by the current situation of domestic IP infringement. Relevant policies and developing trend for domestic environment of IP protection need to be added into consideration and it is also crucial to compare China with other countries at similar level horizontally and with the past longitudinally to get close to the legislative in-tent of this article. Thus, great preliminary work should be done to comprehensively assess the situation, the amount of which usually cannot be handled by a single party to meet the standard of proving of stipulation in the WTO.

2.4 Reform Recommendation for the WTO

In order to tackle follow-up problems, what need to be first analyzed are challenges faced by the WTO, and then what can be done to better address the dispute and, further apply to all IP disputes can be figured out. First, as Stephen Garvey have indicated, there is little precedent to predict for only thirty-eight cases have been submitted to the WTO (Find Dispute Cases, World Trade Org). Although the appellate body has ruled that domestic civil procedures must have force or efficacy under Article 42, it has not ruled on what characteristics may render a procedure ineffective (World Trade Organization 2002).

Current Reluctance of Member Countries to Submit IP Claims. The reason why so few cases were submitted to the WTO is that, as aforesaid, countries may have been deterred from using WTO DSM due to its inability to resolve claims on the 'application of statutes' or the 'ineffectiveness of domestic remedies' with difficulty of proving and time-consuming procedure. Also, there is a significant difference between developed and developing countries' views on desirable IP rules (Fukunaga 2008), while claims filed by developed countries against undeveloped ones could "breed political resentment and serve to undermine the WTO system" (Fukunaga 2008).

What Can Be Done Differently by the WTO. Thus, it is suggested that time should be taken for observation for the WTO to exercise its power requesting for the potential violating party to give relevant information and data in good faith. The aggrieved party can ask the WTO for relevant legal suggestion. Also, in case of abuse of this relief procedure, a preceding supervision mechanism need to be set by the WTO to examine the preliminary allegation on whether the application of the provision is basically within a country's own discretion and to define the dispute concerned for better matching it to a particular stipulation in priority. The WTO should serve as an adviser in procedure issue and legal helper of relevant information collection for the aggrieved party, suggestions of which will not have any legal binding force, but rather a preposition for designing schedule for a claim to

be filed. However, the approach has its defect that it takes time to legally complete the whole procedure and may expand the damage. Thus, it is advised to lower the standard of proof when filing the case, because preliminary evidence is justifiable enough to activate the procedure and follow-up thresholds can block the insufficient claim.

Apart from the above concern, from a procedural perspective, a tricky but realistic problem is daunting to countries to appeal to the WTO mechanism now and maybe for far future. The enforcement of the decision is usually hard to secure, let alone ones with claims on application and ineffectiveness of domestic remedies failure which is originally hard to decide and judge whether a country has fully accomplished or remedied its obligation. Just as what happened to the WTO ruling in DS160, the U.S has still not complied with a nearly 20-year-old WTO decision against a provision of the U.S Copyright Act. As discussed above, it is recommended for the WTO to act as an active service provider, including without limitation making annual official announcement of default of breaching countries to urge these countries to fulfill their obligation under a decision and actively provide sanction strategy to the aggrieved party or request the default party to accept supervision from it and open its IP policies information comprehensively. The announcement can serve as a warning or public statement towards global society of illegality of default to emphasize enforcement of countries' international obligation.

3 Reflection on Appellate Body in WTO Disputes Settlement Mechanism

3.1 Introduction

The World Trade Organization, one of the most important system that promotes and protects international trade, is at risk. The effectiveness of the system largely relies on its ability to look at the appeals of countries when disputes happen and review and reinforce the judgement issued by the panel. However, such ability has been impeded by Trump in 2019, who blocked the new appointment of new nominees until now. The action of the US, although opposed by many countries, revealed that countries have long been dissatisfied with the WTO Appellate Body, and urges people to carry out reforms to the system and thus turn the entire organization into function again.

3.2 The Role of Appellate Body in the Dispute Mechanism System

The Dispute Mechanism System was initially the product of failed mechanism in General Agreement on Tariffs and Trade (GATT 1947). Being complained that the

dispute settlement system in GATT took too long to react and gave every country the possibility to clock the formation of the panel or the "adoption of unfavorable decisions," WTO has been created with a intended powerful dispute settlement mechanism. The WTO, as the biggest trade organization in the world, "places extensive obligations on states to ensure that their national economic regulations comply with WTO standards (Picciotto 2005)". As an organization that relies so heavily on the compliance and cooperation of member countries, the Appellate Body, established in 1995, was the major reforms carried out by the Understanding on Rules and Procedures Governing the Settlement of Dispute (the "DSU"). Such a standing Appellate Body was established to hear appeals from panel decisions in order to correct errors made by the panel (Hart 2021).

The Appellate Body is a part of the Dispute Settlement Body in WTO that includes all members in the WTO. The DSB is granted with the power to establish "panels", consists of different experts to consider the cases reported to WTO when trade conflicts arose among the members. The DSB also has rights to accept or reject the findings of the panel or the results of its appeal. The DSB is also responsible for implementing rulings and regulations and is granted with the ability to authorize retaliation when a country does not obey rulings. In order to strengthen the power of solving disputes and filling the gap of the deficiency of GATT, this new mechanism was granted with the power to prevent a member from blocking the formation of a panel and requires conflicting parties to automatically accept the reports issued by the Appellate Body if they are accepted by the DSB, unless all, or prevailing number, of members objected. When appeals are issued by countries from either side (or both sides), the appeals will be heard by three of the seven permanent members in the Appellate Body. The seven members are required to be experts with outstanding position in the field of international law and trade, and most importantly, they should not have affiliation with any government. These seven members of the Appellate body will be each serving for four-year terms, which would be staggered to guarantee that not all members in the Appellate Body begin and end their terms at the same time. The Appellate Body serves one of the most prominent roles in the Dispute Settlement Body, that it acts as an Appel tribunal that may review a WTO panel's legal interpretations and "uphold, modify, or reverse them (Hart 2021).

3.3 Problems Faced by the Appellate Body

The new reforms posed on WTO was significant, for it creates a binding relationship between the members in the organization and the regulations in WTO: states must implement the decision of WTO, and their domestic laws are compliance to the regulations in WTO. The AB's power "to review the validity of national regulations allows it in effect to overrule even laws enacted by legislatures (Picciotto 2005)".

Although the Appellate Body was efficient in solving many disputes in its first few years, such power granted to the WTO Appellate Body soon raised concern and dissatisfaction among its members. Regulating that the Appellate body should

take 60 days (at most 90 days) to finish its report after a party appeal to it, many members contended that Appellate Body exceeded the time allowed for issuing a report without the agreement of the disputing parties. The time limit for issuing the report is not the only concern, however, many member countries, especially the US, took the extension of deadline without notification as a signal of lack of transparency in the regulatory process of the Appellate Body.

Another problem that raised dissatisfaction and concern lies with both accountability and legitimacy (Picciotto 2005). The power of the Appellate Body lies with the cooperation between the legislates power of each government of each country, while the binding relationship member countries have to the rules and decisions of WTO have granted the Appellate Body higher power to surpass countries' domestic rules. Rulings were only adopted by consensus under GATT, while rulings were now adopted automatically unless there is a consensus to object a ruling under WTO. The system of the Appellate body, as critics demonstrates, "[locks] states into detailed and rigid obligations……[make] it harder to mange the social and political impacts of trade agreements…… and pressurize governments to insist on a strict application (Picciotto 2005)".

Under such concern, the US and Europe became the major members expressing their dissatisfaction about the role of WTO, as well as the Appellate Body of the WTO. Since 2003, the US has issued several reports regarding its concern about the implementation of rules and obligation of the Appellate Body. In December 10, 2003, the US expressed its concern about the Appellate Body creating additional obligations for imposing safeguard measures; in February 2009, the US expressed its concern about the findings of the Appellate Body which "incorrectly expanded the scope of the proceedings"; then in 2015, the US condemned the Appellate Body's failure to follow the mandatory 90-date deadline for issuing a report (Hart 2021). The US also complained about how the Appellate Body unfairly limit the US to protect itself against dumping and subsidies (Barrett 2020). Such dissatisfaction of the US reached a peak when its imposition of tariff on China's imports have not been supported by the WTO. In 2018 March, the US announced to impose tariff on $3 bn of imports from China and eventually reached $200 bn in August. In return, China imposed tariffs on $3 bn of imports from the US and reached $34 bn in July. Accusing the US of violating WTO rules, China filed complaints against the tariffs at the WTO. "We'll have to do something about the WTO," Trump said. "Because they've let China get away with murder (Barrett 2020)". After issuing several complains about the Appellate Body, the United States finally blocked the reappointment of Appellate Body members and refused to launch new selection process to fill the vacancies in the Appellate Body. In the USTR's report on the Appellate Body In 2020, it specifies that the Appellate Body has erroneously interpreted the WTO Member's ability to address simultaneous dumping and trade-distorting subsidization by Non-Market Economies like China and accused the Appellate Body for falsely interpreting Article 19.3. After such blockage imposed by the US, Only three members were left in the Appellate Body which soon stopped functioning. With two of the three members left ended their term in 2019, new appeals were unable to be made since each appeal requires three Appellate Body to participate.

Although countries have attempted to reconstruct the organization of the Appellate Body, most of such attempts have failed. Mexico issued a united proposal, signed by many WTO member states, pressing the DSB to issue a selection of members in the Appellate Body. The US refused to support even if member states continued to submit the proposal from January to May 2018. With increasingly more members, including China, the European Union, Canada, Mexico and other WTO members, arguing and delivering proposals for a new section in the 2018 WTO General Council Meeting, the US expressed little interest and continued to state that the Appellate have gone far beyond in many areas, and accused the Appellate Body for ignoring the express terms of the pertinent WTO agreement.

3.4 Reforms on the Appellate Body

Facing a paralyzed Appellate Body, many has proposed a construction of a new organization that can replace the Appellate Body. The EU and 16 WTO Members declared On 24 January 2020 that they would start to work on "contingency measures that would allow for appeals of WTO panel reports in disputes among ourselves" based on Article 25 of the WTO Dispute Settlement Understanding, until a WTO Appellate Body becomes entirely operational (Gao 2021). On 30 April 2020, the MPIA members notified the MPIA officially to the WTO, which allowed the organization into effect. Although such reestablishment of an system that is expected to replace the role of the Appellate Body seems to be refreshing, it actually possesses many contradicting characteristics that requires further examination: it is still unclear whether the MPIA is within the WTO or not, which can severely impact the legal status of the MPIA and the WTO. What's more, the MPIA lacked the supports of many countries, especially the US. The US was more than skepticism and refused to support this new system. If the US wants to get rid of the appellate stage, as Gao contends, "there is no reason why it would accept another Appellate Body" that "in-corporates and exacerbates some of the worst aspects of the Appellate Body practices (Gao 2021)." The MPIA also possesses problems that the initial WTO tried to avoid and one of its greatest defects is denying WTO members' rights to appeal. The MPIA also loses its function of binding agreement, that an award would only become binding when its parties agree to be bind by it. These two deficiencies of MPIA have revealed the biggest problem of creating a new system to replace the Appellate Body, that the deficient features of GATT may reappear on the new system.

Most of the scholars agree that there exists problems within the membership of the Appellate Body and it is necessary to tackle this in the first place. Some has pro-posed a compulsory vote on the members by the General Council, and Pieter Jan Kuijper argues for a direct appointment of Appellate Body members that applies consensus votes (Vidigal 2019). Ernst-Ulrich Petersmann went even further, arguing that it is the legal duty for WTO members to overcome "illegal 'blocking' of the filling of [Appellate Body] vacancies (Petersmann 2018)". The number of members in the Appellate Body is being further discussed in the context of reforms in the Dispute

Settlement Under-standing. The very first reform could be adding more economic experts into the Panels which are responsible for establishing the facts. Complicated matters related to the competition law is dealt haphazardly, and "econometric and non-econometric indicators to determine the relevant product market (what is a 'like product'?) are treated as equally plausible by panels (Hoekman and Mavroidis 2019)".

Regardless of how many members should added to the Appellate Body, it is necessary to put our sight on the existing problems of WTO that led to the paralyzation of the Appellate Body. Considering the complaints of countries about how the ruling of the WTO presides over their countries' sovereignty, it is necessary to find another common ground between WTO and national powers, since the legality and rights of the WTO largely resides on international norms, the power of which depends on international acceptance and consensus. As more economic structure are emerging in the world, the members of WTO should also discuss and come up with a more precise definition and rules about the competition between different countries and how to evaluate the fairness of the ruling of the Appellate Body. Such discussion should be particularly emphasized in area of the new-emerging economic format, as Ernst-Ulrich Petersmann argues, that the one of the biggest regulatory challenges of WTO is the inadequacy of rules to restrain "anti-competitive abuses of 'state-capitalism' (such as forced technology transfer), other trade distortions (e.g. in new sectors like electronic commerce, maintenance of competition in digital markets), and state-owned enterprises (Petersmann 2018)". As products and trade become more complicated, the WTO trade laws should also be modernized to keep the reports of the Appellate Body up-dated and unbiased.

Modernization of the WTO laws can start with the problem of trade remedy, which by estimate is the most conflicted trading area. This is a vital factor to keep international trade functioning and guarantee that every member in the WTO is being treated fairly. A new Special Appellate Body is recommended to be established, as Jennifer Hillman argues, that this new Special Appellate Body is responsible to deal with half of the current trade remedy disputes, which help to ensure that all the appeals can be heard on time and the report issued by Appellate Body can be issued within the 90-days limit (Hillman 2018). The Appellate Body can also add two or four members, and any three-member division of hearing must have at least two of these new trade remedy expert members. It is also possible to change the selection process of the Appellate Body, that 20–25 professional individuals can be chosen and work on permanent roster (Hoekman and Mavroidis 2019).

The Appellate Body nowadays is still paralyzed. Although this paralyzation indicates a failure of the WTO to prevent itself from ruling by power, rather than ruling by law, it offers a path for countries to rethink about the current global trading system, as well as regulations governing such huge organization. From this aspect, re-forms that lead the all the WTO members to a greater future is underway.

4 Reflection on Regional Trade Agreements

4.1 Introduction

The paralyzed Appellate Body shows that the operation of the WTO has reached an impasse under the influence of the US-China trade war and the counterpart to that situation is the development of regional trade agreements. This article discusses the current development of RTAs, the reasons for their emergence, their impact on WTO and international trade, and approaches to cope with the situation. The emergence of the wide-reaching RTAs illustrates that countries are moving toward regional groupings as political conflicts make it difficult to reach a consensus on global agreements. Reasons behind RTAs are advantages brought about by their regional feature, which also determines that RTAs have a limited negative impact on world trade and the WTO while strengthening regional economic ties. In the long run, the implementation of RTA may create a practice-based foundation for the new content of the global trade agreement, which requires WTO to use the existing mechanism and take action.

4.2 The Growing Importance of RTAs

RTAs in the WTO are taken to mean any reciprocal trade agreement between two or more partners, not necessarily belonging to the same region. As of 1 March 2022, 354 RTAs were in force. These correspond to 577 notifications from WTO members, counting goods, services, and accessions separately (WTO Regional trade agreements facts and figures). The number of RTAs, the countries involved, and the areas covered are remarkable.

Members of the WTO are allowed to participate into RTAs under strict restrictions outlined in three sets of rules. RTAs, in general, must encompass practically all trade—unless they are covered by the Enabling Clause—and enable trade flow more freely among the RTA's members while without raising trade barriers with the rest of the world (WTO Regional trade agreements and the WTO).

To better understand the current progress of RTA, the following is a brief analysis of the features of some notable RTAs and their political and economic impact.

TPP

The Trans-Pacific Partnership Deal (TPP) economies accounted for almost 40% of GDP, and the agreement would have been the largest ever signed by the US, both in terms of the number of countries involved and total trade flows. In terms of the TPP's geostrategic importance, the Obama administration contended that it will reinforce U.S. leadership in Asia and its regional relationships. While Trump has made addressing China's trade-distorting actions a priority, analysts such as CFR's

Edward Alden argue that exiting the TPP diminished Washington's clout and made dealing with Beijing's abuses more difficult (McBride et al. 2021).

RCEP

To encourage free trade, the Regional Comprehensive Economic Partnership (RCEP) will eliminate tariffs on 91% of commodities and impose investment and intellectual property laws. The agreement isn't as comprehensive as the TPP: it eliminates fewer tariffs and doesn't go as far as the TPP in terms of services trade, intellectual property, and labor and environmental norms. The RCEP, coupled with the CPTPP, constitutes one of the world's largest trade blocs, and analysts believe it's yet another proof that Asia is forging along without the United States (Kate 2021).

NAFTA/USMCA

The North American Free Trade Agreement (NAFTA) was a trilateral agreement negotiated by Canada, Mexico, and the United States. NAFTA abolished most tariffs on goods exchanged between the three countries, with a particular focus on agricultural, textile, and automobile manufacturing trade liberalization. The accord also aimed to protect intellectual property, develop dispute resolution processes, and enforce labor and environmental safeguards through side agreements (Chatzky et al. 2020).

4.3 Reasons for Countries Moving Toward Regional Negotiation of Trade Preferences

From the above information, it can be analyzed that the limited region and membership of RTA brings its unique advantages over global trade agreements to serve the political and economic goals of the country, which are the reasons why the countries are moving towards regional groupings.

In terms of political factors, due to the limited membership, countries can choose to form economic alliances with allied countries and use the RTA as a tool to exert influence (Freund and Ornelas 2010).

Take RCEP and TPP as examples, in the context of China and the United States becoming two major economies and maintaining hostile attitudes toward each other, both sides want to expand their political impact in regions through RTAs.

Because the members are limited and share the same political and economic claims, the countries can tilt their focus based on shared claims, thus reaching an agreement within a relatively short period. The RCEP prioritizes tariff reduction without emphasizing intellectual property protection and labor interest protection in the treaty. This feature is in line with the focus of the Asian region and facilitates Asian countries severely affected by the epidemic to recover their economic development as much as possible (Kate 2021). However, Intellectual property protection is a key issue for the WTO, and The WTO Agreement on Trade-Related Aspects of

Intellectual Property Rights (TRIPS) is the most comprehensive multilateral agreement on intellectual property (IP) (WTO TRIPS—trade-related aspects of intellectual property rights). The RCEP pattern may work for the Asian region, but it is difficult to achieve on a global scale.

The RTA can be more tailored to the features of the region, enabling the country to build on its strengths and avoid its weaknesses based on its domestic economic situation. For example, NAFTA consists of two developed countries and one developing country. For the United States and Canada, Mexico is a promising market for exports and as a lower-cost investment location, for Mexico, the United States and Canada's investment can bring more jobs (Chatzky et al. 2020). The basis for the operation of such an agreement is closely related to the economic situation and geographical location of the three countries, which is the unique advantage of regional agreements.

4.4 The Impact on the WTO and International Trade

RTAs in because of the above advantages were chosen by the country and injected vitality into the regional economy. The regional character gives RTA advantages, but it also creates limitations. The limitations of RTA determine its negative impact on international trade and WTO is limited. In the long run, the development and implementation of RTAs can bring a positive impact on international trade and WTO, which also needs WTO to act accordingly.

Outside of an active RTA, countries always need global markets and the WTO as a guarantee. From the perspective of market value, RTAs, while strengthening economic ties outside the region, can not make the regional market more valuable than international trade markets outside the region. From the perspective of stability, even if RTAs are more stable than policies and the current government could use an RTA to tie the hands of an alternative government in the future (Fernandez 1997), they are not stable enough compared with WTO. In the process of participating in various regional agreements, a country needs to consider international trade partners outside the region and make a balance. The WTO must be also taken into account, because it is essential if the agreement does not function well, or in case of trade and trade disputes not covered by RTAs. The act of moving the focus entirely from global international trade and the WTO to regional trade agreements is too risky for the national interest, therefore the negative impact of the emergence and rise of regional trade agreements will be limited.

Furthermore, the WTO and RTAs are not mutually exclusive but mutually reinforcing. According to Bergsten and Schott (1997, p. 2), NAFTA negotiations revived Uruguay Round talks "by reminding the Europeans that the United States could pursue alternative trade strategies." There is some evidence that this shift was intentional, to get the Round started and push it along (Bergsten and Schott 1997). The role of WTO will not only not be weakened, but also remain an important reference for regional trade agreements in the formulation stage. Also, a multilateral system ensures the participation of the smallest and most vulnerable countries and helps

support the integration of developing countries into the world economy (Regional trade agreements and the WTO). Therefore, the influence of WTO will remain strong.

In the long run, in addition to promoting positive WTO action, as the scope of RTAs expands and the number of provisions involved increases, trade practices in accordance with the provisions of RTAs will become more common, which brings the possibility of gradually forming new trade customs. While some RTAs consisting of a few countries may affect only their member countries, the impact of large RTAs such as the TPP and RCEP will be multi-national. After the provisions of the RTAs have been widely used and accepted, the WTO may be able to use them as references for new WTO proposals and reforms. With a period of practice as a basis, the WTO can reach an agreement more smoothly. There can be little doubt that the main economic advantages to participants in regional trade agreements would be even greater if the liberalization were carried out on a wider, multilateral scale. RTAs are a second-best solution (Crawford and Laird 2001). As Kemp and Wan (1976) note "… there is a big incentive to form and enlarge a customs union until the world is one big customs union, that is until free trade prevails." (Kemp and Wan Jr 1976).

As for the response to the growing influence of RTAs, utilizing and enhancing the role of the already existing Transparency Mechanism for Regional Trade Agreements may be a viable way forward. Since December 2006, all RTAs have been subject to the Transparency Mechanism for Regional Trade Agreements' terms and processes. The process specifies when a new RTA should be reported to the WTO, as well as the information and data that must be given. This information allows the Secretariat to put up a factual presentation on the RTA, which will aid WTO members in their deliberations. WTO members decided to work toward transforming the current provisional Transparency Mechanism into a permanent mechanism during the 2015 Nairobi Ministerial Conference (Regional trade agreements and the WTO). This Mechanism can, on the one hand, help provide the WTO with an understanding of the current situation of RTA, use it as the information basis for WTO actions and decisions, and even as a source of experience for future reforms. On the other hand, the mechanism is conducive to countries' understanding of relevant information and the weighing of interests. For an international organization with a large number of members and covers a wide range of interests like WTO, this method is sound and practical.

5 US-China Trade War

Since 2018, trade frictions between China and the US have been heating up, escalating in scale and impact, and finally evolving into a trade war between the two countries. The US government has imposed a series of restrictions on China, while China has taken countermeasures.

5.1 What Is It?

The measures taken by both sides could be divided into four categories. The first is to impose additional tariffs. On July 6, 2018, the United States imposed tariffs on steel and aluminum under Section 232, affecting $3.4 billion worth of Chinese exports. China slapped retaliatory tariffs of equal value on the United States. On August 23, 2018, the United States imposed an additional 25% tariff on $16 billion worth of Chinese goods, including steel products and electronic machinery. China responded by imposing a 25% tariff on American goods of the same value. On September 24, 2018, the United States imposed a 10% tax on $200 billion worth of Chinese goods. China responded by imposing a 10% tariff on $60 billion of U.S. imports. After subsequent trade talks broke down, the United States announced it would raise tariffs to 25% on $200 billion worth of Chinese goods. China then slapped tariffs on American goods (Liu and Woo 2018).

Second, restrict the market access of domestic enterprises. Citing national security reasons, US President Donald Trump has banned government agencies and their contractors from purchasing or using products and services from some Chinese companies. Third, restrictions on Chinese investment in the US. FIRRMA authorizes the United States to review "other investments" made by companies that possess critical technologies or collect and possess sensitive personal data of U.S. citizens, and prohibits them from acquiring U.S. technology companies with industrially important technologies. Fourth, is strict export control. Add Huawei and other Chinese companies to the list of entities subject to export controls.

5.2 Causes

America's restrictions on China stem from three main points of conflict in US and China trade.

First, the US trade deficit with China is too large. The United States argues that its trade deficit is largely due to China's currency dumping and cap-and-trade policies. For years, the deficit has been increasing as production has shifted to low-cost China. It also explains, according to Mr. Trump, why American manufacturing has become hollowed out. Such tariffs are seen by the United States as protection for its domestic economy. China argues that the measures taken by the United States are an infringement of China's rights and are essentially "safeguard measures." Therefore, retaliatory tariffs were imposed on a series of US goods under the Provision of the World Trade Organization (WTO) Safeguards Agreement. Second, the US believes that China has harmed its development in terms of intellectual property rights. They have harmed US intellectual property, innovation, and technology development by requesting an investigation into China's intellectual property, innovation, and technology transfer laws and policies under Section 301 of the Trade Act of

1974 to determine whether some of China's practices are unreasonable or discriminatory (Adekola 2019). At the same time, the United States has filed a complaint with the WTO, arguing that China's laws and regulations on technology licensing do not comply with WTO rules (Ciuriak 2019). China has been named a currency manipulator by the US, which accuses the country of doing so "to obtain an unfair competitive edge in inter-national commerce." And asked the IMF to "eliminate the unfair competitive advantage created by China's latest actions." (US-China Trade War Time Line).

The deeper reason for the US and China trade war is that the US believes that China has obtained great preferential policies and signed a series of obligations after joining the WTO. The conflict between China and the United States also appears in this aspect. First, the impact of China's WTO membership on the manufacturing sector has significantly beyond the WTO's initial predictions (Lighthizer 2010). The Chinese onslaught has led to massive job losses for American workers and permanently worsened conditions for many workers and communities. Secondly, the United States believes that China has not made China an easy market for other countries after it acceded to the WTO. WTO membership is not enough to make China an easy market for foreign companies to supply from outside China.

5.3 Impact

The US does not leave China many options when it comes to a trade war. China has also used the WTO dispute settlement system to take measures of the same magnitude and scale against the United States. And the effects of the trade war are spreading in many ways. More risks are on the horizon after bilateral relations deteriorated over trade, intellectual property, investment, and exchanges.

As the world's first and second-largest economies, the ongoing trade tension between the US and China has increased uncertainties in the global trading system and international cooperation (Hoekman 2020).

At present, the global economy is affected by trade frictions. The rate of global goods trade growth has slowed dramatically, investment demand has reduced, and economic activity has weakened. World goods trade expanded by barely 0.6% year on year in the first half of 2020. The International Monetary Fund expects the global economy to grow by 3.0% in 2020, the slowest rate since the 2008 glob-al economic crisis. The course of trade negotiations also affects commodity market prices.

The Asian economy is also affected by externalities, and its growth rate has slowed down significantly. According to WTO data, Asian imports declined 0.4% in the first half of 2019, the lowest performance in the world. Central banks in major Asian economies have embraced lax monetary policy in response to poor economic demand and declining development, putting Asia's financial vulnerabilities at risk. WTO should play an important role in resolving China-US trade conflicts. The trade war between China and the United States is not only a conflict between the two countries but also reflects policies that need to be changed due to the development of the

world economy. (1) "Enhanced Competition Policy measures". (2) Development of new international conventions on intellectual property, including "A new Convention on Rules for cross-border Data Flows", "Restructuring discipline on subsidies and the Role of The State in the Economy" and "the latest Agreement on Trade-related Investment Measures (Reduction)" (Steinbock 2018).

6 Conclusion

Taken as a whole, the WTO provide a rather comprehensive and relatively robust IP protection and dispute settlement mechanism, which can't be easily substituted by other regional trade agreements. The WTO mechanism is still in its growth and there are certainly and inevitably many defects need to be solved. Rather than claiming that the WTO mechanism is fading away, what need to be considered is how to adjust it to this ever-changing global pattern when there is actually a way out there. More and more signals have showed that the WTO being a passive arbitrator can't actually meet the need of the members and is gradually deviating from the original intent of every member state. The WTO need to be more active and more dynamic to regain trust of its members as well as reconstruct itself to better fit into members' demand.

The Appellate Body nowadays is still paralyzed. Although this paralyzation indicates a failure of the WTO to prevent itself from ruling by power, rather than ruling by law, it offers a path for countries to rethink about the current global trading system, as well as regulations governing such huge organization. From this aspect, reforms that lead the all the WTO members to a greater future is underway.

Despite the development of RTAs, countries still need international markets and the WTO as guarantees. The WTO, as an international organization covering a large number of member countries, plays a role that cannot be replaced by promoting international trade and protecting the interests of developing countries. In addition, the WTO also has mechanisms such as the transparency mechanism to help it adapt to the changing international trend. Therefore, in the future, the WTO will continue to have an important influence on the international community.

The trade war between China and the US is not going well, and the WTO has not played an effective role in settling disputes. At present, the two governments have been in a stalemate in the trade war, and there has been no further development and effective consultation. The resolution of the US and China trade war requires cooperation from many aspects, and the reform of the WTO on its effectiveness is also indispensable. At the same time, measures such as regional trade agreements can also alleviate the global economic slowdown caused by US and China trade frictions to a certain extent.

Acknowledgements All the author are the first authors. All authors contributed equally to this paper.

References

Adekola TA (2019) US–China trade war and the WTO dispute settlement mechanism. J Int Trade Law Policy

Agreement on Trade-Related Aspects of Intellectual Property Rights art. 42 (1994) Marrakesh agreement establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299

Barrett E (2020) Trump's prolonged assault on WTO means its ruling against Chinese tariffs is essentially moot. Fortune. https://fortune.com/2020/09/16/trump-wto-china-tariffs-trade-war-appeals-judges/

Bergsten CF, Schott J (1997) A preliminary evaluation of NAFTA. Testimony before congress

Correa CM (1994) Trends in technology transfer: implications for developing countries, vol 21. SCL Publication Policy, p369

Chatzky A, McBride J, Sergie MA (2020) NAFTA and the USMCA: weighing the impact of North American Trade. Counc Foreign Relat

Ciuriak D (2019) The US-China trade war: technological roots and WTO responses. Glob Solutions J 4:130–135

Crawford J-A, Laird S (2001) Regional trade agreements and the WTO. North Am J Econ Finance 12(2):193–211

Dreyfuss RC, Lowenfeld AF (1997) Two achievements of the Uruguay round: putting TRIPS and dispute settlement together. Va J Int'l L 37:275, 282

Fernandez R (1997) Returns to regionalism: an evaluation of non-traditional gains from RTAs

Find Dispute Cases. World Trade Org. https://www.wto.org/english/tratop_e/dispu_e/find_dispu_cases_e.htm

Freund C, Ornelas E (2010) Regional trade agreements. Annu Rev Econ 2(1):139–166

Fukunaga Y (2008) Enforcing TRIPS: challenges of adjudicating minimum standards agreements. Berkeley Technol Law J 23:10

Gao H (2021) Finding a rule-based solution to the appellate body crisis: looking beyond the multi-party interim appeal arbitration arrangement. J Int Econ Law 24(3):534–550. https://doi.org/10.1093/jiel/jgab031

Garvey S (2018) Resolving US-China IP disputes through the WTO: a legal alternative to unilateral sanctions. Boston College Intellectual Property and Technology Forum, p 2

GATT (1947)

Hart M (2021) The World Trade Organization's (WTO's) appellate body: key disputes and controversies. Congressional Research Service

Hillman J (2018) Three approaches to fixing the world trade Organization's appellate body: the good, the bad and the ugly? https://www.law.georgetown.edu/wp-content/uploads/2018/12/Hillman-Good-Bad-Ugly-Fix-to-WTO-AB.pdf

Hoekman B (2020) Trade wars and the World Trade Organization: causes, consequences, and change. Asian Econ Policy Rev 15(1):98–114

Hoekman B, Mavroidis PC (2019) Burning down the house? The appellate body in the Centre of the WTO crisis. European University Institute, Robert Schuman Centre for Advanced Studies, Global Governance Programme Working Paper No. RSCAS 2019/56

Kate W (2021) An expert explains: what is RCEP, the world's biggest trade deal? World Economic Forum. https://www.weforum.org/agenda/2021/05/rcep-world-biggest-trade-deal/. Accessed 29 Apr 2022

Kemp MC, Wan Jr HY (1976) An elementary proposition concerning the formation of customs unions. J Int Econ 6(1): 95–97

Lighthizer R (2010) Testimony before the US-China economic and security review commission: evaluating China's role in the World Trade Organization over the past decade. In: US-China economic and security review commission

Liu T, Woo WT (2018) Understanding the US-China trade war. China Econ J 11(3):319–340

Mansfield E (1993) Unauthorized use of intellectual property: effects on investment, technology transfer, and innovation. In: Wallerstein MB et al (eds) Global dimensions of intellectual property rights in science and technology, vol 107, pp 110–119

Maskus KE, Konan DE (1994) Trade-related intellectual property rights: issues and exploratory results. In: Deardorfif AV, Stem RM (eds) Analytical and negotiating issues in the global trading system, vol 401, pp 409-16, 439-40

McBride J, Chatzky A, Siripurapu A (2021) What's next for the trans-Pacific partnership (TPP). Council on Foreign Relations

Panel Report (2000) Canada-patent protection of pharmaceutical products, P4.4, WT/DS114/R, pp 7.94–7.104. (Accessed 25 Apr 2022)

Petersmann E-U (2018) How should the EU and other WTO members react to their WTO governance and WTO appellate body crises? In: EUI RSCAS, 2018/71, Global Governance Programme-331, [European, Transnational and Global Governance], [Europe in the World]. http://hdl.handle.net/1814/60238

Picciotto S (2005) The WTO's appellate body: legal formalism as a legitimation of global governance. Governance 18:477–503

Samuelson P (1997) The U.S. digital agenda at the world intellectual property organization. Va J Int Pocky 37:78–82, 88–97

Steinbock D (2018) US-China trade war and its global impacts. China Q Int Strateg Stud 4(04):515–542

US-Chnia trade war time line. https://www.bbc.com/news/business-45899310

USTR 2009 Report

Vidigal G (2019) Living without the appellate body: multilateral, bilateral and plurilateral solutions to the WTO dispute settlement crisis. J World Investment Trade 20(6):862–890. https://doi.org/10.1163/22119000-12340160

Weightman W (2020) Is the emperor still far away? Centralization, professionalization, and uniformity in China's intellectual property reforms. UIC Rev Intell Prop L 13–14

William New (2018) China-US tensions over IP measures rise at WTO dispute body. Intellectual Property Watch, pp 1–2

World Trade Organization (2002) Secretariat, summary by the secretariat: United States—section 211 omnibus appropriations act of 1998, WT/DS176/11, para 215. https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds176_e.htm

WTO Regional trade agreements facts and figures. World Trade Organization. https://www.wto.org/english/tratop_e/region_e/region_e.htm. Accessed 29 Apr 2022

WTO Regional trade agreements and the WTO. World Trade Organization. https://www.wto.org/english/tratop_e/region_e/scope_rta_e.htm. Accessed 29 Apr 2022

WTO TRIPS—trade-related aspects of intellectual property rights. World Trade Organization. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm#issues. Accessed 29 Apr 2022

Air Pollution and Earnings Management

Kexin Zhang

Abstract The development of firms in heavy-polluted industries causes a series of environmental problems. The disharmony between those firms' operations and environmental protection is the main contradiction in Chinese environmental governance. Heavy-polluted firms normally lack the awareness to bear the associated costs of negative externalities, but as public awareness of environmental issues grows, firms attracting public attention are more likely to undergo strict scrutiny of government. Government reacting to public concerns imposes costs on heavy-polluted firms, particularly those with high earnings, by tightening project approval, strictly enforcing regulations and punishing polluted firms. This paper examines the impact of public attention to air pollution on corporate earnings management. I find that heavy-polluted firms manage their earnings in response to public attention to air pollution. The extent of firms' downward earnings management increases with the rising public attention to air pollution. This paper not only provides an incentive for firms to adjust their earnings in the field of earnings management literature, but also verifies firms do react to these external pressures once there are potential costs.

Keywords Earnings management · Public attention · Air pollution

1 Introduction

Throughout history, the economy is normally developed at the expense of the environment. The eighteenth-century industrial revolution dramatically increased carbon dioxide, freon, and carbon monoxide emissions. Previous literature has revealed a strong positive correlation between haze and the degree of industrialization and urbanization development in China (He and Ma 2015). Both of the above seem to confirm a traditional conflict between the economy and the environment. As the

K. Zhang (✉)
Shanghai University of International Business and Economics, No.1900 Wenxiang Road, Songjiang District, Shanghai, China
e-mail: 2273929651@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_67

government continues to implement environmental policies, the public has grown increasingly concerned about the environment in recent years. In addition, with more comprehensive and timely environmental information available to the public, the public can easily participate in monitoring the environmental pollution of firms. This kind of public awareness is beneficial to environmental governance. However, for firms, public attention to the environment can impose costs on them, especially for heavy-polluted firms with high earnings. Due to public pressure, the government will tighten environmental compliance reviews of projects and impose harsher administrative penalties on firms polluting the environment. Therefore, to reduce political costs caused by public attention, firms are predicted to use earnings management to reduce public concern. This paper examines whether firms would use earnings management in response to public attention on air pollution.

In recent years, China has made significant efforts in environmental governance. The government has been expanding the network of environmental quality monitoring stations, disclosing environmental monitoring statistics in realtime. Certain local governments designate firms with a tendency to pollute heavily as key discharge businesses and monitor them for pollution sources. Besides, the media has been constantly tracking environmental issues and vigorously promoting environmental protection. Additionally, an increasing number of firms are being compelled to disclose their Corporate Social Responsibility (CSR) report, of which environmental issues play a major role. With society surrounded by various environmental issues, the public is paying more attention to the environment, particularly air pollution. Because air pollution has a direct impact on our health, and data on air quality is more readily available to the public, directly causing the public reaction. For example, in 2015, the broadcast of Chai Jing's documentary on haze investigation sparked a social sensation.

However, increased public attention to the environment will impose costs on heavy-polluted firms. Public attention to environmental protection causes negative exposure for heavy-polluted firms. To cater to readers' needs and attract more attention, the media would try to dig out negative news of potentially polluting firms. Previous research indicates that high media coverage and public attention result in increased audit fees and audit conservatism (Wu and Ye 2020). Through media reports, the public becomes more sensitive to those heavy-polluted firms. And then, the vibrant public discussion and complaints about environmental pollution will attract the government's attention and thus put pressure on heavy-polluted firms. On the one hand, the government will tighten its control over these heavy polluters. When these firms propose a new project, the government would assess environmental impact before approval. Xie and Lin find that when air pollution occurs, the government will implement stricter environmental policies and tighten the review process for corporate projects in order to avoid jeopardizing its own environmental credibility (Xie and Lin 2020). Therefore, more stringent scrutiny will increase costs for these firms and delay the completion of projects. On the other hand, due to the inability to completely upgrade devices technologically in the current situation in China, manufacturing firms are more or less generating pollution during their production. As the matter of fact, local governments turn a blind eye to corporate pollution emissions for

the sake of economic development. However, when environmental pollution causes public concern, external pressure will compel the government to regulate enterprise pollution behavior. Firms emitting pollution will face fines, and even face closure in some severe cases. The administrative penalties will incur significant costs as well as damage to their reputation.

In particular, firms with higher earnings are more likely to attract public attention. Firstly, earning is an important financial indicator with economic value. Ball and Brown verified that earnings numbers have a value relevance that can influence the stock price (Ball and Brown 1968). Therefore, firms frequently manipulate earnings in order to gain some benefits. Certain firms employ earnings management to avert losses and also for obtaining government subsidies (Burgstahler and Dichev 1997; Jones 1991). At the same time, earnings are viewed as an investment guide to the public. Therefore, for the media, higher-earning firms are more appealing to the public and thus more newsworthy. As demonstrated by the case of *Hurun Rich List*, successful business people who appear on the list garner greater public attention and are thus more newsworthy for the media. To attract the public, the media is more likely to unearth negative information about these billionaires, such as how they became wealthy through illegal business practices (Wu and Ye 2020). Similarly, if a firm expands operations and excels in making a profit, it is more likely to draw public attention and thus become newsworthy. In turn, the media will dig up negative information about these firms, such as whether there were any irregularities during their development. Furthermore, in the public's opinion, it is difficult for firms in heavy-polluted industries to seek a balance between economic interests and environmental protection. When the public environment is polluted but the earnings of heavy-polluted firms are optimistic, the public naturally wonders whether these heavy-polluted firms are making profits at the expense of polluting the environment and whether the operation of heavy-polluted firms has externalities to society. When the public begins to question and be dissatisfied with these polluters, it draws the government's attention to them, strengthening their regulation. Therefore, for these heavy-polluted firms, negative public exposure would lead to conservative accounting. They may reduce public attention by lowering earnings.

To examine whether firms would use earnings management to mitigate the public attention caused by air pollution, I explore the effect of public concern about air pollution on the earnings management of heavy-polluted firms by testing whether these heavy polluters would reduce their earnings as public attention on air pollution increases. I quantify public attention to air pollution through Air Quality Index (AQI), a monitoring indicator of air quality. When the AQI is higher, it indicates that the air pollution is more severe, and the public is more concerned about air condition at that time. I calculate the level of earnings management using the Jones Model and the Modified Jones Model separately. Following that, I develop a multiple linear regression model to examine the relationship between public attention to air pollution and the level of earnings management. The results show that when air pollution is more severe, which increases public attention, the extent of downward earnings management increases. It demonstrates that firms alleviate public concern by lowering their earnings.

Two additional mechanism tests are conducted to examine the effect path of public attention to air pollution on earnings management, that is, whether firms engage in earnings management in order to avoid more stringent government scrutiny caused by public pressure. The first mechanism test explores whether firms that are less afraid of government scrutiny conduct less downward earnings management. I divide the sample into state-owned enterprises (SOEs) and non-state-owned enterprises (Non-SOEs) based on their ownership structure. I argue that, due to their association with government interests, SOEs are more likely to be exempt from rigorous government oversight. Therefore, they will conduct fewer earnings management in response to public attention on air pollution, and the results support our hypothesis. My second mechanism test examines the effect of distance to Beijing on earnings management. Given that environmental protection is managed vertically, I assume that the closer a firm is located to the central government, the more stringent government scrutiny it will face. I arrange locations of sample firms in descending order in terms of their distance from Beijing and classify them into three groups according to the distance. And then, I examine the relationship between public attention and corporate earnings management across a range of distances and discover that the closer a firm is located to Beijing, the more stringent scrutiny it will face, thereby the more downward earnings management it will engage in.

The contribution of this paper is mainly reflected in the following aspects: Firstly, based on the traditional contradictions between the economy and the environment, this paper focuses on the social costs of firms' operations. Prior literature shows that environmental governance negatively influences firms' operations (He et al. 2020). By examining the financial manipulations that heavy-polluted firms conduct in response to more serious air pollution, I demonstrate that it is hard to seek a balance between environmental protection and economic development so that firms manage their earnings in response to potential losses. What is more, this paper also contributes to earnings management literature. I provide an additional incentive for downward earnings management—to reduce public attention. This paper shows that the public can influence government enforcement to heavy-polluted firms by exerting pressure on the government, thereby bringing administrative costs to these firms. This paper confirms that public attention can exert pressure on firms, causing them to internalize environmental factors and adjust themselves.

The following section will delve deeper into my subject. Section two discusses the institutional background and hypothesis development, while section three discusses the data and sample description. In section four, I discuss the research design, which includes the construction of the regression model, as well as the explained and explanatory variables. Section five conducts empirical analysis, including baseline regression results and two mechanism analysis results. Finally, in the sixth section, I provide the conclusion.

2 Institutional Background and Hypothesis Development

2.1 Institutional Background

Since the 18th Party Congress, environmental protection has been elevated to a top priority in the national governance strategy. The 13th Five-Year Plan has significantly improved the quality of China's ecological environment, with numerous targets successfully accomplished and decisive results achieved in the "blue sky, blue water, and clean soil defense war". Currently, green and low-carbon transformation are the major focus of the 14th Five-Year Plan (Ministry of Ecology and Environment of the People's Republic of China 2021), and the 9th meeting of the Central Finance and Economics Commission in 2021 sets the goal of reaching carbon peak by 2030 and carbon neutrality by 2060 (The State Council of The People's Republic of China 2021). Nevertheless, China is also confronted with a significant challenge in the process of environmental governance. The coal-based energy structure of our country has remained largely unchanged, and the majority of air pollution is still attributed to coal combustion (Ministry of Ecology and Environment of the People's Republic of China 2021); additionally, in comparison to developed countries, China is still industrializing and urbanizing at a slow pace, which means that the foundation for green transformation remains weak and the task of carbon peak and carbon neutrality is more arduous.

As technology becomes mature, the environmental monitoring network of China becomes more sophisticated, not only for real-time and accurate monitoring of environmental quality indicators but also for a broader range of applications. During the 14th Five-Year Plan period, the number of urban ambient air quality monitoring points will increase from 1436 to nearly 1800, covering all cities above the prefecture level and new national districts (Ministry of Ecology and Environment of the People's Republic of China 2020), facilitating the government's pollution control guidance in each region. The government also provides real-time disclosure of environmental indicator data, enabling the public to have immediate access to information about air quality. Therefore, the public has a more intuitive sense of the air quality in the environment. Additionally, in terms of supervising listed companies, in 2008, the Shanghai Stock Exchange (SSE) required three types of companies, those are, the sample companies of the "SSE Corporate Governance Panel", companies issuing overseas-listed foreign shares and financial companies, to disclose CSR (Shanghai Stock Exchange 2008), a large portion of which is environmental-related information, such as environmental liabilities and environmental responsibility. Since the disclosed environmental information are subject to government regulation and public scrutiny, which in turn can have an effect on firms' development, the government can compel these firms to self-regulate by forcing them to disclose CSR, particularly those in heavy-polluted industries. CSR enables the public to obtain additional information about the sources of environmental pollution. With growing public awareness of environmental protection, the public will respond more quickly when they have access to more comprehensive information about the environment, particularly

about air quality. Air quality is inextricably linked to our health, and air pollution can cause respiratory diseases and significantly impair our quality of life. Additionally, air monitoring indicators are fairly comprehensive and timely. Such as AQI, a national air quality assessment standard that was released in 2012, not only covers the majority of the country but can also be updated hourly. As a result, people are more aware of and responsive to instances of air pollution.

2.2 Hypothesis Development

When public awareness of environmental protection increases and they are able to respond quickly to air pollution, public attention to air pollution becomes an external cost to heavy-polluted firms. First of all, as the media excavates and exposes negative news about pollutants emitted by heavy-polluted firms, public attention will shift to the firms that threaten air quality, resulting in intense public discussion and dissatisfaction with the offending firms, as well as questions about the government's ability to govern (Xie and Lin 2020). Under public pressure, the government will impose stricter regulations on those polluting businesses. Not only will government tighten the environmental review of firms' proposed projects, but it will also impose strict penalties on polluting behaviors, resulting in significant administrative costs for these heavy polluters. Particularly, the higher the earnings, the more attention the firms will receive from the public. That is because when the public sees the contrast between the high earnings of heavy-polluted firms and the poor environment in which they live, their discontent grows and they begin to blame these polluters with high earnings for environmental problems.

To avoid attracting public attention, which will obstruct firms' development, firms frequently manipulate earnings to conceal their high returns in order to distract public attention and alleviate public discontent. When earnings have economic value, businesses often employ earnings management to advance their interests. According to Liu and Liu, heavy polluters engage in adjusting earnings management downward following a haze outbreak in response to the rising political costs they face (Liu and Liu 2015). For the heavy-polluted firms discussed in this paper, when air pollution is severe, downward earnings management would be an effective tool for managers to alleviate public concern. On the basis of this reasoning, I arrive at the first and primary hypothesis:

H1: In response to public attention to air quality, heavy-polluted manufacturing firms would conduct downward earnings management.

Different firm characteristics would influence the baseline effect. Due to firm heterogeneity, the extent to which firms manipulate their earnings varies in response to external pressures. Firms can be classified as state-owned enterprises (SOEs) or non-state-owned enterprises (Non-SOEs) based on their ownership structure, making them operate in different political environments. SOEs are owned and controlled by the government, which means that their behavior is determined by the government's will and interests. To boost economic performance, governments place a higher

premium on protecting the interests of SOEs and providing them with additional policy support (Xie and Lin 2020). When air pollution becomes more severe, SOEs will adjust their earnings downward by a small amount because they are government-protected and not subject to strict government scrutiny. In comparison to SOEs, Non-SOEs lack government patronage and will face stricter supervision and administrative penalties. As a result, Non-SOEs will adjust their earnings levels more aggressively to avoid public attention. On the basis of this reasoning, I propose the following second hypothesis.

H2: Non-stated-owned enterprises (Non-SOEs), Compared with SOEs, are more likely to conduct downward earnings management in response to public attention.

As the capital of China, Beijing experienced rapid economic development in its early years, which, combined with the high level of social production and unfavorable topography and climate (Zhou and Ru 2012), resulted in serious air pollution problems as well as difficult prevention and control processes. In January 2013, Beijing experienced severe air pollution, with an average mass concentration of $PM_{2.5}$ of nearly 160 $\mu g/m^3$ for the month (Ministry of Ecology and Environment of the People's Republic of China 2019). Since 2013, the government has focused on the strategic positioning of the "four centers" for Beijing in order to carry out comprehensive air pollution control; since 2018, the government has vigorously implemented a three-year air pollution control action plan in order to continuously improve the air quality of the capital. Therefore, Beijing's air quality has significantly improved in recent years.

Based on the influence mechanism of public concern on the impact of corporate earnings management, I argue that the distance between the location of a heavy-polluted firm and Beijing affects the government scrutiny of that firm and thus the extent of corporate earnings management. Due to the mobility of air, air pollution in one region has a ripple effect on neighboring provinces and cities, and Beijing is indeed significantly impacted by emission sources from neighboring provinces and cities in the fall (Zhou and Ru 2012). To maintain the air quality of Beijing, the government will impose stricter controls on the provinces and cities surrounding Beijing. Besides, due to the vertical management of environmental protection, the closer the location of a heavy-polluted firm is to the central government, the more vulnerable it is to environmental policies. As a result, polluters closer to Beijing will manage their earnings to a greater extent so as to avoid drawing the attention of the government and the public. The above influence mechanism inspires my third hypothesis.

H3: Firms located closer to Beijing have more pressure to reduce public attention. The effect would be weaker with the distance to Beijing increase.

3 Data and Sample Description

My sample consists of all publicly traded Chinese firms operating in heavy-polluted industries. I use industries that previously need environmental protection verification when applying for listing or refinancing as heavy-polluted industries. In accordance with the "*Notice on Checking the Environmental Protection of Listed Companies*" issued in 2001 and the "*Provisions on Environmental Protection Verification for companies applying to list and refinancing*" issued in 2003, firms from 14 industries must submit their measures and results in environmental protection to the approval department during the listing and refinancing.

With the exception of firms lacking necessary information, there are currently 1054 publicly listed firms in these industries spreading across 202 cities. Given that we can only access air quality in recent years, the sample period starts in 2014 and ends in 2020. Finally, 4217 observations were obtained. In this paper, the data on air quality comes from the official monitoring station, the city-level data comes from the Economy Prediction System Database (EPS), and the company-level data comes from the China Stock Market and Accounting Research Database (CSMAR).

I employ the AQI to measure the degree of air pollution, which quantifies public attention to air pollution. AQI, the air quality index, is the air quality evaluation standard issued by the government in 2012 to measure the degree of air pollution. The AQI is calculated using six pollutants: sulfur dioxide, nitrogen dioxide, PM_{10}, $PM_{2.5}$, carbon monoxide, and ozone. Based on its value, the AQI is classified into six grades. The greater the index value, the higher the grade, indicating that the more severe air pollution. I collect monthly data on AQI from the China National Environmental Monitoring Center's (CNEMC) website and calculate the annual average value of AQI for each city. When the annual average AQI is greater, it indicates that the air pollution of the city is more severe in the current year, making it easier to draw public attention to air pollution.

According to the descriptive statistics in Table 2, I describe Mean, Standard Deviation, Minimum, Maximum, P25, P50 and P75 of all variables. The variable *AQI_year* which measures the degree of air pollution, *EM_Jones* and *EM_ModifiedJones*, which measure earnings management by using the Jones Model and the Modified Jones Model separately, as well as company-level variables (*ROA*, *Size*, *MB*, *Leverage*, *SOE*, *Age*) and city-level variables (*Population*, *PPE_investment*, *GDP*, *Primary_industry*, *GOV_revenue*, *GOV_expenditure*), all have 4217 observations.

4 Research Design

4.1 Regression Model

To examine the effect of increased public attention to air pollution on corporate earnings management, I conduct regression analysis on earnings management and

Table 1 Variable definition

EM_Jones	Earnings management, computed by Jones Model
EM_ModifiedJones	Earnings management, computed by Modified Jones Model
AQI_year	The degree of air pollution, computed as natural logarithm of annually-average AQI of the city where the firm is located in the current year. This variable quantifies the public attention to air pollution. The higher the value of AQI_year, the higher the public attention to air pollution
ROA	Return on asset (ROA), computed as net profit divided by total assets at the end of the year
Size	The size of the company, computed as natural logarithm of total assets at the end of the year
MB	Market to book ratio, computed as total market value divided by total assets at the end of the year
Leverage	Debt to asset ratio, computed as total liabilities divided by total assets at the end of the year
SOE	Indicator variable for state-owned enterprises (SOEs), equals one if the firm is ultimately controlled by the state, and zero otherwise
Age	The number of years a firm has been founded
Population	Total population at the city level, computed as natural logarithm of the total population of the city where the firm is located in the current year
PPE_investment	Fixed asset investment at the city level, computed as natural logarithm of the total investment for fixed assets of the city where the firm is located in the current year
GDP	Natural logarithm of GDP of the city where the firm is located in the current year
Primary_industry	The proportion of primary industry of the city where the firm is located in the current year
GOV_revenue	Government budget revenue at city level, computed as natural logarithm of government budget revenue of the city where the firm is located in the current year
GOV_expenditure	Government budget expenditure at the city level, computed as natural logarithm of government budget expenditure of the city where the firm is located in the current year

levels of air pollution. The regression model is as follows:

$$EM_{it} = \beta_0 + \beta_1 \log(AQI_{it}) + \beta_2 X_{it} + Year + \varepsilon_{it} \quad (1)$$

where:

EM_{it} = earnings management in year t for firm i
AQI_{it} = the degree of air pollution in year t where firm i is locate
X_{it} = a series of company - level and city - level control variables
$Year$ = year dummy
ε_{it} = error term in year t for firm i

Table 2 Descriptive statistics

Variable	Mean	Std. Dev	Min	P25	P50	P75	Max	N
EM_Jones	−0.01	0.09	−0.41	−0.05	0	0.04	0.27	4217
EM_ModifiedJones	−0.01	0.1	−0.41	−0.05	0	0.04	0.27	4217
AQI_year	4.35	0.25	3.67	4.18	4.37	4.51	4.99	4217
ROA	0.02	0.14	−3.91	0.01	0.03	0.06	0.4	4217
Size	22.33	1.2	18.39	21.54	22.2	23	27.57	4217
MB	2.32	2.69	0.01	0.87	1.61	2.89	44.13	4217
Leverage	0.44	0.3	0.01	0.28	0.42	0.58	10.5	4217
SOE	0.32	0.47	0	0	0	1	1	4217
Age	18.74	5.5	6	15	18	22	53	4217
Population	6.18	0.54	3.01	5.94	6.2	6.58	7.24	4217
PPE_investment	17.23	0.73	13.55	16.81	17.48	17.76	18.24	4217
GDP	8.59	0.98	5.03	7.9	8.68	9.31	10.02	4217
Primary_industry	5.03	4.82	0.04	1.37	3.8	6.84	42.28	4217
GOV_revenue	15.42	1.14	11.85	14.67	15.5	16.28	17.32	4217
GOV_expenditure	15.82	0.9	12.4	15.19	15.74	16.42	17.64	4217

The explained variable is earnings management (EM_{it}) which is separately calculated by Jones Model and Modified Jones Model. The explanatory variable is the degree of air pollution (AQI_{it}) measured by the annually-average AQI, which is used to quantify public attention to air pollution. The control variables are divided into two categories: company-level and city-level. The control variables at the company level are ROA, the size of the firm, market-to-book ratio, ownership structure (SOEs or Non-SOEs), debt-to-asset ratio and the age of the firm. The control variables at the city level include population, GDP, the proportion of the primary industry, the proportion of investment in PPE, government budget revenues and government budget expenditures. The interested coefficient is β_1. The negative β_1 indicates that the earnings management is adjusted downward while the positive β_1 indicates an upward adjustment of earnings management.

4.2 Measure of Earnings Management

I use Jones Model and Modified Jones Model to obtain discretionary accruals which are used to measure earnings management.

Total accruals include both discretionary accruals and non-discretionary accruals. Jones model firstly estimates non-discretionary accruals which are comprised of revenues and fixed assets, and then subtracts non-discretionary accruals from total accruals to obtain discretionary accruals (Jones 1991), which measures earnings management:

$$\frac{TA_{it}}{A_{it-1}} = \alpha_i \frac{1}{A_{it-1}} + \beta_{1i} \frac{\Delta REV_{it}}{A_{it-1}} + \beta_{2i} \frac{PPE_{it}}{A_{it-1}} + \varepsilon_{it} \quad (2)$$

where:

TA_{it} = total accruals of firm i in year t

ΔREV_{it} = revenues of firm i in year t less revenues of firm i in year t − 1

PPE_{it} = gross property, plant, and equipment of firm i in year t

ε_{it} = error term of firm i in year t

In the above equation, gross property, plant, and equipment as well as change in revenues are included in the expectations model to control for changes in nondiscretionary accruals caused by changing conditions. Total accruals (TA) include changes in working capital accounts, such as accounts receivable, inventory and accounts payable, that depend to some extent on changes in revenues. The prediction error, ε_{it}, represents the level of discretionary accruals as well as the level of earnings management. The earnings management level is regressed within each city year, and winsorized at their 1st and 99th percentiles.

Based on the Jones Model, the Modified Jones model assumes that the manipulation of revenues is through receivables (Dechow et al. 1995). I use earnings management computed from Modified Jones Model as the alternative proxy. The Modified Jones Model is estimated for each city-year grouping as follows:

$$\frac{TA_{it}}{A_{it-1}} = \alpha_i \frac{1}{A_{it-1}} + \beta_{1i} \frac{\Delta REV_{it} - \Delta REC_{it}}{A_{it-1}} + \beta_{2i} \frac{PPE_{it}}{A_{it-1}} + \varepsilon_{it} \quad (3)$$

where:

ΔREC_{it} = receivables of firm i in year t less receivables of firm i in year t − 1.

The coefficient estimates are used to estimate the firm-specific non-discretionary accruals (NA) for my sample firms. My measure for discretionary accruals, the level of earnings management, is the difference between total accruals and the fitted normal accruals.

In accordance with the concept of total accruals, I choose the direct method to calculate total accruals. Total accruals are used to evaluate the operational capabilities of the firm. According to the accruals basis, the total profits include not only cash receipts, but also receivables on credit. As a result, total accruals are calculated by deducting net cash from net profit:

$$TA_{it} = N/P_{it} - N/C_{it} \quad (4)$$

where:

N/P_{it} = net profit of firm i in year t

N/C_{it} = net cash from operating activity of firm i in year t

4.3 Measure of Public Attention to Air Pollution

I use the annual average of AQI to measure the degree of air pollution, which quantifies the public attention to air pollution in the city where a heavy-polluted firm is located in the current year.

I collect monthly data on AQI to calculate the annually-average AQI:

$$AQI_{it} = \sum_{m}^{12} AQI_{itm} \tag{5}$$

where:

AQI_{it} = the degree of air pollution of the city where firm i is located in year t

AQI_{itm} = the degree of air pollution of the city where firm i is located in month m of year t

And then, I calculate natural logarithm of AQI_{it} to obtain the variable *AQI_year*.

5 Empirical Analysis

5.1 Baseline Regression

Table 3 reports air pollution effects on earnings management. Columns 1 and 3 examine the relationship between two proxies: the level of earnings management (*EM_Jones*, *EM_ModifiedJones*) and the degree of air pollution (*AQI_year*). Columns 2 and 4 examine the relationship between earnings management and air pollution with the addition of company-level and city-level control variables. The earnings management in Column 1 and Column 2 is calculated by the Jones Model, and the earnings management in Columns 3 and Column 4 is calculated by the Modified Jones Model. The regression results of each column show that the degree of air pollution (*AQI_year*) has a significant negative effect on the level of earnings management (*EM_Jones*, *EM_ModifiedJones*) at the level of 1%. The negative coefficient indicates that when the degree of air pollution increases, the firm will adjust its earnings level downward. Considering Column 2, the coefficient of *AQI_year* is −0.0335, which indicates that when the annually-average AQI increases by 1%, the level of earnings management will be adjusted downward by an average of 3.35% (computed as the absolute value of β_1% divided by the absolute value of the mean of earnings management, that is 0.0335%/0.01 = 3.35%). Consistent with my hypothesis, the results indicate that in response to public attention to air pollution, heavy-polluted firms would conduct downward earnings management. The more severe of air pollution, the more earnings management will be adjusted downward.

Table 3 Baseline regression results

	(1)	(2)	(3)	(4)
	EM_Jones	EM_Jones	EM_Modified Jones	EM_Modified Jones
AQI_year	−0.0177***	−0.0335***	−0.0200***	−0.0365***
	(−2.96)	(−4.83)	(−3.29)	(−5.19)
Size		0.001		0.0021
		(0.73)		(1.57)
ROA		0.3094***		0.3120***
		(26.97)		(26.80)
MB		−0.0013**		−0.0015**
		(−2.27)		(−2.57)
Leverage		0.0087*		0.0094*
		(1.65)		(1.74)
Age		0.0002		0.0001
		(−0.46)		(−0.77)
Population		−0.0024		−0.0023
		(−0.53)		(−0.50)
PPE_investment		0.0059		0.0054
		(1.43)		(1.28)
GDP		0.0059		0.0077
		(0.82)		(1.05)
Primary_industry		−0.0003		−0.0002
		(−0.53)		(−0.46)

(continued)

Table 3 (continued)

	(1)	(2)	(3)	(4)
	EM_Jones	EM_Jones	EM_Modified Jones	EM_Modified Jones
GOV_revenue		−0.005		−0.0059
		(−0.69)		(−0.80)
GOV_expenditure		−0.0111*		−0.0119*
		(−1.67)		(−1.77)
Constant	0.0683***	0.2235***	0.0778***	0.2297***
	(2.62)	(2.78)	(2.94)	(2.81)
Observations	4217	4217	4217	4217
Adjusted R^2	0.0259	0.2226	0.0259	0.2229

Note ***, ** and * represent significant at 1%, 5% and 10% respectively

5.2 Mechanism Tests

SOE and Non-SOE. This section studies the influence path of public attention to air pollution on corporate earnings management. To test whether heavy-polluted firms will adjust their earnings levels downward in fear of government scrutiny, I first compare the sensitivity of earnings management to air pollution for firms with different ownership structures. In China, there are two distinct types of firms with radically different ownership structures: SOEs and Non-SOEs. With government protection, SOEs can avoid strict government scrutiny in the face of external pressure. As a result, I anticipate that SOEs will exhibit a less extent of earnings management in the face of air pollution than Non-SOEs. I categorize sample firms as SOEs and Non-SOEs (the classification standard refers to CSMAR which has already classified these firms). SOE = 0 represents Non-SOEs while SOE = 1 represents SOEs.

Table 4 reports air pollution effects on earnings management separately in the case of SOEs and Non-SOEs. Columns 1 and 3 examine the relationship between the level of earnings management (*EM_Jones*, *EM_ModifiedJones*) and the degree of air pollution (*AQI_year*) in the case of SOEs while Columns 2 and 4 are in the case of Non-SOEs. The regression results of each column show that the degree of air pollution (*AQI_year*) has a significant negative effect on the level of earnings management (*EM_Jones*, *EM_ModifiedJones*), indicating that even though heavy-polluted firms with different ownership structures will be subject to different government scrutiny, they all adjust their earnings downward in the face of public concern caused by air pollution. Comparing Column 3 with Column 4, however, the negative effect of air pollution on the earnings management of Non-SOEs in Column 4 is more significant than that of SOEs in Column 3. Considering the magnitude of the coefficients, the coefficient of *AQI_year* in Column 3 is −0.0259, indicating that when annually-average AQI increases by 1%, the earnings management of SOEs will be adjusted downward by an average of 2.59% (computed as 0.0259%/0.01 = 2.59%). And for the Non-SOEs in Column 4, when the annually-average AQI increases by 1%, the earnings management will be adjusted downward by an average of 4.27% (computed as 0.0427%/0.01 = 4.27%), which is greater than that of SOEs. Therefore, consistent with my prediction, the earnings management of Non-SOEs is more sensitive to air pollution, and Non-SOEs will adjust earnings management downward to a greater extent in the face of external pressures caused by air pollution.

Distance from Beijing. Additionally, distance can also affect government scrutiny. When the heavy-polluted firms are closer to Beijing, the air pollution from the location of the heavy polluters is a greater threat to Beijing, and makes it easier for the central government to manage them vertically. Therefore, I examine the effect of the distance of the heavy-polluted firms from Beijing on the relationship between earnings management and air pollution, thus verifying the influence mechanism. I predict that firms closer to Beijing will adjust their earnings levels to a greater extent in the face of external pressures caused by air pollution. As a province has a unified provincial environmental protection bureau, the management measures will be consistent in a province. Therefore, the distance between the capital of the province

Table 4 Group sample regression——SOEs and Non-SOEs

	(1)	(2)	(3)	(4)
	SOE	Non-SOE	SOE	Non-SOE
	EM_Jones	EM_Jones	EM_Modified Jones	EM_Modified Jones
AQI_year	−0.0224*	−0.0400***	−0.0259**	−0.0427***
	(−1.95)	(−4.57)	(−2.21)	(−4.82)
Size	−0.0025	0.0035*	−0.0021	0.0053***
	(−1.14)	(1.94)	(−0.93)	(2.89)
ROA	0.2791***	0.3132***	0.2840***	0.3148***
	(10.69)	(24.23)	(10.67)	(24.07)
MB	−0.0051***	−0.0009	−0.0053***	−0.0011*
	(−2.65)	(−1.49)	(−2.72)	(−1.68)
Leverage	−0.0308**	0.0167***	−0.0298**	0.0173***
	(−2.35)	(2.83)	(−2.23)	(2.89)
Age	0.0009*	−0.0002	0.0009*	−0.0002
	(1.89)	(−0.51)	(1.94)	(−0.59)
Population	0.0028	−0.0047	0.0038	−0.0052
	(0.35)	(−0.84)	(0.46)	(−0.91)
PPE_investment	−0.0049	0.0129**	−0.0052	0.0121**
	(−0.74)	(2.43)	(−0.76)	(2.25)
GDP	0.0018	0.0054	0.0017	0.0084
	(0.15)	(0.56)	(0.14)	(0.87)
Primary_industry	−0.001	0.0002	−0.0011	0.0003
	(−1.19)	(0.26)	(−1.30)	(0.43)
GOV_revenue	−0.01	−0.0028	−0.0111	−0.004
	(−0.82)	(−0.31)	(−0.89)	(−0.43)
GOV_expenditure	0.0026	−0.0162**	0.0033	−0.0175**
	(0.21)	(−2.03)	(0.26)	(−2.17)
Constant	0.3153**	0.1412	0.3251**	0.1409
	(2.18)	(1.43)	(2.21)	(1.41)
Observations	1361	2856	1361	2856
Adjusted R^2	0.1852	0.2449	0.1828	0.247

Note ***, ** and * represent significant at 1%, 5% and 10% respectively

where a heavy-polluted firm is located and Beijing represents the distance of this firm to Beijing. Firstly, I rank the distance between the capitals of the provinces where these heavy-polluted firms are located and Beijing in descending order. Group = 1 is the top third of the ranking, including heavy-polluted firms which are closest to Beijing; Group = 2 is one-third to two-thirds of the ranking; Group = 3 is the

last third in the ranking, including heavy-polluted firms in the provinces which are farthest to Beijing.

Table 5 reports air pollution effects on earnings management separately in the different ranges of distances. Column 1 and Column 4 show the regression results between earnings management (*EM_Jones*, *EM_ModifiedJones*) and degree of air pollution (*AQI_year*) in the case of Group = 1, firms of which are closest to Beijing. The results show that there is a significant negative correlation between these two variables at the level of 1%. The correlation coefficient of *AQI_year* is −0.1192 (−0.1232), which indicates that when the annually-average AQI increases by 1%, the earnings management will be adjusted downward by an average of 1.192% (1.232%). In the case of Group = 2 and Group = 3 in other columns, the results show that there is no significant correlation between earnings management and the degree of air pollution. Therefore, consistent with my hypothesis, when the location of heavy-polluted firms is closer to Beijing, they will downward earnings to a greater extent in the face of public attention pressure caused by air pollution.

6 Conclusion

Based on the traditional conflict between economic development and environmental protection, this paper discusses the impact of public attention to air pollution on earnings management. This research demonstrates that when public concern about the environment increases, the degree of earnings management by heavy-polluted firms increases. In the context of gradually increasing public awareness of environmental protection, air pollution will obtain more public attention. By exerting pressure on the government, public attention will impose costs on these polluting firms. Especially profitable heavy polluters will attract more public attention, undergoing more stringent government audits and administrative penalties. To avoid such costs, firms prefer to adjust their earnings levels downward to make them less attractive. Additionally, whether or not the heavy polluters are ultimately controlled by the government and their distance from Beijing will affect their extent of managing earnings in response to external pressures. In comparison to Non-SOEs, SOEs will face less external pressure because they are backed by the government. The closer firms are to Beijing, the more likely they are to be noticed by the public and the government, necessitating a more intensive approach to earnings management.

Under the background that the nation places a premium on environmental governance, resolving pollution caused by heavy-polluted firms has been one of the priorities for the government. This study discusses the earnings management that firms will engage in as the air crisis worsens, which lends some credibility to our government's environmental governance. Firstly, for heavy-polluted firms, public concern about the environment does exert pressure on polluters to respond. However, when these businesses prefer to use earnings management to avoid costs, it is more critical for them to address the root cause of the problem by strictly adhering to pollutant emission standards and implementing a green transition. Secondly, for government,

Table 5 Group sample regression—distance from Beijing

	(1)	(2)	(3)	(4)	(5)	(6)
	group = 1	group = 2	group = 3	group = 1	group = 2	group = 3
	EM_Jones	EM_Jones	EM_Jones	EM_Modified Jones	EM_Modified Jones	EM_Modified Jones
AQI_year	−0.1192***	0.0244	−0.0114	−0.1232***	0.0258	−0.015
	(−7.31)	(0.95)	(−1.08)	(−7.42)	(0.99)	(−1.42)
Size	0.0012	0.0035	−0.0007	0.0023	0.0042	0.0007
	(0.61)	(0.90)	(−0.32)	(1.11)	(1.09)	(0.33)
ROA	0.2377***	0.3375***	0.4816***	0.2396***	0.3419***	0.4845***
	(15.41)	(10.03)	(24.24)	(15.26)	(10.04)	(24.19)
MB	−0.0019*	−0.0018	−0.0007	−0.0023**	−0.0022*	−0.0007
	(−1.80)	(−1.41)	(−0.92)	(−2.11)	(−1.67)	(−0.96)
Leverage	−0.0034	0.0193	0.0222**	−0.0032	0.0209	0.0237**
	(−0.50)	(1.04)	(2.11)	(−0.46)	(1.11)	(2.24)
Age	−0.0002	0.0008	0.0004	−0.0002	0.0008	0.0004
	(−0.45)	(1.12)	(1.22)	(−0.43)	(1.03)	(1.15)
SOE	−0.0019	−0.002	−0.0046	−0.0032	−0.0026	−0.0055
	(−0.40)	(−0.27)	(−0.99)	(−0.68)	(−0.36)	(−1.18)
Population	0.0203*	−0.0172	−0.0117	0.0199*	−0.0189	−0.0085
	(1.74)	(−1.24)	(−1.57)	(1.68)	(−1.34)	(−1.13)
PPE_investment	0.0026	0.0083	0.0177*	0.0023	0.0085	0.0138
	(0.46)	(0.58)	(1.86)	(0.39)	(0.60)	(1.44)
GDP	0.0006	0.0245	0.0117	0.0032	0.0262	0.0132

(continued)

Table 5 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)
	group = 1	group = 2	group = 3	group = 1	group = 2	group = 3
	EM_Jones	EM_Jones	EM_Jones	EM_Modified Jones	EM_Modified Jones	EM_Modified Jones
	(0.04)	(1.07)	(1.31)	(0.22)	(1.14)	(1.47)
Primary_industry	−0.001	0.0016	−0.0013	−0.001	0.0017	−0.001
	(−0.97)	(1.35)	(−1.55)	(−0.95)	(1.43)	(−1.19)
GOV_revenue	0.0058	−0.0143	−0.0302**	0.0032	−0.0144	−0.0233
	(0.37)	(−0.78)	(−2.12)	(0.20)	(−0.78)	(−1.63)
GOV_expenditure	−0.0310*	−0.0015	0.0063	−0.0305	−0.0024	−0.0012
	(−1.70)	(−0.07)	(0.49)	(−1.64)	(−0.12)	(−0.09)
Constant	0.7290***	−0.2285	0.0745	0.7436***	−0.2408	0.1066
	(3.97)	(−1.05)	(0.56)	(3.98)	(−1.09)	(0.79)
Observations	2085	654	1478	2085	654	1478
Adjusted R^2	0.1917	0.2058	0.3619	0.1912	0.2099	0.3631

Note ***, ** and * represent significant at 1%, 5% and 10% respectively

whether SOEs or Non-SOEs, should be treated equally, subject to strict oversight, and severely punished for violations. Simultaneously, the government should vigorously support the transformation of heavy-polluted firms' production technology in order to reduce pollutants at the source.

References

Ball R, Brown P (1968) An empirical evaluation of accounting income numbers. J Account Res 6(2):159–178

Burgstahler D, Dichev I (1997) Earnings management to avoid earnings decreases and losses. J Account Econ 24(1):99–126

Dechow PM, Sloan RG, Sweeney AP (1995) Detecting earnings management. Account Rev 70(2):193–225

He F, Ma D (2015) Association study between haze pollution and industrialization. Soft Sci 29(6):110–114 (In Chinese)

He G, Wang S, Zhang B (2020) Watering down environmental regulation in China. Q J Econ 135(4):2135–2185

Jones JJ (1991) Earnings management during import relief investigations. J Account Res 29(2):193–228

Liu Y, Liu M (2015) Have smog affected earnings management of heavy-pollution enterprises?—based on the political-cost hypothesis. Account Res 3:26–33 (In Chinese)

Ministry of Ecology and Environment of the People's Republic of China (2021) How to lay out the green transformation in the 14th five-year plan in the face of difficult tasks—Minister of ecology and environment huang runqiu interviewed by Outlook weekly. http://www.mee.gov.cn/ywdt/hjywnews/202104/t20210406_827488.shtml

Ministry of Ecology and Environment of the People's Republic of China (2019) Beijing 2013–2018 air pollution control history: comprehensive measures, comprehensive treatment, resolutely winning the battle for the blue sky of the capital. http://www.mee.gov.cn/ywgz/xcjy/shxc/201909/t20190909_733022.shtml

Ministry of Ecology and Environment of the People's Republic of China (2020) National urban ambient air quality monitoring points will increase to nearly 1,800 during the 14th five-year plan. http://www.mee.gov.cn/ywdt/hjywnews/202001/t20200111_758804.shtml

Shanghai Stock Exchange. Notice on the 2008 annual report of listed companies (2008), http://www.sse.com.cn/aboutus/mediacenter/hotandd/c/c_20150912_3988269.shtml

The State Council of The People's Republic of China (2021) Xi jinping presided over the ninth meeting of the Central Finance and Economics Commission. http://www.gov.cn/xinwen/2021-03/15/content_5593154.htm

Wu D, Ye Q (2020) Public attention and auditor behavior: the case of *Hurun Rich List* in China. J Account Res 58(3):777–825

Xie J, Lin X (2020) Air pollution, pessimistic expectations, and the investment behavior of polluting enterprises: evidence from China. Econ Rev 5:124–136 (In Chinese)

Zhou T, Ru X (2013) Research on the causes of hazy weather and control measures in Beijing. J North China Electr Power Univ (Social Sciences) 2:12–16 (In Chinese)

Linear Programming Approach in Agricultural Production-Land Allocation

Xuan Liang

Abstract In this paper, a Linear Programming model is developed to obtain a land allocation plan that can yield the optimal profits and is applied to a set of parameters in a small-holder production farm. The objective of the model is to maximize the profit. The limited resources—Land, fertilizers, irrigation water, labor, and fuel—are transformed into constraints in the model. It is found out that the plan obtained by the LP model is more profitable than the original plan of the farm, which presents that the LP model can help the farmers to make better production plans.

Keywords Linear programming · Land allocation · Small-holder production

1 Introduction

The agriculture sector is fundamental to modern society concerning people's daily life. In the agriculture sector, the available natural resources such as land and water are indisputably important factors that can influence the production. For farmers, appropriately allocating those limited resources is vital to optimizing the profits. Despite the natural resources, there are also external elements related to humans such as fertilizer, labor, and farm tools that may improve the amount of crops but raise the prime cost. Having so many components to consider, farmers still need to decide which crops to grow and which livestock to raise, reasonable seasons, and market demand so that they can maximize their profits, which is indisputably a complex and challenging task (Alotaibi and Nadeem 2021). As a result of the difficulty in agricultural production, a linear programming approach can be used to develop a mathematical model that acts as the complete farm subject to restraints represented by linear relationships can be developed using a LP (Linear Programming) approach (Alotaibi and Nadeem 2021).

X. Liang (✉)
UC SANTA BARBARA, Santa Barbara, CA 93106, USA
e-mail: xuanliang@ucsb.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_68

The LP model is a technique that helps to solve problems which aim to get an optimal quantity under certain restrictions. In operation research where objectives and functions are all linear, formulating a LP model is the most suitable method to solve the problem (Bhatia and Bhat 2020). A LP model includes three fundamental parts: an objective function to be optimized, constraints represented by linear relations, and non-negative decision variables which must be involved in the function and relations. There are several tools that can be used to get solutions in a LP model, including Microsoft Excel and software like LINGO, LINDO (Majeke et al. 2013). In this paper, the Solver function in Microsoft Excel will be applied to solve the LP model.

While initially developed to solve military and industrial problems, the LP model is broadly applied in many other areas in financial, marketing, transportation, and other resource allocation problems, including agricultural production (Bhatia and Bhat 2020). In agriculture, the LP model can be also helpful by allocating available resources to get maximum income. To be more specific, under certain circumstances, various situations in agricultural production such as feed mix problem, land allocation problem, crop rotation problem, and water irrigation problem can be transformed into linear relationships between different variables. After transforming real life problems into a mathematical model with linear equations, it is easy to solve the model by mathematical calculation. While farms are various in size and products, different LP models can be developed to solve each different problem.

The objective of this paper is to apply the LP model as a farm decision tool to improve the resource efficiency of smallholder farm production so that the profits will be maximized. The allocation of land under limited resources such as labor, seeds, and fertilizers should be studied. The allocation of land under each kind of crop is commonly based on the area used to be cultivated in previous years (Bhatia and Bhat 2020). Therefore, in order to obtain maximum profits, both land and water resources for different crops should be optimized.

2 Related Work

The research of LP model's application in agriculture has become more popular these years.

In this paper (Alotaibi and Nadeem 2021), the researchers investigated the applications of the LP model in the agriculture sector in different areas. Based on a number of previous works, this paper summarized three main reasons for using the LP model in agriculture and discussed some shortcomings. This study (Bhatia and Bhat 2020) applies the LP model in real production. The researcher developed a farm model for Jaipur District of Rajasthan by using linear programming in order to determine the feasible optimal crop combination and how these crops will be allocated to increase the production. This research (Majeke et al. 2013) is a specific case study of using the LP model in a real farm. The researchers chose a Model A2 resettled farmer as a research area. By formulating a LP model, this study found out a production plan for the farm that can get more profits than the plan suggested by traditional method

of trial and error that the farmers used to apply. This research (Dehua 1982) also uses a LP model to discuss the area allocation problem in crop production. However, unlike the previous two, this study formulates a model that includes the option of different soil but ignores the constraints of other resources such as water and fertilizers. The research (Simeng et al.) discusses how to use the LP model to optimize production plan. While this research is not about agriculture, it precisely discusses how the change of prerequisites will influence the final results. This study (Mellaku et al. 2018) is also a case study that applied the LP model to smallholder farmer crop production in Ethiopia. As the researchers gathered a large amount of data from local groups, they found out that the average profitability of the traditional land use practices was far much lower than the estimated level given by LP model. Hence, the LP model can greatly enhance local crop production.

3 Research Area

In this study, I will focus on the smallholder crop production. That is, suppose that the farmer has a fixed area of farmland and fixed kinds of crop to raise. Besides, all the available resources are limited and fixed, so the mathematical model can be constructed as linear equations. Also, we don't consider the effect of the market, so the gross income by each kind of crop will not change, so we can represent the income as a constant coefficient, same thing for the price of seed.

4 LP Model Formulation

Suppose a farmer has a fixed number square kilometers of land which will be used for n types of crops. For each crop i, the expected income based on area for the next season will be c_i yuan/acres. Now, we want to construct an optimization model that would help the farmer to achieve an optimal crop enterprise combination that will maximize the total gross income for the next season. The decisions variables and activity coefficient are given by Tables 1 and 2.

Then we can formulate an LP model:

$$\max \sum_{i=1}^{N} c_i x_i \tag{1}$$

subject to (2–7)

Table 1 Decision variables

x_i	The area allocated for crop i

Table 2 Activity coefficient

c_i	The gross income for crop i per acres
w_i	The total amount of water used for crop i per acre
f_i	The total amount of fertilizer used for crop i per acre
l_i	The total number of labors worked for crop i per acre
u_i	The total amount fuel used on crop i per acre
X	The total area of the land
W	The max available amount of water
F	The max available amount of fertilizer
L	The max available number of labor
U	The max available amount of fuel

$$\sum_{i=1}^{N} x_i \leq X \tag{2}$$

$$\sum_{i=1}^{N} w_i x_i \leq W \tag{3}$$

$$\sum_{i=1}^{N} f_i x_i \leq F \tag{4}$$

$$\sum_{i=1}^{N} l_i x_i \leq L \tag{5}$$

$$\sum_{i=1}^{N} u_i x_i \leq U \tag{6}$$

$$x_i \geq 0, i = 1, 2, \ldots, N \tag{7}$$

4.1 Objective Function

The objective function (1) represents the sum of the gross income brought by each kind of crop.

4.2 Constraints

Then, we should consider the limited resources: land, water, fertilizers, labor, seed price.

Constraint (2) means that the sum of the area allocated for each crop cannot be larger than the total area. Similarly, the constraint of water (3) means that the sum of the irrigation water allocated for each crop will be less than or equal to the available water resources. Constraint of fertilizers (4) implies that the sum of the fertilizers used in each crop will be less than or equal to the available number of fertilizers. Constraint of labor (5) represents that the sum of the workers allocated for each crop will be less than or equal to the available number of workers. Constraint of seed (6) means that the sum of the amount of fuel spent on each crop cannot be larger than the available amount of fuel. Also, the non-negativity (7) because area allocated for each crop cannot be negative.

5 LP Model Application

Suppose a farmer has a farm with 100 acres of land and he plans to use it for rice, pea, potato, cabbage, and tomato production in the next season. The expected gross income for next season is; 320 yuan/acres from rice, 330 yuan/acres from peas, 250 yuan/acres from potatoes, 310 yuan/acres from cabbage, 300 yuan/acres from tomatoes. The manager would like to get an optimization model that can help him to achieve an optimal crop enterprise combination for the next season. His goal is to maximize the total gross income. Before the mathematical model was constructed, the manager had made a plan to allocate 40 acres for rice, 10 acres for peas, 20 acres for potatoes, 15 acres for cabbages and 15 acres for tomatoes. He wants to know whether this production plan can yield maximum returns.

The limited resources include land, fertilizers, fuel, water, labor are given by Table 3.

Then, we can apply the LP model to that information, and we can get:

$$\max \quad 320x_1 + 330x_2 + 250x_3 + 310x_4 + 300x_5 \tag{8}$$

subject to

$$x_1 + x_2 + x_3 + x_4 + x_5 \leq 100 \tag{9}$$

$$2000x_1 + 4000x_2 + 1500x_3 + 4000x_4 + 2800x_5 \leq 300000 \tag{10}$$

$$2x_1 + 2x_2 + 2x_3 + 3x_4 + 3x_5 \leq 300 \tag{11}$$

Table 3 Parameter for LP formulation

Resource	Rice i = 1	Peas i = 2	Potatoes i = 3	Cabbages i = 4	Tomatoes i = 5	Limit
Land (x_i)	1	1	1	1	1	X = 100
Fertilizer (f_i)	2	2	2	3	3	F = 300
Fuel (u_i)	200	300	100	150	200	U = 30,000
Labor (l_i)	7	5	1	4	4	L = 500
Water (w_i)	2000	4000	1500	4000	2800	W = 300,000
Income (c_i)	320	330	250	310	300	

$$7x_1 + 5x_2 + x_3 + 4x_4 + 4x_5 \leq 500 \tag{12}$$

$$200x_1 + 300x_2 + 100x_3 + 150x_4 + 200x_5 \leq 30000 \tag{13}$$

$$x_1, x_2, x_3, x_4, x_5 \geq 0 \tag{14}$$

5.1 Results

Using Microsoft Office Excel we can solve the LP model. The Result is given by Table 4.

The results show that the optimal plan is to allocate 29 acres for rice, 49 acres for peas, 12 acres for potatoes, and 10 acres for tomatoes. Under this plan, the gross income will be 31,450 yuan. And the utilization rate of the available resources is given by Table 5. The land, irrigation water, and labor are all exhausted, but the available amount of fertilizer and fuel are not fully utilized.

Table 4 Production plan by LP model

Crop	Rice	Peas	Potatoes	Cabbages	Tomatoes
Land (acres)	29	49	12	0	10

Table 5 Utilization rate of plan given by LP model

Resources	Land	Water	Fertilizer	Labor	Fuel
Limit	100	300,000	300	500	30,000
Utilized	100	300,000	210	500	23,700
Utilization rate	1	1	0.7	1	0.79

5.2 Comparison to Original Production Plan

Now, we compare the production plan given by LP model to the original production plan in Table 6.

Under the original plan, the gross income will be 30,250 yuan. Hence, the production plan by LP model increases the farmer's gross income by 1200 yuan. In other words, the LP model can increase the gross income by 3.97%. Hence, it is obvious that the original plan cannot yield a maximum profit. Instead, the LP model gave the farmer a better production plan that can get optimal profit (Table 7).

While the production plan given by LP model indisputably generates a better profit. On the other hand, if we compare the utilization rate between the two plans, we can find out that the original plan utilized less resources than the production plan given by LP model except for fertilizers. Since the only goal in this LP model is to yield the maximum money, we do not consider the number of used resources as long as they are less than the limit. However, if the objective function includes environmental friendship as a factor so that we should use as few resources as possible, the original plan might be better than the production plan by this LP model. Hence, under different objective functions, different LP models should be formulated and a solution to a specific LP model cannot be applied to others.

Table 6 Original production plan

Crop	Rice	Peas	Potatoes	Cabbages	Tomatoes
Land (acres)	40	10	20	15	15

Table 7 Utilization rate of original plan

Resources	Land	Water	Fertilizer	Labor	Fuel
Limit	100	300,000	300	500	30,000
Utilized	100	252,000	230	470	18,250
Utilization rate	1	0.84	0.77	0.94	0.61

Table 8 Limit of labor versus net income

Labor limit	Labor worked	Income (yuan)
500	500	31,450
520	520	31,650
540	540	31,860
560	548	31,960
580	574	32,230
600	600	32,500
620	600	32,500
640	620	32,500

5.3 Limit of Labor Versus Net Income

In the production plan obtained by the LP model, we can see that while both the used amount of fertilizer and fuel for seed are much more than the limit, the available amount of water and labor are exhausted. Now, we want to check how the limit change of labor can influence the results given by the LP model. Hence, we fix the other constraints and change the limit of labor to see how the gross income varies.

Using Microsoft Excel, we get the results given by Table 8.

When the limit of labor increases by 20 each time, the income is generally increasing in an irregular pattern. When the limit of labor increased from 500 to 540, the increase of the income is increasing as well. However, when the limit of labor changed from 540 to 560, the income only increased by 100 yuan. Maybe it is because the labor are not fully working here, as there are still 12 workers left. Then, as the limit changed from 560 to 580 and from 580 to 600, the income increased 270 as well, which is much more than previous times. However, as the limit went past 600, the gross income did not change any more. Hence, it is convincing that 600 is a vertex of the labor's limit where the gross income will be maximized when other constraints are fixed. A clearer representation of the relationships between the Labor's limit and gross income is given by Fig. 1.

6 Conclusion

In this paper, an LP model is formulated to address the land allocation problem in agriculture. The LP model is applied to a set of numerical data. By comparison between the traditional method of production plan and the production plan given by the LP model, it can be seen that the LP model provides a better strategy for farmers to decide the production. Further discussion is made to check the relationship between the limit of labor and the gross income.

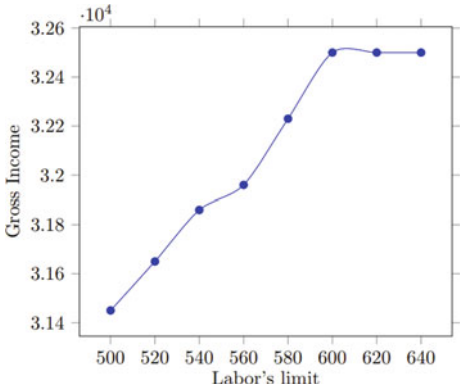


Fig. 1 Labor's limit versus gross income

References

Alotaibi A, Nadeem F (2021) A review of applications of linear programming to optimize agricultural solutions. Int J Inform Eng Electron Bus (IJIEEB) 13(2):11–21. https://doi.org/10.5815/ijieeb.2021.02.02

Bhatia M, Bhat GMJ (2020) Linear programming approach—application in agriculture. J Emerg Technol Innov Res 6(5):155–157

Dehua J (1982) The discussion of structural optimization in agriculture. Chin J Agric Resour Reg Plann

Majeke F et al (2013) A farm resource allocation problem: a case study of model A2 resettled farmers in Bindura, Zimbabwe. Int J Econ Manage Sci 2(7):01–04

Mellaku MT, Reynolds TW, Woldeamanuel T (2018) Linear programming based cropland allocation to enhance performance of smallholder crop production: a pilot study in Abaro Kebele, Ethiopia. Resour J 7(4):1–15

Simeng P, Sanmao Y, Zhuoxia Linear programming theory of producting optimization. College of Mathematics and Computer Science, Jishou University

New Energy Vehicle Research on Marketing Strategy in China

Yiran Liu

Abstract In the context of the global target of carbon neutrality, traditional oil-powered automotive companies are facing risks and challenges, while the new energy vehicle sector is emerging as a new growth area. In the past two years, China's new energy vehicle industry has shown explosive growth relying on corporate R&D and national policies such as tax subsidies; however, since the end of 2021, government investment in new energy vehicles has shifted from direct subsidies to infrastructure development, and even in the face of rising oil prices, new energy vehicles have yet to make a new breakthrough. Under such circumstances, the new energy vehicle companies' own product upgrades and sales strategies have become a new breakthrough for sales growth. This paper takes Xpeng as the research object, through a questionnaire survey, to understand consumers' demand for new energy vehicles. Based on the PEST theory and 4P theory, the paper explores the macro background of the development of new energy vehicles and the future marketing strategies and focus points of Xpeng.

Keywords New energy vehicle · Marketing · Strategy

1 Introduction

In recent years, due to the shortage of oil resources and ecological damage, the traditional automobile industry has received an impact, and new energy vehicles have gained new opportunities for development in such an environment. Although the state has adopted various policies to boost the sales of new energy vehicles, there is still a big gap with the sales of traditional petrol vehicles. Therefore, the exploration of the market to make it more in line with the needs of consumers has become an important point for the breakthrough innovation of new energy vehicles.

Y. Liu (✉)
Central University of Finance and Economics, Beijing, China
e-mail: Fiona.liuyr@outlook.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_69

2 Related Concepts and Theories

2.1 Overview of New Energy Vehicles

New energy vehicles are vehicles that use non-conventional fuels (mainly clean fuels) as a power source (or use new types of on-board power units) with advanced technologies such as power control and drive, compared to conventional fuel vehicles that use fossil fuels such as oil. The industry generally classifies new energy vehicles according to their power source: electric vehicles (EVs), hybrid electric vehicles (HEVs) and fuel cell vehicles (FCEVs); and NiMH, Li-ion and fuel cell powered vehicles according to their battery type.

2.2 Overview of Marketing Theory

PEST Theory. PEST, P means Politics, E means Economy, S means Society and T means Technology.

Politics is the policies, legal regulations and policies of the country or region in which the company is located. The PEST model is a tool for analysing the macro environment (i.e. the external environment) in which a company operates (Electric Vehicles 2014).

Economy refers to the economic development of the country or region in which the company is located. The main indicators measured include inflation rate, GDP, etc., which in a certain sense expresses the consumption level of the region and also influences the sales decision of the company.

Society refers to the social development of the country or region in which the company is located, including the demographic situation, religious beliefs and customs, etc. Knowledge of the social situation can help the company to better select its market.

Technology refers to the degree of technological and technical development of the country or region in which the company is located, which can to a certain extent reflect the degree of development of the region, and more developed technology can also provide better protection for the company.

4P Marketing Theory. The 4P theory—Product, Price, Place and Promotion, was first proposed by American marketing professor Jerry McCarthy and has become one of the classic theories in marketing. In his book "Marketing Management: Analysis, Planning and Control", Philip Kotler discussed the 4Ps in more detail, and from the perspective of enterprises, arranged and combined the above four variables to form different marketing mixes to meet different market demands and help enterprises to achieve their marketing objectives more efficiently.

Product is the core of the 4P theory, price, place and promotion all revolve around product. product is mainly about creating a more competitive product and product portfolio through product development and product packaging.

Price is divided into new product pricing and subsequent price adjustments, etc. New product pricing is usually based on cost, pricing of similar alternatives, market acceptance and other factors; later on, it will be adjusted accordingly based on market response, policy incentives and sales.

Place is the channel through which goods are sold, that is, the process by which they are brought to market. Offline sales are conducted "face to face" with the customer, which is more conducive to the consumer's experience of the product, and the customer's propensity to buy is greater. The disadvantage is that the scale is limited and the coverage is not wide enough. Online sales have a wider coverage, but they do not give consumers an intuitive experience and feeling.

Promotion is a promotional policy adopted by companies in response to the market. Promotion plays a greater role in the consumer's decision to buy. By stimulating consumers' desire to buy through short-term price reductions and bundled sales, the aim is to expand profitability.

3 Xpeng New Energy Vehicles Marketing Status

3.1 Overview of the Development of the Xpeng Car

Founded in 2014, Xpeng Auto is a technology company focused on researching the future of mobility, with its main product being new energy vehicles, and is now one of the leading smart electric vehicle companies in China. With multiple R&D centres in Beijing, Shanghai, Guangzhou, Shenzhen and Silicon Valley and San Diego in the US, the company has a cross-regional and cross-cultural diversity of communication and integration. It also has several production bases with an annual production peak of 500,000 vehicles. Through the new retail model of "self-built and self-operated + authorized operation, 2S + 2S, online + offline", Xpeng provides customers with an "integrated, multi-touch" service experience. As of June 9, 2022, there are 381 sales shops covering 139 cities and 970 self-operated charging stations covering all prefecture-level cities and municipalities. In the past three years, the sales volume of Xpeng's vehicles, represented by the P7, has been increasing year by year (Table 1).

Table 1 Xpeng vehicle deliveries 2019–2021

Year	Deliveries
2019	12,728
2020	27,041
2021	98,166

3.2 Survey on Xpeng New Energy Vehicles Marketing Status

Purpose of the Survey. The current questionnaire for new energy vehicles is relatively mature, and this questionnaire was designed based on the Liu Yi questionnaire model, combined with the research subjects of this paper (Yi 2021). The questionnaire covers basic information statistics (gender and age of respondents); factors influencing the desire to purchase a new energy vehicle; and the perception of new energy vehicle brands.

Survey Data Statistics and Analysis. The questionnaire was distributed online and 155 valid questionnaires were received. To ensure the objectivity and reliability of the questionnaire, anonymity was used. The respondents covered different stages of the population from 18 to over 50 years old, and the proportion of men and women was roughly similar. The results of the questionnaire reflect to a certain extent the marketing problems of Xpeng, and also reflect the consumer demand for new energy vehicles.

Firstly, safety (83.2%) and range (70.3%) are the two most important factors for consumers to consider when purchasing a new energy vehicle. Of the respondents, 80.6% would consider purchasing a new energy vehicle, while the rest of those who would not purchase a new energy vehicle also have concerns about safety and range, so addressing energy anxiety and improving safety testing are key points to gain more consumer trust. The remaining influencing factors are the construction of supporting facilities (59.4%), maintenance and insurance costs (58.7%) and service life (50.3%). In terms of price, respondents' expected price range is mainly in the RMB 100,000–200,000 range (58%), and Xpeng Auto should be expanding its products in the 100,000–150,000 range.

Secondly, the acceptance of new energy vehicles. Among the respondents, 80.6% are willing to consider new energy vehicles, which shows that under the concept of low carbon and environmental protection, new energy vehicles are being accepted by more and more consumers. On the one hand, 82% of respondents have already purchased a car, but only 11% of them are new energy vehicles, indicating that the public still prefers traditional petrol cars while accepting new energy vehicles; but on the other hand, most petrol car owners will consider new energy vehicles to a greater extent when replacing their cars in the future, and the policies they are most concerned about are public charging piles (78.7%), purchase subsidies (71%) On the other hand, most petrol car owners will consider public charging piles (78.7%), purchase subsidies (71%) and tax incentives (51%).

Third, marketing analysis of Xpeng vehicles. The new energy vehicle brands that respondents are most willing to buy in order are BYD (48.4%), Tesla (35.5%), Ideal (15.5%), Xpeng (13.5%) and other brands (18.1%). This shows that Xpeng's awareness is relatively low and there is still a lot of room for marketing and promotion. BYD, as a traditional car brand, has a stronger awareness and consumer base, while launching a diverse range of new energy vehicles with Chinese naming characteristics; in contrast, the emerging brand Xpeng still has to work on its products and promotion.

4 Analysis of the New Energy Vehicle Market Environment for XPeng-Based on PEST Theory

4.1 Analysis of Political Environment

Since 2021, "carbon neutral, carbon peak" has been written into the summary of the government's work report, and the government advocates vigorously developing new energy industries and optimising industrial structure, which has driven the rapid development of new energy vehicles in China. 2010 onwards, led by the policy, China's new energy vehicles are gradually promoted and the technology is gradually developed. Around 2016, the new energy vehicle market was gradually improved and entered a development phase; in 2021, along with the government's promotion, new energy vehicles exploded in growth (Hao and Zhaoqin 2022). China's favourable policies for new energy vehicles are boosting the development of automotive companies while also exposing them to more intense competition (Fig. 1).

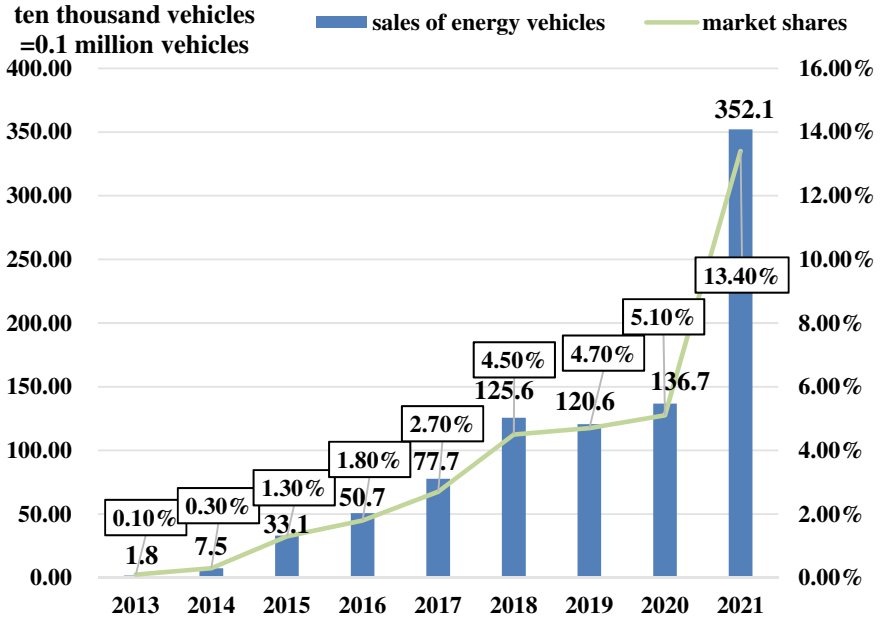


Fig. 1 New energy vehicle sales and market share, 2013–2021 (*Data source* China Automobile Association)

4.2 Analysis of Economic Environment

In 2021, China's GDP reaches $17.7 trillion, an increase of 8.1% over the previous year; per capita GDP reaches $12,551, exceeding the world's per capita GDP level. Even in the face of the epidemic, China's economic volume and GDP per capita continue to grow year on year, and consumption levels continue to rise, providing a good economic foundation for the sale of new energy vehicles.

In 2022, the price of petrol in China was adjusted upwards several times due to the increase in international crude oil prices, but as the price of new energy vehicles was also increased at the same time therefore it was not significantly reflected in sales (Peng et al. 2022). Question 8 of the questionnaire shows that approximately 70% of respondents have increased their desire to buy new energy vehicles due to the increase in oil prices, which is also an opportunity for new energy vehicle sales.

4.3 Analysis of Social Environment

In recent years, the concept of green is prevalent in China, which is a very good social basis for the promotion of new energy vehicles. The other less than 20% of respondents said they would not consider new energy vehicles mainly because of three reasons: range, instability in extremely cold weather and driving experience, which can also be improved through technological development.

4.4 Analysis of Technology Environment

Although there is a large gap between China and developed countries in the field of traditional fuel vehicles, the field of new energy vehicles has reached international standards. From the start of China's new energy vehicle industry in 2010, relying on the research and development and manufacturing of the state and various enterprises, some of China's new energy vehicle enterprises have mastered the key technologies and manufacturing methods of new energy vehicles, and have unique advantages, with BYD representing the automotive enterprises in the field of international trade in lithium batteries are highly competitive (Lv 2020).

5 Marketing Strategy Development for Xpeng

5.1 Marketing Issues of the XPeng

Product and Core Technologies are Still at A Disadvantage. European and American countries have been laying out their development strategies for new energy vehicles since 2009; the promotion of new energy vehicles began after 2016, while China's new energy vehicles started late in comparison, and although they are developing rapidly, they still have disadvantages (Teng et al. 2018).

Compared to other brands, Xpeng has fewer products and a single appearance, which cannot meet diversified needs; in terms of lithium battery technology, there is still a gap with some new energy vehicle enterprises in Europe and the United States, and there is also a disadvantage compared to the domestic BYD; although China has promulgated safety testing standards for new energy vehicles, most new energy vehicle enterprises do not implement them enough, and there are still certain safety hazards.

Inadequate Promotion and Sales Model. The incentives for the purchase of a car from Xpeng are small and are not well reflected in the online and offline publicity. From question 7 of the questionnaire, we can see that the purchase subsidy and tax incentives ranked in the top three policies that respondents are concerned about for new energy vehicles, and the lack of incentives is hardly attractive to consumers.

Insufficient Price Incentives. Only two levels of headings should be numbered. Lower level headings remain unnumbered; they are formatted as run-in headings.

5.2 Marketing Strategy of Xpeng

Promote Technology Development and Product Upgrading. In the 4P theory, the product is the core. The product should be the core point of Xpeng, to promote the core technology of lithium battery and the safety of the car, and to promote the range and safety as the core selling point, question 4 of the survey questionnaire shows that range and safety are the two factors that consumers give the highest priority to new energy vehicles. The P7 is promoted for its long range, and its sales volume not only exceeds that of other P7 products, but also beats many luxury brands and national brands of new energy vehicles.

Increasing the Product Price Range. Xpeng is now focusing its products in the RMB 170,000–240,000 range, using luxury as a selling point. Question 5 of the questionnaire indicates that there is a larger customer base for new energy vehicles in the 100,000–200,000 range, as well as some demand for new energy vehicles in the 200,000–300,000 and 80,000–100,000 range, so Xpeng should diversify its product offering by adding affordable cars in the 100,000 range and luxury cars in the 300,000 range to its current range as a way to expand its customer base.

Expanding Sales Channels and Increasing Promotional Mechanisms. In the context of China's rising national consumption level, increasing the number of shops in second and third tier cities will expand the sales coverage and enhance the after-sales experience for users. In the past two years, it has become increasingly common for new energy vehicles to be located in large shopping malls, and it is important that Xpeng should follow this direction and open experience shops in shopping malls.

Although Xpeng car wired channels, but the performance is not ideal, in response to this phenomenon should increase the online sales channels to bring the customer experience, can use 3D, VR and other technologies to strengthen the online experience; at the same time to increase the promotion, and social platforms, purchase in the platform cooperation, increase the investment in the advertising market.

6 Conclusions and Discussion

The new energy vehicle industry has become a new growth area in the context of both Chinese and international efforts to reduce carbon emissions. As the world's leading producer and sales market for automobiles, China has become a pillar industry. In the field of traditional petroleum vehicles, China has a certain gap with some developed countries; however, in the field of new energy vehicles, although China started late, it has been able to achieve "overtaking" and still has great prospects for development in the future. Oil resources are finite and environmental protection is a matter of urgency for the whole world, so new energy vehicles will be the trendsetter in the automotive industry. As a representative Chinese new energy vehicle company, Xpeng has a promising future.

Based on the results of the questionnaire survey, this paper makes an analysis of the current situation of the Xpeng and draws the following conclusions.

Firstly, since its inception in 2014, Xpeng has relied on its technological sense and intelligence, and has gained a certain customer base with the P7 as its main product, which has a considerable popularity.

Secondly, Xpeng currently has product and technical disadvantages, offline shops are not widespread enough, advertising is not enough such problems.

Thirdly, according to the current situation of Xpeng, the future marketing strategy of Xpeng will be optimised in the context of the macro background analysis of China.

Appendix

Survey on factors influencing the purchase of new energy vehicles

1. **What is your gender?**
   A. Male (55.5% 86)
   B. B. Female (44.5% 69)

2. **Your age**

   A. 18–25 years old (7.7% 12 persons)
   B. 25–30 years old (1.9% 3 persons)
   C. 30–40 years old (18.1% 28 persons)
   D. 40–50 years old (58.1% 90 persons)
   E. E. Over 50 years old (14.2% 22 persons)

3. **Have you purchased a car**

   A. Yes (petrol vehicles) (71.0% 110 persons)
   B. Yes (new energy vehicles, hybrid vehicles) (11.0% 17 persons)
   C. No (23.9% 37 persons)

4. **Which of the following factors is your priority when buying a car?**

   A. Range (70.3% 109 persons)
   B. Security (83.2% 129 persons)
   C. After-sales service (61.9% 96 persons)
   D. Construction of ancillary facilities (59.4% 92 persons)
   E. Service life (50.3% 78 persons)
   F. Maintenance and insurance costs (58.7% 91 persons)

5. **What do you expect the price point of a new energy vehicle to be?**

   A. Under 50,000RMB (2.6% 4 persons)
   B. 50,000–80,000RMB (2.6% 4 persons)
   C. 80,000–100,000 RMB (12.9% 20 persons)
   D. 100,000–150,000 RMB (29.0% 45 people)
   E. 150,000–200,000 RMB (29.0% 45 persons)
   F. 200,000–300,000 RMB (17.4% 27 persons)
   G. Over 300,000 RMB (6.5% 10 persons)

6. **Of the following new energy vehicle brands, the one you would most like to buy is?**

   A. Tesla (35.5% 55 persons)
   B. Xpeng (13.5% 21 persons)
   C. Ideal (15.5% 24 persons)
   D. Azure (23.9% 37 persons)
   E. BYD (48.4% 75 persons)
   F. Other (18.1% 28 persons)

7. **What new energy vehicle incentives are you most concerned about?**

   A. Car purchase subsidy (71.0% 110 persons)
   B. Tax benefits (51.0% 79 persons)
   C. Parking fee waiver (43.2% 67 persons)
   D. Public charging posts (78.7% 122 persons)
   E. No restrictions (45.2% 70 persons)

F. Partial waiver of bridge tolls (36.1% 56 persons)

8. **Would higher oil prices encourage you to buy a new energy vehicle?**

   A. Yes (69.0% 107 persons)
   B. No (31.0% 48 people)

9. **Would you consider purchasing a new energy vehicle in the context of your planned car purchase?**

   A. Yes (80.6% 125 persons)
   B. No (19.4% 30 persons)

10. **What is your attitude towards the development of domestic new energy vehicles?**

    A. Hopeful, promising future (91.6% 142 persons)
    B. Highly competitive, not very positive (7.7% 12 persons)

References

Electric Vehicles (2014) Transp Res Part A Policy Practice 6(2):14–31

Hao F, Zhaoqin X (2022) New energy vehicle industry opportunities and development strategy thinking under the background of "double carbon". Decis Inf 05:68–76

Lv Q (2020) Analysis of effective strategies for marketing of new energy vehicles—taking BYD as an example. Autom Pract Technol 45(23):252–254. https://doi.org/10.16638/j.cnki.1671-7988.2020.23.083

Peng J et al (2022) Can high fuel prices promote consumers to buy new energy vehicles? J Transp Eng Inf. https://doi.org/10.19961/j.cnki.1672-4747.2022.05.021

Teng S, Dan F, Liming H (2018) The current situation of foreign new energy vehicle development and inspiration for China's development. Chem Times 32(09):30–35. https://doi.org/10.16597/j.cnki.issn.1002-154x.2018.09.009

Yi L (2021) Research on marketing strategy of ideal ONE new energy vehicle. East China Jiaotong University, MA thesis

Non-fungible Token (NFT): Introduction, Current Market and Legal Problems

Qunyao Jin

Abstract Non-fungible token (NFT) is a unique cryptocurrency based on Ethereum smart contracts, which is used to bind digital assets to prove their ownership. After merging with gaming platforms, luxury goods, sports and art industries, NFTs generate substantial business opportunities, with sales $24.9 billion in 2021. However, the NFT market faces far more challenges than opportunities and is relatively immature. Few studies analyze the current NFT market in detail and comprehensively from multiple angles simultaneously. Therefore, this article first reviews several essential stages in the history of NFT, then focuses on analyzing the current situation of the NFT market from both positive and negative aspects, and finally points out the institutional problems that need to be solved for the further development of the NFT market in the future. Through this research, we found that the NFT market has cooled compared to 2021, but we cannot simply claim that the NFT market is collapsing. At the same time, the lack of supervision and the validity of contracts are stumbling blocks that urgently need to be solved for further development of the NFT market. This article provides an objective, comprehensive analysis of market conditions for newcomers to NFTs and those who want to invest in NFTs, and informs them of potential risks.

Keywords Non-fungible token (NFT) · Current market · Legal problems · Potential risks

1 Introduction

Non-fungible tokens (NFTs) are digital assets with unique characteristics. Unlike Bitcoin, Ether (ETH) or other tokens that can be exchanged with each other, NFTs have unique identification codes and metadata, which can record digital assets and become their unique credentials (Jordanoska 2021). It is derived from the blockchain,

Q. Jin (✉)
Department of Economics and Management, Beijing Jiaotong University, Weihai 264401, China
e-mail: 19711088@bjtu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_70

mainly the smart contract of Ethereum. Other involved technologies are: Address and transaction, and data encoding (Wang et al. 2021).

Since the first NFT artwork appeared in 2014, NFT technology has existed for more than a decade. Its high transaction volume is astounding compared to its short history. The gorgeous data has made many people eager to invest in it, and many people ignorant of blockchain have begun to pay attention to this field, hoping to profit from it. Indeed, NFTs have fundamentally changed the form of digital transactions (Wang et al. 2021) and are likely to become the mainstream model in the future. Nevertheless, for now, NFT still faces double difficulties in technology and system in terms of security, especially in government supervision and legal system, there are still significant deficiencies. Just in May 2022, the daily trading volume of NFTs fell off a cliff, making many people think that NFT was a scam, and now they have been exposed, and the general trend is over. However, nowadays, there is still a lack of systematic, objective and updated research, which makes many people only obtain fragmented information from comments on the Internet and disputes from various parties, thus becoming more confused and hesitant. Therefore, this article aims to briefly introduce the development history and essential characteristics of NFT to those who are new to the NFT investment field and those who are interested in NFT so that they have a general understanding of NFT; analyze the current state of the NFT market and help investors Decision-making; finally point out the main problems and obstacles in the NFT market, as well as possible future development directions and application areas.

In order to achieve the above goals, this article first explains some subversive characteristics of NFTs, and screens and integrates vital events and turning points in the development of NFTs. Then, the question of "Is NFT Market Collapsing?" raised by The Wall Street Journal was analyzed from both positive and negative aspects, and finally, a clear picture of the current NFT market situation was obtained. Finally, it analyzes the current trade washing, fraud violations of NFT, and the legal problems of contract validity. Afterwards, it innovatively proposes some possible solutions.

The rest part of this work is organized as follows. Section 2 provides some background information about NFTs, and Sect. 3 examines whether "is NFT market collapsing". Further, Sect. 4 discusses the main speculative behaviors and legal issues in the NFT market at present. Section 5 presents possible future application areas.

2 Background

The leading technologies in NFT are: blockchain, smart contract, address and transaction and Data Encoding (Wang et al. 2021). Qin Wang et al. summarized two de-signs of NFT system, and both of them have the same underlying operating mechanism (Fig. 1).

NFT has the properties of "verifiability, transparent execution, availability, tamper-resistance, usability, atomicity, tradability", making it a promising intellectual property (IP)-protection solution (Wang et al. 2021). Therefore, it was first used in

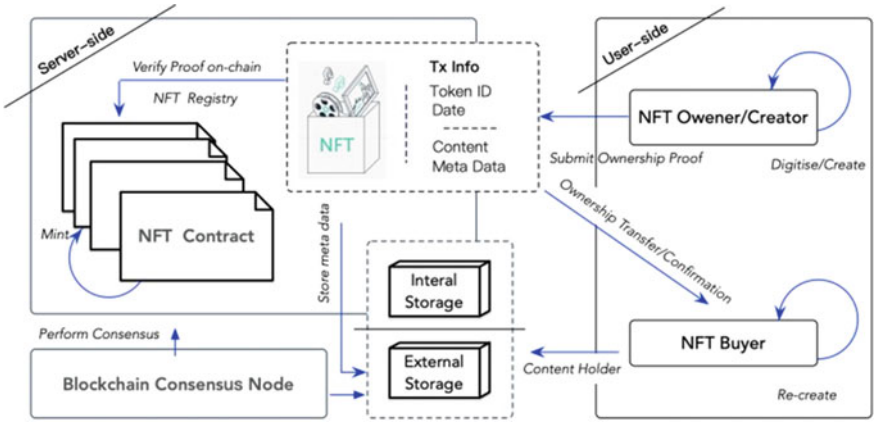


Fig. 1 Workflow of NFT systems (Wang et al. 2021)

art, collectables, and games industries, where it is challenging to identify ownership, and transactions are very dependent on a centralized industry (Nadini et al. 2021). The emergence of NFT has fundamentally subverted these industries, making it easy for everyone to know who created the work in the first place and what trans-actions have been experienced through the distributed ledger. Creators earn a fee (citation) every time their work is traded (Simplilearn 2022).

Since the first NFT work emerged in 2014 (NFT Insight 2021), NFTs have existed for more than 10 years. From the timeline provided by Nadini, Alessandretti et al., it can be concluded that the development of NFT can be roughly divided into three stages: (1) 2014–2018: The art category dominated the market entirely. (2) January 2019–July 2020: NFT market was shared by three categories: Art, Games, and Metaverse. (3) Mid-July 2020–2021: Art and Collectible assets dominated the NFT market. Block-buster transactions in the NFT market with sensational impact Including: Rare Pepes (2016), CryptoPunks (2017), CryptoKitties (2017), NBA TopShot (2020), and Wolf Game (2021) (NFT Insight 2021). Past research has conducted more detailed research on some of the technical risks of NFTs, including: Spoofing (Authenticity), tampering (Integrity), and information disclosure (Confidentiality) (Wang et al. 2021), but specialized research on institutional and regulatory issues is scarce. This research in this area will fill this gap (Fig. 2).

Before 2022, although there have been concerns about the performance of the NFT market (Munster 2021), the transaction volume and value of NFT products have been rising, and the transaction value has reached $40 billion by the end of 2021 (Tumblr 2022). Therefore, there are still investors who are constantly entering the NFT market. However, according to the report of Nonfungible.com, Non-fungible tokens sold daily dropped by 50% in the first quarter of 2022, which made various media reports led by the Wall Street Journal: "NFT market is collapsing" So, what is the truth? Is NFT just a speculator's carnival, a financial bubble? Next, I will discuss this question objectively from both negative and positive aspects.

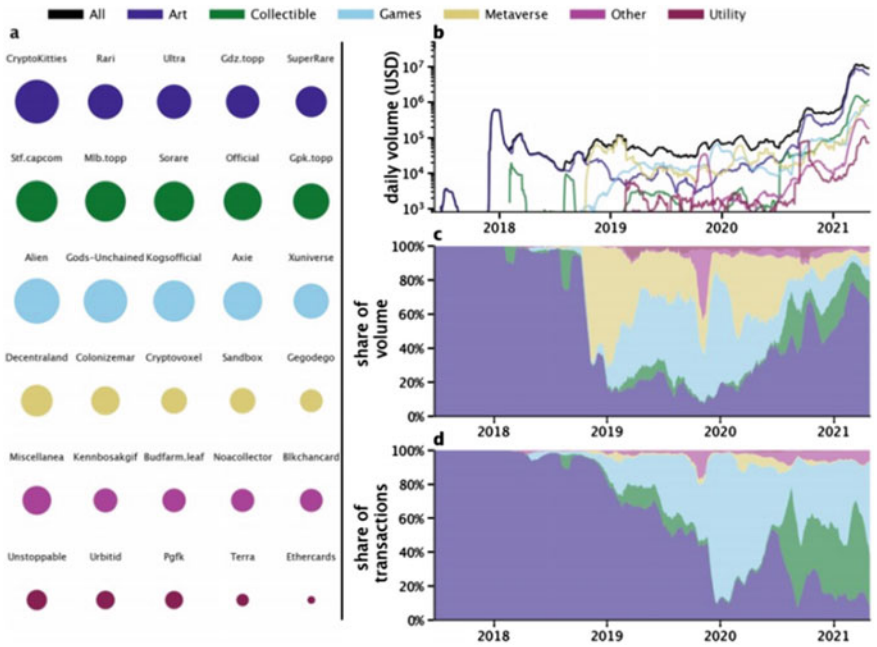


Fig. 2 Transaction history of NFT Market (Nadini et al. 2021)

3 Is the Current NFT Market Collapsing?

3.1 Negative Voice

"The NFT market is collapsing", Wall street journal stated on May 3, 2022, and posted this chart which looks most terrible. This chart was first reported by Non-Fundible in 2022 and made almost everybody think the NFT market is coming to an end as the sale of non-fungible tokens daily fell to about 19,000, which is an impressive 92% decline from a peak in September last year. At the same time, "Collapsing," "flatlining," and "falling fast"—these are words major pubs are using to de-scribe the current NFT market (Hiken 2022).

Moreover, the number of active wallets in the NFT market dropped by 88% compared to November 2021 (The Wall Street Journal). Furthermore, it seems that the people have also lost interest in it. According to Google Trends, the number of searches for the NFT term has fallen roughly 80% since January. As the Ukrainian war started in February, the intense focus was on it instead of new digital assets (Tassi 2022).

Due to this big crash in the NFT market, many wealthy people and business magnates suffered huge losses. Many NFTs are worth far less than before. For example, the first tweet, which sold for $2.9 million in March 2021, now is only worth $14,000

(Walker 2022). Game companies like Square Enix, famous for Final Fantasy, and Ubisoft are all thigh-deep in this slump. It seems the NFT market has collapsed irreparably (Walker 2022).

3.2 Positive Voice

All the above remarks and reports convey a negative message. However, on the other hand, not everyone agrees with this view.

The first and most convincing evidence is the positive response to the Wall Street Journal by NonFoungible.com, the data source. It mainly refutes the report from the following three aspects (NonFungible.com): (1) Although the number of active wallets has decreased, the purchase of There are still more homes than sellers, and it can be assumed that people are still interested in NFTs. (2) Compared to the transaction volume in the last quarter of 2021, the transaction volume in the first quarter of 2022 only fluctuates. (3) The asset, USD and active wallet volume are still up compared to the first quarter of 2021. Gauthier Zuppinger, chief operating officer for NonFungi-ble, claimed that "in no way did the site come to the conclusion that the market was 'collapsing'" (Locke 2022).

What is more, according to a report of chainanalysis, the NFT market has shown signs of recovery since mid-April. Overall, more than $37 billion has been sent by cryptocurrency wallets to NFT marketplaces in 2022 as of May 1. That has nearly caught up to last year's total of $40 billion sent in 2021. That massive spike in activity was primarily due to popular NFT projects like Otherdeeds, the Bored Ape Yacht Club metaverse land NFTs, that pulled in more than $700 million (Locke 2022).

There are also signs that the market is getting bigger. According to the report of Taylor Locke, "The number of active NFT buyers and sellers has increased each quarter since Q2 of 2020". It appears that this quarter is on pace to continue that streak. As of May 1, around 491,000 addresses have bought or sold NFTs in the second quarter of 2022, which could easily top first-quarter numbers, according to the report (Locke 2022) (Fig. 3).

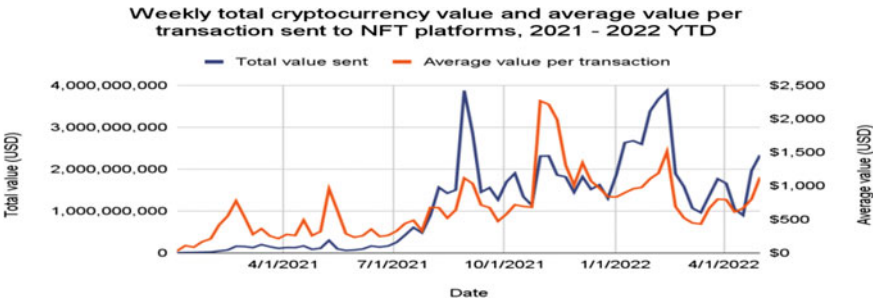


Fig. 3 A sign of a recovery in the NFT market

3.3 Conclusion for This Part

First of all, it needs to be stated that neither the data mentioned above nor the comments of some others are necessarily completely objective and credible because the institutions that provide the data and the people who comment may have interests in the NFT market.

From the analysis of the first two sections, we can draw a crucial message for the NFT market: although the number of NFT transactions has decreased, the transaction value has increased. It does not indicate that the NFT market is collapsing but rather a market that goes from one-time large-volume commodities (Like CryptoPunk and CryptoKitties) to smaller, value-added collections. At the same time, the macroeconomic environment in May 2022 is not optimistic. The Russian-Ukraine war hit a lot of financial industries. Also, when evaluating an NFT marketplace, we always need to look at it holistically to include the number of NFT transactions, users, buyers and sales volume (Locke 2022).

On the other hand, and more importantly, NFT is as evil as the Ponzi scheme, as its underlying ideas and aspirations, including blockchain, decentralization, smart contract, and NFT for IP protection, are all real and beautiful. Besides, NFTs will expand the market size of art and collectables much the same way Uber and Lyft increased the taxi market. NFT is an asset worth hundreds of millions of dollars. It has existed for more than ten years and will not disappear but will probably still exist in a hundred years.

However, buying NFTs for profit rather than for collection is not recommended because there are still many illegal transactions in the current NFT market, and there are some legal flaws. These factors have significantly increased the uncertainty of investment. I will elaborate on the illegal transactions and legal issues involved in NFTs in the next section.

4 Legal Problems in NFT Market and Possible Solutions

4.1 Illegal Transaction

Wash trading: Wash trading refers to the process that buyer and seller repeatedly trade assets with-out taking any market risks, to deliver misleading information to the market (Jordanoska 2021). This activity will seriously disrupt the market order because it artificially controls the transaction volume and transaction value of the market, making people question the transaction's authenticity. In the NFT market, this phenomenon also exists. Victor et al.'s research showed that in their sample, 2.04% of the sales trans-actions were suspected of wash trading, possibly increasing the real transaction volume by as much as $149 million during this period. This result can be used as a feasible lower bound estimate for NFT wash trading on Ethereum.

Increasing transaction fees may be a viable solution. Fraudulent agents will choose to abandon the attack as long as the rewards and incentives are lower than the cost of the attack. But at the same time, it should be noted that the increase in handling fees may also dampen the enthusiasm for genuine transactions.

Fraud: NFT Marketplace has a high degree of anonymity and does not check the identity of users and the authenticity of NFT works. Thus, fraud activity often happens. For example, a person may sell a fake NFT which does not have the owner's consent (Jordanoska 2021). In order to avoid scams in the NFT marketplace, investors can (1) Will The key is kept secret. Never share cryptocurrency wallet information with anyone. These keys, along with any recovery codes, should be private. No one needs to know these passwords for any reason. (2) Research NFT sellers. Please review the seller's NFT marketplace account and check for the blue check verification mark before purchasing. Also, research a seller's social media accounts, check out that seller's other listings and look for any online reviews. (3) View the transaction history of NFT. Be wary of day-trading NFTs (Hetler 2022).

4.2 Major Legal Problems

Traditionally, contracts are in oral or written form; the establishment of the legal relationship occurs after its signature and execution are driven by one of the parties; in smart contracts, on the other hand, the format is codified, and there is an anticipation of the legal relationship, and they are self-executable; aspects of immutability and anonymity that do not exist in the traditional contract are also observed. These situations require an urgent review of the legal concepts inherent in the theory of contracts, as more and more participants are seeking the use of blockchain and smart contracts, as they are of essential importance, not only in the international art trade but also in meeting different needs commercial and in different sectors (de Sousa 2022).

Contractual Effects: General speaking, a contract must have an agreement of will, with an objective verification, and the will must be manifested in actions or demonstrated through a declaration; it is also necessary for the instrument to have parties with legal capacity, the object to be lawful and that there is a motivation (de Sousa 2022). However, in computer language, execution means the beginning of the program on the computer, and this is the moment that will definitively establish the link between the parties, so until then, there would not be a contract with force of law. Thus, the use of the smart contract is not compatible with the will to perform the contract other than the automatically built instrument (de Sousa 2022).

Another highly discussed aspect is the immutable nature of smart contracts, as once introduced and activated, it cannot be modified and will be executed automatically. This situation can bring legal problems, considering that not all unpredictable events could be established ex-ante in smart contracts, which are possibly correctable in traditional contracts. Thus, a smart contract may not be desirable if it differs from

the intentions of the parties, even more when such codes are not written by the parties themselves. In such a way, the inflexibility of the smart contract would be a difficult problem to be solved, especially in the universe of business relationships, where the modification of the fulfilment of obligations is an intrinsic characteristic. The immutability of these contracts can bring another consequence: the impossibility of termination.

All these main contractual effects require from the legal order new methods of hermeneutics, a new way of understanding digital phenomena, and greater interpretive flexibility to change the scope and applicability of current legal institutes (de Sousa 2022).

5 Conclusions

The emergence of NFT has completely changed the form of digital product authentication and trading, and has been widely used in industries such as art, games, and metaverse. However, the Wall Street Journal article on May 3, 2022, claimed that the NFT market is collapsing. This statement makes many people doubt the NFT market and lose confidence in it. This research pointed out that this may be temporary market volatility, there are some macroeconomic effects like the Ukraine war, and there is still much interest in NFTs.

The approach of the traditional legal institutes in the art market seems no longer adequate, and a review of the concepts and nature of legal institutes should be adopted, reformulating the paradigms for the new legal, social and technological reality.

To summarize, the non-fungible token is unlikely to disappear in a short time as it represents a trend, but there is no doubt that NFT requires more and more explicit legal constraints and government regulation.

References

de Sousa FM (2022) Token-art system and the new international art market: the impacts of NFT technology and the legal aspects involved. J Law Market Innov 1(1):98–116

Hetler A (2022) 8 ways to avoid NFT scams. WhatIs.com, TechTarget, 26 May 2022. www.techtarget.com/whatis/feature/8-ways-to-avoid-NFT-scams

Hiken A (2022) NFT market uncertainty-how brands and agencies are reacting to the downturn. Ad Age, 24 May 2022. adage.com/article/digital-marketing-ad-tech-news/nft-strategies-brands-agencies-are-using-crypto-market-plunges/2418176

Jordanoska A (2021) The exciting world of NFTs: a consideration of regulatory and financial crime risks. Butterworths J Int Banking Finan Law 10:716

Locke T (2022) The NFT market is probably not as down as you think it is. Fortune, 12 May 2022. fortune.com/2022/05/05/nft-market-sales-not-flatlining-data-shows/

Munster B (2021) Speculating on NFT speculation. Medium, road less ventured, 13 Sept 2021. medium.com/road-less-ventured/speculating-on-nft-speculation-9bce00ee6502

Nadini M et al (2021) Mapping the NFT revolution: market trends, trade networks, and visual features. Sci Rep 11(1):1–11

NFT insight. A brief timeline of NFT's, NFT insight, 7 Dec 2021. www.nft-insight.com/p/a-brief-timeline-of-nfts?s=r

NFT sales are flatlining. The Wall Street Journal, Dow Jones & Company, 3 May 2022. www.wsj.com/articles/nft-sales-are-flatlining-11651552616

Our NFT market report Q1 2022 is published. NonFungible.com. nonfungible.com/news/corporate/nft-market-report-q1-2022

Simplilearn (2022) Everything you need to know about NFT: Simplilearn. Simplilearn.com, Simplilearn, 20 June 2022. www.simplilearn.com/tutorials/blockchain-tutorial/what-is-nft

Tassi P (2022) Interest in NFTs and the metaverse is falling fast. Forbes Magazine, 14 Apr 2022. www.forbes.com/sites/paultassi/2022/03/10/interest-in-nfts-and-the-metaverse-is-falling-fast/?sh=7f24a801ebbd

Tumblr, Author Chainalysis Team (2022) NFT transaction activity stabilizing in 2022 after explosive growth in 2021. Chainalysis, 20 May 2022. blog.chainalysis.com/reports/chainalysis-web3-report-preview-nfts/

Wang Q et al (2021) Non-fungible token (NFT): overview, evaluation, opportunities and challenges. arXiv preprint arXiv:2105.07447

Walker J (2022) NFT market collapses just as square Enix sells tomb raider to bet big on blockchain. Kotaku, 13 May 2022. kotaku.com/nft-market-collapse-square-enix-ubisoft-sega-konami-sca-1848878945

Research on the Impact of Non-interest Income Innovation on Bank Performance

Yujia Wu and Shaonan Zhu

Abstract Commercial banks have been dealing with a more complex business climate recently. Joint-stock commercial banks are more inventive than other banks since they have some unique characteristics when compared to other banks. The influence of the most recent initiatives concerning non-interest income on bank performance is becoming more evident. The author thinks it is important to investigate how joint-stock banks' non-interest income impacts their financial performance. First of all, this paper's literature review reveals that there are varying views on the connection between non-interest revenue and commercial banks' performance. Second, it is discovered that there are both positive and negative effects between non-interest income and bank performance based on the analysis of its internal structure and current circumstances. To further understand the relationship between the two, empirical research is necessary. The author then decides to conduct empirical study using panel data on 8 joint-stock banks between the years of 2012 and 2020.We may now go back and look at the precise relationship between the two after the data description and stability test reveal that the research data is generally stable. Reviews then uses the data to create the regression model. The robustness test that the author used to make the regression results more accurate and rigorous revealed that the variables still support the original finding. As a result, the author draws the conclusion that joint-stock commercial banks' non-interest income is closely correlated with bank performance.

Keywords Non-interest income · National joint-stock commercial banks · Bank performance

Y. Wu and S. Zhu are contributed equally.

Y. Wu (✉)
Business School, Jiangnan University, Wuxi 214122, China
e-mail: 15001020350@xs.hnit.edu.cn

S. Zhu
W. P. Carey School of Business, Arizona State University, Tempe 85281, USA

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_71

1 Introduction

1.1 Research Background

As early as the 1980s, commercial enterprise banks in western developed countries began to attach importance to and develop non-interest business income. During the 2008 U.S. financial crisis, the over-development of innovation in non-interest income brought harm because there was no harm in strict regulation in the first place. Therefore, since then, research has continued to strengthen the supervision of commercial banks' income in addition to traditional fees. Nowadays, commercial banks in developed western economies take two measures to address the main problems of non-interest income. One is to increase the proportion of other innovation income, and the other is to use Internet financial management tools to evade the supervision methods of the regulatory authorities effectively to conduct interest rate reform. This leads banks to lower lending and raise deposit rates to attract more customers, leading to lower bank revenues and increased risk. Therefore, commercial banks are forced to diversify their income. Non-interest income can increase the bank's overall income and improve the bank's economic strength, such as increasing the bank's capital through investment income and improving the bank's service capabilities to attract more customers to do business with the bank. Increasing the bank's capital adequacy ratio and operating capacity can improve commercial banks' performance. Still, credit card and investment failure will increase the bank's risk. Risk assessment accounts for a large proportion of bank performance evaluation, which may also reduce the bank's performance.

The rapid development of non-interest business of Western commercial banks can be traced back to the gradual development of financial liberalization in the 1980s. However, in China's financial market, since Chinese commercial banks started operating in the 1990s, In the process of interest rate liberalization, China's traditional deposit and loan business has always been the main source of income for commercial banks. Previously, non-interest income accounted for a low proportion of operating income. But with the emergence of the "financial disintermediation" phenomenon, capital supply can circumvent the commercial banking system. Financial markets can provide funds and financing directly to customers. Therefore, the competition in the banking industry has become increasingly fierce, and the proportion of profit models in which intermediary business income is mixed with consulting and investment has increased. The spread between deposit and loan interest rates continues to shrink, making it unsustainable for the traditional profit model. There are several ways that banks can increase their income. Take a less risky approach to risk hedging.

1.2 Literature Review

Domestic and foreign research conclusions about non-interest income on bank performance are mainly divided into positive and negative effects.

Favorable Impact on Bank Performance

Related Foreign Literature. Many industry insiders believe that increasing non-interest income can broaden the source of bank income, reduce bank operating costs, and increase the bank's capital. This behavior is an effective means of increasing the strength of the bank. For example, Lee et al., Through a survey of business data of more than 2000 commercial banks in Asian, concluded that developing non-interest business can broaden banks' income channels and achieve diversification (Lee et al. 2014a). It has had a significant positive impact on the bank's development and improved bank performance. Lee et al. used the non-interest income data of commercial banks in 22 Asian countries from 1995 to 2009 (Lee et al. 2014b). They found that Asian banks' business models could eliminate potential crises, and the diversified non-interest income profit model is conducive to improving banks' market competitiveness and the banking industry's overall profitability.

Chinese-Related Literature. Chinese scholars have also contributed greatly to the positive impact of non-interest income on commercial banks. Zhu (2016) used a panel model of five commercial bank business data from 2008 to 2015 and found a significant positive correlation between intermediary business and commercial bank performance (Zhu 2016). Wu Tianliang cited the official data of 16 listed commercial banks in China from 2010 to 2018, proving that non-interest income has a boosting effect on bank performance (Wu 2019). Wang and Yang, based on the data of 16 listed commercial banks in China, the SBM-DEA model measured the operational efficiency of the commercial banks they studied (Wu 2018). By creating a unit scale, non-interest-related income, to study the impact of commercial banks' operational efficiency and Nonlinear effects. Due to their low efficiency, we would like to point out a significant nonlinear relationship between commercial banks' non-interest-related income (depending on investment size) and efficiency gains. When assets were valued at $210 billion, the share of non-interest income in revenue had a very significant positive effect on the efficiency of commercial development banks. Xie and Han used the data of 25 municipal commercial banks from 2010 to 2019 to investigate the relationship between non-interest-related income and the city's operating performance (Xie and Xue 2021). The findings show that non-interest income as a business improves the bank's performance, and this income volatility is higher than the synergistic effect of operating with different cultural activities.

Adverse Impact on Bank Performance

Related Foreign Literature. Many scholars believe that the negative impact is mainly that non-interest income will increase bank costs and expenses and increase the volatility of bank income. Among them, foreign scholars believe that the negative correlation theory is Ritab AlKhouri et al. used the six listed banks of Islamic banks

in the Gulf Cooperation Council as samples during 2003–2015, using the systematic generalized matrix method, the study found that the diversification of non-interest income had a negative impact on the performance of GCC banks (AlKhouri and Arouri 2019). Barry Williams et al. used part of the data of Australian operating banks to find that the lower the proportion of non-interest income and the higher the proportion of other businesses, the lower the risk it faces and the higher the return (Williams and Prather 2010). Chen constructed a quantile regression model and studied their interaction. The study found that banks with different risk appetites have different attitudes towards non-interest income (Chen et al. 2017). Still, this operation should be more cautious, and the degree of inconsistency is greater, which is riskier for banks.

Chinese-Related Literature. Many domestic scholars also have many opinions on the negative impact of non-interest income on bank revenue realization. Chen studied the data of more than a dozen listed banks from 2010 to 2018 and showed that the proportion of non-interest income is directly proportional to the operating risk of commercial banks (Chen 2020). Therefore, she judged that the expansion of non-interest income will lead to the contraction of the shareholding system. And there is a significant negative correlation with the revenue of joint-stock banks. Wu took 19 listed commercial banks in my country from 2008 to 2016 as a sample and made a panel data model based on the overall sample (Wu 2018). Finally, they found risks is still the same regardless of the overall consideration. From the perspective of income composition, there is a significant negative correlation with the performance of commercial banks. Han et al. used five rural commercial banks in China from 2008 to 2018 as a panel data model (Xie and Xue 2021). They found through empirical research that the emergence of non-interest income should be mainly responsible for the decline in the performance of rural commercial banks.

Based on the above references, we can see that non-interest income's impact on commercial banks' performance has gradually become one of the key problems that scholars at home and abroad have solved through research in recent years.

1.3 Research Gap and Framework

Aiming at the research and development results of the current related problems of Chinese enterprises, most of the research takes the whole banking industry as a research and analysis object, and there is few research on the national joint-stock commercial banks. And the internal distribution of non-interest income is rarely discussed to analyze the performance of national joint-stock banks. Therefore, this paper will consider the internal structure of national joint-stock banks and provide specific conclusions.

Detailed introduction to the internal structure of non-interest income.

(1) Net income from handling fees and commissions: handling fees and commissions charged by helping customers handle business on their behalf. Including the settlement, consulting, consulting, and other services.
(2) Investment gains and losses: the gains or losses obtained by the bank by investing in the capital or money market.
(3) Gains and losses from changes in fair value: Bank assets are calculated by fair value and the difference between the end and the period's beginning.
(4) Exchange gains and losses: the difference between the exchange rate changes caused by the bank's foreign exchange transactions.
(5) Other business income: non-interest income other than the above.

The performance of national joint-stock banks means that they use a set of financial indicators and certain evaluation methods to examine the degree of achievement of their business objectives. The indicators of modern national joint-stock banks mainly cover their asset quality, profitability, internal control, and other factors. Regarding asset quality, it is necessary to consider the total amount of foreclosed assets on and off the balance sheet and risk capital. Therefore, to improve their performance, national joint-stock banks must pay attention to risk prevention and control and enhance the safety and stability of their business activities. In terms of structural adjustment, adjust the inherent income structure dominated by traditional income and increase the proportion of other income. To sum up, when considering the research direction, we will conduct research on the effective impact of non-interest income on bank capital adequacy ratio, including changes in operating capacity and side effects.

2 Method

2.1 Current Situation Analysis

By examining recent news stories and their yearly reports, we may examine the current non-interest income innovation scenario. This analysis can be broken down into two parts: the first part examines non-interest income's internal structure to determine its proportion and level of innovation; the second part examines the benefits and drawbacks of non-interest income innovation as seen in the news.

2.2 Empirical Analysis

Data Source and Variable Selection. The data of this article comes from the flush financial statements, the main financial indicators of Netease Finance, the income statement of Sina Finance, and the financial statements of Eniu. The paper selected from 2012 to 2020 as the data range.

Metric of Bank Performance. ROA: return on assets. We use ROA for measuring Commercial Banking performance. The ROA measures the net profit for each unit of assets that can be generated. The higher the rate of return, the greater the ability of banks to lower their costs and improve their performance. This indicator is mainly used in the analysis of profits and the measurement of business performance (Xie and Xue 2021).

A Measure of Non-Interest Income. NIIR: The proportion of interest-free revenues. We use the proportion of non-interest income can exclude the impact of the size of banks and better measure the impact of the overall development of non-interest income on bank performance (Wu 2019).

Control the Selection of Variables.

(1) LNA: the logarithm of the bank assets. We use the asset logarithm as a measure of bank size.If a bank's asset scale is large and its business ability is strong, the lower the return on assets will be (Zhu 2016).
(2) CIR: the cost-to-income ratio. We use the cost-income ratio as a measure of bank profitability. The smaller it is, the more revenue, banks are able to generate (Wu 2018).
(3) BLR: the non-performing loan ratio.The increase in the non-productive lending ratio will lead to a deterioration in the quality of bank assets, and banks will face more risks negatively related to bank performance growth (Zhou 2016).

Study Hypothesis and Model Building. The paper used Eviews9 software as an analysis tool to conduct regression analysis on the panel data model of 8 national joint-stock banks. The panel data model can combine the time series with the cross-section sequence, and the corresponding estimation method can solve the common heteroscedasticity and autocorrelation problems well. Based on the previous variable analysis, the panel model is established as follows:

$$ROAit = \alpha it + \beta 0NIIRit + \beta 1LNAit + \beta 2BLRit + \beta 3CIRit + \mu it \quad (1)$$

Among them, ROAit represents the t-year return of i commercial bank, NIIRit represents the non-interest income in t-year, LNAit represents the logarithm of t-year, and BLRit represents the non-performing loan ratio of i commercial bank. Cirit represents the t-year cost-income ratio of i commercial bank. β0, β1, β2, β3 Represents all the parameters to be estimated. It is a random disturbance term, representing all the factors that may have an impact on the model but are ignored.

3 Result

3.1 Current Analysis

Current Situation of Innovation and Development of the Internal Structure of Non-Interest Income. Figure 1 shows the proportion of the internal structure of non-interest income of eight national joint-stock banks in 2020. I will analyze the proportion of internal structure and its current development.

(1) The commission income accounts for 79%, accounting for the largest proportion of non-interest income and the most innovative part. Taking China Merchants Bank and Ping An Bank as examples, China Merchants Bank's service fee business innovation focuses on building the retail and corporate ecosystem and exploring wealth management paths. The handling fee income of Ping An Bank is mainly from retail, wholesale and interbank. It can be found that the common feature of the handling fee income of joint-stock banks is to develop the retail industry mainly. However, from the main content of their retail development, their retail industry is mainly reflected in bank apps. For example, Ping An Bank is divided into eight key customer groups according to market segmentation. Each customer group has an app segment. However, the retail business of joint-stock commercial banks is also limited to their apps. There is no further extension and development.
(2) Investment income: investment income is banks' second largest source of non-interest income, accounting for 14% of the total non-interest income. However, according to the latest report of the securities times, the investment income of 38 A-share listed banks fell year on year. For example, China CITIC Bank fell 34.5% year on year this year, and the main source of the decline in revenue is the decrease in the return on investment in securities such as bonds and funds.
(3) Exchange gain/loss: exchange gain/loss accounts for 2% of the internal structure of non-interest income. According to the report of the securities times, this is because the epidemic led to a decline in exchange earnings in 2020. Still,

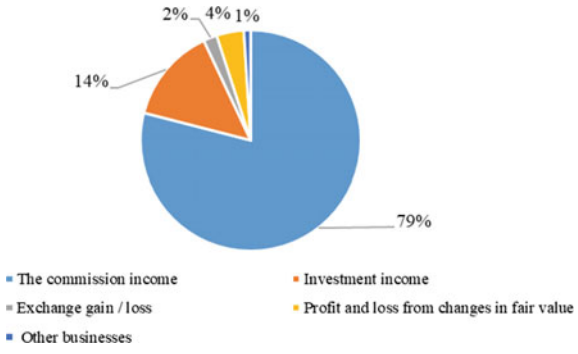


Fig. 1 Internal structure of non-interest income

exchange earnings began to rise because of the continuous recovery of COVID-19. However, we should still be alert to the risk of exchange rate decline caused by non-interest income.

(4) Profit and loss from changes in fair value: Assets are valued at fair value and the difference between the value of the asset and the fair value at the end of the next valuation period.

(5) Other businesses: other businesses account for a small proportion of the internal structure of non-interest income. Developing other businesses has not attracted the attention of national joint-stock banks.

Innovation of Non-Interest Incomes Expands Banks' Income Channels. The marketization of interest rates and the Internet financial industry have made the national joint-stock banking industry more competitive with the traditional financial industry and made its non-interest income continue to innovate. According to the data given by flush, as shown in Fig. 2, Income other than interest, is positively correlated with rising operating income. Therefore, non-interest income can broaden the income channels of banks and increase their operating income. Moreover, taking Ping An Bank as an example, the innovation of writing non-interest income in its statements has expanded its income channels. The main source of non-interest income is the increased handling fee income from wealth management, credit card, corporate settlement, and wealth management businesses. The income channels of banks have been expanded.

Innovation of Non-Interest Income Increases Banks' Costs. The process of non-interest income innovation is also constantly hitting a wall. In the research and development process, commercial banks must train employees, package non-interest income-related products, and then carry out product marketing. All these require banks to pay various R & D expenses. According to Fig. 3, according to the relevant data given by flush, the increase in non-interest income will continuously

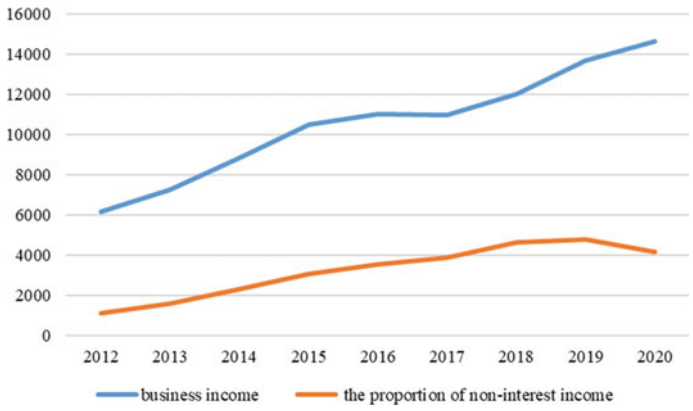


Fig. 2 The relationship of corporate income to non-interest income

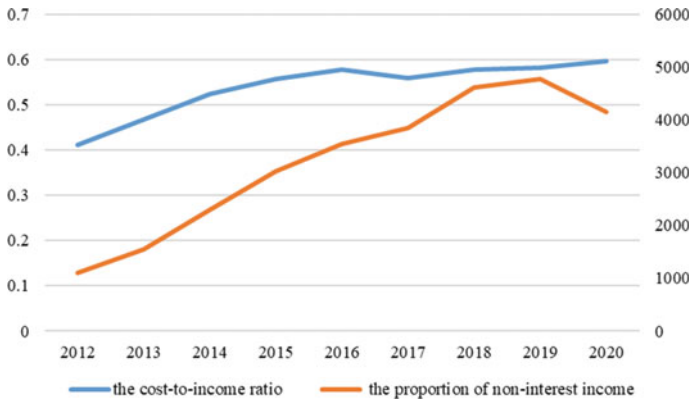


Fig. 3 Relationship between revenues other than interest and the cost-to-revenue ratio

increase the cost of national joint-stock banks, and the increase in cost will reduce their profits and ultimately reduce their performance.

To sum up, through the analysis of the current situation, it is found that the innovation of non-interest income has both advantages and disadvantages for the development of bank performance.

3.2 Model Regression Results and Analysis

Because the number of samples is relatively small, we need to analyze the regression results by directly using individual fixed effects, and the results are shown below.

The regression results of the sample model of shareholding commercial banks are shown in Table 1, with a goodness of fit of 0.757543 and an adjusted fit of 0.743068, which indicates good goodness of fit. A P-value of less than 0.05 indicates a high significance level for the regression model. The Figure shows that the P-values of all the variables are less than 0.05. Therefore, all the P-values are significant, and therefore the significance test was passed. In summary, the revenue valve of the state-owned commercial equity banks is to some extent influenced by the proportion of non-interest-related revenues and has passed the significance test. And the positive correlation exists between non-interest business income and return on capital investment.

At the same time, we can also know from the table that although the total assets of enterprises can increase the scale of bank development, they did not increase banks' return on capital. This is because the size of banks is too large, which can theoretically improve banks' profitability. Still, the excessive risk and operating costs can increase the overall risk level of banks. The increase in cost input weakens banks' ability to make gains, which is also quite consistent with current economic phenomena. The loan ratio of non-performing enterprises is an important factor index that the CBRC

Table 1 Empirical results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.024469	0.001472	16.62413	0.0000
D (NIIR,1)	4.88E-05	1.74E-05	2.802064	0.0066
D (LNA,1)	−0.000405	0.000122	−3.314194	0.0015
D (BLR,1)	−0.001733	0.000459	−3.777690	0.0003
D (CIR,1)	−0.014530	0.00216	−6.557402	0.0000
R-squared		0.757543		
Adjusted R-squared		0.743068		
Durbin-Watson stat		0.675840		
F-statistic		5233439		
Prob (F-statistic)		0.000000		

concerns with and supervises. The non-performing loan ratio reduces the operating performance of banks, but the impact is not significant, perhaps because banks have begun to value the prevention of non-performing loans.

In summary, the negative impact of control variables on the return on capital is mainly due to economies of scale beyond the best level. Because the further expansion of scale leads to more management and implementation of human and material resources costs and operational risks, that is, the increase in economies of scale. In this case, it is suggested that banks control and manage their scale to keep it at an appropriate level and avoid blind expansion. To sum up, national joint-stock banks should pay more attention to the innovation of non-interest income businesses and improve their business quality when exploring future business strategies.

4 Discussion

The rapid development of non-interest business of Western commercial banks can be traced back to the gradual development of financial liberalization in the 1980s. However, in the history of financial development, after China's purpose-built banks started their business activities in the 1990s in the process of China's interest rate liberalization. China's traditional deposit and loan business has always been commercial banks' main income source. In the past, In addition to fee income for a relatively low proportion of operating income. But with the emergence of the "financial disintermediation" phenomenon, the supply of funds bypasses the commercial banking system. Financial markets have emerged as a means of direct delivery to the demand side and financing. Therefore, the competition in the banking industry is becoming increasingly fierce. The proportion of profit models in which intermediary business income is mixed with consulting, investment, and other methods has increased. The deposit and loan interest rate gap has been continuously narrowed, so the traditional

profit model cannot be sustained. There are several ways a bank can do to increase the bank's revenue. Take a less risky approach to risk hedging. E.g.:

4.1 Strengthen Linkage with Internet Companies to Increase Fee Income

From Fig. 1, the bank's commission income has a prominent position in it. The news reports show that the retail industry is a project that major national joint-stock banks are concerned about. However, the main promotion of the project is only reflected in the bank app. Therefore, to increase the income of fee-related businesses, national joint-stock banks can cooperate with Internet companies (such as Baidu) to promote private wealth management brokers. For example, such as the financial version of the small speaker and so on.

4.2 Innovate Financial Products and Create Brand Characteristics

From the result part, we can see that the overall non-interest income positively correlates with bank performance, so we should give a higher percentage of the overall non-interest income. Quality customers determine the yield level of interest income, and the bank's ability to meet customer demand determines its non-interest income. To increase the volume of this income, we need to innovate and package products. It is necessary to take the essence of foreign business development, remove the dross, and innovate non-interest income products suitable for China's national conditions. Based on the strategy, improve the competitiveness of the domestic market further, but also improve their start-up capabilities and create their characteristics.

4.3 Increase Investment in Talent Training and Expand Other Business Income

From the current conclusions it can be drawn of internal structure of non-interest income that other businesses account for a relatively small proportion of other non-interest income. Therefore, to expand its income from other businesses except for fee income and increase the proportion of other business income, banks need to attract and train professional talents to improve product research and development capabilities and personalized service capabilities. High-tech businesses such as corporate investment in construction banking and asset securitization require the support of our professional management talents.

During the current period, non-domestic capital banks entered the domestic financial market, impacting the original banking business. Many banks could not cope with such impacts, resulting in a decline in their financial market share. Therefore, major banks must increase their investment in the non-interest business.

5 Conclusion

Based on previous research, this paper first selects the data from 2010 to 2020, which are from 8 Chinese banks across the country, with ROA as the explained variable, the proportion of non-interest income as the explained variable, and the letters are denoted as NIIR. Taking LNA as the control variable, which represents the non-performing loan ratio, cost-return rate and total assets, we construct a panel data model to analyze the impact of non-interest income on the operating conditions of state-owned joint-stock enterprises.

Positive changes in non-interest income have a significant impact on improving the return on assets of national joint-stock banks, but the impact is not large. This may be because China's national joint-stock banks did not have a more detailed understanding of the advantages and disadvantages of this structural change in the early stage of development. And they are listed and self-financed, so they are faced with the risk. At the same time, it considers the business structure of national joint-stock commercial banks, the country's policy environment, and economic development. This conclusion can reflect to a certain extent that the non-interest income of my country's national joint-stock commercial banks is related to bank performance. However, according to the specific analysis of relevant scholars, the result obtained in this paper is not the best form. It is affected by the current development of my country's banking industry to a certain extent. Non-interest income has obvious advantages. In the future, with the continuous development of my country's city commercial banks, the business structure of non-interest income tends to be reasonable. It is an inevitable choice to promote the development of non-interest income.

References

AlKhouri R, Arouri H (2019) The effect of diversification on risk and return in banking sector: evidence from the Gulf Cooperation Council countries. Int J Managerial Finance

Chen CR, Huang YS, Zhang T (2017) Non-interest income, trading, and bank risk. J Financial Services Res 51:1–35

Chen J (2020) Analysis of the impact of non interest income on the performance of commercial banks. Hebei Enterp 05:46–47. https://doi.org/10.19885/j.cnki.hbqy.2020.05.019

Lee C-C, Hsieh M-F, Yang S-J (2014a) The relationship between revenue diversification and bank performance: do financial structures and financial reforms matter? Jpn World Econ 29:18–35

Lee CC, Yang SJ, Chang CH (2014b) Non-interest income, profitability, and risk in banking industry: across-country analysis. North Am J Econ Finance 27(3):48–67
Williams B, Prather L (2010) Bank risk and return: the impact of bank noninterest income. Int J Managerial Finance
Wu T (2019) An empirical study on the impact of non interest income on the performance of listed commercial banks in China. Prod Res 12:42–45. https://doi.org/10.19374/j.cnki.14-1145/f.2019.12.010
Wu Q (2018) Research on the relationship between non interest income and commercial bank performance. Northeast Normal University
Xie T, Han X (2021) Research on the impact of non interest income on the operating performance of urban commercial banks in China. Credit 39(06):87–92
Zhou Z (2016) Influencing factors of non interest income in China's banking industry—based on the data of 41 commercial banks from 2003 to 2015. Southern Finance 12:26–39
Zhu H (2016) An empirical study on the impact of non interest income on the performance of commercial banks. Shang 26:204

Portfolio Optimization for Banks in the Hong Kong Stock Market

Jingyi Jiang

Abstract Hong Kong, is an important financial center in China and a window connecting the Chinese mainland and other countries in financial exchanges. The Hong Kong market can also quickly respond to economic changes in other countries, and then transfer to the Chinese mainland market. Because of this, studying the stock trend in Hong Kong, and judging the weight of the minimum risk asset portfolio and the optimal risk asset portfolio can help us understand the changes of the stock trend in mainland China more quickly, as well as determine the optimal investment strategy in mainland China. According to the selected data, the experimental results are as follows: to form the minimum variance portfolio, a large amount of investment in China Construction Bank Corp. is needed; to form the optimal risk portfolio, a large amount of investment in The Bank of China is needed.

Keywords Hong Kong · Portfolio optimization · China

1 Introduction

As an important financial center in China, the development of the Hong Kong stock market has also had a certain impact on A shares. Hong Kong is a booster for the expansion and opening of Chinese financial industry. As the earliest city in China to implement financial opening, it has become an effective and important strategy to give full play to its status as an international financial center to promote the financial opening of Chinese mainland. Hong Kong's financial opening model of "connectivity" can provide a new channel for the Chinese mainland to fully integrate into the international economic system (Ba 2020). After nearly 50 years of development, Hong Kong's financial market has accumulated a lot of experience, its financial system and regulatory system have been gradually improved, and its risk resistance has been continuously enhanced (Tang 2020). Hong Kong has a broad space for

J. Jiang (✉)
Southwest University, Chongqing, China
e-mail: ljq@bbc.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_72

development, and the construction of the Guangdong-Hong Kong-Macau Greater Bay Area has comprehensively deepened the connection between Hong Kong and the mainland (Liu and Ruan 2020). The Hong Kong market of China plays the role of intermediate market in the correlation between the mainland and the United States (Lin et al. 2021).

In the context of Russia-UKraine conflict and global inflation, mainstream overseas institutions generally look down on the world economy. In terms of global economy, IMF, Morgan Stanley and other organizations and institutions generally hold a pessimistic attitude, believing that under the catalysis of geopolitics, the global economy is gradually moving from integration to multi-polarization. This will have a negative impact on the global supply chain (Shang 2022). In this context, As the financial center of China, Hong Kong is more worthy of study. Currently, numerous investigations have been done regarding the HongKong financial market. For example, the exchange of ETF products between Hong Kong stocks and the mainland market is an opportunity. As an international market, Hong Kong market has attracted the attention of global capital (Yang 2020). The spillover effect of Hong Kong earnings and volatility on Shanghai stock market shows a trend of rising volatility. The length of the period of influence has also increased (Yan 2020). The study found that after the opening of the Shanghai Hong Kong stock connect, the Hong Kong market volatility intensified, resulting in the instability of Hong Kong market. This result shows that as an innovative mechanism, the launch of The Shanghai-Hong Kong Stock Connect is bound to arouse a large number of investors' pursuit, resulting in a large amount of capital inflow, thus exacerbating the volatility of the Hong Kong market (Qiao 2020). The return of Chinese concept stocks is an important opportunity to promote the reform of China's capital market, but it will also bring new challenges. In the context of the two-way opening of the capital market, we should examine the return of China concept shares from the perspective of the great changes in the global economic and financial pattern, make full use of Hong Kong and mainland markets, and actively expand other overseas markets (Ba et al. 2021). Global inflation has eroded profits. As a big manufacturing country in the middle reaches of the world, China's profits are obviously affected by the price of upstream raw materials, and the cost pressure is difficult to be transmitted downward, leading to the erosion of profits of Hong Kong-listed companies (Zou 2022). However, the Hong Kong investment portfolio is limited, and its advantages have not been fully utilized. Thus, in this paper, portfolio optimization in the Hong Kong financial market is of interest.

The rest of this paper can be summarized as follows. Section 2 show the data and methods, respectively. Section 3 depicts the results of this paper, and Sect. 4 is the conclusion.

Table 1 Descriptive statistics of the selected assets

	Industrial and Commercial Bank of China Ltd.	China Construction Bank Corp.	Bank of China Ltd.
Mean	0.0052	0.0036	0.0050
Std. dev	0.0746	0.0681	0.0718
Sharpe ratio	0.0477	0.0277	0.0465

2 Data and Methods

2.1 Data

This paper collects data on 66 stocks of Hang Seng from the datastream database, and in particular, selects 3 stocks through comparability analysis: Industrial and Commercial Bank of China, China Construction Bank and Bank of China. Because the Industrial and Commercial Bank of China has a huge customer base, is the heart of the Chinese people most familiar with the bank. And the Industrial and Commercial Bank of China ranks first among the five largest banks in China, which can be called the largest bank in China. Second, the comprehensive bank, China construction bank capital to market in the world's second, strength, with abundant liquidity, capital adequacy, to customers the debt financing and equity financing, merger, acquisition and reorganization, offering activities such as financing and securities underwriting in provide a strong guarantee, and has strong ability to resist risks. Finally, Bank of China has incomparable advantages over other banks in foreign exchange and international business. With extensive overseas branches, Bank of China can provide the fastest, most convenient and safest international remittance. Perform descriptive statistics on the three stocks, the mean, standard deviation and Sharpe ratio data are shown in Table 1.

Through visualizing the data, we can discover that the 'Industrial and Commercial Bank of China Ltd.' has the highest average return, while the 'China Construction Bank Corp.' has the lowest average return. When it comes to Standard deviation, 'China Construction Bank Corp.' is the lowest, while 'Industrial and Commercial Bank of China Ltd.' is the highest. What's more, the 'Industrial. and. Commercial. Bank of China Ltd.' has the highest Sharpe ratio and the, while the 'China Construction Bank Corp.' has the lowest Sharpe ratio.

2.2 Methods

By definition, the Expected return and traditional Sharpe ratio is calculated as:

$$\sum_i Weight_i = 1 \tag{1}$$

where $Weight_i$ is the weight of the Asset $_i$ in the portfolio. The return and standard deviation of one certain portfolio can be calculate as follows.

$$\text{Portfolio Return } = \sum \text{ Weight }_i \cdot \text{ Asset Return }_i \tag{2}$$

where Asset Return $_i$ is the compound return of Asset$_i$'s time series data.

$$E[\text{ Portfolio Return}] = \sum_i \text{Weight}_i \cdot E[\text{ Asset Return }_i] \tag{3}$$

where $E[$ Asset Return $_i]$ is the expected return of Asset $_i$. $E[$ Portfolio Return $]$ is the expected return of the portfolio.

$$\begin{aligned}&\text{Var[Portfolio Return]}\\ &= \sum_{i,j} \text{Weight}_i \cdot \text{Weight}_j \cdot \text{Cov}\big[\text{Asset Return}_i, \text{Asset Return}_j\big]\end{aligned} \tag{4}$$

where Cov denotes the variance–covariance between Asset Return $_i$ and Asset Return $_j$. Var denotes the variance of portfolio return. The Sharpe ratio of one portfolio can be achieved by the following equation,

$$\text{SharpeRatio } = \frac{E(R_P) - R_f}{\sigma_P} \tag{5}$$

where $E(R_P)$ is the expected return of the portfolio, R_f is the risk-free rate, usually assumed to be constant and σ_P is the standard deviation of the portfolio, a mathematical measure of the total risk of the portfolio, taking into account both systematic risk and non-trivial systemic risk. It can be seen from the formula: when SR is greater than 1, one unit of risk brings more than 1 unit of excess return; when SR is less than 1, one unit of risk brings less than 1 excess return; when SR is equal to zero, the excess return is zero; when SR is less than zero, the average growth rate of net worth after investment is lower than the risk-free interest rate, indicating that investment is meaningless. The Sharpe ratio can carry out resource allocation and performance evaluation of the investment portfolio, so as to provide an effective decision-making scheme and avoid investment risks, which has important guidance for maintaining the stability of the securities trading market and promoting rapid economic development. The Sharpe ratio needs to be compared among funds of the same type. The greater the Sharpe ratio of the fund, the larger the excess return obtained within the unit risk, and the higher the investment value. Through the research results, it can be concluded that when the weight ratio of a certain type of assets is high or the weight ratio of a certain type of assets is low, the Sharpe ratio of the entire asset portfolio is the highest and the best investment portfolio.

3 Results

First of all, we conducted a Fama experiment, and the experimental results are shown in the figure below. we can conclude that the light gray is the nonsystematic risk, while the dark gray is the systemic risk. With the increase of the number of stocks, the systemic risk cannot be dispersed, and the diversification of non-systematic risk is also limited. That means that in the end there is almost only systemic risk that cannot be dispersed. We can see that 3 stocks is an inflection point, so we chose N = 3.Then increase the number of shares, and the overall risk remains about 0.002 (Figs. 1 and 2).

Form the Fama experiment, it can be found that contains 3 assets is enough to reach the aim of risk diversification in the Hong Kong stock market. Furthermore, banks inside the capital market is always regarded as safe-haven assets, thus, the

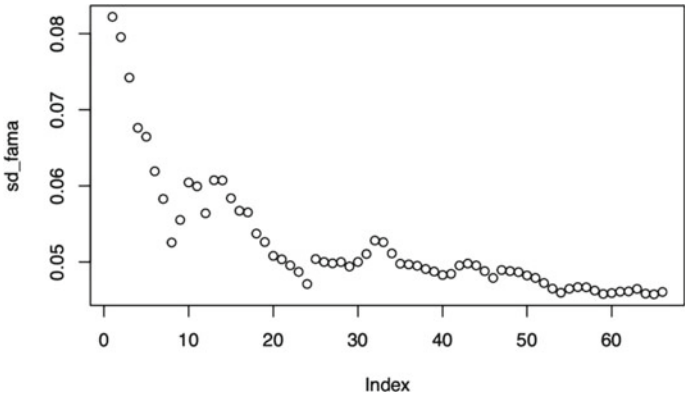


Fig. 1 Fama experimental point diagram

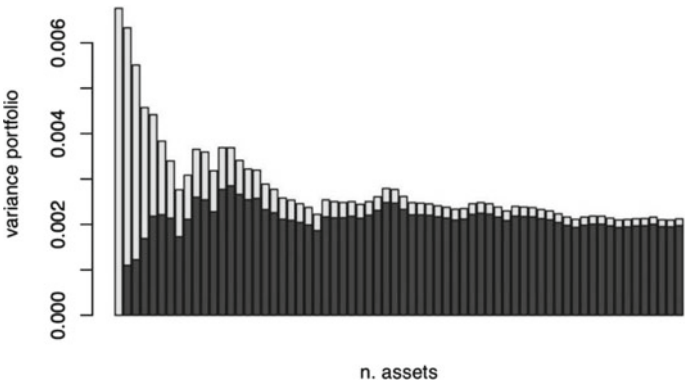


Fig. 2 Fama experimental bars

in-depth investigation are focused on the bank industry. Specifically, we selected the stocks of Industrial and Commercial Bank of China, China Construction Bank and Bank of China for independent homodistribution test, and the test results are shown in the figure below. As we can see from the picture below: it is concluded that their histograms are close to the normal density curve and centered at zero, so these three stocks all satisfy the normal distribution Suppose (Figs. 3, 4 and 5).

By using the ACF function, the inspection results are shown in the figure below, the correlation of the three stocks does not statistically exceed the extreme value, so the three stocks also satisfy the requirements of the independence and identical distribution assumptions (Figs. 6, 7 and 8).

Then, according to the expected return of assets and risk-free assets, we can draw Fig. 9.

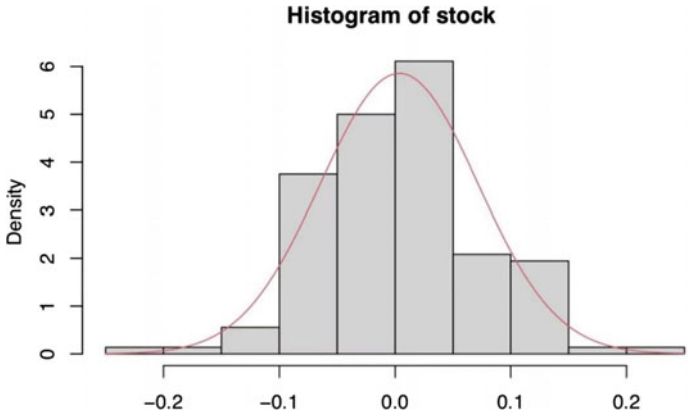


Fig. 3 'Industrial and Commercial Bank of China Ltd.' Normal distribution test

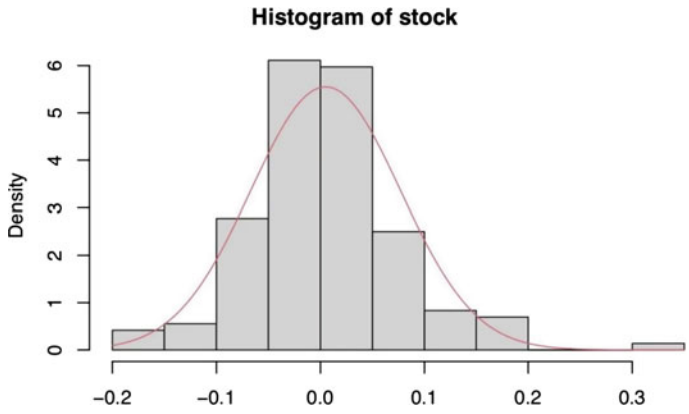


Fig. 4 'China Construction Bank Corp.' Normal distribution test

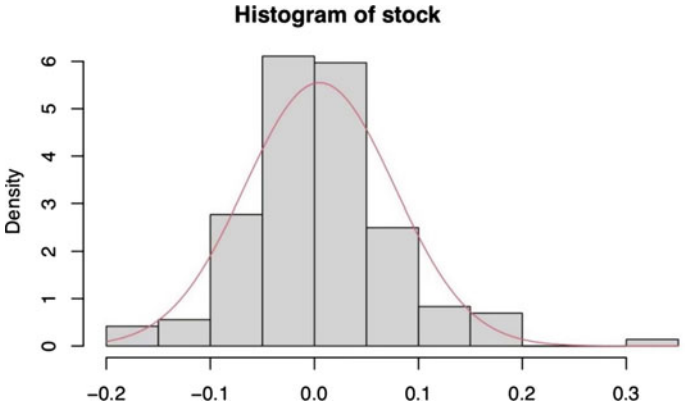


Fig. 5 'Bank of China Ltd.' Normal distribution test

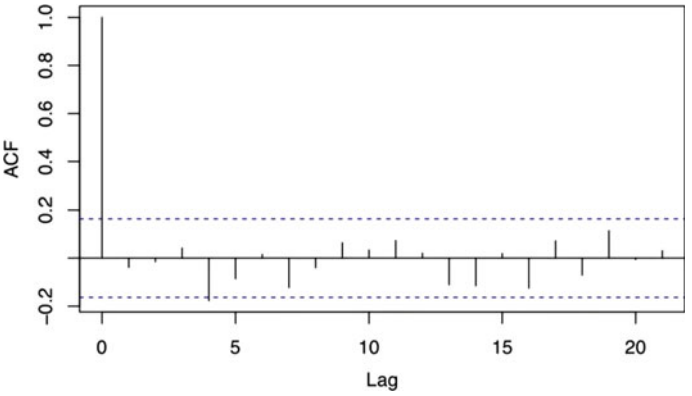


Fig. 6 'Industrial and Commercial Bank of China Ltd.' ACF experimental

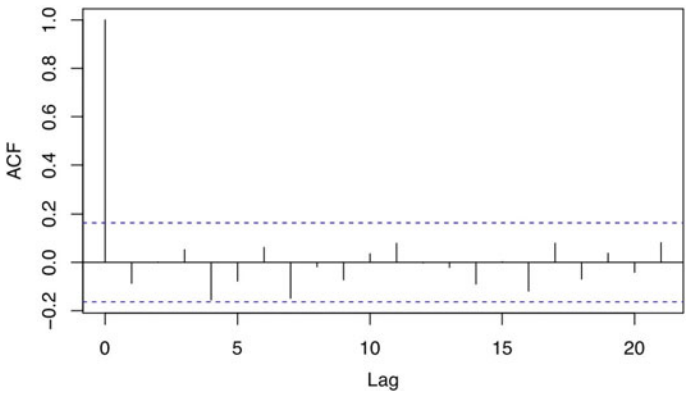


Fig. 7 'China Construction Bank Corp.' ACF experimental

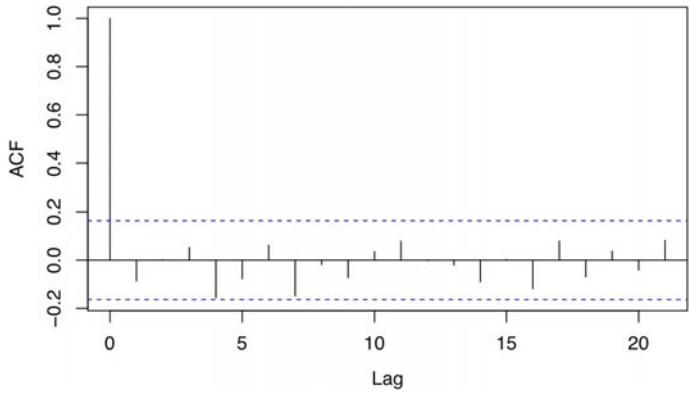


Fig. 8 'Bank of China Ltd.' ACF experimental

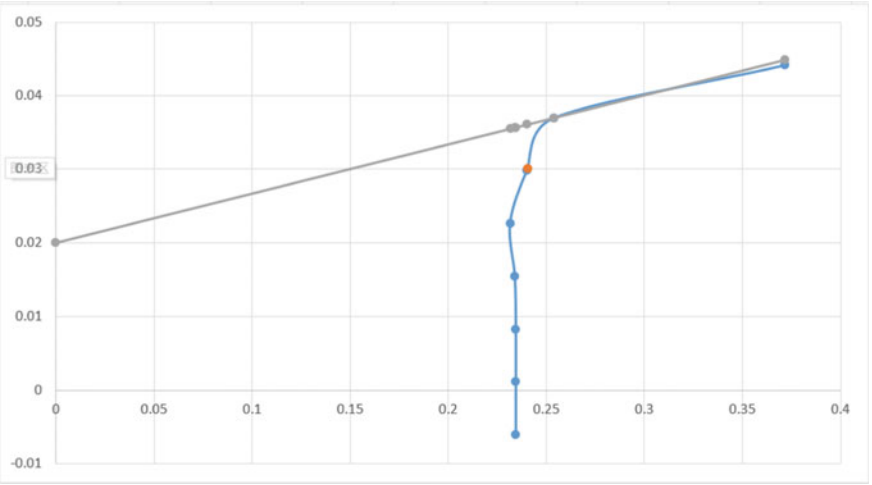


Fig. 9 Asset efficient frontier and capital markets line

According to the figure above, we can get that the weight of the minimum variance combination is: 65.418% invested in China Construction Bank Corp, 34.582% invest in Bank of China, Ltd. The Characteristics of the minimum risk portfolio are shown in Table 2.

Table 2 Characteristics of minimum risk portfolios

r_p	0.0202
σ_p	0.2309
Sharpe ratio	0.0010

Table 3 Minimum risk portfolio weight

	Industrial and Commercial Bank of China Ltd.	China Construction Bank Corp.	Bank of China Ltd.
Weight	0	0.6542	0.3458

Table 4 Minimum risk portfolio weight

	Industria. and Commercial Bank of China Ltd.	China Construction Bank Corp.	Bank of China Ltd.
Weight	0.4018	0	0.5982

Table 5 Characteristics of optimal venture portfolio

r_p	0.0301
σ_p	0.2408
Sharpe ratio	0.0418

The ratio of the minimum variance portfolio can be obtained through calculation, as shown in Table 3.

As can be seen from the descriptive statistics above, Industrial and Commercial Bank of China Ltd. has the largest standard deviation and China Construction Bank has the smallest weight. Therefore, when calculating the minimum risk portfolio, Industrial and Commercial Bank of China Ltd. has 0 weight and China Construction Bank has the largest weight. Similarly, we can also get the weight of the optimal risk asset portfolio (maximum Sharpe ratio) is: 40.184% invested in Industrial and Com mercial. Bank of China Ltd., 59.816% invest in Bank of China Ltd. The weight of the optimal risk asset portfolio is shown in Table 4.

The Characteristics of the optimal risk asset portfolio are shown in Table 5.

Therefore, according to the experimental situation, in order to obtain the maximum Sharpe ratio, we cannot invest a lot in China Construction Bank Corp. as we do in the least risk portfolio but invest in the other two assets with high Sharpe ratio. Similarly, when investing, investors should not blindly seek for assets with low risk, which will result in small risk and small return. We should pay more attention to observe the sharpe ratio of assets and ensure that the sharpe ratio of the portfolio is the highest, so as to obtain the optimal portfolio of risky assets.

4 Conclusion

It can be seen from this paper that Hong Kong, as a financial center in China and an important financial city in the world, is worthy of our study. The Hong Kong market has a big impact on the mainland market and is the fastest Chinese market to respond to changes in other countries' financial markets. It can be learnt from the research

that judging the minimum risk portfolio and the optimal risk portfolio of assets in Hong Kong market can be used for reference in the Chinese mainland market. The experimental results of this paper are as follows: it is necessary to invest a lot in China Construction Bank Corp. and not in Industrial and Commercial Bank of China Ltd. to obtain the minimum variance portfolio; You need to invest heavily in Chinese banks and not in China Construction Bank Corp. to get the optimal risk portfolio, which is the portfolio with the largest Sharpe ratio. At the same time, when choosing investments, we should also make it clear that we should not blindly pursue the asset with the least risk but pay more attention to the tangibility of the efficient frontier and the capital market line, that is, the asset portfolio represented by the highest Sharpe ratio, which is the optimal risk asset portfolio.

References

Ba S (2020) The balance of payments pattern in mainland China and the new positioning of Hong Kong's financial center. Open Herald 3:14–21

Ba S, Fang Y, Chai H (2021) Double open the capital market is a regression: motivation, impact and response. J Tsinghua Univ Financ Rev 9:27–29

Lin H, Du J, Zhang S (2021) Sharpe ratio: estimation method, applicability and empirical analysis. J Stat 2(06):73–88

Liu Y, Ruan J (2020) Building an international science and technology financial center: reflections on Hong Kong's connecting with the belt and road initiative. Soc Sci 6:39–45

Qiao Y (2020) Analysis of the impact of shanghai-Hong Kong stock connect on the volatility of Hong Kong Market. China Collect Economy 29:86–88

Shang H (2022) Strategic stalemate period of Hong Kong stocks: might as well fight "guerrilla war." Dynam Anal Stock Market 12:29–30

Tang Y (2020) Confidence in Hong Kong's financial industry is stable. Global Times, 007

Yan T (2020) Research on spillover effect of Hong Kong stock market on shanghai stock market after shanghai-Hong Kong stock connect opening. Lanzhou University of finance and economics

Yang D (2020) Hong Kong opportunities in the exchange of Hong Kong stocks and mainland market. Wealth Manage (11):13

Zou Y (2022) South capital "bottom" Hong Kong. The economic observer, 020

Portfolio Optimization for Five Representative Companies in China

Ruitao Guan, Haotian Lan, Yingjun Li, and Che Zhou

Abstract Portfolio optimization plays a significant role in the contemporary financial field. This paper directly analyzes the decision of asset allocation under the situation of multiple assets existence in Chinese financial market. We select five specific companies which have already succeed in the Shenzhen stock exchange and adopt Mean–variance Model to ensure the expected return and adjust the right portfolio to minimize the total investment risk. Then we calculate the minimum risk portfolio and the maximum Sharpe ratio portfolio for a given asset and the maximum expected return portfolio for a given risk and find the minimum risk portfolio for a given return. The result shows that: First, finding the investment portfolio exclusively by the smallest variance is not so practical in the reality. Besides, Vanke has the highest return among the five firm, which is deemed as the most appropriate assets to be selected to invest. The findings may be useful to related investors interested in multiple-asset investment.

Keywords Portfolio · Optimization · Sharp ratio · Mean–Variance model

R. Guan, H. Lan, Y. Li, C. Zhou: These authors contributed equally.

R. Guan
Sichuan University, Chengdu, Sichuan Province, China

H. Lan
Jinan University, Jinan, Guangdong Province, China

Y. Li (✉)
North China Electric Power University, Beijing, China
e-mail: 120191130815@ncepu.edu.cn

C. Zhou
Zhejiang University of Finance and Economics Dongfang College, Jiaxing, Zhejiang Province, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_73

1 Introduction

Recent theoretical developments have revealed that risk is always present with the activities of human society. Most of the time people take risk as God-given. Its cash flow is uncoverd to changes in demand, raw material costs, technology, and an ostensibly endless list of other uncertainties (Richard et al. 1980). managers can do little about it. In today's economic society, risks become more complex and diversified due to the rapid development of economy, deepening of social division of labor and the increasing complexity of various economic phenomena. Therefore, a good sense of risk is of great significance for survival in the changing tide of economic development. Especially in the field of investment, investment returns are accompanied by risks. The greater the investment returns are, the greater the risks will be. The existence of risks makes the investment full of uncertainty, and risks returns may be offset or even cause serious losses due to risks. Therefore, in investment, risk awareness and risk prediction and control appear to be particularly important.

In view of this situation, it is particularly important to learn how to use portfolio investment. David who runs Yale's endowment, once posted a video about portfolio investing. The video clearly mentions that no matter how good an investor's analysis is, investor can only mine the existing information and cannot predict the future information, which is the uncertainty of the future. Obviously, the seller is likely to ignore the uncertainty, while the investment portfolio depends on probability and expectation, not the absolute certainty of individual stocks. On average, portfolio risk does fall with diversification, but the power of diversification to reduce risk is limited by systematic or common sources of risk (Zvi et al. 1989). Thus, this appears as a more straightforward problem. What is the optimal allocation of the portfolio? How is their control of risk different? What is their risk and their return rate?

Actually, there are numerous studies regarding portfolio optimization. Some studies aim to focus on the industries of on retail, new energy vehicle, and technology. Suleman, Awais, and Muhammad, for example, investigated the importance of oil assets for portfolio optimization and discovered that in the case of investments in oil and gas firm stocks, buyers can form an optimal portfolio by spending a larger proportion of their investments on firm stocks rather than on oil assets (Suleman and Muhammad 2019). Laura and Eric studied portfolio management in businesses and discovered that building and sustaining a meaningful and value-adding portfolio is a substantial issue for many organizations, particularly if they want to reassess their balance between designing and manufacturing items (Laura and Eric 2022). Some of the present portfolio research is based on a market environment study. For example, Yi investigated Optimal portfolio choice for higher-order risk averters and discovered that Fourth-degree dominance presupposes those investors are prudent and temperate, and thus also prefer skewness and detest kurtosis (Yi and Thierry 2022). Using this dominance criterion effects in superior out-of-sample investment performance because that allows for better concentration in recent winner industries, which tend to show persistent positive abnormal returns and a favorable higher-order risk profile due to the industry-level price momentum effect. Felix and Daniel

suggested a simple double-shrinkage portfolio selection strategy to increase the portfolio's out-of-sample performance (Daniel and Felix 2021). Using a variety of real-world datasets, researchers demonstrate that the proposed portfolio approach is rather stable, yielding greater Sharpe-ratio values and lower conditional value at risk values. Thus, the double-shrinkage selection rule improves the performances of the portfolios significantly. Above all, this shows that portfolio application research in The Chinese market is still relatively limited. By reading the literature and books, researchers learned through BKM that Portfolios of two risky assets fairly tend to break down, and they illustrate the tenets and announcements that be true to portfolios of many assets. It point in think about a two-asset portfolio as an asset allocation determination. But what happens when there are multiple assets, or when other companies are involved. Therefore, this paper will select several representative companies in China in this paper and calculate the data of their statements to solve our question. Finally, the analysis comes out and the conclusions are drawn.

There are many alternative ways to solve these problems. We will calculate the minimum risk portfolio and the maximum Sharpe ratio portfolio for a given asset and the maximum expected return portfolio for a given risk and find the minimum risk portfolio for a given return. In general, we ought to mostly invest in PNGAY when aiming to minimize variance under a fixed return and when we are considering maximizing Sharpe value. Moreover, we should invest mostly in VANKE and ZHENYE when we intend to maximize return under a fixed variance and to minimize variance respectively.

The above contents will be detailed in the following parts. Section 2 shows the data, Sect. 3 depicts the methods, Sect. 4 presents the results and Sect. 5 is the conclusion.

2 Data

The data in this article is derived from RESSET Database (http://www.resset.cn/). We select the representative companies. i.e., PNGAY, VANKE, GUOHUA, ZHENYE, SHENZHOU for closing prices, from December 31, 2013, to December 31, 2021. The stock code of those five stocks is C000001, C000002, C000004, C000006, C000008, each of them have numerous trading record in the Shenzhen stock exchange. We select those five companies for the sake of the typical data and great research value. To implement further investigations, we do data cleaning to match the time. Finally, 132 data are collected. We transfer these closing prices to log-returns and some basic information is shown in Table 1.

Through visualizing the data, we can find that the VANKE has the highest average annual rate of return which is 23.03%. Similarly, the rate of GH-TECH and GH-TECH is 21.76% and 21.89% respectively. Those three companies have an average rate of return higher than 20%. Coming to the next is PNGAY, which has an annual rate of return of 17.77%. ZHENYE, however, has the lowest figure which is 6.62%, much lower than other companies. As the data of the annual rate of return in recent

Table 1 Descriptive statistics of the selected assets

	PNGAY	VANKE	GUOHUA	ZHENYE	SHENZHOU
Mean	0.1777	0.2303	0.2176	0.0662	0.2189
Variance	0.1479	0.2016	0.5771	0.1257	0.5629
Max	0.7692	0.7935	1.948	0.6494	1.4544
Min	−0.2845	−0.2679	−0.5016	−0.4558	−0.5497

eight years being collected, we can calculate the variance of each stock. As a result, we discover that SHENZHOU and GH-TECH has similar variance, which is 0.5629 and 0.5771 respectively. Other three stocks have a lower variance which are all below 0.2. We can find that both SHENZHOU and GH-TECH has a high rate of return with high risk existed. To give a clear explanation, we compare each single data and find that GH-TECH has the highest max rate of return which is 194.8%, followed by SHENZHOU with 145.44%. ZHENYE has the lowest max rate of return which is only 64.94%. What's more, the min rate of return of PNGAY and VANKE are the two highest in five companies. Both are beyond −30%. In contrast, both GH-TECH and SHENZHOU get their min rate of return lower than −50%.

3 Method

3.1 Mean–Variance Model

When investors invest in the market, they should first make investment decisions at the beginning of the period. Investors need to obtain the optimal investment decisions through the analysis of the current situation of market development, that is, the portfolio that maximizes the expected return and minimizes the uncertain risk. On the basis of this goal, the Mean–variance Model uses the relevant knowledge of mathematical statistics to help people find the best balance between income and risk through mathematical models. Therefore, through the Mean–variance Model, investors can analyze and judge the market more intuitively and accurately and make correct investment decisions based on relevant evidence.

$$\sigma^2\left(R_p\right) = \Sigma\Sigma \mathrm{x_i x_j Cov}(R_i - R_J) \tag{1}$$

$$r_p = \Sigma x_i \mathrm{r_i} \tag{2}$$

Constraint:

$$\Sigma x_i = 1 \tag{3}$$

where R_p is the portfolio return, R_i is the return of the I stock, X_i and X_J are the investment proportion of securities I and J, σ^2 (R_p) is the portfolio investment variance (total portfolio risk), and Cov $(R_i and R_J)$ is the covariance between the two securities.

Mean–variance Model has created preconditions and theoretical basis for many investment theories. Through the above equation, it can be seen that under the given expected investment return, when the proportion of different investments in the portfolio changes, the relevant investment risks will also change (Sharpe 1963). Through this model, investors can determine the expected return rate of X_i in advance when investing in different projects, and then get what kind of investment ratio can be used to minimize the portfolio risk σ^2. In this way, investors can have a clearer and comprehensive grasp of the investment to be made and have more evidence to follow in decision-making. At the same time, they will also have a rough estimate of the possible risks and benefits in the future, which is conducive to the formulation of plans and goals by enterprises (Xonn and Yamazaki 1991).

3.2 Sharpe Ratio

Many existing investment theories and long-term investment experience show that risk and return play a very important role in investment decision-making. Return is the most essential goal of our investment, and risk is an adverse factor that may hinder us from obtaining returns and causing losses. Therefore, improving returns and reducing risks are crucial in the investment process. At present, many investment theories only pay attention to one of the two. Some guide us how to find valuable investments in complex economic markets that have achieved high returns, and some tell us how to measure and avoid risks through relevant decisions and means. Sharp ratio takes into account both risks and benefits. The central idea of sharp ratio is that rational investors will choose the portfolio with maximum return under the determined risk level or choose the portfolio with minimum risk under the expected return rate. At the same time, sharp ratio also believes that the premise for investors to choose a portfolio is that it can at least bring higher returns than the risk-free portfolio (Scholz 2007).

$$\text{Sharpe ratio} = [\mathrm{E}(R_p) - R_f]/o_p \tag{4}$$

where $\mathrm{E}(R_p)$ is expected rate of return on investment portfolio, R_f is risk-free rate and Σ p is the standard deviation of the portfolio. Sharp ratio is based on the concept of capital market line (CML), which indicates the excess return per unit of risk in a portfolio. If the sharp ratio is positive, it proves that the investment is reasonable. When the sharp ratio is greater than 1, it proves that the yield is greater than the risk turbulence, otherwise it is less than the risk turbulence. The higher the sharp ratio, the better the portfolio. If the sharp ratio is negative, it means that the bottom has been reached and investment is not recommended (Bayley and López de Prado 2012).

4 Result

In realistic, people always consider investing not only on a single item. Therefore, the combination of different investments plays a crucial role in realistic. It is the idea of portfolio. By that, we are aiming to find some different portfolios under four different constraints. We use variance to reflect risk and use return to reflect the payoff. They are all practical and comprehensive. The first constraint is minimum variance under no other constraints and it means that people consider the portfolio with the least risk; The second is that minimum variance under fixed return and it means that people are considering to find a minimum risk and a return that they eager to achieve; The third is that maximum sharp ratio and it means that people are considering return and risk simultaneously by the idea of sharp ratio; The forth is that maximum return under a fixed variance which means that people want to achieve the highest payoff but not to be exposed to a higher risk. Following the conclusions and data above, we find four different optimal portfolios corresponding to four different constraints and aims, and the result are shown in the table below. The first row is the name of five different firms, and the first column is our optimization goals and constraints, some basic information is shown in Table 2.

When we emphasize the second row, which means we are trying to find minimum variance portfolios under no other constraints. Consequently, ZHENYE weighs 43.11% in this case, since ZHENYE, in terms of variance, the figure of ZHENYE is significantly smaller than other firms' counterparts, which is 0.1257. In addition, ZHENYE weighted zero at minimum variance portfolios. It is because that ZHENYE has the highest variance. In terms of finding minimum variance under fixed return, when we fixed the return at 0.1821, which can be easily achieved within various portfolios, we find that PNGAY weight 47.18%. The reason for that is when we consider

Table 2 Different portfolios under four different constraints

	PNGAY (%)	VANKE (%)	GUOHUA (%)	ZHENYE (%)	SHENZHOU (%)
Minimum variance (no other constraints)	41.13	11.24	4.52	43.11	0.00
Minimum variance under fixed return	47.81	27.03	9.90	13.11	2.15
Maximum sharp ratio (no other constraints)	45.14	39.04	11.83	0.00	3.99
Maximum return under fixed variance	22.42	62.39	11.19	0.00	4.01

Table 3 Return, variance, Sharpe ratio of the four different optimal portfolios

	Return	Variance	Sharpe ratio
Minimum variance (No other constraints)	0.1374	0.0778	0.3694
Minimun variance under fixed return	0.1821	0.0888	0.4962
Maximun sharp ratio (No other constraints)	0.2046	0.1029	0.5308
Maximum return under fixed variance	0.2166	0.1304	0.5049

the minimum variance under a certain return. We are considering an implicit ratio between variance and return. Obviously, PNGAY is the most outstanding firm in this competition of ratio. Generally thinking, conversely, SHENZHOU is not as good as other firms in terms of the ratio between variance and return. When we emphasize the fourth row, the Sharpe ratio is also a numerically value implicitly including a ratio between return and variance, so the result is similar to its row 3 counterpart. However, since in row 3 we fixed the return, there is some slight difference between them. In maximizing Sharpe ratio, SHENZHEN weight 0.

When we maximize the return under a certain variance, we fixed the variance at 0.1304, which is the average value of those five different variances. Apparently, it can be easily achieved under different investment portfolios. Visually, VANKE weighs 62.39 in this maximum return portfolio, indicating that VANKE has the highest return among those five firms. It is indeed the case when we go back to the original data The related results are shown in Table 3.

After the analysis of the reason why our portfolios forms like that table above, we are trying to find out the corresponding return, variance(risk), Sharpe ratio to those four different optimal portfolios respectively. Firstly, when minimizing variance under no other constraints, we succeed in minimizing variance since its figure is 0.0778. However, the return is not impressive, and it is only 0.1374, which makes our investment a poor payoff. Moreover, the Sharpe value is not impressive as well. As a result, using the sole idea of finding a portfolio with minimum variance is not so practical in realistic. Secondly, we want a minimum variance under a fixed return. When assigning the return at 0.1821, which is the mean of the four different returns under four different companies. Clearly, when comparing to the term of merely minimizing variance, we have achieved an increase of 0.0447 in return with the increase of 0.01 in variance. Consequently, it is more practical than only minimizing variance. Thirdly, we want a maximum Sharpe ratio. Thanks to the idea of Sharpe ratio, which consider risk(variance) and payoff(return) simultaneously, this term is probably the most practical and comprehensive idea in our research. By the table, we have a return of 0.2046 and we are only having to suffer from a variance of 0.1029. Lastly, when trying to find a maximum return under a fixed variance, we find that the result is also really impressive, with the return of 0.2166 and the variance of 0.1304. Therefore, it is reasonable for us to claim that this optimization is practical in realistic.

5 Conclusion

Nowadays, most of the portfolio research is based on the analysis of general market situations. In this paper we aim to do portfolio analysis by concerning several assets. Analyzing the five representative Chinese firms may help the potential investors to determine their investment decisions and get used to the current situation of Chinese financial market. In the paper we collect the data of five representative firms in Shenzhen stock exchange and then optimize the investment portfolio by Mean–variance Model. We ultimately construct the maximum Sharp ratio portfolio to confirm the appropriate one. The study finds that, Vanke has the highest return and Sharp ratio among all the five firms and PNGAY performs best when the return is fixed. The result infers that finding a portfolio solely by a minimum variance is not so practical but minimize variance under a fixed return may perform better.

References

Bayley D, López de Prado M (2012) The sharpe ratio efficient frontier. J. Risk 15(2):3–44

Daniel R, Felix K (2021) A shrinkage approach for Sharpe ratio optimal portfolios with estimation risks. J Bank Finance 133:106281

Laura N, Eric LL (2022) Where variants and familiarity meet: portfolio management in companies that design and produce. Procedia CIRP 109:P502–507

Richard AB, Stewart CM, Franklin A (1980) Principles of corporate finance. McGraw-Hill Companies, New York, p 645

Scholz H (2007) Refinements to the sharpe ratio: comparing alternatives for bear markets. J Asset Manag 7(5):347–357

Sharpe WF (1963) A simplified model for portfolio analysis. Manage Sci 10(2):277–293

Suleman S, Muhammad S (2019) The importance of oil assets for portfolio optimization: the analysis of firm level stocks. Energy Econom 78:217–234

Xonn H, Yamazaki H (1991) Mean-absolute deviation portfolio optimization model and its applications to Tokyo Stock Market. Manage Sci 5:519–531

Yi F, Thierry P (2022) Optimal portfolio choice for higher-order risk averters. J Bank Finance 137:106429

Zvi B, Alex K, Alan JM (1989) Bodie kane marcus investment. McGraw-Hill Companies, New York 197

Portfolio Strategies for Different Types of Households Under the Impact of COVID-19

Chen Zhong

Abstract With the spread of the epidemic, the economies of all countries have been affected and destroyed to a certain extent. Therefore, they began to analyze and discuss what kind of portfolio method different types of families should choose to maximize their income and be safer and more reliable. Because COVID-19 is still continuing, family confrontation methods are still being studied. From the perspective of economics, this study analyzes and summarizes the investment portfolio direction of different types of families under the COVID-19 at the present stage and finally studies the future development direction. The final result of this study is that under the 2019 coronavirus disease, low-income families can buy less risky bonds and make bank savings; middle-class families can buy commercial insurance or pensions and choose long-term investment; and wealthy families need to make diversified investments, diversify risks, and seize investment opportunities according to the specific situation. Every family needs to make its own portfolio according to its actual situation in order to maintain and increase the value of assets.

Keywords COVID-19 · Family investment · Family portfolio · Resource allocation · Optimize configuration

1 Introduction

Through investigation and research, it is found that COVID-19 not only poses a threat to people's health but also makes people face a financial crisis. Due to the collapse of many enterprises, the unemployment rate and poverty rate have risen sharply, and the low-income people are the most affected. Therefore, it is expected that the national economy will be greatly reduced. A report from the World Bank estimated that 11 million people could fall into poverty across East Asia and the Pacific (World Bank 2020).

C. Zhong (✉)
Jilin University, Lambton College, Changchun 130103, China
e-mail: Zhongchen010212@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_74

More than 90% of families have been affected by the epidemic. The problems of unemployment, shutdown, and bankruptcy in society are very serious, and family assets are facing a great threat. Because of the epidemic, many families have caused huge losses due to lack of experience, and at the same time, social progress has also been threatened. Therefore, different portfolio suggestions will be made according to different types of family situations. In the current research report, the number of systematic studies on the portfolio direction of family types is relatively small, and the number of single studies is relatively large, such as for the portfolio direction of retired families or the asset allocation of families under the epidemic. This study will summarize and analyze the more suitable portfolio types and asset allocations according to the three basic family types.

This paper uses the methods of literature research and qualitative research.

Literature research: Using the keywords "COVID-19," "Family Portfolio," and "resource allocation," obtain literature related to the research topic, read and sort it out, find the entry point of the research, and form the theoretical framework of the research using network resources, school library network database resources, and other methods.

Qualitative research: Investment methods and asset allocation methods of households under the 2019 corona-virus disease are obtained through online platforms. These methods are then analyzed and studied to reflect the basic and distributional characteristics of the data and to describe the overall situation.

The significance of this study is that it is now in the post-epidemic stage. The significance of this study is to better help families learn from the losses of the previous epidemic, change their investments, find their own investment methods, and allocate assets reasonably. While helping families better manage their finances and maintaining and increasing the value of their property, they can also promote the recovery and development of the social economy and get on track faster. It also enables all families to learn to prevent emergencies and reduce possible losses.

2 Introduction to Related Concepts

2.1 Family Types

Generally speaking, family types are mainly divided into low-income families, middle-class families, and rich families according to the income gap between the rich and the poor. Low-income families have fewer assets, and the scope of investment is also very narrow, so they cannot bear risks. Middle class families are in the middle of the wealth pyramid. While meeting food and clothing needs, they will also incur a lot of expenses, which is far from achieving wealth freedom. In order not to shrink their wealth, they need to formulate scientific investment and financial management plans. Rich families have a lot of assets at their disposal, and most of them will be used for investment. They pursue more diversification of investment

and greater profits. Different types of families are also affected to varying degrees by COVID-19. Investors today appear to be more risk-averse and choose investments that offer moderate returns with low risk that are pretty safe. Investors also need to be educated on mutual fund schemes, Gold ETFs, and the best times to enter and exit the stock market (Gurbaxani and Gupte 2021).

2.2 Asset Allocation

By allocating a portfolio's assets in accordance with a person's objectives, risk tolerance, and investment horizon, asset allocation is a type of investment strategy that seeks to strike a balance between risk and reward. In the capital market, liquidity, security, and profitability are important factors in asset allocation. Only when these three points are weighed together is there a healthy way to allocate assets. If household investment follows these elements, it can not only minimize risks but also obtain profits.

A portfolio is a collection of financial assets, such as securities, bonds, commodities, cash, and cash equivalents, such as closed-end funds and exchange-traded funds (ETFs). Most people think that a portfolio's core consists of equities, bonds, and cash. Although this is frequently the case, it need not be the exception. Various types of assets, such as private investments, real estate, and works of art, may be included in a portfolio. The so-called portfolio strategy is a combination of operational objects and methods that investors formulate according to their own investment philosophy in a certain period of time and in conformity with the market and their own opportunities. COVID-19 is changing people's traditional investment methods. A household's likelihood of altering its investing strategy is 16.03 percent. Namely, the total investment amount is reduced by 9.15% if a family member, coworker, classmate, friend, or acquaintance lives in the same town or village as COVID-19 (Yue et al. 2020).

3 Portfolio Strategies for Different Types of Households

3.1 Low-Income Families

For low-income families, bonds or tax-free bonds are a good investment option. According to Hanspal, "Most recently, the COVID-19 pandemic's spread and the regulatory actions taken to stop the virus from spreading threw major stock markets around the world into a tailspin, with the S&P500 losing an astounding third of its value during the rapid decline in stock prices in February and March 2020" (Hanspal et al. 2021). At this stage, the number of household stock investment has increased, but it is unstable. Affected by other factors, the number of bonds and tax-free bonds has increased significantly. In the next quarter, the stock and fund

investment willingness of households with different levels of financial assets are compared, and the results show that the fund investment willingness index of each group of households is higher than the stock investment willingness index. This shows that families are more inclined to invest in funds than stocks. From the above analysis, it can be seen that the impact of the epidemic makes families more rational in investment, and individuals who have experienced significant external risks are also consciously reducing personal risks (Li et al. 2020). Low-income families do not have much assets, so the investment risk is smaller and more reliable, which is a very ideal investment direction.

Secondly, investment in time deposit accounts is also a very good way. There is still a gap between China and developed countries in infrastructure and social welfare. To meet the needs of pensions, education, and medical treatment, residents retain the liquidity of funds and choose to save (Tong and Haihong 2020). When the epidemic occurs, bank savings not only have low risks but can also obtain greater benefits. Low net worth households invest more in bank accounts and similar assets because they are more reliable and secure.

3.2 Middle Class Families

Middle class families can contribute to commercial pensions or RRSPs because middle class families have the ability to pay for these, and also provide protection for future assets. At this stage, affected by the epidemic, the risk aversion of household investment has increased, the propensity to save has generally increased, and the consumption level has decreased slightly. At the same time, a higher proportion of households have significantly increased their willingness to allocate insurance assets, while their propensity to allocate overseas assets is relatively reduced. Studies have shown that high-income people are more willing to buy insurance, which leads to a stronger willingness of high-income families to buy commercial insurance (Kexin 2022). A pension fund is a long-term fund invested in the capital market. Through market-oriented investment, it can maintain and increase its value and reduce inflation. Most endowment insurance belongs to dividend type insurance. For example, 70% of the profits of insurance companies are distributed to customers. Although inflation has always existed and cannot be avoided, the profits of insurance companies obviously grow together. Therefore, families investing in pensions or insurance funds can resist inflation to a great extent. Similarly, the income from long-term investment is larger and more stable, which is also very suitable for middle-class families.

3.3 Rich Families

Rich families have a lot of disposable assets. Diversified investment portfolios can share risks and find more suitable investment methods. Their investment methods are also broader, such as real estate, securities assets, and industrial assets investment. For example, during the epidemic period, wealthy families can invest in the medical field, and the profit return will be more than usual, but it will be judged according to the current specific situation. These can be done through online investment. The acceptance of online investment and wealth management model is gradually increasing, and in the future, online and intelligent service methods will be more and more popular with Chinese families (Gan et al. 2020).

At the same time, wealthy families can invest in physical objects to maintain and increase the value of their assets. The best investment for rich families in inflation is to buy entities, such as land, which are not afraid of inflation. When deflation occurs, with more cash and fewer physical goods, it is very simple to sell physical goods. It can maximize assets. Therefore, for wealthy families, the ability to bear risks is stronger than before, and, of course, the risks will be more dispersed. If we can plan the investment reasonably, we can maximize the benefits. Here is an example. If all assets of a wealthy family are regarded as the number "1", 10% can be used to buy highly liquid financial products, such as monetary funds; 20% can be used to buy debt funds with less risk; 30% can be invested in trust companies; and 40% can be invested in the primary market, such as potential but unlisted small companies. Nearly 30% of people prefer to learn from professional investment institutions. The so-called "professional things are left to professional people". Professional investment institutions have professional knowledge and skills, can capture relevant information more quickly, and can effectively formulate a reasonable asset allocation plan to realize the appreciation and preservation of wealth (Binni 2021). Wealthy families have abundant funds and stronger ability to resist risks. Shocks to financial wealth hit primarily groups with more savings who are better able to cope with these shocks (Hanspal et al. 2020).

4 Conclusion

All in all, the final result of this study is that under the coronavirus disease in 2019, low-income families can buy low-risk bonds and make bank savings; middle class families can buy commercial insurance or pensions and choose long-term investment; and wealthy families need to diversify their investments, spread risks, and seize investment opportunities according to specific circumstances.

According to the three most basic family types, low-income families need to make less risky investments while maintaining value to stabilize their assets. Middle-class families need to face the continuous impact of COVID-19. Each family needs to make its own portfolio according to its actual situation. At the same time, three elements

can be remembered: liquidity, security, and profitability. In this way, we can increase the value and maintain the value of our assets, allocate our assets reasonably, and learn how to avoid risks and solve difficulties in case of emergencies in the future. There are some limitations to the current paper. This study is only aimed at the situation of most families and carries out theoretical analysis. If there are more data models and specific data, the reliability will be higher. Future research will be done by doing questionnaires to understand the reality and modeling to simulate the results of portfolio planning.

Acknowledgements First of all, I would like to express my deepest gratitude to the teachers and professors in my university. They not only taught me knowledge and patiently answered my questions, but also provided me with valuable guidance at every stage of writing this thesis. In addition, I want to thank all my friends and parents for their encouragement and support. They help me find data and give me profound inspiration to guide me to complete my thesis. The completion of this paper is inseparable from each of them.

References

Binni W (2021) Research on problems and suggestions of household consumption and financial management under the background of COVID-19. Sci Technol Econ Mark 02:51–52

Gurbaxani A, Gupte R (2021) A study on the impact of COVID-19 on investor behaviour of individuals in a small town in the state of Madhya Pradesh, India. Australasian Account Bus Financ J 15(1):70–92

Hanspal T, Weber A, Wohlfart J (2021) Exposure to the COVID-19 stock market crash and its effect on household expectations. Rev Econ Stat 103(5):994–1010

Hanspal T, Weber A, Wohlfart J (2020) Income and wealth shocks and expectations during the COVID-19 pandemic (No.8244). CESifo Working Paper. https://www.econstor.eu/handle/10419/216640

Kexin H (2022) Study on the optimal allocation of household assets under the COVID-19. CO-Operat Econ Sci 08:51–53

Li G, Xiaomeng L, Xiang W et al (2020) Trends in household wealth in china under the shock of the new crown epidemic. Financ Forum 04:110–123

Li G, Xiaomeng L, Xiang W et al (2020) The changing trend of household wealth in China under the impact of the COVID-19. Financ Forum 10:3–34

Tong Z, Haihong M (2020) Household asset allocation in the post epidemic era. Bus Econ 9:168–170

World Bank (2020) East Asia and Pacific in the time of Covid-19. World Bank East Asia and Pacific Economic Update (April):234. https://openknowledge.worldbank.org/handle/10986/33477

Yue P, Gizem Korkmaz A, Zhou H (2020) Household financial decision making amidst the COVID-19 pandemic. Emerg Mark Financ Trade 56(10):2363–2377

Portrait Analysis of Salesperson's Personal Traits: Using the Big-Five Model as an Example

Jingyi Chen, Shijie Ma, and Dan Xu

Abstract The relationship between each of the Big-five Personal Traits and salespersons was investigated by a survey with a sample of 73 Chinese salespersons in different industries, which include education, financial insurance, real estates and others. The result showed there was a positive correlation between extraversion and salesperson's traits while a negative correlation between agreeableness. The correlation of other 3 traits were not clear enough. The limitation and the implication to practice was also discussed.

Keywords Personal traits · Organization behaviour · The Big-five personality

1 Introduction

This study is about figuring out the "Personal Portrait" of the salespersons using the Big-five Personality model. We focus on finding out the relevance between the five personalities ("Neuroticism" "Agreeableness" "Extraversion" "Conscientiousness" "Openness") and the common salespersons. We are trying to articulate how a salesperson's potential personality would be and what kind of people may have the potential to become a salesperson.

J. Chen
Jurong Country Garden International School, Nanjing 210000, Jiangsu, China

S. Ma (✉)
College of Business and Public Management, Wenzhou-Kean University, Wenzhou 325000, Zhejiang, China
e-mail: mas@kean.edu

D. Xu
Shanghai Yijia Intelligent Technology Co., Ltd, Shanghai 200040, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_75

The study comes from the popular concept "Big-five Personal Traits" from Organization Behaviors. There were many previous studies regarding "Big-five Personal Traits" and their applications. However, only a few of them applied the theory into the career "Personal Portrait". Moreover, the number of articles about the salesperson, especially in China, is limited. Hence, we are going to apply the theory to identify the relationship between each trait and salespersons.

The concept of Big-five Personality Traits is Classic. It was raised in 1992. However, its application in China is still limited. Most of its modern applications are in the psychology field or theoretical field. Many of the companies are using it to test if one person is suitable for a particular vacancy, but still not common. This research is going to analyze a specific field: Salespersons. In summary, to make sure what.

Personality a salesperson would possess, the following questions have to be addressed: (1) What is the relationship between Neuroticism" "Agreeableness" "Extraversion" "Conscientiousness" "Openness" and a salesperson? (2) What are the relevance index between each trait and the salesperson? (3) How would each trait contribute to the behavior of the salespersons?

In this research, the ultimate goal is to find the relevance between each personal trait with the job salesperson. The objective is to develop a framework of salesperson's personality portraits. Also, this research has a sub-goal: to identify the difference between a top salesperson and average ones in personalities. The motivation to do this research comes from the course "Leadership Style and Organization Behaviors". The Big-five Personalities come from this course and we want to apply the theory into practice. Therefore, we find the specific field: salesperson to test if the theory we learned is practical. The study would be helpful for HR departments in Chinese companies to select their salesperson. The research also helps potential salespersons to do a self-evaluation.

2 Literature Review

2.1 Personal Traits

The origin and definition of personality traits . Personality traits originated in the 1940s in the United States, represented by psychologists Galton Willard Allport and Raymond Bernard Cattell (Li 2016). Modern personality trait theory is a long process of evolution. The first one is the personality trait theory of Allport, a famous psychologist. He is the first person to put forward the personality trait theory. The definition of this theory is that the individual holds the general neuropsychological structure of the focus of reality, has many stimuli that are functionally equivalent, and has the consistency of adaptive and expressive behaviors in different situations (Pervin 1994). For example, a person with aggressive traits may be competitive but may be aggressive when working with others. Because Freudians put too much emphasis on people's subconscious dissatisfaction and suspicion and the experimental tendency

of psychology, he developed the personality trait theory, which analyzed various representative personality traits (Frosh 1987). He thinks that comparing individuals cannot obtain the uniqueness between individuals and cannot know certain particular individual traits. He proposed traits as the basic unit of personality and personality. Allport divides personality traits into common traits and individual traits, and common traits mean that all people have them to varying degrees. Moreover, individual traits are divided into three categories:

1. The primary trait is also called the pivotal trait. The primary trait is the most typical, the most general trait of a person.
2. Central traits (core traits) are several essential traits that constitute individual uniqueness.
3. The secondary trait is usually shown under certain exceptional circumstances (Xue 2012).

The second Raymond Bernard Cattell theory of personality traits, he further developed based on Allport's theory, he used factor analysis method, put forward a theoretical model based on personality traits, the model is divided into four layers of individual traits and common traits; Surface and root traits; Physical characteristics and environmental characteristics; Dynamic traits, competence traits, and temperament traits (Cattell 1987). Moreover, the most important is that it puts forward 16 independent root traits in terms of root traits. Raymond Bernard Cattell believes that each person has 16 traits, showing different degrees. The third is the modern five-factor trait theory. Since the 1980s, researchers have reached a relatively consistent consensus on the description mode of personality traits, which is called the "Big five Personalities." Many psychologists also consider it to be the best model of personality structure. The five dimensions are neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. The fourth Eysenck three-factor model of personality is extraversion, neuroticism, and psychoticism (McCrae 2009).

Personality Traits Controversy. In personality science, there are generally three different research orientations: clinical, relevant, and experimental (Liu 1991). Regardless of their research approach, the common goal of psychologists is to build a model that can explain personality traits. We can see that different famous personality psychologists will put forward a personality model throughout ancient and modern times, but their consistency is minimal because the number and nature of their factors are very different (Liu 1991). Therefore, it's hard to get a consensus. Nowadays, the four most critical controversial points in western personality psychology are individual and situation and their interaction, the relationship between self-concept and its necessity, externality, behavioral cognition and emotion, and the research methods and strategies of personality (Liu 1991). First of all, people and situations and their interactions. This topic is the most intense but also the earliest. To put it simply, how do individual personality tendencies interact with each other in specific or unique situations, and how does the situation determine individual-specific behaviors? The second is the question of self-concept. This involves the theoretical structure of the self, and research shows that this self-consciousness can influence individual

behavior in many situations, such as moral choices. The third is the relationship between behavior, cognition, and emotion. The reasons for the debate are as follows: firstly, there are different views on the importance of the three factors; secondly, there is a relationship among the three factors, especially the causality. Fourth, research methods and strategies. The point of this discussion is how can we better study better understand the complexity of personality (Liu 1991)?

2.2 Big-Five Personality Model

In recent years, the prominent five personalities have a personality model of consensus, most psychologists with a basic assumption have been throughout, the basic assumption is the lexical hypothesis, assuming the critical part of people's lives will be descriptive language vocabulary, and if one crucial thing and widespread, so in the language will be given more words to describe, so from the vocabulary to find personality traits, will become the critical way for the study (Liu 1991). They form the beginning of the English dictionary found 17,953 describe personality differences in vocabulary. After constantly streamlining, a team of the last two psychologists found the same five factors and formed today's prominent five personalities (Liu 1991). Extraversion, agreeableness, accountability, openness to experience, and neuroticism are the five personality types. People who score high on extroversion are gregarious, talkative, confident, and very social in a group. However, there can be group conflict if there are too many extroverts in a team. Low-score people tend to be silent, solemn, and quiet. This type of person prefers to be alone. Agreeableness also falls into two categories, with high scores for honesty, openness, conflict avoidance, exhibitionism, and empathy. Low scores are generally hostile, manipulative, ruthless, selfish, defensive, heavy and shrewd, show-off. Accountability, high scores are efficient, organized, follow the rules, accurate. Low scorers tend to be absent-minded, impulsive, and inattentive. Openness, high scores tend to be curious, creative, imaginative, and open to new things. Low scores are generally rational, like fixed lifestyles affairs, and do not challenge authority. Neuroticism high scores are characterized by anxiety, nervousness, anger, depression, shyness. Low score, relaxed temper, easygoing, calm, self-control, strong adaptability (Zu 2013).

3 Researches and Analysis

3.1 Methodology

In this paper, we used the mixed-method approach (Creswell 1999). The mixed-method involved data collection and analysis. For some data analysis, we adopted the quantitative method (Rutberg and Bouikidis 2018) and for the conclusion, we used

the qualitative method (Campbell 2014) to show the relationship between salesperson and their personalities. These methods would help us to have precise data.

In this research, we tested the salespersons' personal traits using the ten-item personality inventory (TIPI) Big Five Personality Traits Tests written by the University of Texas (Gosling et al. 2003). We sent them out to the salespersons from different companies and fields to see their scores of them and to conclude the common traits of the salesperson.

The research was about the relationship between salespersons and their personal traits. Therefore, it would help the HR department of some companies which require good salespeople. In addition, the research would help those who wanted to be a salesperson or those who were already in this field to check if their personality was suitable to be a salesperson.

A sample of 100 salespeople from different types of fields were applied to our research. The sample population would be simply randomly sampled, which may cause sample error. We should try to avoid most errors.

Data from this research was complex as it was about people's minds and thoughts. Therefore, in the research. We tested the average with TIPI personal traits test to see how they react to the test. Specifically, online questionnaires were adopted to collect the data. We used structured questionnaires in order to simplify the answers, which particularly were multiple choices and score measurements.

In this research data was analyzed and presented by bar-chart, pie-chart, or other methods. In addition, the final data would be presented both graphically and in the text in order to make it easy to read and visible simultaneously.

In order to make the result of sampling valid, the questionnaires were checked by the supervisor of the researcher. Moreover, we had checked several times to make sure the survey questions were correct and understandable.

Ethical considerations were important for the research. It was about how the research would do harm to society or human nature. For ethical considerations, we could not force people to do something they do not want or do dangerous by the name of research. This research had no negative results.

3.2 Analysis and Interpretation of Data

General Introduction. Among the 100 surveys distributed, we have successfully collected 72 effective answers. In this section, we are going to present the result of the first 4 questions, which include gender distribution, age, working industries, and working experiences (For the detailed questionnaire, please refer to Appendix 1: survey questions.). From the 72 people sampled, there were 28 (38.89%) males and 44 (61.11%) females (see Fig. 1) and the ratio of males to females is about 0.4.

For the age distribution, there were 36 (50%) people from 20 to 30, 31 (43.06%) people from 31 to 40 and 5 (6.94%) people from 41 to 50. The age distribution is smooth and reasonable, for which most of the samples are in the suitable working

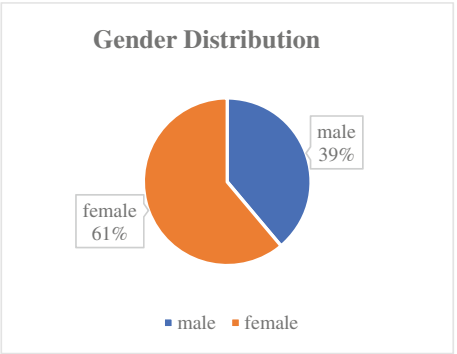


Fig. 1 Gender distribution

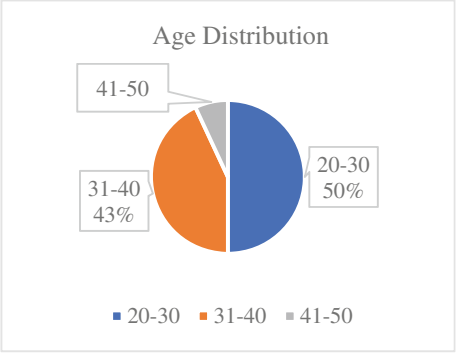


Fig. 2 Age distribution

age of salespersons and the samples we chose include fundamentally all age groups (see Fig. 2).

For the third question "what industry are you working in?", the answer was various and complex because it is an open-ended survey question. We collected answers from IT to electronic commerce. Due to the complexity of the answers, we categorized the fields from the answers into four main parts: education, real estate, financial insurance, and others. Specifically, there were 21 (29%) people from the education industry, 22 (30.5%) people from real estate, 16 (22.2%) from the financial insurance industry, and 13 (18%) from other industries (see Fig. 3). The survey result is useful because it will help us to see how salesperson works in different industries would behave towards the test and whether they have different personality traits.

The fourth question is relevant to the below one, which is the years working in the field. Since it is also an open-ended question, we also present the figure with some categorization. We found that 24 (33.3%) of our samples worked as a salesperson for less than 5 years. 40 (55.5%) of our samples work between 5 and 20 years. And the other 8 (11.1%) had working experience of more than 20 years (see Fig. 4). The working experience distribution is reasonable because according to Fu (2009) most

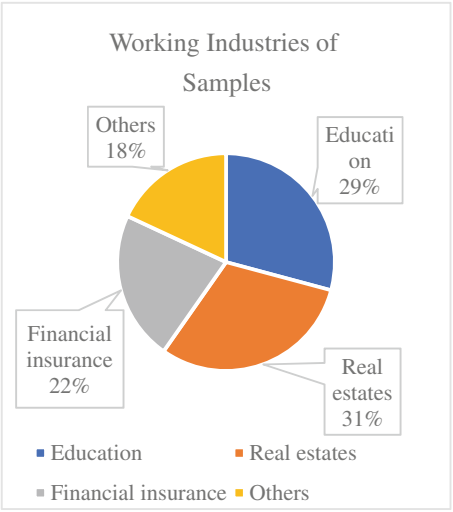


Fig. 3 Working industries of samples

of the salesperson would choose to work less than 20 years to get better performance. Our survey result was in accord with that conclusion.

Analysis of Neuroticism in Salespersons. According to Robert, and Oliver (McCrae and John 1992), the new definition of Neuroticism would be: "Neuroticism reflects the process of individual emotion regulation, the tendency of experiencing negative emotions and emotional instability." Therefore, based on this concept, we have 2 related questions in our survey to test the perspective of Neuroticism and they are: "If I see myself as anxious and easily upset?" and "If I see myself as calm and emotionally stable?" The first question is a reverse scoring question (Please refer to Appendix1 to see the detailed survey questions and the way to calculate the scores). The reason

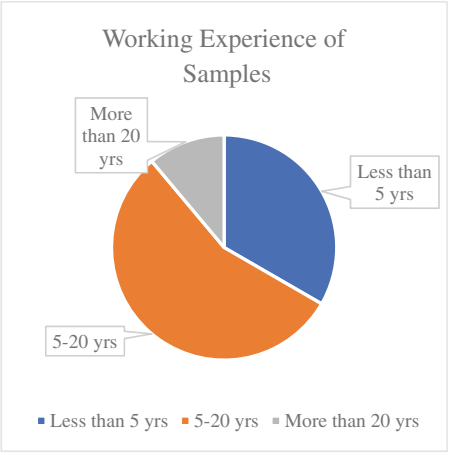


Fig. 4 Working experiences of samples

we chose these 2 questions is that according to the definition if a person gets anxious and easily upset about something often, he or she must be Neuroticism. Therefore, highly neurotic individuals tend to have psychological pressure, unrealistic ideas, excessive demands, and impulses and are more likely to experience negative emotions such as anger, anxiety, depression, and so on. They respond to external stimuli more strongly than ordinary people, and have poor emotional regulation and coping ability, often in a bad emotional state. And they are less able to think, make decisions, and respond effectively to external pressures. In contrast, people who scored low on the neuroticism scale were less upset, less emotional, and calmer. According to the result of our research, the average score of the question "If I see myself as anxious and easily upset?" is 4.82, which is below the average of the total (5.15). It means most of our samples would define themselves as "a little bit anxious". The average score of the question "If I see myself as calm and emotionally stable?" is 5.36, which is above the total average. Therefore, the average score of neuroticisms would be 5.09. According to a study of TIPI written by Gosling et al. (2003), if the average score (calculated by take average of the two question scores) is higher than 4.83, it would be a typical high score. Thus, in our research, most of the salespersons do not get a higher score than it and we could define them as low in Neuroticism. We could also get that being a salesperson is not highly related to the personality of Neuroticism.

Analysis of Extraversion in Salespersons. According to one recent study (Wilt and Revelle 2009), the most suitable definition for "Extraversion" would be the amount and density of human interaction, the need for stimulation, and the capacity for pleasure. Therefore, we selected two questions to test our samples if they satisfied the definition of Extraversion. The first question was "If I see myself as enthusiastic?" and the second question was "If I see myself as reserved and quiet?" The second question is a reversed scoring question. The reason we chose these two questions is that we think being enthusiastic would be a positive side in perspective Extraversion, being enthusiastic means a person who liked to socialize and to connect him or her with people around, which is suitable for us to test if that person had the density or desire to participate in human interactions or how much they could get from the interactions. Vice versa, the second question would help us to determine if some people do not like to get involved in social interactions. Those people would not be fit in the concept of "Extraversion". From the result of our survey, the average score of the question "If I see myself as enthusiastic?" was 5.42, which is higher than the total average (5.15). The average score of the question "If I see myself as reserved and quiet?" is 5.36. And we can easily calculate the average score of Extraversion is 5.39. According to Gosling, Rentfrow and Swann, a score over 4.44 would be a typical high score. Therefore, most of our samples got a typical high score on the test of "Extraversion". It meant that the job salesperson had a close relevance of the personality Extraversion.

Analysis of Agreeableness in Salespersons. In Theoretical conceptualizations of agreeableness and antagonism, William (2019) says agreeableness describes individual differences in motives for communal aspects of human sociality and maintenance of social harmony. An agreeable person demonstrates disposition-based motivation to establish and maintain positive relations with others. People with many of these qualities are considered very agreeable, whereas others at the other end of the continuum are seen as less agreeable (antagonistic). The later are likely to be described as "distrustful," "manipulative," and "arrogant". Therefore, we selected two questions to test our samples if they satisfied the definition of Agreeableness. The first question was "If I see myself as sympathetic and warm?" and the second question was "If I see myself as critical and quarrelsome?" The second question is a reversed scoring question. From the result of our survey, the average score of the question "If I see myself as sympathetic and warm?" was 6.15. The reversed question "If I see myself as critical and quarrelsome?" is 4.97. Take the average of the score for question 1 and the (recoded) score for question 2 and so the TIPI Agreeableness scale score would be: $(6.15 + 3.03)/2 = 4.59$. According to Dr. DeNeui, the norm is 5.23 and a score below 5.23 would be a typical low score. Therefore, most of our samples got lower score on the test of "Agreeableness". It meant the personality Agreeableness was negatively associated with salesperson.

Analysis of Openness in Salespersons. Openness is defined as the extent to which an individual is intellectual, imaginative, independent-minded and so forth. The counterpart is conventional and uncreative. In prior researches, it seems there is close relation between openness and job performance for all types of work. We are eager to see if openness is positively associated with salesperson generally. There are two questions in TIFI to test our samples if they satisfied the definition of Openness. The first question was "If I see myself as open to new experiences, complex?" and the second question was "If I see myself as reserved and quiet?" The second question is a reversed scoring question. For the result of our survey, the average score of the question "If I see myself as open to new experiences, complex?" was 5.6. The average score of the question "If I see myself as reserved and quiet?" is 4.42. Take the average of the score for question 1 and the (recoded) score for question 2 and so the TIPI Conscientiousness scale score would be: $(5.6 + 3.58)/2 = 4.59$. According to Dr. DeNeui, the norm is 5.38 and our final score is obviously a bit lower than it on openness. As a result, we can conclude that openness is not a common characteristic of salespeople.

Analysis of Conscientiousness in Salespersons. Conscientiousness is defined as the propensity to follow socially prescribed norms for impulse control, to be goal directed, to plan, and to be able to delay gratification (Roberts et al. 2009). In prior researches, it seems there are always a close correlation between conscientiousness and job performance for all types of work. We are inclined to see if conscientiousness is positively associated with salesperson generally. There are two questions in TIPI to test our samples if they satisfied the definition of Conscientiousness. The first question was "If I see myself as dependable and self-disciplined?" and the second question was "If I see myself as disorganized and careless?" The second question

is a reversed scoring question. For the result of our survey, the average score of the question "If I see myself as dependable and self-disciplined?" was 5.64. The average score of the question "If I see myself as disorganized and careless?" is 5.11. Take the average of the score for question 1 and the (recoded) score for question 2 and so the TIPI Conscientiousness scale score would be: $(5.64 + 2.89)/2 = 4.265$. According to Dr. DeNeui, the norm is 5.4 and our final score is somewhat lower than it on conscientiousness. Therefore, contrary to findings before, we can conclude that conscientiousness has no close correlation with salespeople from our research.

4 Conclusion and Limitations

4.1 Conclusion

From the data analysis, we can clearly see that there was a close correlation between being a salesperson and the personality of extraversion. We can conclude that most salespeople were outgoing and enthusiastic. This should be an important factor for sales manager when they are looking for potential candidates. As the same time, the data reflected a negative correlation between salesperson and the personality of agreeableness. This answered the pressure and the difficulty for managing salespeople. While for the other 3 personalities neuroticism, openness and conscientiousness, the correlation was not clear enough. This study broke away from the traditionally accepted traits, which had been always positively linked with salespeople the personality of conscientiousness.

4.2 Limitations

In this article we gave out a questionnaire to salespeople mainly in three industries and try to summarize their common personality traits based on their scores on Big Five personality dimensions of the TIPI scale. This direct method obviously has limitations. First, the article used a very short scale to measure the Big Five personality traits. We choose this TIPI scale in order to save participants time as we know salespeople normally have a busy schedule. Second, this study was only conducted in three industries, and it is possible that the results might vary a lot in different organizations. And the data we got was not a very big sample. This might cannot display the general tendency of salesperson's personality traits. Finally, as we want to provide some solid finding what kind of person is likely to be a top-sales. We missed to analyze salespeople in different industries and compare underperformed and average salespeople with top-sales. With this kind of data fathered, this article might come in more value for future study.

Acknowledgements We appreciate for the equal contribution of every author and every participant who joined the research and offered help in surveys, interviews, and conclusions. Thanks to Mr. Runji Wang for helping in data analysis. Thanks everyone who had offered suggestions on the research.

Appendices

Appendix 1. Questionnaire

Ten-Item Personality Inventory (TIPI)

Here are some personality traits that may or may not apply to you.

Please select a number from 1 to 7 next to each statement to indicate how much you agree or disagree with the statement. The number 1 means strongly disagree and 7 means strongly agree. You should evaluate all features, even if they don't fit your personality.

The questionnaire results are for research reference only, and your personal information will not be disclosed.

1. **Your gender:**

   A. Male B. Female

2. **Your age:**

   A. Between 20 and 30 B. Between 31 and 40 C. Between 41 and 50

3. **What is the industry you work in? _____**
4. **How long have you worked in this industry? _____**
5. **I see myself as:**

Items	1 Strongly disagree	2 Disagree moderately	3 Disagree a little	4 Neutral	5 Agree a little	6 Agree moderately	7 Agree strongly
Extraverted, enthusiastic							
Critical, quarrelsome (R)							
Dependable, self-disciplined							
Anxious, easily upset (R)							

(continued)

(continued)

Items	1 Strongly disagree	2 Disagree moderately	3 Disagree a little	4 Neutral	5 Agree a little	6 Agree moderately	7 Agree strongly
Open to new experiences, complex							
Reserved, quiet (R)							
Sympathetic, warm							
Disorganized, careless (R)							
Calm, emotionally stable							
Conventional, uncreative (R)							

TIPI scale scoring ("R" denotes reverse-scored items): Extraversion: 1, 6R; Agreeableness: 2R, 7; Conscientiousness; 3, 8R; Emotional Stability: 4R, 9; Openness to Experiences: 5, 10R

Appendix 2. Measurement Scales

Mean response and standard deviation deviations TIPI scale (N = 202)

Personality dimension	Mean	Std. deviation
Extraversion	4.96	1.27
Agreeableness	5.01	1.09
Conscientiousness	5.90	0.99
Emotional stability	5.22	1.13
Openness to experiences	5.43	1.03

*Source*Gosling, S. D., Rentfrow, P. J., & Swann, W. B., Jr. (2003). A Very Brief Measure of the Big Five Personality Domains. Journal of Research in Personality, 37, 504–528

Appendix 3. Survey Results

Items	1	2	3	4	5	6	7	Mean
Extraverted, enthusiastic	0 (0%)	1 (1.39%)	5 (6.94%)	9 (12.5%)	14 (19.44%)	34 (47.22%)	9 (12.5%)	5.42

(continued)

(continued)

Items	1	2	3	4	5	6	7	Mean
Critical, quarrelsome (R)	6 (8.33%)	29 (40.28%)	13 (18.06%)	11 (15.28%)	8 (11.11%)	4 (5.56%)	1 (1.39%)	4.97
Dependable, self-disciplined	0 (0%)	0 (0%)	1 (1.39%)	7 (9.72%)	21 (29.17%)	31 (43.06%)	12 (16.67%)	5.64
Items	1	2	3	4	5	6	7	Mean
Anxious, easily upset (R)	10 (13.89%)	19 (26.39%)	15 (20.83%)	12 (16.67%)	9 (12.5%)	6 (8.33%)	1 (1.39%)	4.82
Open to new experiences, complex	0 (0%)	0 (0%)	0 (0%)	11 (15.28%)	21 (29.17%)	26 (36.11%)	14 (19.44%)	5.6
Reserved, quiet (R)	5 (6.94%)	9 (12.5%)	13 (18.06%)	18 (25%)	13 (18.06%)	9 (12.5%)	5 (6.94%)	4
Sympathetic, warm	0 (0%)	0 (0%)	0 (0%)	1 (1.39%)	16 (22.22%)	26 (36.11%)	29 (40.28%)	6.15
Disorganized, careless (R)	12 (16.67%)	18 (25%)	22 (30.56%)	11 (15.28%)	4 (5.56%)	5 (6.94%)	0 (0%)	5.11
Calm, emotionally stable	0 (0%)	0 (0%)	5 (6.94%)	9 (12.5%)	22 (30.56%)	27 (37.5%)	9 (12.5%)	5.36
Conventional, uncreative (R)	3 (4.17%)	16 (22.22%)	19 (26.39%)	15 (20.83%)	10 (13.89%)	7 (9.72%)	2 (2.78%)	4.42
Total	36 (5%)	92 (12.78%)	93 (12.92%)	104 (14.44%)	138 (19.17%)	175 (24.31%)	82 (11.39%)	5.15

References

Campbell S (2014) What is qualitative research? Clin Lab Sci 27(1):3

Cattell RB (1987) Intelligence: its structure, growth and action. Elsevier

Creswell JW (1999) Mixed-method research: Introduction and application. In: Handbook of educational policy. Academic press, pp 455–472

Frosh S (1987) The politics of psychoanalysis: an introduction to Freudian and post-Freudian theory. Yale University Press

Fu FQ (2009) Effects of salesperson experience, age, and goal setting on new product performance trajectory: a growth curve modeling approach. J Mark Theor Pract 17(1):7–20

Gosling SD, Rentfrow PJ, Swann WB Jr (2003) A very brief measure of the big five personality domains. J Res Pers 37:504–528

Graziano WG, Tobin RM (2019) Theoretical conceptualizations of agreeableness and antagonism. In: The handbook of antagonism. Academic Press, pp 127–139

Li Y (2016) Empirical research on the impact of positive personality traits on job performance of knowledge workers in enterprises. Master's thesis, Liaoning University

Liu Z (1991) The controversial focus of contemporary western personality psychology. Trends Psychol 01:8–13

McCrae RR, John OP (1992) An introduction to the five-factor model and its applications. J Pers 60(2):175–215
McCrae RR (2009) The five-factor model of personality traits: consensus and controversy. In: The Cambridge handbook of personality psychology, pp 148–161
Pervin LA (1994) A critical analysis of current trait theory. Psychol Inq 5(2):103–113
Roberts BW et al (2009) Conscientiousness
Rutberg S, Bouikidis CD (2018) Focusing on the fundamentals: a simplistic differentiation between qualitative and quantitative research. Nephrol Nurs J 45(2):209–213
Wilt J, Revelle W (2009) Extraversion
Xue Z (2012) Personality psychology. Guangdong Higher Education Press
Zu J (2013) The influence of the big five personality of salesperson on team performance—with the big five personality of team leader as the moderating variable. China Bus Trade (20):168–169+171

Pre-establishment National Treatment and Negative List Model: From BIT Negotiations to Negative List of Shanghai Pilot Free Trade Zone

Dongxu Chen

Abstract In the context of deepening economic system reform, China is actively exploring the implementation of the "pre-establishment national treatment and negative list" model. As a new trend in the development of investment rules, this model has become a core provision in investment agreements, with the ultimate goal of achieving investment liberalization. At the fifth round of the US-China Strategic and Economic Dialogue, China proposed for the first time to conduct substantive negotiations on the basis of pre-establishment national treatment and negative list. The US-China negotiations are full of conflicts and compromises, and China should clarify where the differences between the two countries lie and maximize the benefits for its own country. China (Shanghai) Pilot Free Trade Zone is experimenting with the reform of foreign investment management system, and the key to the reform is the negative list. The introduction of the negative list is significant, but it also reveals that there are still problems with the supporting management measures in China. In response to the problems that emerged during the pi-lot, the next step of reform should be to start from the list classification, supporting measures and legal policies.

Keywords Pre-establishment national treatment · Negative list · Bilateral investment treaty · Shanghai pilot free trade zone

1 Introduction

With the expansion of foreign investment in China, the Chinese government has actively promoted the reform of the foreign investment management system. In 2019, China released the Foreign Investment Law and its implementing regulations, which not only clarify that "the State shall implement a pre-establishment national treatment plus negative list management system for foreign investment", but also refine the implementation procedures of the negative list management system. Against the

D. Chen (✉)
East China Normal University, Shanghai 200241, China
e-mail: 10185201207@stu.ecnu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_76

backdrop of the challenges of globalization and the rise of bilateralism, bilateral investment agreements (BITs) are receiving attention from various countries. China has also attached great importance to the construction of bilateral in-vestment agreements with the U.S. and has conducted 25 rounds of bilateral agreement negotiations. In July 2013, at the fifth round of China-U.S. Strategic and Economic Dialogue negotiations, China agreed for the first time to conduct substantive negotiations on investment agreements based on pre-establishment national treatment and negative lists (China Daily 2013). Subsequently, the China (Shanghai) Pilot Free Trade Zone (SPFTZ) was established with the objective of "exploring the establishment of a pre-establishment national treatment and negative list management model for investment". This paper first briefly describes the "pre-establishment national treatment and negative list" model, then discusses the legal issues related to this model in the China-US BIT negotiations, and finally proposes feasible suggestions for the improvement and promotion of this model in the context of foreign investment management system reform.

2 A Brief Review of the "Pre-establishment National Treatment and Negative List" Model

Pre-establishment national treatment and negative list are a kind of commitment and policy of the host country for foreign investment access (Sun et al. 2014), which was first adopted in the North American Free Trade Agreement (NAFTA) (Zhang 2015). In recent years, the combination of the two has gradually become a new trend in the development of investment rules. However, for developing countries in a vulnerable position, pre-establishment national treatment commitments would pose significant risks to a relatively closed domestic economy, and a negative list would need to be prepared to retain discretionary powers.

2.1 The Origin and Role of Pre-establishment National Treatment

National treatment refers to the equal treatment accorded by the host country to civil and economic subjects of its own and other countries. From the French Civil Code of 1804 to the Agreement on Trade-Related Investment Measures (TRIMS), national treatment was gradually extended from the civil to the economic sphere, and eventually covered the three major parts of trade in products, trade in services and investment. Pre-establishment national treatment first appeared in the foreign investment legislation of the U.S. In 1978, the U.S. Foreign Investment in Agriculture Reporting Act adopted the same reporting requirements for both domestic and foreign investors, and the law did not distinguish between investors' nationalities. 1992 saw

the first appearance of pre-establishment national treatment in a multilateral agreement when the U.S. led the signing of the North American Free Trade Agreement (NAFTA). Subsequently, Article 3 of the U.S. Model BIT in 2004 formally defined pre-establishment national treatment. Influenced by the United States, many developed and developing countries have accepted pre-establishment national treatment. Throughout the formation and development of pre-establishment national treatment, it has undergone an evolution from principles to rules, from flexible provisions to fixed models, and from the claims of large countries to a universal system.

Different countries have successively adopted pre-establishment national treatment, in addition to the influence of the United States, or mainly from its superiority in promoting investment liberalization. In the early days, BIT adopted post-access national treatment, which only gave foreign investors no less favourable treatment than domestic investors during the operation stage, with the aim of protecting domestic vulnerable investors. With the development of economic globalization, the demand for foreign investment from developing countries and the demand for foreign investment from developed countries have increased simultaneously, and in-vestment liberalization has become a common demand. International investment agreements extend national treatment from post-access to pre-establishment, allowing foreign investors to compete with domestic investors on an equal footing.

2.2 The Relationship Between the Positive and Negative Lists

If pre-establishment national treatment is considered as an obligation, then the negative list and the positive list are the modes of obligation (Li 2013). The positive list model only grants national treatment to the enumerated items of the clause, while the negative list only excludes the application of national treatment to the enumerated items of the clause. The ultimate goal of both models is to achieve investment liberalization, but the differences between the two models are evident because of the different national conditions and stages of their implementation. First of all, the obligation to sign the negative list is greater than the positive list for the contracting parties. National treatment will be applied unconditionally to all industries and sectors, except for those items declared as reserved. Moreover, the number of items in the negative list can only be gradually reduced, so the level of obligations will only gradually increase. The items in the positive list can be added selectively, leaving time and space for the parties to develop their disadvantaged industries. Second, the negative list is more difficult to prepare. The positive list only requires the inclusion of industries in which the country has comparative advantages; the negative list requires not only examining the disadvantaged industries at present, but also forecasting the emerging industries in the future with a forward-looking perspective. Finally, for foreign investors, the negative list is more transparent. Foreign investors only need to avoid the negative list items and invest in industries that are stable and predictable. In contrast, the positive list has a broader range of non-conforming

measures, and unclear boundaries make it easy to enter prohibited and restricted areas by mistake.

3 Legal Issues in the U.S.-China BIT Negotiations

3.1 Text Analysis of the U.S. Model BIT

The changes in the content of the U.S. Model BIT are a reflection of the development of the U.S. economy and show phased characteristics.

Influenced by trade promotion policies, the 2004 U.S. Model BIT provides for pre-establishment national treatment for the first time. In 2002, U.S. President George W. Bush signed the Bipartisan Trade Promotion Authority Act (BTPA), which directly influenced the development of the 2004 U.S. Model BIT. According to Article 3(1) of the 2004 U.S. Model BIT, the national treatment granted by one contracting party to the other covers the investor's establishment, acquisition, expansion, management, operation, operation, sale, or other investment disposition phase. National treatment covers the entire process of investment, which is highly consistent with the U.S. trade promotion objectives.

The 2012 U.S. Model BIT includes a negative list clause in the face of the conflict between domestic trade protectionism and foreign investment entry. 2007s subprime mortgage crisis led to difficulties for U.S. domestic entities, and foreign investors wanted to take advantage of this opportunity to enter the U.S. market. In order to protect the U.S. national enterprises and buy time for their recovery, the U.S. revised the model again. On the other hand, in order to negotiate better with emerging economies such as China and India, the model was revised to take into account the characteristics of emerging economies. Compared to the 2004 model, the 2012 model differs in that the parties can adopt general exceptions or non-conforming measures provisions allowed by the treaty to achieve exemptions or deviations from their obligations under national treatment (Tao 2016). Thus, for the first time, the U.S. model BIT combines pre-establishment national treatment with a negative list system. If pre-establishment national treatment reflects investment liberalization, the inclusion of the negative list reflects post-crisis investment protection.

3.2 Conflicts and Compromises in the U.S.-China BIT Negotiations

In terms of negotiating attitudes, commonalities between China and the United States have increased, but there are still differences in some areas. Both China and the United States are currently host and home countries for investment and need to balance the interests of both the maintenance of foreign investment regulatory sovereignty

and the protection and promotion of overseas investment (Li 2013). However, due to their different economic status, stages of economic development, and national interests, the negotiating positions of the two countries are not entirely consistent (Tao 2016). The United States is most concerned with the clarity of China's investment laws, while China is more concerned with the implementation of pre-establishment national treatment. At the Fifth Round of the U.S.-China Strategic and Economic Dialogue, China agreed to conduct substantive negotiations with the United States based on pre-establishment national treatment and a negative list (China Daily 2013). The adoption of this model means that China has abandoned its previous post-entry national treatment and positive list models and has embraced the idea of a model U.S. BIT. That is, China and the United States have basically reached a consensus on the bilateral investment management model. The differences between the two countries are mainly reflected in the basic framework of the negative list. First, China and the United States have different definitions of investment. The U.S. BIT Bilateral Investment Agreement 2012 Model has a broader definition of investment, including direct and indirect investment. At present, China's investment mainly refers to foreign direct investment (Sun 2014). Second, the negative lists of the two countries are set in different ways. The U.S. uses the national security review reservation with a broad national security concept to reserve the autonomy for its government to decide (Yang 2014). The negative list in the SPFTZ is influenced by the Foreign Investment Industry Guidance Catalogue, which appears to be too extensive. Finally, the two sides have different approaches to the reversal mechanism. The U.S. model BIT adopts a "ratchet" system where policies can only be relaxed, not tightened, on the basis of the agreement signed (Sun 2014). In the absence of experience in negative list formulation and inadequate forecasting of future emerging industries, China rashly adopts the prohibition of reversal mechanism, which will lead to the loss of its government's power of industrial protection. Therefore, China was hesitant to adopt the "ratchet" system during the negotiation process.

3.3 China's Countermeasures to the U.S.-China BIT Negotiations

First, China should maintain a steady posture and a balanced principle in the negotiations. Currently, China and the U.S. are facing a trade war and an economic recession caused by the epidemic, and conflicts have been highlighted for a short period of time, and the negative list negotiation is in a difficult situation. As a bargaining chip (Hu 2014), countries will play repeatedly against the negative list, so the negotiations will generally go through a long process. The list makers should pay close attention to the new business models in economic development, assess the value of their existence in the negative list, and improve the content of the negative list in the FTA continuously. In addition, while negotiating with the United States, China should

also promote bilateral investment agreement negotiations with neighboring countries and the EU. The importance of this is that by putting forward its own claims in the international investment arena, China can develop a voice in the emerging investment regime (Cui 2013). Along with the transformation of China's economic status, the purpose of China's negotiations should change from a purely foreign investment attraction to a direction that takes into account foreign investment.

Second, China should strive to regulate and reserve the negative list formulation. At present, the negative list has not formed a unified standard (Hu 2014), and the way it is listed is directly related to the degree of national openness and foreign investment attractiveness, so it is necessary to improve the negative list of classification standards. Considering that the current negative list is based on the National Economic Industry Catalogue, it is recommended to match the corresponding CPC classification (the Central Product Classification developed by the United Nations Statistics Division) to help foreign investors understand China's negative list (Fan and Zhang 2014). The negative list is retained in three main ways. First, China should include in the negative list new industries that may emerge in the future (Cui 2013). Second, for new industries that cannot be foreseen and included, China needs to seek the authority to conditionally expand the negative list (Gong 2013). Drawing on the U.S. model investment example, China can introduce a reservation for future non-conforming measures by making a reservation statement in Annex II of the non-conforming measures. Third, the negative list is inevitably subject to disputes over the understanding of the content, and the list can be designed with general terms or underwritten expressions, following the practice of similar interpretations and reserving enough space for defense.

Finally, China should actively promote the development of China's model bilateral investment. Regardless of the economic strength of the United States, its high standard of model bilateral investment is sufficient to give it an advantageous position in the negotiations. The U.S. constantly modifies the model according to its changing economic environment and investment needs in order to maximize its own interests. Therefore, a mature investment model is the key to successful negotiations. As the largest developing country, China has its own development needs. Copying the contents of developed countries' agreements, which seem to meet international standards, often ignores its own national conditions and may not be in its national interest. China's 2010 draft BIT model national treatment is limited to post-access, with insufficient legal basis for specific legal measures. 2012 the Ministry of Commerce refined the draft BIT model, with a tendency to move closer to a high standard of investment protection.

4 Pre-establishment National Treatment and Negative List Model for China

4.1 Background of the Reform of Foreign Investment Management System in SPFTZ

With the change of China's own economic status and the improvement of international investment agreements, the unification of domestic and foreign investment policies has become a general trend (Lu et al. 2007), and the negative list system has a realistic basis. As China gradually opened up its industries and became one of the largest capital importers, countries that had earlier signed bilateral investment protection agreements with China made requests for amendments. Netherlands and Germany advocated adding a "freeze clause" (Lu et al. 2007) to the non-conformity measures, with the ultimate goal of gradually reducing or even eliminating them. Although this commitment does not create mandatory obligations, it lays the foundation for the formation of a "ratchet" negative list. China has a dual role of capital import and export, but there are still hidden barriers to investment, which are not in line with the development trend of investment liberalization.

Prior to the reform, China had formed a foreign investment management system with hierarchical management, case-by-case approval and departmental supervision (Hao 2013). According to the "Catalogue for the Guidance of Foreign Investment Industries", foreign investment projects are divided into three categories: encouraged, restricted and prohibited. The current foreign investment legislation in China adopts a dual-track system, with separate legislation for domestic and foreign investors had protected the nation's disadvantaged industries. However, differential treatment not only violates the principle of market fairness but may also lead to information asymmetry and lack of policy transparency. In terms of the approval model, China has adopted a case-by-case approval system, with sectoral regulations formulated by the competent authorities for management by industry (Han 2014). The case-by-case approval system is conducive to controlling the quality of foreign investment, but the potential approval procedures and administrative costs cause inefficient approvals.

After the Fifth US-China Strategic and Economic Dialogue, the SPFTZ began to compile a negative list, taking into account the changing economic situation at home and abroad. On the one hand, international investment rules have changed, and more and more developing countries have adopted the model. On the other hand, the dividend of WTO accession is gradually diminishing and economic transformation must be achieved as soon as possible in order to maintain the economic growth rate. After the reform, the foreign investment projects in industries outside the negative list were changed from an approval system to a filing system (Sun et al. 2014). The record system is conducive to improving the efficiency of economic operation, but also poses a challenge to the regulation and risk prevention and control of foreign investment in China.

4.2 Problems Faced by the Negative List System in Shanghai

The negative list formulated in the SPFTZ is groundbreaking and has important implications for domestic reform and foreign opening, but there are still some problems.

First, the quality of the content of the current negative list needs to be improved. The negative list in the SPFTZ is longer and has a diverse range of non-conforming measures (Wang 2014), thus the volume and classification of the negative list is not justified. The reduction of restrictive measures is consistent with investment liberalization, but the waiver of content increases the risk of future development of new industries. The waiver implies a negative commitment, which could adversely affect China's foreign economic interactions even if China could unilaterally backtrack. In addition to this, the negative list suffers from ambiguity. The poor quality of the text of the list does not make it easy for foreign investors to understand in practice and does not facilitate the review work of law enforcement officers.

Second, the negative list of supporting management measures lags behind. The negative list directly affects foreign investment access, and the key to foreign investment access lies in the setting of access procedures. According to the 2013 version of the negative list, only the areas within the list need to be approved, the areas outside the list can be filed. The administrative mode of foreign investment access from the approval system to the "filing system + approval system" is conducive to simplifying foreign investment access procedures and breaking the hidden barriers to foreign investment access. It should also be taken into account that the adoption of the filing system weakens the supervision of foreign capital by the administrative authorities, so the boundaries of the negative list need to be clarified.

Finally, if the negative list is to be promoted nationwide in the SPFTZ, there are shortcomings in the legislative body and the scope of radiation. 2013 version of the negative list is a local government regulation formulated by the Shanghai Municipal Government, which is not wrong to conduct small-scale economic experiments; however, foreign investment access involves the national economic policy and even sovereignty issues, and long-term local autonomy may form local protectionism. Negative list needs to form a formal text and clear content, suitable for the development of a unified legal regulation by the state. The negative list system was only implemented within the SPFTZ in the early stage, with a relatively narrow scope of radiation, which cannot fully reflect the problems of the system.

4.3 Improve and Promote the "Shanghai Model" in a Targeted Way

As the first practice of negative list in China, all sectors of the society have high expectations for SPFTZ. However, the response of Shanghai practice is lower than expected. To improve the negative list system, we should start with the text content

and foreign investment management system. When the "Shanghai model" is mature enough, we will then consider expanding it to the whole country.

First of all, the formulation of the main body should improve the list of industry classification methods, discretion to set out the contents. The negative list of the SPFTZ is classified according to the National Economic Classification of Industries (GB/T4754-2011), which is different from the internationally accepted Service Sector Classification List (GNS/W/120) and the UN Provisional Central Product Classification Catalogue. The negative list is the focus of BIT negotiations, and in order to better connect with international practices in the negotiations, some scholars suggest that the SPFTZ adopt the internationally accepted classification or develop a document corresponding to the current classification for reference application (Sun et al. 2014). The current negative list is more complex, and when deleting the contents of the list, a scientific and reasonable way is to test it according to economic models or pilot practices to prevent potential economic risks.

Second, the reform of the foreign investment management system should be accelerated and matched with corresponding review and supervision measures for different aspects of foreign investment. The reform has led to an increase in the number of filings, thus it is necessary to strengthen the management of foreign investment filings, unify domestic and foreign investment registration and filing procedures as soon as possible, and the use of Internet big data to identify investment risks (Wang 2014). The key to reform is to build a scientific and reasonable ex ante regulatory system, which requires improving the transparency of administration, providing applicants with written answers and giving them the right to appeal. In addition to the items listed in the negative list, national security review can be used as a bottom-up clause to retain certain discretionary powers. Standardize access before the approval, but also should strengthen post-access supervision. The record system imposes higher requirements for market supervision, liability tracing and risk control, and it is recommended that special rules of procedure for enforcement of foreign investment violations be formulated (Wang 2014).

Finally, from the perspective of the country as a whole, the coordination of legal policies should be maintained and the current model of Shanghai FTA should be promoted on the track of rule of law. Compared with post-access national treatment, pre-establishment national treatment is more equitable, and the ultimate goal is to abolish our domestic foreign investment separate legislative model (Yang 2014). The prerequisite for the standardization of policy implementation is the harmonization of legal basis, so the rank of effectiveness between different policy documents should be clarified. The negative list replaces the Catalogue for the Guidance of Foreign Investment Industries, and the rank of both is departmental regulations. The application of the Negative List is limited to the SPFTZ, which is a special legal regulation. Whether according to the principle that new law is better than old law or special law is better than general law, the negative list should be applied in priority.

5 Conclusion

In order to balance investment protection and investment liberalization, the NAFTA combined negative list and pre-establishment national treatment, thus forming a new investment management model. The U.S. included it in the model investment agreement and actively promoted it in the negotiations, making it gradually become an international investment rule. In this context, China adopted this model in order to better integrate into international capital markets. After President Trump took office, the U.S.-China Strategic and Economic Dialogue stalled and negotiations on bilateral agreements were put on hold. President Biden has emphasized economic cooperation between the two countries, but still has no intention of restarting the dialogue. Changes in the international situation cannot negate the positive significance of the model, and thus the pilot work in the SPFTZ should still continue. The most important thing at this stage is to draw lessons from the SPFTZ project and lay the foundation for the model to be replicated nationwide.

References

Cui F (2013) 2012 U.S. model bilateral investment treaty and Sino-US BIT negotiation. Int Trade Issues (02):123–131

Fan ZL, Zhang BM (2014) International comparative and empirical study on the "negative listings." Shanghai Econ Res 12:31–40

Gong BH (2013) Legal analysis on the "negative listings" of the national treatment for FDI into China (Shanghai) pilot free trade zone. World Trade Organ Dev Res 06:23–33

Han B (2014) Pre-establishment national treatment and negative list approach: effect of Sion-US BIT in China's foreign investment management system. Int Econ Rev (06):101–110+7

Hao J (2013) The evolution of China's foreign investment system and future reform goals. China Econ Trade J 15:30–32

Hu JX (2014) A preliminary study of pre-access national treatment. J Shanghai Jiaotong Univ (Philos Soc Sci Ed) 01:65–73

Joint U.S.-China economic track fact sheet of the fifth meeting of the China-U.S. strategic and economic dialogue. China Daily, 13 July 2013

Li QL (2013) A brief discussion on the approaches for the national treatment commitments in IIAs. Int Econ Trade Explor 03:80–90

Lu JY, Yu JS, Qi CS (2007) New treatise on international investment treaties and agreements. People's Publishing House, Beijing

Sun YX (2014) International experiences of negative list management for foreign investment: the case of China (Shanghai) pilot free trade zone. Reform 10:37–45

Sun YX, Ji L, Zhou RY (2014) Negative list (2013) in China (Shanghai) pilot free trade zone and its improvement. Foreign Econ Manag 03:74–80

Tao LF (2016) Research on U.S. bilateral investment treaties. Law Press, Beijing

Wang ZM (2014) An international comparison of transformation experiences of "negative list" and its enlightenment to China. Int Econ Trade Explor 09:72–84

Yang HK (2014) Interpretation of the negative list of China (Shanghai) pilot free trade zone and its promotion. Jianghuai Forum 03:5–11

Zhang GP (2015) A legal interpretation of pre-establishment national treatment plus negative list. Jiangsu Soc Sci 03:140–146

Re-examining the Existence of the Environmental Kuznets Curve: Evidence from Six Kinds of Canadian Air Pollutions

Feiling Lu

Abstract This paper investigates the relationship between ambient air pollution levels and economic growth in Canada. Panel data of six different air pollutant emissions across 11 districts in Canada from 1979 to 2019 are collected and appropriately modified. Gross Domestic Product (GDP) per capita is used as the main economic growth indicator. Other relevant independent variables are also incorporated to better explain the variance of the ambient air pollution level. Linear regressions are conducted using different models. According to the environmental Kuznets curve hypothesis, there is an inverted U-shaped relationship between pollution and economic growth. In this study, NO_X, NO, NO_2 and CO are found to be following the environmental Kuznets curve in Canada. However, SO_2 and O_3 show a U-shaped relationship with GDP growth in Canada.

Keywords EKC · Air pollution · GDP

1 Introduction

In recent years, natural environment protection has become a key concern globally. The relationship between environmental pollution and economic growth has been studied by many scholars, and an inverted U-shaped relationship between the pollution indicator and GDP per capita is found. Intuitively, the inverted U-shaped correlation reveals typical stages of economic development. In the initial phase, people mainly focus on developing the economy, even at the expense of environmental degradation. Then the curve reaches its turning point, where the negative impact of economic activities on the natural environment is maximized. In the second stage, the environmental damage begins to decrease, which means people pay more attention to environmental protection. The curve is also referred to as the Environmental Kuznets Curve (EKC) (Selden and Song 1994).

F. Lu (✉)
University of Wisconsin-Madison, Madison, WI 53706, USA
e-mail: flu44@wisc.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_77

The EKC illustrates that, to some extent, pollution is inevitable in the early stage of economic development. Also, as the economy grows to a certain point, the problem of pollution will be mitigated. The EKC could be used as a reference for policymakers. For developing countries, economic growth is the primary task for the governments. Therefore, the governments might temporarily ignore environmental pollution but focus on solving problems such as hunger and poverty.

Meanwhile, it is essential to understand the maximum bearing capacity of the natural environment. As demonstrated by (Song et al. 2008), once the pollution exceeds the tolerable limit of the natural environment, the impact of these environmental damages will be permanent and irreversible. Therefore, understanding the bearing capacity of the natural environment is essential for both developing and developed countries. Traditional economic theories regard economic growth and the natural environment as different concepts. However, in an environmental economics concept, the natural environment is also an important economic indicator. Only when the natural environment is considered can one know the actual losses and gains of the economy.

Canada, as the second-largest country, its pollutant emission is not only related to its own environment but also related to the ecology of North America and the Arctic Circle. He and Richard (He and Richard 2010) studied the relationship between CO_2 emission and per capita GDP in Canada. The anticipated EKC feature was not observed but a monotonically increasing relationship. In this paper, other than CO_2, the relationship between some other common air pollutant emissions and GDP per capita of Canada is studied. Panel data of several different pollutant gas emissions in the provinces and territories of Canada are used. Linear regressions are conducted to verify the existence of the inverted U-shaped relationship (EKC) between gas emission and GDP per capita. Meanwhile, some reasonable alternative variables are also included in the model to better explain the gas emission variance.

2 Literature Review

The inverted U-shaped relationship between environmental degradation and economic growth was first proposed by Grossmann and Krueger (Grossmann and Krueger 1991, 1993). In their studies, the ambient level of both sulfur dioxide and dark matter suspended in the air have a quadratic relationship with per capita GDP. At the low-income level, air pollution increases with the growth of GDP per capita. Once the economy reaches an inflection point, the concentration of air pollutants will decrease as per capita GDP increases. Since then, a lot of research has been carried out to verify the EKC and understand the internal reasons. Panayotou (Panayotou 1993) attributed the inverse U-shaped relationship to the structural effect. As the economy of a specific region develops to a certain level, the proportion of high-pollution industries such as the resource extraction industry and the chemical industry in the total economy will decrease. Those industries will be replaced by “cleaner” industries,

so the environmental condition will be promoted. Some scholars believe that technological progress is also a major reason for the inverted U-shaped relationship. As the economy grows to a certain stage, advanced technologies will be adopted, so environmental degradation will be mitigated. Stokey (Stokey 1998) attributed the EKC to demand factors, i.e., as the per capita income increases, the demands for a better natural environment will also be enlarged. Andreoni and Levinson (Andreoni and Levinson 2001) believed that the scale effect is one of the reasons for EKC. As the economy grows, the increasing scale of pollution control helps to reduce the pollutant discharge and improve the environment.

However, the EKC model shows uncertainties in some research. The inverted U-shaped relationship is not universally applicable for all pollutants. Grossmann and Krueger (Grossmann and Krueger 1991) found that the concentration of suspended particles decreased almost monotonically as per capita GDP increased from 1000 to 17,000 USD. Similar results were also found by Hettige et al. (Hettige et al. 1999) and Holtz-Eakin and Selden (Holtz-Eakin and Selden 1995). Also, if the turning point is extremely high, the inverted-U shape may be observed because the high economic growth level cannot be easily achieved by many countries. Moreover, the possibility of the EKC also depends on the econometric models. Researchers found that when other relevant variables such as population and adjacent country income are incorporated, the coefficients of per capita GDP either loss their significance or no longer show the U-shaped feature (Kaufmann et al. 1998; Rothman 1998; Torras and Boyce 1998). The existence of EKC also varies between countries. By studying the relationship between carbon dioxide emission and GDP per capita, Roberts and Grimes (Roberts and Grimes 1997) found only a few high-income countries could achieve environmental benefits from economic growth. For the low-income countries, the environmental condition is worsened. Galeotti et al. (Galeotti et al. 2006) found that the inverted U-shaped relationship between carbon emission and GDP only exists in OECD countries. For non-OECD countries, carbon emissions almost increase monotonously as the GDP increases. However, Azam and Khan (Azam and Khan 2016) studied the EKC hypothesis by conducting OLS regressions using CO_2 emission as the indicator of environmental degradation. Energy consumption, trade openness, and urbanization are used as indicators of economic growth. Their study authenticated the EKC hypothesis for low-income countries, namely Tanzania and Guatemala, but failed for a high-income country (USA). The different findings imply that the existence of the inverted U-shaped relationship might depend on the selection of regression variables.

Besides gaseous pollutants, the EKC is also studied with many other pollution indicators. Dietz et al. (Dietz et al. 2012) studied the relationship between the environmental intensity of human well-being (EIWB) and GDP per capita. Rather than the inverted U-shaped relationship, their model demonstrated a U-shaped relationship. Wu et al. (Wu et al. 2018) investigated the correlation between PM2.5 concentration and some economic indicators, including GDP per capita, the proportion of construction area, and the proportion of the non-agriculture area. Their results illustrate the inverted U-shaped relationship between GDP per capita and PM2.5 concentration, but there is no evidence of the EKC of the other two independent variables. Song

et al. (Song et al. 2008) examined the EKC hypothesis between GDP per capita and pollutant emissions. All the gas pollution, water pollution, and solid pollution showed an inverted U-shaped relationship with GDP. However, the turning point is so large that only the high-income regions can achieve environmental benefits. In less developed regions, the pollution problem is increasingly severe. Caviglia-Harris et al. (Caviglia-Harris et al. 2009) examined the EKC using the Ecological Footprint (EF), a more comprehensive measurement of environmental degradation. The authors failed to find any evidence of the EKC relationship between EF and economic growth.

3 Data and Model Specification

3.1 Data

Firstly, for all the six kinds of air pollution, the original data is collected from the National Air Pollution Surveillance Program (NAPS) of Canada, which is the main source of ambient air quality data in Canada. The six kinds of air pollutions are SO_2 (sulfur dioxide), O_3 (ozone), NO_X (nitric oxide), NO_2 (nitrogen dioxide), NO (nitrogen monoxide), and CO (carbon monoxide). The NAPS program began in 1969. In the beginning, only data of sulfur dioxide and particulate matter was collected. Moreover, more kinds of air pollution data have been incorporated in recent years. This study requires a long period to capture the trend of air pollution. Therefore, this paper chooses these six kinds of air pollutants of which daily provincial data from 1974 to 2019 is available. The original daily emission data is converted to the emission level per day using the yearly average and is used as the dependent variable in this study.

Secondly, the main independent variable is Canada's Gross Domestic Production (GDP). The real GDP per capita at basic prices is collected from Canada Statistics. The base year of all the GDP is 2012, which means using the chained (2012) dollars as price. To better interpret the changes in air pollution level, some other control variables are also used in the regression models (Statistics Canada), namely population density, percentage of the agricultures of the total real GDP (per capita), and percentage of oil and energy industry of the total real GDP (per capita). The incorporation of population density is to determine how daily human activities would affect air pollution levels. The population density is calculated based on each provincial area of land and the population of each year. The percentage of agriculture and the oil and energy industry is calculated by using the total real industry production per capita divided by the total real GDP per capita. Data from 1974 to 2019 for each province is collected and used in this study. Only a few missing values exist in the original data set, and those empty values are replaced by linear or polynomial interpolation values. Two districts of Canada are excluded in this study, namely Nunavut and Northwest Territories. The air pollution level in these two districts is extremely low compared

with other areas in Canada, so they are eliminated in this study. The percentage of agriculture in total GDP is usually an indicator of the development level of a district. Therefore, it is also included as a supplementary independent variable in this study. Also, it is commonly believed that the oil and mining industry is a high pollution industry. The proportion of mining, quarrying, and oil extraction industry in total GDP is used as a supplementary independent variable to investigate how it would impact the emission of air pollutants.

3.2 Econometric Model

In the base model (model 1), only GDP and GDP squared are used as explanatory variables. The data of the real GDP per capita is in different orders of magnitude. Therefore, a natural log transformation is applied to GDP, and the two explanatory variables are named lngdp and lngdp2, respectively. The transformed values are used in the linear regressions. A detailed description of the variable name can be found in Table 1.

In the STATA code, the six modified ambient air pollutant emission levels are named according to their chemical formula, respectively, namely SO_2, O_3, NO_X, NO_2, NO, and CO. For the first model, using the fixed-effects (within) regression estimator. The formula of model 1 is given as follow:

$$\text{ambient emission} = \alpha + \theta_1 * \text{lngdp} + \theta_2 * \text{lngdp2} + \varepsilon \tag{1}$$

This regression equation will run six times to test the relationship between each ambient and the real GDP per capita. The model uses panel data which includes eleven major provinces in Canada. The symbol θi is the coefficient of each independent

Table 1 Variables used in the regressions

Variable name	Description
lngdp	Natural log of GDP
lngdp2	Square of natural log of GDP
so2	Sulfur dioxide
o3	Ozone
nox	Nitric oxide
no2	Nitrogen dioxide
no	Nitrogen monoxide
co	Carbon monoxide
pop	Population density
alg	Proportion of Agriculture in total GDP
oil	Proportion of mining, quarrying and oil extraction in total GDP

variable. α indicates the constant of the regression model. ε indicates the error of the regression.

Then in model 2 to model 4, Population density (pop), the percentage of the agriculture industry of the total real GDP per capita (alg), and the percentage of the mining, quarrying, and oil extraction industry of the total real GDP per capita (oil) are incorporated respectively. Model 2, Model 3, and Model 4 are shown as follow:

$$\text{ambient emission} = \alpha + \theta_1 * \text{lngdp} + \theta_2 * \text{lngdp2} + \theta_3 * \text{pop} + \varepsilon \tag{2}$$

$$\text{ambient emission} = \alpha + \theta_1 * \text{lngdp} + \theta_2 * \text{lngdp2} + \theta_3 * \text{agl} + \varepsilon \tag{3}$$

$$\text{ambient emission} = \alpha + \theta_1 * \text{lngdp} + \theta_2 * \text{lngdp2} + \theta_3 * \text{oil} + \varepsilon \tag{4}$$

To further promote the accuracy of the OLS estimation, all three supplementary independent variables are incorporated in model 5 as shown below

$$\begin{aligned}\text{ambient emission} = \alpha + \theta_1 * \text{lngdp} + \theta_2 * \text{lngdp2} \\ + \theta_3 * \text{pop} + \theta_4 * \text{agl} + \theta_5 * \text{oil} + \varepsilon\end{aligned} \tag{5}$$

4 Results and Discussion

The relationship between air pollution and economic growth is studied using the previously mentioned regression models with pollutant gas emission and GDP per capita as indicators.

For each air pollutant, regressions using model 1 (base model) are conducted, and the coefficients, confidence intervals, and the R-squared are shown in Table 2. The regressions which take emissions of nitrogen oxide (NO_X), nitric oxide (NO), nitrogen dioxide (NO_2), or carbon monoxide (CO) as the dependent variable show a typical EKC feature, i.e., the inverted U-shaped relationship. The coefficient of the logarithm of GDP per capita (lngdp) has a positive confidence interval, and the coefficient of the logarithm of GDP per capita squared (lngdp2) has a negative confidence interval with a confidence level of 99%. However, for the regressions using sulfur dioxide (SO_2) or ozone (O_3) as the dependent variable, the coefficient of the lngdp is negative, and the coefficient of the lngdp2 is positive. For these two regressions, the relationship between air pollution and economic growth is U-shaped. The R-squared of the regressions ranges from 0.489 to 0.684, which shows that nearly half of the variance of air pollution can be explained by the model (Tables 3, 4 and 5).

Table 2 Statistic summary of regressions using model 1

Variables	so2	o3	nox	no2	no	co
lngdp	−26.82***	−14.16***	68.16***	67.37***	51.03***	2.518***
	(−34.71 to −18.93)	(−22.47 to −5.853)	(38.68 to 97.63)	(55.04 to 79.70)	(31.96 to 70.10)	(1.570 to 3.467)
lngdp2	1.170***	0.941***	−4.149***	−3.787***	−3.178***	−0.154***
	(0.774 to 1.566)	(0.524 to 1.359)	(−5.628 to −2.670)	(−4.406 to −3.168)	(−4.135 to −2.221)	(−0.201 to −0.106)
Constant	155.0***	68.77***	−242.1***	−279.1***	−175.5***	−9.047***
	(115.8 to 194.2)	(27.51 to 110.0)	(−388.4 to −95.78)	(−340.4 to −217.9)	(−270.2 to −80.78)	(−13.76 to −4.338)
Observations	499	499	499	499	499	499
R-squared	0.489	0.581	0.530	0.684	0.656	0.602
Number of id	11	11	11	11	11	11

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 3 Statistic Summary of Regressions Using Model 2

Variables	so2	o3	nox	no2	no	co
lngdp	−27.38***	−14.32***	65.05***	67.80***	50.24***	2.468***
	(−35.21 to −19.55)	(−22.64 to −6.000)	(36.19 to 93.92)	(55.47 to 80.13)	(31.19 to 69.28)	(1.523 to 3.413)
lngdp2	1.222***	0.956***	−3.858***	−3.827***	−3.104***	−0.149***
	(0.829 to 1.616)	(0.538 to 1.375)	(−5.310 to −2.406)	(−4.447 to −3.207)	(−4.062 to −2.145)	(−0.196 to −0.101)
pop	−0.198***	−0.0561	−1.108***	0.153	−0.282*	−0.0179**
	(−0.323 to −0.0739)	(−0.188 to 0.0761)	(−1.566 to −0.649)	(−0.0430 to 0.349)	(−0.584 to 0.0209)	(−0.0330 to − 0.00293)
Constant	158.9***	69.89***	−220.1***	−282.2***	−169.9***	−8.689***
	(120.0 to 197.9)	(28.53 to 111.2)	(−363.5 to −76.57)	(−343.5 to −220.9)	(−264.5 to −75.20)	(−13.39 to −3.993)
Observations	499	499	499	499	499	499
R-squared	0.499	0.581	0.551	0.686	0.659	0.607
Number of id	11	11	11	11	11	11

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

The results of the regressions using model 2, model 3, and model 4, including coefficients, confidence intervals, and the R-squared, are illustrated above from Tables 3–5. Similar results are obtained compared with the base model. The confidence intervals of lngdp are positive when using NO_X, NO_2, NO, and CO_2 as explained variables. The confidence intervals of lngdp2 are negative, which means that emissions of NO_X,

Table 4 Statistic summary of regressions using model 3

Variables	so2	o3	nox	no2	no	co
lngdp	−27.57***	−13.49***	67.03***	66.07***	47.13***	2.249***
	(−35.38 to −19.75)	(−21.74 to −5.236)	(37.55 to 96.51)	(53.90 to 78.24)	(29.16 to 65.10)	(1.412 to 3.086)
lngdp2	1.224***	0.893***	−4.069***	−3.693***	−2.897***	−0.134***
	(0.831 to 1.616)	(0.478 to 1.308)	(−5.550 to −2.587)	(−4.305 to −3.081)	(−3.800 to −1.994)	(−0.176 to −0.0921)
alg	7.313***	−6.643***	11.08	12.83***	38.45***	2.657***
	(3.204 to 11.42)	(−10.98 to −2.302)	(−4.426 to 26.59)	(6.427 to 19.23)	(29.00 to 47.90)	(2.217 to 3.097)
Constant	156.5***	67.38***	−239.8***	−276.5***	−167.4***	−8.492***
	(117.8 to 195.3)	(26.45 to 108.3)	(−386.0 to −93.58)	(−336.8 to −216.1)	(−256.6 to −78.32)	(−12.64 to −4.341)
Observations	499	499	499	499	499	499
R-squared	0.501	0.588	0.532	0.694	0.696	0.692
Number of id	11	11	11	11	11	11

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 5 Statistic summary of regressions using model 4

Variables	so2	o3	nox	no2	no	co
lngdp	−26.84***	−14.22***	68.12***	67.08***	50.68***	2.490***
	(−34.74 to −18.95)	(−22.50 to −5.945)	(38.62 to 97.62)	(55.32 to 78.84)	(32.13 to 69.23)	(1.613 to 3.368)
lngdp2	1.170***	0.941***	−4.150***	−3.788***	−3.179***	−0.154***
	(0.774 to 1.566)	(0.526 to 1.357)	(−5.630 to −2.669)	(−4.378 to −3.198)	(−4.110 to −2.249)	(−0.198 to −0.110)
oil	0.923	2.967**	1.607	13.91***	16.69***	1.335***
	(−1.674 to 3.520)	(0.244 to 5.691)	(−8.096 to 11.31)	(10.04 to 17.78)	(10.59 to 22.79)	(1.046 to 1.623)
Constant	155.1***	69.16***	−241.9***	−277.3***	−173.3***	−8.869***
	(115.9 to 194.3)	(28.05 to 110.3)	(−388.4 to −95.42)	(−335.7 to −218.9)	(−265.3 to −81.16)	(−13.23 to −4.512)
Observations	499	499	499	499	499	499
R-squared	0.489	0.585	0.530	0.714	0.676	0.660
Number of id	11	11	11	11	11	11

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

NO_2, NO, and CO show an inverted U-shaped relationship with GDP per capita. On the other hand, the emissions confidence intervals of lngdp and lngdp2 are negative and positive, respectively, when using C and O_3 as explained variables. Therefore, these two air pollutants show a U-shaped relationship with GDP per capita (Table 6).

The statistical significance of additional explanatory variables varies in different pollution gases. The regression coefficient of population density is statistically significant when regressing on SO_2, NO_X, NO, and CO. However, for O_3 and NO_2, population density is not statistically significant at a 90% significance level. In model 3, the proportion of agriculture in total GDP showed significance when regressing most air pollutants except NO_X. The proportion of the energy industry in total GDP is not statistically significant at a 90% confidence level when considering SO_2 and NO_X emission. From model 3 to model 5, slight improvements in R-squared are observed. Incorporating additional explanatory variables could explain more of the pollutant emission variance.

Then regressions based on a more comprehensive model are conducted. In model 6, the previously mentioned variables, namely population, agriculture proportion,

Table 6 Statistic summary of regressions using model 5

Variables	so2	o3	nox	no2	no	co
lngdp	−28.01***	−13.45***	64.23***	67.51***	47.69***	2.305***
	(−35.78 to −20.23)	(−21.63 to −5.258)	(35.35 to 93.11)	(56.03 to 79.00)	(29.89 to 65.50)	(1.504 to 3.106)
lngdp2	1.269***	0.885***	−3.778***	−3.852***	−2.963***	−0.141***
	(0.878 to 1.661)	(0.473 to 1.298)	(−5.234 to −2.323)	(−4.431 to −3.273)	(−3.861 to −2.066)	(−0.181 to −0.100)
pop	−0.186***	−0.0360	−1.213***	0.478***	0.121	0.0134*
	(−0.319 to −0.0529)	(−0.176 to 0.104)	(−1.706 to −0.720)	(0.282 to 0.675)	(−0.183 to 0.425)	(−0.000262 to 0.0271)
alg	6.877***	−8.949***	7.011	8.533***	33.90***	2.267***
	(2.575 to 11.18)	(−13.48 to −4.416)	(−8.974 to 23.00)	(2.176 to 14.89)	(24.05 to 43.75)	(1.823 to 2.710)
oil	−1.715	4.355***	−8.625	15.86***	11.32***	1.015***
	(−4.531 to 1.100)	(1.389 to 7.321)	(−19.09 to 1.836)	(11.70 to 20.02)	(4.869 to 17.77)	(0.725 to 1.305)
Constant	159.9***	68.20***	−217.6***	−284.8***	−169.3***	−8.707***
	(121.3 to 198.5)	(27.54 to 108.9)	(−361.0 to −74.25)	(−341.8 to −227.8)	(−257.7 to −80.91)	(−12.68 to −4.728)
Observations	499	499	499	499	499	499
R-squared	0.509	0.597	0.553	0.729	0.704	0.719
Number of id	11	11	11	11	11	11

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

and energy industries proportion, are all included, and the regression results are shown in Table 6. The conclusions drawn from the previous models are unchanged in model 5. The coefficients of lngdp and lngdp2 are statistically significant for all the air pollutants at a 99% significance level. Emissions of NO_X, NO_2, NO, and CO show an inverted U-shaped relationship with GDP per capita. SO_2 and O_3 show a U-shaped relationship with GDP per capita. The regression using model 5 shows an improvement in R-squared compared with the base model.

The effect of population density on air pollution is statistically significant at a 99% significance level for SO_2, NO_X, and NO_2 and at a 90% significance level for CO. The impact of the estimator of population density on O_3 and NO emission is not statistically significant. A possible reason for this observation is that the emission of these four air pollutants is highly related to daily human activities. The proportion of agriculture in total GDP is statistically significant in all the regressions except the one using NO_X as the explanatory variable. The OLS estimators are mostly positive numbers, which means that as the proportion of agriculture in GDP increases, the air pollutant level also tends to increase. The coefficient of "oil" is statistically significant for the regressions using O_3, NO_2, NO, and CO at a 99% significance level. The OLS estimators are all positive, meaning that the percentage of mining, quarrying, and oil industry in total GDP is positively related to the emission of the aforementioned gas pollutants. The observation is consistent with the common belief that these industries are high-pollution industries.

Though He et al. (He and Richard 2010) did not find any evidence of the EKC between CO_2 emission and GDP per capita, the findings of this study illustrate the existence of the EKC relationship for NO_X, NO, NO_2 and CO. The observations about SO_2 and O_3 in this study are different from Giovanis (2013), in which both SO_2 and O_3 showed a typical inverted U-shaped correlation with economic growth. Overall, the EKC is not a universal law, and different results might be found when studying different countries or using different environmental indicators.

5 Conclusion

In this paper, linear regressions are conducted on the ambient air pollutant level of different air pollutants. The natural log of GDP per capita and the square of the natural log of GDP are used as the primary explanatory variables. Besides, some other relevant variables are also incorporated in the linear regressions.

In the regressions using Model 1, a typical EKC feature is observed when using the emissions of NO_X, NO, NO_2, or CO as dependent variables. For those air pollutants, the OLS estimator of lngdp is positive, and it is negative for lngdp2, indicating an inverted U-shaped relationship. At the first stage of economic growth, air pollution increases with GDP growth. After reaching an inflection point, air pollution will decline as GDP increases.

For SO_2 and O_3, the conclusion is the opposite. The coefficient of lngdp is negative, and the coefficient of lngdp2 is positive. These two pollutants show a U-shaped

relationship with economic growth. In the initial stage, the emission of SO_2 and O_3 decreases as GDP increases. However, after reaching its minimum level, the emission of SO_2 and O_3 will increase as the GDP grows.

The interpretation of the additional independent variable differs according to the different types of air pollutants. Population density is found to be strongly related to the emission of SO_2, NO_X, and NO_2. The OLS estimators of population density for SO_2 and NO_X are negative. The result is contrary to common sense that frequent human activities will lead to more pollutant emissions. Except for O3, the emission of all other air pollutants is highly correlated with the percentage of agriculture in total GDP. The emission of O_3, NO_2, NO, and CO is highly dependent on the proportion of mining, quarrying, and oil extraction in total GDP. As the coefficients of "oil" are all positive for these four air pollutants, it can be inferred that the larger proportion these industries have, the more air pollutant emission there will be.

References

Andreoni J, Levinson A (2001) The simple analytics of the environmental Kuznets curve. J Public Econ 80(2):269–286

Azam M, Khan AQ (2016) Testing the Environmental Kuznets Curve hypothesis: a comparative empirical study for low, lower middle, upper middle and high income countries. Renew Sustain Energy Rev 63:556–567

Caviglia-Harris JL, Chambers D, Kahn JR (2009) Taking the "U" out of Kuznets. Ecol Econ 68(4):1149–1159

Dietz T, Rosa EA, York R (2012) Environmentally efficient well-being: is there a Kuznets curve? Appl Geogr 32(1):21–28

Galeotti M, Lanza A, Pauli F (2006) Reassessing the environmental Kuznets curve for CO_2 emissions: a robustness exercise. Ecol Econ 57(1):152–163

Grossmann GM, Krueger AB (1991) Environmental impact of a North American free trade agreement. NBER working paper, 3914

Grossmann GM, Krueger AB (1993) Environmental impacts of a North American free trade agreement. In Garber PM (ed), The Mexico–US free trade agreement, pp 13−56. MIT Press, Cambridge

He J, Richard P (2010) Environmental Kuznets curve for CO_2 in Canada. Ecol Econ 69(5):1083–1093. https://doi.org/10.1016/j.ecolecon.2009.11.030

Hettige H, Mani M, Wheeler D (1999) Industrial pollution in economic development: Kuznets revisited. In Fredriksson P (ed), Trade, global policy and the environment, World Bank Discussion Papers, vol 402. World Bank, Washington, DC

Holtz-Eakin D, Selden TM (1995) Stoking the fires? CO_2 emissions and economic growth. J Public Econ, 57, 85−101. Im KS, Pesaran MH, Shin Y (1997) Testing for unit roots in heterogeneous panels. Mimeo

Kaufmann R, Davidsdottir B, Garnham S, Pauly P (1998) The determinants of atmospheric SO_2 concentrations: reconsidering the environmental Kuznets curve. Ecol Econ 25:209–220

Panayotou T (1993) Empirical tests and policy analysis of environmental degradation at different stages of economic development. Geneva, Switzerland: International Labour Office, Working Paper, WP238

Roberts JM, Grimes PE (1997) Carbon intensity and economic development 1962–1991: a brief exploration of the environmental Kuznets curve. World Dev 25(2)

Rothman D (1998) Environmental Kuznets curves—real progress or passing the buck? Ecol Econ 25:177–194
Selden TM, Song D (1994) Environmental quality and development: is there a Kuznets curve for air pollution? J Environ Econ Environ Manag 27:147–162
Song T, Zheng T, Tong L (2008) An empirical test of the environmental Kuznets curve in China: a panel cointegration approach. China Econ Rev 19(3):381–392
Stokey NL (1998) Are there limits to growth? Int Econ Rev 39(1):1–31
Torras M, Boyce J (1998) Income, inequality, and pollution: a reassessment of the environmental Kuznets curve. Ecol Econ 25:147–160
Wu J, Zheng H, Zhe F, Xie W, Song J (2018) Study on the relationship between urbanization and fine particulate matter (PM2.5) concentration and its implication in China. J Clean Prod 182:872–882

Research and Analysis on Influence Factors of Consumers' Online Purchasing Behavior After Pandemic in Perspective of Mental Accounting

Xinjia Chen

Abstract The coronavirus disease 2019 (Covid-19) pandemic has had a large impact on the online industry. There is a lot of uncertainty in online shopping, which can make consumers perceive risks. Therefore, the decision-making process of consumers online is more complex than traditional shopping and it is important to study the psychological process of consumers in order to develop a realistic marketing strategy. This paper focuses on the study of the influence of online consumption factors on consumers' online consumption behavior after a pandemic and establishes a "consumer black box" model by using the gain and loss evaluation principle in the mental accounting theory. On this basis, with consumers as the main research object, a questionnaire survey and empirical analysis are conducted. The results show that the three dimensions of convenience, online word-of-mouth, and the impact of the pandemic have a significant positive impact on the purchase intention of online consumers. Price has a negative correlation with consumers' purchase intention. The research results will help guide e-commerce companies to enhance consumers' perceived value and gain a sustainable competitive advantage.

Keywords Online purchase · Mental accounting · Consumer black box theory · Pandemic

1 Introduction

With the explosion of Covid-19 in early 2020, consumers' consumption patterns and attitudes have changed dramatically. More and more consumers no longer prefer traditional shopping methods and are relying on the internet to move from offline to online purchases. At the same time, the rapid advances in information technology have led to the development of online commerce applications, and online shopping has become the primary means of purchase for many consumers.

X. Chen (✉)
College of Business and Economics, The Australian National University, Canberra 2601, Australia
e-mail: u7412974@anu.edu.au

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_78

Academics have paid much attention to the study of consumer behavior at present, but most scholars have only focused on consumer pre-consumer search behavior, during the purchase process and post-purchase explicit behavior. In the post-pandemic era, with the rise of online shopping largely influencing and changing people's shopping behavior, scholars have begun to realize that there is more uncertainty in online shopping than in traditional shopping, and many scholars have analyzed consumer psychology from a variety of disciplines (including cognitive psychology, social psychology, and behavioral economics). However, most of the research focuses only on the impact of consumer behavior on psychological accounts through the insinuation of consumption behavior into psychological accounts, rather than determining how it affects their consumption behavior from the perspective of psychological accounts. At the same time, most scholars researching the level of traditional shopping have done little research on the factors influencing consumers' online shopping behavior in the post-pandemic era.

This paper assesses the perceived benefits and losses of consumers in the online shopping process from the perspective of psychological accounts, analyses various factors affecting consumers' online shopping behavior in the post-pandemic era through building a black box model and posting questionnaires, analyses the validity of the model by constructing a model of consumers' online shopping intentions, and draws corresponding research conclusions. The results of this study will not only help companies to improve consumer retention and attract new and potential consumers through online marketing but will also help to provide important theoretical value for the country to expand domestic demand and stimulate consumption in the post-pandemic era.

2 Literature Review

2.1 Prospect Theory

American psychologists Kahneman and Tversky combined psychology with economics to develop Prospect Theory (Tversky and Kahneman 1979). This theory can be illustrated by a value function, as shown in Fig. 1.

According to Fig. 1, This reference point '0' affects people's psychology, which in turn affects their choices and judgement. Individuals are risk-averse in the relative gain zone and risk-averse in the relative loss zone. This is perceived loss, and sometimes people tend to feel loss more strongly than gain. Therefore, changing the reference value can be used to alter consumer judgements of gain and loss and risk preferences.

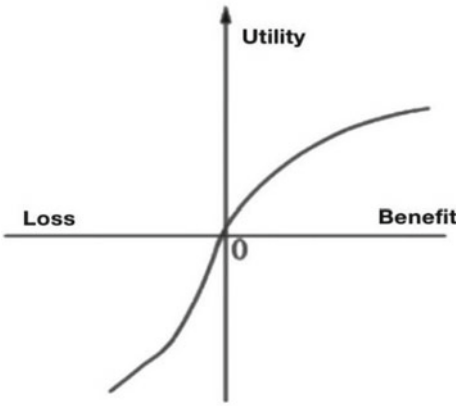


Fig. 1 Value function

2.2 Mental Accounting

"Mental accounting", first introduced by professor Thaler at the University of Chicago, is an important branch of behavioural economics that reveals why people behave irrationally, deviating from basic economic principles and simple rules of economic arithmetic.

Thaler proposed a mental accounting theory based on prospect theory (Thaler 1985). It was not until 1999 that a summary of recent research on mental accounting was presented, suggesting that the three main components of mental accounting theory were a framework of gains and losses and trading utility, account-specific budgetary controls, and rules for the frequency and trade-offs between accounts. As an improvement on prospect theory, the mental accounting theory includes aggregated outcomes, whereas the value function of prospect theory is defined by only one indivisible outcome. Since online shopping decisions can be influenced by multiple decision factors (price, risk, convenience, etc.), the mental accounting theory is useful as an alternative to the theoretical study of online shopping decisions, especially in the context of online shopping.

2.3 The Impact of Mental Accounting Theory on Online Purchasing

The existence of mental accounts has a profound impact on consumers' online shopping behaviour and purchasing decisions.

According to Fig. 2, Consumers formulate their own online shopping concepts based on marketing communications, word of mouth, personal experiences, and expert opinions, which further influence perceptions and attitudes. These concepts have been deeply imprinted in consumers' minds. When they have the motivation

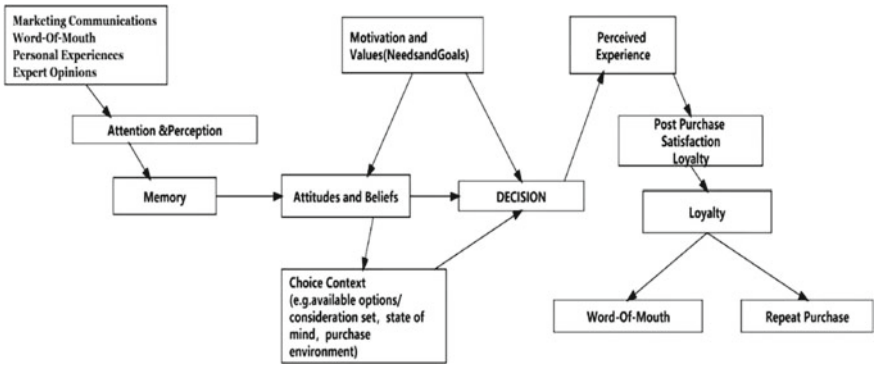


Fig. 2 Consumer behaviour model

and need to buy a product, they make situational choices based on past attitudes and beliefs to influence the final purchase decision. In the repeated online shopping consumption experience, post-purchase satisfaction is formed in the online shopping experience, which will reduce the perceived risk and uncertainty (Grewal et al. 2003). Because consumers repeatedly buy and use a certain brand for a long time, people's mental accounts feel the benefits and have a good shopping experience, they will have loyalty, commitment, emotional maintenance, and even emotional dependence on the brand.

2.4 Consumer Online Shopping Behaviour in the Post-pandemic Era

Online purchasing is the process of activity that consumers exhibit in relation to the purchase of goods or services, including the process of searching for information about goods and acquiring them (Amsari and Sari 2022). Online shopping can bring convenience to consumers, but it also brings certain risks. The research on the perceived risk of online shopping has become the key research content in the field of consumer online shopping behavior research. Perceived risk is the uncertainty about the negative consequences that customers may have when making a purchase decision (Naovarat and Juntongjin 2015; Tsiakis 2012).

The pandemic sparked a meteoric rise in online sales. Consumer behaviour was influenced by the COVID-19 pandemic itself and by government restrictions. During the COVID-19 crisis, consumers of all generations preferred to purchase goods and services digitally (Jensen et al. 2021). Overall, there was a marked shift towards online shopping consumption. The frequency of shopping has also increased (Armando 2021). Moreover, Cheng Koo and Martha G. Russel show that online consumer behaviour is influenced by demographic characteristics, online shopping

channels, perceived effectiveness of channels, and consumers' own shopping preferences (Shamim et al. 2021). In addition, the decision to make an online purchase is influenced by the consumer's experience of using the Internet, their attitude towards the security of online transactions, and their perception of the entertainment and convenience of online shopping.

3 Research Model and Hypotheses

Combined with the prospect theory of online shopping and the model of consumer acceptance of online shopping, the mental accounting of online shopping is simply divided into gain account and loss account. Among them, the gain account is used to evaluate the perceived benefits of online shopping, such as the price of goods, and the source of the gain is the perceived usefulness of online shopping, not just the monetary gain, but also the non-monetary component (Hee-Woong and Gupta 2009). The loss account is used to evaluate the perceived loss of online shopping, and the source of the loss is the perceived risk of online shopping.

3.1 Mental Assessment and Hypotheses of the Impact Attributes of Online Shopping

Price. From the perceived gain perspective, this study mainly considers the difference between the actual price of the product and the expected price of consumers when proceeding with online shopping. During the pandemic, due to the economic depression and increased unemployment, people will value comparing prices for the same goods. Consumers can check not only the current price of a product but also the past price of the product to gain a better understanding of the price of the product, thus forming their own psychological reference price (or desired price) for the product. They mentally evaluate and mentally code the price before making a purchase decision, such as above or below the reference price (Dodds et al. 1991).

The price of a product is a useful factor for consumers shopping online and plays a dominant role. This is because if the price of a product is lower, consumers are more likely to buy online and perceive that they are getting a bargain, which in another way is a gain. In addition, when shopping online, consumers tend to "compare prices" and choose the online store that they perceived as usefulness.

H1: Perceived price negatively influences perceived benefit for online customers.

Convenience. The biggest advantage of online shopping compared to offline shopping is the convenience of shopping. The convenience of online shopping can bring a variety of benefits to people, shopping online saves shoppers time and effort and gives consumers maximum convenience (Berry et al. 2002). According to mental

accounting theory, great convenience means that consumers spend less time and energy searching for information about products, and have less difficulty paying for them, which largely increases the utility of the transaction.

H2: Perceived convenience positively influences perceived benefit for online customers.

Before and after the Covid-19. Global lockdowns, social distancing, and other measures to limit the spread of the Covid-19 pandemic have prompted consumers to shop more online. The consumer needs for online shopping in the Covid-19 has accelerated digital deployment, with the continuous improvement of artificial intelligence technology, it has greatly helped the development of the tertiary industry such as online retail, online medical, and online gaming. The long duration of the pandemic has made people more mature in their online consumption concepts (Etumnu and Widmar 2020). As online technology products are also more responsive to the basic needs of consumers, shoppers perceive usefulness and have a very broad and profound impact on shopping and consumption.

H3: Covid-19 positively influences perceived benefit for online customers.

Online Word of Mouth. When shopping online, consumers will pay great attention to the online review information on the website before shopping, which can be called online word-of-mouth review information (Lee and Youn 2009). Consumers take these online word-of-mouth reviews as an important reference. The main reason is that online word-of-mouth influences the perceived risk of online shopping. If a merchant and its products have a great online reputation in all aspects, consumers' perceived risk of online consumption will be reduced, and their trust in the online store will be improved, so they can buy products here with confidence (Zhong and Zhang 2013). On the contrary, if the online reputation is unsatisfactory, and the rating rate is low, consumers will psychologically increase the perceived risk of shopping at this store, so they choose to give up the purchase and turn to other stores for shopping.

H4: Online word of mouth negatively influences perceived risk for online customers.

3.2 Consumer Black Box

The general model of consumer behaviour is: "stimulus—consumer black box—purchase response". The complex psychological activity that occurs when a consumer is stimulated by the external environment is self-performed within the consumer and is described as an invisible "black box" (Jisana 2014) (Fig. 3).

This paper introduces the consumer acceptance model of online shopping, in which consumers perceive the usefulness of online shopping. Consumers' purchasing decision-making process is influenced by factors such as internal and external factors; personal factors, as an invisible part, have a significant impact on purchasing decisions. According to mental accounting theory, consumers divide this perceived

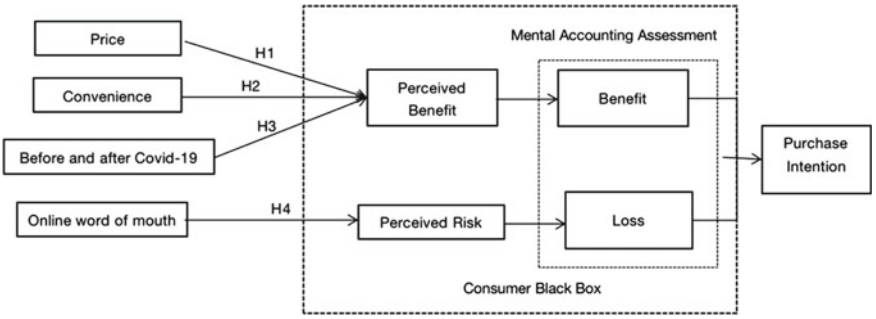


Fig. 3 Consumer black box (Wang 2014)

benefit into their mental account of the acquisition, which they perceive as a profit. Likewise, consumers accept that the presence of uncertainty in the online shopping model poses some risk to them, which is perceived risk. This perceived risk is classified by consumers in their mental account of loss, which is referred to here as perceived profit and loss. They evaluate perceived gains and perceived losses in order to make a decision whether to consume online. In this paper, we refer to this process of evaluating consumers' psychological accounts in the online consumption process as the "consumer black box model" (Wang 2014). Based on the above analysis of the consumer black box model and the relationship hypothesis, the following basic framework is derived below.

Perceived benefits are positively influenced by price, convenience, before and after the Covid-19 conditions, which in turn affect the consumer's mental account of gain; perceived risks of online shopping are negatively influenced by online word-of-mouth, which in turn affects the consumer's mental account of loss.

4 Methodology

Before the formal research study, in-depth research into authoritative and relevant literature, and in-depth interviews with some internet users and scholars with an online shopping experience to conduct in-depth interviews and develop the initial questionnaire, edit the questionnaire mainly based on previous experience and self-development. In order to make the sample more representative, different age groups and consumer groups were selected for the questionnaire survey. Purify the initial questionnaire by analyzing the reliability and validity and delete the questions that do not meet the requirement.

Table 1 Descriptive statistical analysis of sample characteristics

Demographic variable		Data
Gender	Male	58.22%
	Female	47.18%
Online shopping experience (years)	Mean	2.77
Monthly disposable amount on online	Mean	$387.80
Number of responses		146

4.1 Data Collection

The main product categories are mostly low-touch products and contactless services in online shopping (EIAA 2006). Product A was selected for this study because it is a low-touch product, which is not a necessity but is very common in daily life. There is little difference in quality compared to other products (possibly a confounding factor affecting the results (Hee-Woong and Gupta 2009).

The questionnaire is divided into two parts, the first part is the basic information of the respondents, thus conducting a descriptive analysis of the sample characteristics; the second part is a description of the variables related to the perceived benefits and perceived losses of internet users' online shopping intentions. Through the online survey questionnaire, a total of 146 valid questionnaires were returned (Tables 1 and 2.

4.2 Confirmatory Factor Analysis

The convergent validity refers to the characteristics of a test score or the outcome of a measure. After the factor analysis, reliability tests are done to further understand the reliability and validity of the questionnaire. A commonly used convergent validity test in the Likert scale is the Cronbach's alpha coefficient, the magnitude of which indicates the reliability of the questionnaire, generally greater than 0.7 is in the acceptable range.

Reliability Analysis. The reliability coefficients of the variables in this study are reflected in Table 3.

Among them, the online shopping influencing factors survey and its four dimensions have all reached the standard of 0.7. Therefore, the internal consistency across all variables showed that all items maintained good consistency. Subsequently, all data can be used as analytical tests.

Validity Analysis

The KMO and bartlett's test for each variable in the study is reflected in Table 4.

Factor analysis in SPSS was used to perform KMO and bartlett's tests on the scales of the questionnaire. Based on the validity test results of the online shopping

Table 2 Measurement instrument

Const	Wording	References
Price	When the price of product A is higher than my psychological expectation, I will not choose to buy product A online. I prefer to buy more product A during promotion. I can always "shop around" to find a price that matches my expectations	Self-development
Convenience	Buying product A online can save me time, reduce unnecessary costs, and a concise page can quickly lock down the product A I want to buy	Peck et al. (2001), Torkzadeh and Dhillon (2002)
Before and after Covid-19	Due to the impact of the pandemic, I need to buy product A online and have more time to visit shopping websites. Taking into account safety and health factors, I prefer to buy product A online after the epidemic	Grashuis et al. (2020)
Online word of mouth	The large number of negative reviews on this product A will make me feel that the purchase is very risky, and I will also choose not to buy it. The ratio of the number of negative reviews has a great impact on my decision-making behavior	Bansal and Voyer (2000), Park et al. (2007)
Perceived benefit	The website helps me choose the right product, the quality is trustworthy, and the quality is better. Product A displayed online is very pleasing to the eye and makes me feel very happy	Sweeney and Soutar (2001)
Perceived risk	The product A purchased online sometimes cannot be used normally or the function does not achieve the expected effect. When filling out the purchase information, I feel the risk of privacy being leaked. When product A is defective, it is difficult to find after-sales personnel to coordinate and exchange	Cheung and Lee (2001), Devine and Gefen (2001)

Table 3 Results of the reliability analysis testing

Variables	No. of item	Cronbach's alpha
Online prise	4	0.831
Convenience	3	0.717
Price	4	0.751
Before and after pandemic	3	0.746
Perceived	2	0.724
Perceived lose	2	0.703
Online purchasing intention	18	0.936

Table 4 KMO and bartlett's test

Kaiser–Meyer–Olkin		0.912
Bartlett's test of Sphericity	Approx. Chi-Square	959.709
	df	91
	Sig.	0.000

influence survey, it was found to have a KMO value of 0.912 and the chi-square statistic of the bartlett's spherical test reached the 5% level of significance, therefore it was considered to have the validity of the study.

4.3 Hypothesis Testing

The regression model is exhibited in Table 5, different variables (price, convenience, before and after the pandemic, and online word-of-mouth) are used as independent variables respectively, and the perceived benefit and perceived loss are used as dependent variables for regression analysis. In this study, convenience and pandemic had a positive effect on perceived benefits with regression coefficients of 0.623 and 0.682 respectively. Price had a negative effect on perceived benefits with a regression coefficient of −0.871. Online word-of-mouth had a negative effect on perceived losses with a regression coefficient of −0.533.

Table 5 Regression analysis of each variable

Hyposis	Std. loading	t-value	Sig	Result
H1	−0.871	−21.283	0	Support
H2	0.623	9.563	0	Support
H3	0.682	11.179	0	Support
H4	−0.533	−7.568	0	Support

4.4 Discussion

The results of the analysis show that price has the greatest impact on perceived benefits, with pandemics and convenience having a decreasing impact in that order. This means that before making a purchase decision due to a reduction in expected income during a pandemic, consumers will mentally judge the difference between their expected price and the actual price of the product and will be more likely to purchase low-priced and discounted goods. Before the pandemic, shopping was mainly a combination of online and offline, while online consumption became the dominant factor as residents went out less due to various policies at the time of the pandemic. And with the impact of digital transformation developments such as online healthcare and online teaching, people felt a reduction in various costs of living and an increase in perceived profit accounts increased people's willingness to spend. Internet users are highly educated and young, and this group lives a fast-paced life with a heavy focus on the efficiency and convenience of shopping, creating a psychological inclination for consumers to save physical effort and time. A more convenient form of shopping can help consumers increase the value of their psychological account acquisition and thus make quicker purchase decisions. The survey demonstrates that when the number of consumers who are sources of online word-of-mouth information is high, other consumers who have not yet made a purchase decision will perceive a greater amount of online word-of-mouth information, which can reduce their perceived risk and increase their willingness to purchase.

5 Conclusion

Based on mental accounting theory, this study examined online purchase decision factors of online shops from a post-pandemic era perspective and established a consumer black box theory. Questionnaires and empirical analyses were conducted for online users, leading to the following conclusions.

Under the influence of the pandemic, people have become more reliant on technology-led consumption methods. Although price as a traditional influencing factor still dominates in the post-pandemic era, both the convenience features of the platform and the trust in consumers will have a positive impact on purchase intentions in the long run. As the online shopping demographic tends to be more popular and the demand for online shopping is higher among different age groups, it has also become more important to strengthen customers' adhesion to brands and optimize the online buying process and product display to enhance the shopping experience.

In this paper, there are still some limitations in the research process. Firstly, the research is deficient in focusing the data sample mainly on Chinese internet users, showing that this conclusion only applies to the Chinese Internet region. Secondly, the limited sample size of the study is prone to variation and has certain limitations. Lastly, this paper only considers the study of consumers' willingness to buy from

online channels after the pandemic without further comparing online and offline channels. Future research could refine the combination of online and offline to provide consumers with a better service.

References

Amsari S, Sari DP (2022) Consumer factors in deciding to purchase online at shopee e-commerce during the covid-19 pandemic. In: International seminar of Islamic studies, pp 174–182

Armando R (2021) Disruption in the consumer decision-making? Critical analysis of the consumer's decision making and its possible change by the COVID-19. Turk J Comput Math Educ (TURCOMAT) 12(4):468–1480

Bansal H, Voyer P (2000) Word-of-mouth processes within a services purchase decision context. J Serv Res 3(2):166–177

Berry LL, Seiders K, Grewal D (2002) Understanding service convenience. J Mark 66(3):1–17

Cheung C, Lee W (2001) Characterisation of nanosurface generation in single-point diamond turning. Int J Mach Tools Manuf 41(6):851–875

Devine P, Gefen D (2001) Customer loyalty to an online store: the meaning of online service quality. In: ICIS 2001 proceedings, p 80

Dodds WB, Monroe K, Grewal D (1991) Effects of price, brand, and store information on buyers' product evaluations. J Mark Res 28(3):307–319

EIAA (2006) UK leads the way in online shopping. European Interactive Advertising Association Web site, Accessed June 2007 at http://www.eiaa.net/news/eiaa-articlesdetails.asp?lang=1&id=85

Etumnu CE, Widmar NO (2020) Grocery shopping in the digital era. Choices 35(2):1–8

Grashuis J, Skevas T, Michelle S (2020) Grocery shopping preferences during the COVID-19 pandemic. Sustainability 13(2):5369

Grewal D, Iyer GR, Sharma A (2003) The internet and the price–value–loyalty chain. J Bus Res, pp 391–398

Hee-Woong K, Gupta S (2009) A comparison of purchase decision calculus between potential and repeat customers of an online store. Decis Support Syst, pp 477–487

Jensen K, Yenerall J, Chen X, Yu T (2021) US consumers' online shopping behaviors and intentions during and after the COVID-19 pandemic. J Agric Appl Econ 53(3):416–434. https://doi.org/10.1017/aae.2021.15

Jisana TK (2014) Consumer behaviour models: an overview. Sai Om J Commer Manag 1(5):34–43

Lee M, Youn S (2009) Electronic word of mouth (eWOM) how eWOM platforms influence consumer product judgement. Int J Advert 28(3):473–499

Naovarat S, Juntongjin P (2015) Factor that affecting success of E-Marketplace in Thailand. In: 2015 International conference on computer science and information systems (ICCSIS-15), pp 24–25

Park D-H, Lee J, Han I (2007) The Effect of on-line consumer reviews on consumer purchasing intention: the moderating role of involvement. Int J Electron Commer 11(4):125–148

Peck J, Childers T, Carr C (2001) Hedonic and utilitarian motivations for online retail shopping behavior. J Retail 77(4):511–535

Shamim A, Siddique J, Noor U, Hassan R (2021) Co-creative service design for online businesses in post-COVID-19. J Islamic Mark

Sweeney J, Soutar GN (2001) Consumer perceived value: the development of a multiple item scale. J Retail 77(2):203–220

Thaler R (1985) Mental accounting and consumer choice. Mark Sci, pp 199–214

Torkzadeh G, Dhillon G (2002) Measuring factors that influence the success of internet commerce. Inf Syst Res 13(2):187–204

Tsiakis T (2012) Consumers' issues and concerns of perceived risk of information security in online framework. The Marketing Strategies. Procedia—Soc Behav Sci, pp 1265–1270

Tversky A, Kahneman D (1979) Prospect theory: an analysis of decision under risk. Econometrica, pp 263–292

Wang N (2014) Research and simulation of influence factors of consumers online purchase behavior in perspective of mental accounting. Master's thesis, Beijing University of Post and Telecommunication

Zhong K, Zhang C-Q (2013) A study on the influence of consumers' perceived value on online purchase intention: online word-of-mouth as a moderating variable. J Shenyang Normal Univ: Soc Sci Ed 37(3):53–56

Research on Business Model and Normalization of Data Factor Trading Market

Hongqi Ruan and Xiaolong Li

Abstract With the development of Internet technology, the data factor plays a more important role in the national economy. Researching the features of the data factor, the business model of the data factor trading market, and putting forward measures to normalize the market will promote the activity of the market and improve data factor productivity. To research the business model of the data factor trading market, this paper discusses the data factor trading market represented by Guiyang Big Data Exchange and the board data factor trading market represented by Taobao. Comparing the business model of these two types of markets helps discover the shortages of existing data trading markets. Based on these shortages, this paper puts forward four perspectives to normalize the data factor trading market, protecting data privacy, anti-piracy, monopoly of data supply, and determination and assignment of property rights.

Keywords Big data · Data factor trading market · Market surveillance

1 Background

With the development of data mining and mega data, data factor occupies a gradually important place in production. Jinping Xi, the president of the People's Republic of China, mentioned that data is a new production factor, a not only fundamental, strategic resource, but also important productivity. Research shows that, by 2025, the scale of global data is expected to reach 175 ZB. Due to the huge population size of China, it will occupy an absolute advantage in data holding. At that time, the reasonable use of data will play a significant role in the development of the national economy. Factor market promotes the effective allocation of resources. From 1997 to 2007, 39.2% of China's total factor productivity was contributed by marketization (Fan et al. 2011). To clarify the role of data factors in the national economy at the

H. Ruan · X. Li (✉)
Beijing University of Post and Telecommunications, Peking, China
e-mail: tell714@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_79

micro-level and deduce their influence at the macro level can help analyze the reasonable model of the data trading market and formulate corresponding policies based on relevant knowledge. Strengthening the reasonable control of data factor trading platforms will further enhance the role of data elements in economic development.

Data factor has complex features while there are great differences among factors. The past research focused on data factors, but less of them studied the data factors trading market according to its characteristics, to make up the research gap, this paper will discuss the data factor itself and meanwhile show the business model of the data trading market. It is widely acknowledged that knowing the characteristics of an item helps to build its market, so the business model will be discussed from the perspective of the data factor's character. For the implementation of the business model, we also need to discuss the standardization of the data factor trading market from the perspective of manufacturers, consumers, and the government.

To illustrate the data factor and the business model, this paper will be divided into parts as follows. In the first part, previous studies will be shown, and the definition of data factor and data trading market will be discussed. In the second part, several characters of the data factor will be briefly introduced, including its exclusiveness, noncompetition, economical efficiency of scale, positive externality, and property ownership. In the third part, the business model and standardization of the data factor market will be discussed based on the characteristics mentioned above. Finally, we will have a summary at the end of the paper.

2 Previous Studies

There have been multiple studies in data factors, some studies describe it as the organic combination of virtual body and entity under objective logic (Xiao and Qi 2021). Some studies believe that data factors are collected, processed, mined, and processed by artificial intelligence, cloud computing, blockchain, and other technologies, and are a special labor product with regenerative nature (Guan and Qin 2021). British economist Petty pointed out that land is the mother of wealth, and labor is the father of wealth and the factor of mobility (Petty 1963). In this paper, data is divided into processed statistical data and raw data, data factor refers to the raw data generated by consumers in the process of receiving enterprise services or after service completion and collected by enterprises providing services, which can be used in machine learning.

In the past, the community usually discuss big data and data mining from a technical perspective, however, with the development of the data factor, more and more scholars are trying to explore problems from social and economic perspectives. In the past several years, some studies have explored the characteristics and market of data factor from the perspective of political economy. They believe that data factor does not directly form the material form of use-value, nor do they have direct use-value, and their reproduction does not need extra labor and put forward that the better and healthy development of the digital economy is the necessary condition for its

marketization (Li and Wu 2021). Some studies put forward that illegal phenomena such as data theft, data crawler, and data hacking should be eliminated. Meanwhile, the government should integrate and open government data to get through the data channel between the government and the society (Si 2020). Yang said that the marketization of data supply is the key to cultivating the data factor market, the government should cultivate diversified data suppliers, especially enterprises that can play a leading role in the data value chain. Secondly, it should stimulate the demand for data applications in other industries and reduce the transaction cost of data factor (Yang 2020). Chen and Zhao suggested that there are several shortcomings in China's data factor market competition governance, such as the emergence of new unfair competition and monopolistic behavior which has impacted the existing competition order, meanwhile numerous regional data trading platforms are easy to cause regional segmentation of the unified market and so on (Chen and Zhao 2021). In a word, there have been lots of studies talking about the regulation of the data market while less study discussed the business model of the data market which is suitable for China.

3 Features of Data Factor

In general, data factor is considered to have exclusivity, non-competition, economical efficiency of scale, and positive externality (Mao and Chen 2021), the following discussion will focus on four points.

3.1 Exclusivity

Exclusivity, also called exclusivity, means that when a user uses this factor, other users cannot use it at the same time. For each data, when blinded by a vendor, then stored in the database of the vendor, the vendor does not allow the other manufacturers or individuals to access or use it, moreover, from the perspective of rational man, owners don't want to be in their use of data factor that a share data with other manufacturers, both to the exclusivity of data factor.

3.2 Non-competitive

Non-competitive, also called non-antagonistic, means that the factor will not be damaged when a user uses it, that is, the number of users does not affect the value of the data. Manufacturers use data factor, data tends to be a "copy", cleaning, pretreatment, etc. may change the operation of the data set is aimed at the "copy",

so when the vendor to complete the use of the data, "original" will not change, the next user to receive the same data, reflecting the data factor in a non-competitive.

3.3 Economical Efficiency of Scale

"Economies of scale", or "returns to scale", was first advocated by Marshall, the founder of modern economics (Yan 2003). Economical Efficiency of Scale refers to the fact that enterprises increase their output more than their input while increasing their input. Economical efficiency of scale refers to the expansion of production scale within a certain range that will make the average cost decline. The economical efficiency of the scale of the data factor is both external and internal. With the continuous increase of high-tech enterprises, people's lives are gradually digitized. In this process, people interact with intelligent devices more and more and generate a large amount of data. Eventually, all people's real-life can be found in the database, the total amount of data will be maximized, and the average cost will reach a minimum at a certain point, which reflects the external economy of scale of data factor. With the continuous expansion of the scale of an enterprise, its technological level and influence will continue to raise the difficulty of acquiring data and the cost of acquiring unit data factor will continue to decline until the lowest point, which reflects the internal economy of scale of data factor.

3.4 Positive Externality

Speaking from economics, the positive externality is the incidental benefit or benefit brought by people's production or consumption of social goods to other people's production or consumption behavior (Zhong 2003), mentioned above, data factor is in the process of consumers accepting the service, rather than a deliberate production, therefore, the production data factor in the process of the consumers get the profits from the services, manufacturers, vendors use data factor are also likely to produce benefits to other individuals, for example, when Taobao uses data factor to recommend users, it not only facilitates users to find the goods they need, but also helps merchants to complete the promotion, but users and merchants do not need to pay for this.

3.5 Property Ownership

At present, the determination of data factor of property right is not clear, but the data factor of the property right is the precondition of its circulation, for sure, property rights need to trace back to its source of data factor, mentioned above, in the process

of consumers to accept the service, its data browsing history, age, gender, etc. all consciously or unconsciously recorded by manufacturers, formed the raw data, from this point, data factor should be owned by both consumers and manufacturers. In the actual use of data factor, if they are not processed and analyzed by manufacturers, data factor basically cannot create value, and consumers do not contribute any intentional labor to the data. When considering the property right of data factor, both distribution efficiency and rights and interests protection should be taken into account. Therefore, the original ownership of data factor should mainly include consumers' privacy and manufacturers' labor to collect data (Table 1).

Table 1 Comparison between the business model of data factor trading market represented by GBDEx and the business model of broad data factor trading market represented by Taobao

Sections	Data factor trading market represented by GBDEx	Broad data factor trading market represented by Taobao	Comparison
Customer segmentation	Sellers and buyers are both manufacturers	The seller is the market, the buyers are users of the platforms	GBDEx has complex customer segmentation but ignores the problem of the property right of data factor. While Taobao's model specially solves this problem
Value proposition	Facilitating the circulation of data	Not directly related to data factor	None
Sphere of business	Matchmaking, data cleaning, and other services	Services based on its main business	None
Revenue source	Transaction fees and service fees	Same with the revenue of the main business	It is harmful to a market if there is only data service as revenue resource but supporting industrial chain absent
Cost structure	Server fee, personnel cost, etc.	Same with the cost of the main business	None
Key partner	The government and the manufactures	Users and manufacturers from the platform	Based on governmental support, GBDEx has a natural advantage on credit

4 Data Factor Trading Market

4.1 Business Model

Data factor trading market is the market for trading data factor. This paper considers that the data factor trading market is mainly at present divided into two types according to their different business models. One is the data factor trading market in the full sense represented by Guiyang Big Data Exchange (hereinafter referred to as GBDEx), and the other is the Internet platform represented by Taobao, which is the data factor trading market in the broad sense. Internet platforms do not directly sell data, but they use data to provide services and make profits so that more people can enjoy the convenience brought by data. Therefore, Internet platforms are considered as broad trading markets.

Drucker said that nowadays, the competition among enterprises is not between products, but between business models (Drucker 1998). The definition of business model is still up in the air, but the business model can be roughly explained from the perspective of finance, organization, comprehensive, marketing, and entrepreneurship (Pan 2013). The financial explanation from the value chain, Sterwart describes it as a logical expression of how an enterprise can obtain and maintain its revenue stream (Sterwart and Zhao 2000). The organizational explanation starts from the organization itself, considers that the business model is the integration and institutional arrangement of all individuals involved in enterprise operation under known internal and external conditions, resources, and capabilities (Luo et al. 2005). The comprehensive explanation considers that a business model is a tool to describe how enterprises position and integrate variables such as economic logic, operation structure, and strategic direction (Yuan 2007). The marketing explanation directly equates the business model with marketing strategy (Qi 2011). The entrepreneurship explanation considers that the business model is progress in which entrepreneurs use resources and personal endowment to start a business (Wang and Li 2005).

In this paper, the business model will be discussed from the perspective of comprehensive, according to the classification by Osterwalder and Pigneur, the business model consists of nine sections, including customer segmentation, value proposition, the sphere of business, customer relationship, revenue source, core resource, key business, key partner, and cost structure (Osterwalder and Pigneur 2010). The business model is the key to supporting the long-term operation of the trading market. The following sections will be selected to discuss the business model of the two types of data factor trading markets.

Customer Segmentation. The data factor trading market itself is a market, including buyers and sellers, and the market is a bridge to communicate buyers and sellers. Customer segmentation refers to the division of existing customers into different groups according to certain standards. A correct division of customer groups can help reduce costs more effectively and obtain good market penetration (Hu 2005).

According to the GBDEx 702 convention (Guiyang Big Data Exchange 2015) (Table 2), its hand in the customer group is very extensive, but it is not hard to see, its hand in the customer group focused on a variety of manufacturers, in the convention did not mention that the manufacturer's customers are the source of data, ignoring the problem mentioned above that data factor in the ownership of the property, easy to cause the resistance of the society.

Internet platforms' customers in the data exchange field are similar to their customers when they are doing their main business, in the case of Taobao, Taobao sellers and users left data when trading, this batch of data to strengthen the Taobao recommendation system, provides a convenient for businesses and users at the same time, such convenient also represents a cleanout treasure to the data source "pay" the data factor of the cost of privacy, the purchase was completed.

Value Proposition. The value proposition is the value description of the enterprise to meet the needs of various departments, reflecting the enterprise to provide services to solve problems (White Paper on Big Data 2021).

Table 2 Customer group division of GBDEx (from GBDEx 702 convention)

Data types	Core data types	Corresponding customer group
Government data	Government statistics, government approval data	The applicability is very wide
Medical data	Case data, clinic data, drug circulation	Pharmaceutical companies, medical device companies, etc.
Economy data	Enterprise data, personal data, number of self-employed	Banks, small loan companies, Internet finance companies
Enterprise data	Data of small, medium, and micro enterprises and foreign-funded enterprises	E-Business
E-Business data	Commodity transaction data, commodity circulation data, etc.	The applicability is very wide
Energy data	Oil, gas, all related data	Energy enterprises
Traffic data	Parking lot data, vehicle location data, etc.	Internet of vehicles, car companies, automotive aftermarket
Merchandise data	Electronic label data, commodity logistics data, etc.	Supply chain related enterprises
Consumption data	Personal consumption data, personal credit data, etc.	Financial institutions, car companies, consumer goods companies
Education data	Learning trajectory data, education consumption data	Educational institutions
Social contact data	All data about social contact	The applicability is very wide
Social data	Data about social management and government management	Related government apartment

Big data exchange, will actively play Guiyang policy advantages in the field of big data modeling, data cleaning, data, financial derivatives design advantages, and so on, connect the supply and demand of big data, let each other between global data collision, fusion results, global service, data into government decision-making, the first decision of enterprise management factor (Chesbroug and Rosenbloom 2002).

In the Internet platform, the circulation of data factor is for the convenience of its operation, so its value proposition often does not directly mention data factor.

Sphere of Business. GBDEx's business scope mainly includes: matching transaction parties, providing technical support such as data cleaning, modeling, analysis, and visualization for buyers, standardizing transactions, allowing mortgage of data rights for loans, etc.

The business scope of Taobao and other Internet platforms mainly focuses on their main business. Data cleaning, modeling, analysis, visualization, and other technologies are provided by the platform itself and cannot be counted as a business.

Revenue Source. The source of revenue is the foundation of an enterprise's profit, which can be said to determine its lifeblood.

GBDEx's income sources are divided into data trading commissions, data futures commissions, and data financing commissions. Although failed to get GBDEx earnings, CAICT issued a white paper on the large data of 2021, explicitly mentioned in the data interaction point to point mode is difficult to form under the guidance of supply and demand, market regulating mechanism and the vast majority of trading firms have stopped operations or change in direction, exchange envisaged mostly failed to be born at the beginning of the opening, business performance is poor, low trading volume and insufficient market capacity (Wright 2011). The emergence of this phenomenon is easy to understand, above GBDEx pattern is "peer-to-peer", requires sellers and buyers, sellers as suppliers have strong ability of data collection and data stability, large user groups to provide large amounts of data, such companies are often in the market has a strong or stronger control ability, and their profits as the prerequisite, It is critical to keep other vendors out of the market, so these do not provide critical data, and the data factor circulating in the market is relatively valueless, the supply and demand relationship is not satisfied, and the market will suffer a downturn. The data of existing data providers are unsalable, gradually lose confidence in the market, and eventually withdraw from the market, leaving only the government's open data in the market. Such timely data cannot play a decisive role in the development of enterprises, and this series of chain reactions lead to the current situation.

In contrast, the profit model of the Internet platform does not revolve around data, but every piece of data contributes to its profit. Taking Taobao as an example, the support of data can effectively improve the transaction volume on Taobao. The prosperity of the market greatly promotes the entry of manufacturers and users and further increases the transaction volume. The commission fee of each transaction, the monthly commission fee of the manufacturer, and the derivative APP of Taobao are the main profit sources of Taobao.

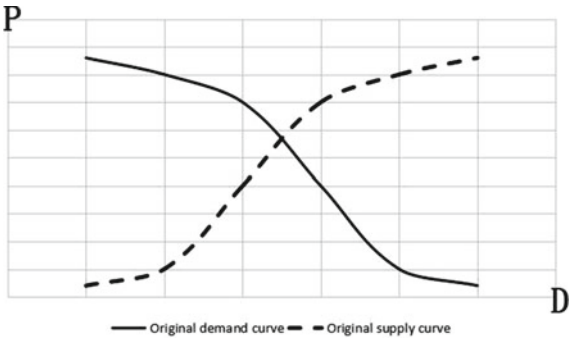


Fig. 1 Original supply and demand curve

Cost Structure. GBDEx's expenses mainly include server expenses, personnel costs, etc., while the cost of the Internet platform is roughly the same as its main business.

Key Partner. GBDEx is the result of government-enterprise cooperation, so GBDEx has a great dependence on the government and participating manufacturers, and the important partners of the Internet platform are mainly various manufacturers.

4.2 Normalization

As the academic circle has not reached a consensus on the supply and demand model of the data factor market, this paper improves the supply and demand relationship under the traditional economy and roughly obtains the supply and demand curve of the data factor used in this paper (Fig. 1).

As mentioned above, the data factor has economical efficiency of scale, when a manufacturer has less data, the cost to produce new data is high. Since sellers will never sell data at a lower price than the cost to produce data, at this time price is high. As the gradually increasing of data manufacturers has, ability to produce new data is enhancing, economical efficiency of scale has formed, at this time, cost becomes lower. However, with the increase of supply, the capacity of all manufacturers to produce data is gradually restricted by their capital, industry, and other conditions and tends to a certain lower limit. So the supply curve is stable at first, then steep, and finally stable.

Data factor has exclusivity, so its price is positively correlated with its demand. When there is less data supply in the market, the benefits it can provide are quite limited, so the buyers are not willing to buy. When the data supply increases gradually, the benefit provided also increases rapidly. But the price buyer pays for data factor does not exceed its expected benefit, so it tends to the certain upper limit. The demand curve is stable at first, then steep, and finally stable.

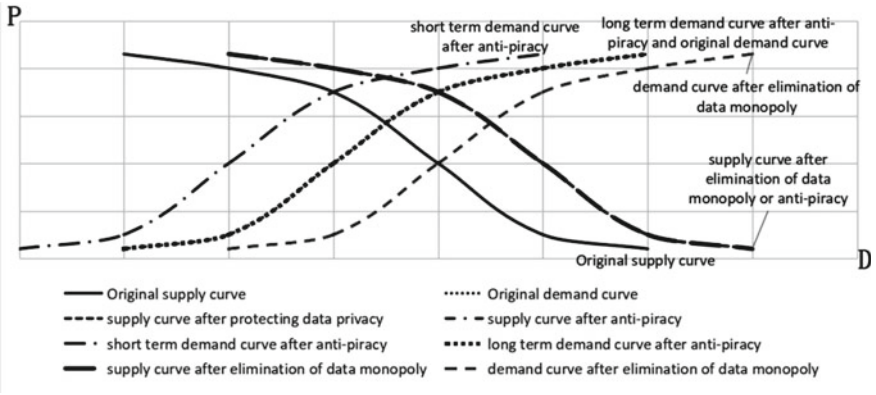


Fig. 2 Supply and demand model after normalization

Protecting Data Privacy. Protecting user privacy has always been a big important issue related to the interests of the data source, which directly determines the legitimacy of the data exchange the nature of big data is to use the group speculates that the characteristics of the generality of individual groups derived from the analysis of the training set, the generality of the data analysis for want, personal information such as name, id number, Bankcard numbers, and passwords are useless information. Therefore, the process of protection will not seriously affect the training quality of the data set. It may be difficult for merchants to avoid collecting personal privacy information when collecting data, but they should protect the privacy of the data set when trading to ensure that the data obtained by the buyer does not contain private information. The supplement of the data factor will be promoted after protecting data privacy. After protecting data privacy, the supply capacity of the whole market will increase, the supply curve shifts to the right, the equilibrium price rises, the market is stimulated and the profits of the exchange are improved (Fig. 2).

Anti-piracy. Data can be copied indefinitely, offline data replication is difficult to trace, and the cost is close to zero. Therefore, blockchain technology can be used to add every piece of seller's data to the blockchain, and data transmission needs to be carried out online. However, such protection measures will be costly if the government subsidizes the manufacturers, and there needs to be some incentive mechanism for the manufacturers to modify the data to adapt to transactions on the blockchain. Buyers and sellers, and data sets, need to be recorded for every transaction, effectively preventing piracy and ensuring that the non-competitive nature of the data is not abused. For the sellers, the possibility of making profits from selling data factor increases, the willingness to provide data will increase, and the supply curve will shift to the right. For the buyers, the willingness to participate in data transactions will decrease in the short term, but the pirated data transaction is not conducted in the market originally. For the market, the profit is still rising. For the whole supply and demand model, the demand curve shifts to the left, forming the supply and demand

model in the short term. In the short term, although there is no significant change in trading volume, the transaction price rises and the market transaction amount rises. Since the buyers still need data factor, the demand curve will return to its original state in the long run (Fig. 2).

The Monopoly of Data Supply. Mentioned above, the data of the effective supply is generally in the industry has a leading even monopoly enterprise, these companies need to prevent other firms to enter, the data is the core competitiveness, so often will not sell your data, this leads to data monopolies, have these data is not the key, the key is the other makers can't have. Although the EU advocates non-intervention and self-regulation by the market (Li and Wu 2021), such a situation seriously restricts the development of small and medium-sized enterprises and makes the data market lose its vitality. Therefore, it is necessary to guide monopoly manufacturers to sell data from the perspective of legislation or administration. Internet platform sale data but not the data service business model is feasible, each data have been used, there is no supply of question not clear, the benefit to maximize the manufacturer's data, to retain the need of data, maintain a leading position, and also provides small businesses with a certain living space. After the elimination of the data supply monopoly, the quality of data in the market is improved, the demand curve moves right, and so does the supply curve. Although the transaction price does not rise, the transaction volume increases, and the overall transaction volume increases (Fig. 2).

Determination and Assignment of Property Rights. To give full play to the non-competitive nature of data, the property right of data is divided into ownership and use rights. Ownership includes ownership generated by the labor of data collection by the manufacturer and ownership of data source. Before the transaction, the seller needs to consolidate the ownership and can either buy out or compensate the data source with certain benefits, but with the consent of the data source. After integration, the property rights of data elements will be relatively simple. During the transaction, you can choose to trade ownership, right of use, or both. Manufacturers with the right of use but no right of ownership are not qualified as sellers (Fig. 2).

5 Conclusion

In the background of booming big data, this paper mainly discusses the features of data factor, the business model of the data factor trading market and how can we normalize the market. This paper considers that the data factor has four features, including exclusivity, non-competition, economical efficiency of scale, and positive externality, then briefly discusses the property right of the data factor. What's more, we choose six blocks out of nine, including customer segmentation, value proposition, the sphere of business, revenue source, cost structure, and a key partner to discusses the differences of business model between the data factor trading market represented by GBDEx and the broad data factor trading market represented by Taobao according to the nine elements business model put forward by Osterwalder

and Pigneur. This paper mainly contributes in two perspectives, firstly, this paper supple concludes the shortages raised by the former scholars. Secondly, this paper supplements former studies by considering that normalization of the data factor trading market can be started from the perspective of protecting data privacy, anti-piracy, monopoly of data supply, determination and assignment of property rights, according to the features of data factor and the relationship between demand and supply.

Consequently, there is still much to be done to unify theory building. First, due to the rough demand–supply model of the data factor we use, the real situation might be different from what is discussed in this paper. Secondly, when executing what we raise to normalize the data factor trading market, new difficulties might be discovered since the four ways we mention are all theoretical. Last, how to deal with the problem, data cannot be previewed before trading, is not clear. So later studies can be started from three or more ways according to this paper. First, how to improve the "point-to-point" data factor trading market and solve the problems of supply–demand difficulty and clearance. Secondly, how to decentralize data trading at a low cost. Finally, how can we eliminate the information gap in data factor trading as far as possible.

References

Chen B, Zhao B (2021) Promotion of the high-quality development of data element markets by competition law. J Shanghai Univ Finance Econ 23(2):3–16

Chesbroug H, Rosenbloom RS (2002) The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Soc Sci Electron Publ 11(3):529–555

Drucker P (1998) The coming of the new organization. Harv Bus Rev (9)

Fan G, Wang X, Ma G (2011) Contribution of marketization to China's economic growth. Econ Res J 9:4–16

Guan X, Qin X (2021) The data factor's dual attribute and its interaction effects. Teach Res 8:68–76

Guiyang Big Data Exchange 702 Convention (2015)

Hu S (2005) Analysis of customer segmentation methods. Ind Technol Econ 24(7):66–69

Li Z, Wu Y (2021) Data factor market cultivation and digital economy development: based on the perspective of political economy. Acad Res 7:114–120

Luo M, Zeng T, Zhou S (2005) Enterprise business model innovation: an explanation based on rent theory. China Ind Econ 7:73–81

Mao Z, Chen J (2021) The core of data factor marketization. China Finance 12:39–40

Osterwalder A, Pigneur Y (2010) New generation of business models. China Machine Press, Beijing

Pan Y (2013) Discussion of business model definition. New Econ 26:23–24

Petty W (1963) A treatise of taxes and contribution. The Commercial Press, Beijing

Qi Y (2011) On the marketing significance of business mode. China Bus Mark 25(9):88–93

Si X (2020) The data factor market calls for new rules of data governance. Libr Inf 3:7–8

Sterwart DW, Zhao Q (2000) Internet marketing, business models, and public policy. J Public Policy Mark 19(3):287–296

Wang W, Li Q (2005) Research on the business model from an entrepreneurial perspective. For Econ Manage 27(11):32–40

White Paper on Big Data (2021)

Wright JD (2011) Does antitrust enforcement in high tech markets benefit consumers? Stock price evidence from FTC v. Intel
Xiao X, Qi Y (2021) The value attributes of data factor. Res Econ Manag 42(7):66–75
Yan B (2003) On enterprise-scale and scale economy. Acad Exch 11:86–89
Yang R (2020) The key of cultivating data factor market: marketization of data supply. Libr Inf 3:27–28
Yuan L (2007) Reconstruction of business model theory system. China Ind Econ 6:70–79
Zhong X (2003) Negative effects of positive externalities of goods and their elimination. Technoecon Manage Res 1:66–67

Research on College Students' Consumer Behavior Characteristics and Marketing Strategy Optimization of Estee Lauder

Liqi Shi

Abstract Studying the marketing strategies of brands today remains a critical topic. Many researchers have found that big brands still need to constantly update and adjust their approach to cope with the changing Chinese market. Yet, international brands still need more research in China because of the rapid rise of the Chinese market. Therefore, this paper will focus on the consumer behavior characteristics of female college students, Estee Lauder, as a case study to investigate how high-end brands can develop potential customer groups in China. The research methods of this paper are as follows: survey method and data analysis method. The result is that although Estee Lauder has the market share, it still needs a "smart" strategy to maintain the market and expand the consumer base. Therefore, premium brands in China still need to focus on product, sales, marketing, and operational strategies to cope with the competitive market.

Keywords Estee Lauder · College students · Consumer behavior characteristics · Marketing strategy

1 Introduction

1.1 Research Background

According to the latest data from Statista, the global cosmetics market has approximately $80.73 billion in revenues, making it a very profitable industry. The primary product categories in the cosmetics market include skin care, hair care, color cosmetics, fragrances, toiletries, and other supplies. Skincare is the top category, accounting for approximately 42% of the global market, so the brand's marketing

L. Shi (✉)
GBS, UCSI University, 56000 Kuala Lumpur, Malaysia
e-mail: 1001957132@ucsiuniversity.edu.my

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_80

strategy must have a firm grip on this market (Statista 2020). Estee Lauder, in turn, is one of the leaders in this industry and has the value of research to explore.

Founded in 1946, Estée Lauder, headquartered in New York, is a global leader in premium beauty with a diversified portfolio of more than 25 brands sold in approximately 150 regions and countries; this brand is a worldwide leader in high-end beauty (The Estée Lauder Companies Inc 2022a). According to Estee Lauder's global operating regions, Estee Lauder is implementing a strategy in the Asia Pacific region: Focus on China, which means that China is the most critical market in the Asia–Pacific region. Therefore, it is of detailed significance to study the female college audience, which is very important in the Chinese consumer group (The Estée Lauder Companies Inc 2022b).

The cosmetic market is highly competitive, and the selection and development of marketing strategies are crucial for brands to open up and innovate the market (Qian and Chen 2019). This study takes female college students as the entry point and analyzes cosmetics consumption's behavioral characteristics in this group. And it aims to expand the audience of the Estee Lauder brand to explore how well-known big brands can stabilize their position and boost their profits in the highly competitive cosmetics market.

1.2 Literature Review

Zhang et al. found that the Chinese cosmetics market is highly competitive. Capturing a share of the cosmetics market requires marketing strategy choices and critical considerations for the brand. In the cosmetics industry, it is the entry point to make female college students potential consumers and study their consumer behavior characteristics; the study analyzed the behavior of this audience. It provided targeted advice to brands regarding product positioning, price, brand awareness, promotional strategies, and innovation of marketing models. It also points out that female college students are a vast potential consumer group (Zhang et al. 2015). At the same time, a study found that light luxury cosmetics are related to the group of female college students, pointing out that female college students have the consumer psychology of pursuing quality and beauty. The consumer behavior characteristics of female college students tend to purchase imported brands. The survey found that less than 22% of female college students are willing to buy local brands. Brand awareness and the tendency to emulate social media traffic, thus building a brand image and changing the light luxury cosmetics marketing style (Zhu and Zhang 2018). A study points out that brand competition is fierce, and the college student market has become a favored market segment for many companies. The share of local cosmetic brands in the Chinese cosmetic market was only 30%, proving that Estee Lauder, the international brand explored in this study, is worth mentioning. At the same time, a survey found that female college students possess consumer behavior characteristics such as easy impulse spending, focus on cosmetic ingredients and quality, and pursuit of imported brands, which leads to relevant observations (Guo et al. 2018).

1.3 Research Gap

Most of the articles studied the marketing strategies of local brands in the Chinese market, focusing on describing how emerging local cosmetic brands can gain a particular market share (Wang 2020). It is a different point of focus from the Chinese market strategies of major international brands or focusing on the female college consumer group to analyze their behavioral characteristics and conclude that methods such as low prices are needed to attract this group (Zhang et al. 2015). Few articles have studied the marketing strategies of high-end cosmetic brands with a particular market share, using the female university student group as a foothold to drive their brands in the Chinese market, segmenting specific audiences to achieve their goals.

Early entry into the Chinese cosmetic market, occupying a particular market share, and having visibility are the advantages of large international brands. This study takes Estee Lauder as an example to examine the marketing strategy of high-end cosmetic brands in the Chinese market, taking the female college audience as the entry point in the current competitive situation. In this article, female students are the potential audience and target market. This paper identifies the problems of international brands developing in the Chinese cosmetics market and proposes corresponding solutions.

1.4 Research Framework

This paper firstly refers to literature to understand the cosmetics market in China, summarize the previous behavioral characteristics of female college consumers, and screen the previous marketing strategies to see if they have specific implications for developing high-end cosmetics. Secondly, this paper uses questionnaires to understand the various understandings of the Estee Lauder brand among female college students to make a more targeted strategic analysis. In addition, to address the problems identified, we propose corresponding solutions to give constructive opinions on the strategy of high-end cosmetics in the Chinese market, taking Estee Lauder as an example.

2 Method

This paper used three methods, questionnaire and data analysis, to investigate female college students in school. The specific findings are as follows: 225 questionnaires in this study, and the number of valid questionnaires was 198, with a reasonable return rate of more than 80%, so this survey is accurate.

2.1 Survey Method

The survey research method investigates and understands objective situations, obtains direct information, and analyzes such data (Kothari 2004). In this paper, female college students who wear makeup daily and high-frequency weekly account for about 56%, indicating that most female college student groups love beauty and the idea of maintaining their image. At the same time, 70% of female college students attach great importance to skin care. The above shows the potential for female college students to be the entry point of the cosmetics market.

2.2 Data Analysis

Data analysis is a process of cleaning, transforming, and modeling data to discover valuable information in business decisions (Vassakis et al. 2018). This study aimed to extract useful information from the Estée Lauder brand data and optimize the marketing strategy based on the data analysis. Some specifics are as follows:

(a) The choice of cosmetics category for female college students is 48% for cosmetics and 68% for skin care products, so the skincare market is promising. (b) Female college students choose Estee Lauder based on more elements, and safety is the basis. In addition, the most prominent is that more than 45% feel that brand awareness is essential. About 40% of people think the ads will attract them, keeping skin stable and brand image closely behind at around 35%. There is also a combination of other people's recommendations and celebrity effects. (c) Fill in the blank shows that female college students also have diversified expectations of Estee Lauder products. The more prominent ones are anti-premature aging, whitening, moisturizing, firming, etc. (d) 73.9% of the respondents think Estee Lauder is a cost-effective product. Only 26% had the opposite attitude. Since Estee Lauder's pricing is not considered low, the survey results will influence the marketing strategy. Estee Lauder will not go for a low-price strategy as emerging brands do. Notably, 72.2% of the respondents pay attention to Estee Lauder products' discount activities. This phenomenon is because discount promotions positively affect purchase intention and can be used in pricing and promotional strategies (Santini et al. 2015). (e) In the survey of shopping channels of female college students, online shopping accounts for about 52%, and offline brick-and-mortar shopping is 47%, indicating that e-commerce and experience are equally important.

The questionnaire survey can intuitively get some conclusions from the data, increase the brand's knowledge of the target group, and facilitate the brand's marketing strategy development.

3 Results

In 2021, the global cosmetics market will grow by more than $8 billion in revenue to $80.74 billion. Statista Consumer Market Outlook estimates that income will exceed $100 billion by 2022 and reach approximately $131 billion in annual revenue by 2026. Skincare is one of the most profitable product categories, with revenues expected to generate roughly $177 billion in 2025. The Asia Pacific will account for approximately 43% of the global cosmetics market by 2020 (Statista 2020, 2021a). Statistics show that Estee Lauder is ranked second globally with 7.93 billion dollars of value among the ten leading global cosmetic brands in 2022 (Statista 2022). Estée Lauder's increasing global net sales in the Asia Pacific since 2010 and through 2021, from an initial 1510 million dollars to 5486 million dollars in 2021, attest to the brand's growing sales in the Asia Pacific and the gradual adaptation of the product to the Asia Pacific market (Statista 2021b). The Asia Pacific is Estée Lauder's fastest-growing region, and the company is gradually adapting to Asia's discerning consumers. Estee Lauder will focus on mainland China in the Asia Pacific region (The Estée Lauder Companies Inc 2022a) and build an R&D innovation center with the latest technology in mainland China to develop skincare products in the Asian market. Therefore, in the future development, China market is a vital part of Estee Lauder's global strategy and needs to adopt suitable marketing strategies in the China market to segment the market audience and expand the target consumers.

Based on the summary of the literature, it is easy to conclude that the behavior of female college consumers has the following characteristics:

(a) Tend to consume impulsively, which has irrational characteristics (Wang and Hu 2019). The factors that lead to impulsive consumption are more diverse. The freshness and excitement of new products, the exquisite brand packaging, and the eye-catching colors of the brand may all stimulate sudden consumption. (b) Female college students have the consumer behavior characteristics of pursuing trends and emphasizing individuality (Wang and Hu 2019, Zhu and Zhang 2018). The study found that this subtle sense of contradiction exists in college women. Consumers do not want to be outdated and compete for trends but at the same time prefer brands that promote individuality. (c) At the same time, female college consumers have brand sensitivity and trust in big brands. They believe that the high-end line of brand names reflects their status. This group's tendency to buy imported cosmetic brands shows that less than 22% are willing to buy local brands (Guo et al. 2018) and tend to buy high-quality products. The survey showed that female college students generally believe that even though affordable skin care products are safe and affordable, they prefer to choose light luxury cosmetics. (d) Tend to accept the influence of internet celebrities and the celebrity effect. Internet celebrities with goods and advertising have long been commonplace in today's highly developed social media, and celebrity spokespersons influence consumers. Most female college students are willing to try to buy the products recommended by social media. (e) Female college students focus on ingredients and safety when buying cosmetics. There is a distrust factor for affordable products, and they are willing to pursue brands because they believe

that brands are a guarantee of safety and quality. The behaviors described above also characterize the behavior of most consumers (Wang and Hu 2019, Zhu and Zhang 2018).

The consumer behavior characteristics of female college students using Estee Lauder have certain commonalities with those of female college students, but there are also specific differences, i.e., uniqueness. Female college consumers who use the Estee Lauder brand also pursue fashion and emphasize individuality, and Estee Lauder products meet these two characteristics in their packaging and products. In the questionnaire, 57% of Estee Lauder's female college consumers are there because they look for individuality, and 39% focus on fashion sense. At the same time, female college students who buy Estee Lauder are sensitive to international brands, and Estee Lauder is a first-tier global cosmetic brand. In the survey, some consumers said outright, "I have been using Estee Lauder because I trust this brand." Estee Lauder's female college students also accept internet celebrities and celebrity spokespersons and buy the brand because they are star-struck. Finally, Estee Lauder has never had any negative news. Its ingredients are safe, and its origin is specifically "green and ecological" which is also the commonality of female college consumers.

Estee Lauder's female college student consumer group has certain uniqueness. The pursuit of high-end cosmetics does not mind the higher price but tend to buy that product with a discount. They pay more attention to the practicality of the products, i.e., the products they believe need to be able to address skin problems in a targeted manner, e.g., skin care products to fight premature aging and cosmetics to cover up blemished skin. At the same time, Estee Lauder's female college consumers pay more attention to service experience, whether offline purchases or online shopping, including counter environment hygiene, decoration style, sales staff's service attitude, and after-sales attitude of using the products. If they buy online, they focus on genuine products with qualified batches. They need salespeople to understand the product performance and fast logistics.

Estee Lauder's marketing strategy also has specific problems. Product line single, skin care products only anti-aging repair, while product targeting is not robust. Estee Lauder is an American brand that produces cosmetics that are suitable for European and American skin types but not necessarily Asian people. Sales staff are not familiar with the products. In the customer consultation, problems can not accurately introduce the related products; simultaneously, the lack of combination set sales, resulting in explosive goods, can not drive the relatively cold outcomes, and consumers are familiar with other products is low. Not listening to customers' opinions, social media operation is just for show, not promptly responding to consumers' questions. There is no balanced marketing strategy, as most products are not well known, and Chinese consumers are currently very averse to excessive celebrity and internet celebrity marketing.

4 Discussion

The high-end line of cosmetics represented by Estee Lauder, to a certain extent, has similar problems. A marketing strategy is to attract more consumers in the Chinese market, where new brands are rising. High-end brands such as Estee Lauder, which need to maintain their original market share, also need to have a sense of crisis. Intelligent strategies are critical for brands.

4.1 Product Strategy

For a single product line, Estee Lauder should develop new product lines, including investing in technological support, establishing a research and development base, and targeting the deployment of cosmetics and skin care products suitable for Asian skin types. At the same time, since the launch of night anti-aging products in 1984, Estee Lauder has had no popular product output for the time being. In addition to anti-aging can also launch a product line that considers the effects of whitening, spot removal, brightening, etc.

4.2 Sales Strategy

The sales staff's familiarity with the product and mastery of its features should be linked to their performance. In addition to a good service attitude, more professional sales will give consumers trust and positively influence consumers' purchasing power (Statista 2021b). At the same time, increasing sales requires skill and the model of introducing combination sets in sales. Use popular sales products to boost sales of "unexpected winner" products. Niche products will add to the customer's taste experience.

4.3 Marketing Strategy

Big international brands have mature marketing teams, and nowadays, in the Chinese market. For example, through social media marketing channels such as RED, SINA web, Wechat, and Douyin, marketing channels such as celebrity endorsement and web celebrity-driven goods, and the rise of live-streaming with interests, the purchasing awareness of the Chinese people is awakening. Currently, we always see comments on the internet, "XX brand is marketing all day long, which is annoying" so we should streamline marketing channels and have stable exposure, but not great marketing. At the same time, we should balance the marketing strategies of popular

and niche products, and niche products will also have a specific purchase market when facing female students.

4.4 Operation Strategy

Social media operations are critical. Estee Lauder should operate an official public number to give consumers timely answers to their questions and solve their problems. It should also organize regular scientific product activities, sweepstakes, and voting activities, which is also a marketing strategy. At the same time, it can popularize various products, increase netizens' familiarity with its brand, and develop potential customers.

5 Conclusion

5.1 Findings

This study takes high-end cosmetics Estee Lauder and its potential female college consumers as the entry point. A comprehensive and specific analysis of the brand's product strategy problems in the Chinese market. Such as a single product line that does not target Asian skin types, the sales strategy problems of sales staff unfamiliar with the merchandising business, poor professionalism, and lack of sales mix. As well as marketing strategy problems such as over-marketing and the operational issues of negligent management of official accounts, along with the corresponding intelligent solutions, namely intelligent marketing strategy, the essence of which is to develop potential target audiences based on consumer groups.

Using Estee Lauder as a case study, this study provides some insight into the development of the international cosmetics industry in the Chinese market, addressing the problems that exist for many brands today with the rise of social media. Such marketing and even premium brands with a particular customer base still need a sense of apprehension and develop potential consumers.

5.2 Limitations and Future Study

There are some limitations to this study. When collecting primary data, the sample size of the questionnaire was not enough. There were also some unreasonable questionnaire questions, which may lead to inaccurate paper analysis results. In future research, a sufficient sample size should be collected and reduce the error brought by the lack of samples for the results.

References

Kothari CR (2004) Research methodology: methods and techniques. New Age International
Guo H, Zhu Y, Yang X (2018) Research on marketing strategies of domestic cosmetic products in colleges and universities. Mod Econ Inf 01:378
Qian L, Chen Y (2019) Analysis of marketing strategy of "grass" marketing of domestic cosmetics. Mod Mark (Inf Ed) 11:226–227
Santini FO, Sampaio, CH, Perin MG et al. (2015) An analysis of the influence of discount sales promotion in consumer buying intent and the moderating effects of attractiveness. Rev Adm (São Paulo) 50:416–431
Statista (2020) Topic: cosmetics industry, 22 Jan 2020. www.statista.com/topics/3137/cosmetics-industry/#dossierKeyfigures. Accessed 4 June 2022
Statista (2021a) Global: cosmetics market revenue 2013–2026, 27 Oct 2021. www.statista.com/forecasts/1272313/worldwide-revenue-cosmetics-market-by-segment#statisticContainer. Accessed 4 June 2022
Statista (2021b) Net sales of Estée Lauder worldwide 2010–2021, by region, 27 Aug 2021. www.statista.com/statistics/267950/net-sales-of-Estee-lauder-worldwide-by-region
Statista (2022) Brand value of the leading 10 cosmetic brands worldwide 2022, 10 May 2022. www.statista.com/statistics/243722/brand-value-of-the-leading-15-cosmetic-brands-worldwide/. Accessed 4 June 2022
The Estée Lauder Companies Inc (2022a) Who we are. www.elcompanies.com/en/who-we-are. Accessed 4 June 2022
The Estée Lauder Companies Inc (2022b) Asia/Pacific. www.elcompanies.com/en/who-we-are/global-operations/asia-pacific. Accessed 4 June 2022
Vassakis K, Petrakis E, Kopanakis I (2018) Big data analytics: applications, prospects and challenges. In: Mobile big data. Springer, Cham, pp 3–20
Wang Z, Hu F (2019) Exploring the marketing strategy of female college students in domestic cosmetic companies. Technol Mark 26(08):187–188
Wang Z (2020) The rise of domestic beauty brands: analysis of the marketing strategy of "perfect diary". Media Forum 3(04):143+148
Zhang Y, Ma X, Feng L (2015) Research on cosmetic marketing strategy based on the empirical evidence of female college students' consumption behavior—an example of Hubei Xiangyang. Brand (Second Half of the Month) 04:25–26
Zhu D, Zhang X (2018) Light luxury cosmetics, how to crack the consumption code of female college students? Sales Mark (Manage Ed) 06:48–52

Research on Digital Transformation Based Luxury Brands Marketing Strategy

Yujia Cao

Abstract Despite travel restrictions brought about by the embargo, luxury brands are embracing the digital future. Digital marketing is gradually becoming an integral part of luxury giants' marketing models as they adapt their brand positioning and marketing models to capitalize on the emerging technologies. The Chinese market is home to some of the largest tech giants in the world as well as digitally savvy consumers. It is interesting to note that technology is integrated into almost every aspect of life and the digital transformation of luxury seems inevitable. Research and analyze the existing online marketing models of luxury brands based on digital transformation, determine the realities of the interface between luxury marketing and digital marketing, and develop efficient digital marketing strategies for Chinese luxury brands, to promote the modernization of high-end luxury brands.

Keywords Digital transformation · Luxury brands · Marketing strategy

1 Introduction

Chinese consumers have long been accustomed to luxury consumption (Lingjing 2012). China has become the world's largest luxury goods market as a result of the rapid development of its economy and economic growth in the 1990s (Sivakumar 2012). In recent years, the growth rate of the domestic luxury market has slowed, the traffic of domestic stores is decreasing, and the opening of new stores by luxury brands is also slowing down (Langlois 2013). In recent years, the world's top luxury brands have settled in the first-tier cities in China and gradually extended to second and third tier cities due to the slowdown in luxury market growth rates. China is still the leading market for luxury goods, and conventional luxury brands are still king in China despite a slowdown in growth rates (Pelikánová 2021). There is no doubt that Chinese luxury is a global market with enormous potential and possibilities (Phau

Y. Cao (✉)
University of Massachusetts Amherst, Amherst, MA 01002, USA
e-mail: YujiaCao@umass.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_81

2009). In addition, Chinese consumers are becoming more mature, and their attitude towards luxury goods has changed; they no longer consider them a symbol of status and trend (Henninger 2017). More and more consumers are looking for experiential consumption, paying more attention to design and diversifying their preference for brands (Gambetti 2012).

Millennial consumer behaviors, digital e-commerce platforms, and the increased presence of luxury street "trendy" brands are shaping the fashion industry's future (Chevalier 2020). In the Deloitte report, "Global Luxury Power," it is estimated that by 2025, 75% of the global workforce will be millennials; at present, 58% of millennials have access to online information about luxury brands. Millennials' buying habits can be fully understood by luxury brands (Yinghan 2022). A comprehensive understanding of millennials' consumer behavior and buying habits will help luxury brands boost their business.

Before losing more brand supporters, traditional luxury brands must start transforming their brands (Truong 2009). In addition, due to the rapid development of information technology, we have entered the digital era. Digitalization has been widely used in various industries with numerous success stories. The epidemic has accelerated the retail industry's digital transformation, with more and more consumers adapting to online shopping during the home quarantine. Many luxuries brick-and-mortar companies have already begun their digital transformation process. Luxury brands today are most concerned with using digital platforms to create effective conversion paths. Digitalization has also impacted the consumer culture of luxury goods, and the inherent marketing strategies of luxury brands must be adjusted in time. Many luxuries brick-and-mortar companies have already started their digital transformation process. Today's main concern of luxury brands is using digital platforms to establish effective conversion paths.

2 Digital Transformation

Luxury brands have been reluctant to adopt digital marketing due to their distance from the brand. However, in recent years, the performance of luxury brands has continued to decline while consumer online usage has increased significantly. A survey found that consumers with household incomes above $100,000 in the U.S. have increased the amount of time they spend online each week from 2011 to 2013. Spending has also risen. The above situation shows the necessity of digital marketing for luxury brands, which is indispensable in the new position. Burberry was the first luxury brand to use digital marketing. Through its digital marketing on social media platforms, it has significantly increased its annual sales and enhanced the interaction between users and the brand. Louis Vuitton, the world's premier leather goods brand, is concerned that wireless transactions are becoming mainstream.

With the widespread coverage of wireless networks and the advent of 4G, new opportunities for digital marketing emerged. Louis Vuitton has developed an app, Louis Vuitton, through which users can scan a Louis Vuitton ad screen with the

Louis Vuitton PASS app logo, and data space with product information, videos, and images will appear. By tracking the behavior of the users who install the app and mining the vast amount of data generated, Vuitton can obtain information about the needs and behavior of the users, thus allowing the brand to get closer to the consumers. Gucci's revenue has not grown for three years since 2012, staying in the range of 3.4–3.6 billion euros. By implementing a new strategy for "digital marketing + rejuvenation," Gucci has achieved significant growth for five years and generated nearly 10 billion euros in 2019. With such an impressive rise in sales and a century-old store, such a change is nothing short of remarkable.

3 Luxury Brand Digital Marketing Analysis

As fashion brands engage in digital marketing, it partly alleviates the urgent needs during the epidemic and partially shows goodwill to a new generation of online shoppers. The luxury industry's digital exploration posed the challenge of combining mass social media with luxury. Instead, brands are using social media to gain exposure. Luxury must be genuinely user-driven and integrated to achieve a sustainable growth model. For the luxury industry, an efficient digital transformation is required. The following points must be earned.

3.1 Personalization and Customization

Luxury brands need to explore more deeply at the user level and establish efficient communication with users. Track users' sales behavior, design products that meet users' needs, and use socialization + and localization + mobile to develop a perfect interaction between the digital world and the real world of the brand so that users can get brand information anytime and anywhere so that users can enter the physical store and enhance the user experience. They need to develop the brand app and close the distance between the brand and the users through the app. As a result of the "currency" circulating on social media, McKinsey found that luxury goods are the social capital of the young generation, and that they use it to enhance their status on and off line. A brand's value can be increased by developing luxury products that satisfy the psychological preferences of different consumer groups. Identify the representative image that matches the tone through the development of luxury goods.

3.2 Multifaceted

With the epidemic's impact, the luxury industry has to adjust its production timelier than before, requiring brands to use data insights to integrate digital platforms effectively. The public has recognized the value of digital marketing as an essential role in product design, production, sales, and service. An integrated digital marketing platform should provide adequate planning reference, market, and user information. In addition, the platform should also use practical digital tools to support the efficient operation of the entire value chain. Precise marketing. Live streaming, private domain, and new retail can be the main ways of sales. Live broadcast and community can channel fans to each other, and multi-channel can reach and convert precise customers quickly and repeatedly. The live broadcast can guide users to consume, and the shopping method is relatively simple and convenient to attract consumers through interaction. New retail is reconfiguring the three elements of people, goods, and fields. To attract more consumers, innovations have been made in this area. For example, the live-streaming anchor can attract consumers through themselves and through the brand's product influence to sell through customers and focus on the live effect. And live with goods is also relatively intuitive, can be a full range of consumer fans to show the goods, and will answer the goods, solve user questions, and help users better understand their interests. These are the advantages of digital marketing methods. Merchants have begun to deepen the private domain traffic, create a closed loop of benign interaction between public and private traffic, and maximize the value of personal domain traffic sharing.

3.3 Increase Luxury Brand Culture and Tonality

Luxury goods have long viewed the transmission of brand culture and values as a more critical development goal than selling products. In the digital era, they ensure that significant brands also need to play with uniqueness in the heavily homogenized social media. Digitalization is an irreversible trend. A more effective and profound digital transformation is required for the luxury industry to continue to deliver unique brand values and appeal on a global scale. Luxury goods need to connect and communicate with consumers more grounded and digital, becoming a gap that luxury goods must cross to increase brand culture and tone. Luxury brands such as Dior, LV, Chanel, and Giorgio Armani have been stationed in Tall; Dior has become the first luxury brand to be stationed in Jitterbug and B station; Chanel has also started cooperation with Jitterbug—released 12 short videos of Chanel J12 watch ads; LV opened its live debut on the platform; Gucci held a 12-h long live fashion show.

The luxury industry is increasingly using social media to get closer to consumers and lower its profile. A luxury industry in constant transformation is part of the anxiety over the influx of users; connected channels are also accelerating that transformation. Luxury has always been closely related to the tip of the pyramid, the wealthy

and upper classes, creating a distance between consumers. Making consumers dream about it has always been the infallible rule of marketing in the luxury industry, forming the mystery of luxury brands and their high prices. In today's digital era and the background of consumption upgrade, the consumption concept of Chinese consumers has transitioned from material consumption to spiritual consumption. People are becoming more and more rational in luxury consumption, no longer pursuing the symbolic symbols brought by luxury goods. Luxury goods are now within reach of every Chinese consumer. Such changes have brought luxury goods into people's daily life to the greatest extent and improved people's awareness of brands. The luxury market is gradually "sinking," targeting consumers in the second and third-tier cities, which account for 70% of China's total population. These consumers are actively seeking to upgrade their lifestyles.

Enjoying light luxury life is the expectation of consumption upgrade for the sinkers. Highly young and low penetration are the distinctive features of the new generation of high-end consumers. Millennials, post-90s, and Generation Z, bursting with consumption desire, become the target of luxury needs to pay attention to; they have broader global brand knowledge and a higher appreciation of aesthetics. As for the post-00s, they buy luxury goods for social needs; the post-90s have their favorite IP co-branding will choose to go for it; the post-80s buy luxury goods more to improve their quality of life. "No strategy is spontaneous," said Michael Porter, the father of competitive strategy.

Luxury goods into e-commerce, live streaming, and other digital marketing channels will not seem to drop but will be more convenient for consumers to buy. It is necessary to focus on the communication of luxury culture. Culture is a dynamic built daily of constant dialogue between people, brands, creators, and various institutions. Brands must continuously promote their own brand culture and, at the same time, blend with local culture to build a lasting relationship with the next generation of consumers.

(1) IP crossover and co-branding. To match the common language of consumer groups and pull in consumers' distance.
(2) Generation Z young idol endorsement. The mutual acceptance of Z-generation top stars and the deep involvement of the stars themselves will become a critical detonation point in the marketing campaign of luxury brands.
(3) Change according to the "trend," create explosive models with collection value and special meaning, and make reasonable use of hunger marketing.
(4) Establish the correct values. De-logo, luxury combines nature and creativity, and there should be some sustainable actions.
(5) Luxury goods are being redefined. Luxurious objects have become symbols of culture and resonance rather than symbols of wealth. As luxury moves forward, "new positioning, new experiences, new cultures, and new boundaries" must be established.

It is essential that luxury brands create a new consumer context and dialogue through the new communication platform. On the one hand, they need to de-deify,

equalize, and make it approachable, and at the same time, they need to maintain the brand's tone and culture, design, craftsmanship, etc., to justify the high premium.

3.4 Addition of "Product Manager" Digital Business and Content Center

Digital marketing also means adjustments to target groups and product design, which inevitably comes with organizational structure changes. The position of Chief Merchandising and licensing Officer was created. The place is like that of a "product manager." After the creative director completes the innovative design, the "product manager" will coordinate with them and bring the product online according to the current resources and market needs. The addition of Digital Business and Innovation is responsible for e-commerce, consumer insights, technology, and digital transformation. Luxury brands need an integrated department of professionals to analyze the evolution of digital marketing.

3.5 Strategies to Improve Store Efficiency

As a bridge connecting brands and end users, channel strategy determines the brand's revenue structure. It should take the following approaches to optimize the revenue structure: reduce distributors' share, focus on online sales, and change the directly operated stores. From the point of view of weight, now used stores are the top priority. Too much reliance on dealers will undoubtedly weaken the brand's own ability to realize. So, the first step of channel change is to cut the share of dealers and put the realization channel back in their hands. E-commerce is without a doubt a crucial component of digital strategies. First, change the old layout, closer to the familiar "magazine style" of the post-90s. Secondly, the content display needs to be richer to promote user retention and conversion on the website. Again, strengthen the quality of pictures on product detail pages and improve the checkout process.

In terms of store operation, five strategies can effectively improve sales density.

Store differentiation strategy: According to the characteristics of different regions, to create a store with features suited to the needs of consumers, additional Store Profiling needs to be implemented based on typical customer sources, traffic characteristics, and user feedback.

Talent strategy: Increase investment in the store workforce. Companies continue to recruit talented people, creating many new positions to create a seamless store experience, such as Runner and Floor Manager.

Training strategy: New ways and tools to train staff, cross-selling skills, and most importantly, a change in positioning from a general salesperson to a problem solver or

consultant. This move has dramatically brought the relationship between consumers and store guides closer to the consumption habits of the post-00 era. For retailers to cross-sell more products and increase their sales, trinkets and ready-to-wear should be displayed together with coordinated visual displays.

Clienteling: For example, using the latest mystery shopping program to plan a flexible customer journey and evaluate the entire process from in-store browsing to return in the store; and for example, in critical areas for example, in key areas, the store conducts cross-functional team's continuous exposure, for the same user, through the service of different functional groups to improve the user experience and achieve the final conversion.

Store operation: Continuous optimization of store experience and front warehouse operation; continuous observation of the payment process; optimization of tools for store shopping guides. The speculation is that they may be equipped with more efficient weapons (such as CRM), enhanced store management, and hiring and training more talents.

4 Conclusion

The global luxury market is in crisis. The analysis focuses on traditional luxury brands' specific digital marketing transformation strategies, which are divided into association, feeling, response, identification, and relationship, according to the classic 5R model. The analysis focuses on how to transform traditional luxury brands in the fashion industry and where they will lead in the future. In the current academic research, there are few studies combining digital marketing and traditional luxury brand transformation, so it can make up for the limitations of the research in the field of integrated marketing communication of luxury brands to a certain extent, extend and develop theoretically, and provide clues and analytical framework for other researchers to think about. In addition, the analysis focuses on specific strategies and combines them with the actual market development, using sufficient research information and market data.

Globalization and long-term development benefit the fashion industry; traditional luxury brands benefit from their transformation and development and are further integrated internationally. The author's research aims to develop the country's luxury brands. In the new era, domestic high-end apparel brands can enhance their brand awareness, strengthen interaction with users, and enhance user experience through digital marketing, thus improving their brand value.

References

Chevalier M (2020) Luxury retail and digital management: developing customer experience in a digital world. Wiley

Gambetti R (2012) The grounded theory approach to consumer-brand engagement: the practitioner's standpoint. Int J Mark Res 54(5):659–687

Henninger C (2017) Consumption strategies and motivations of Chinese consumers: the case of UK sustainable luxury fashion. J Fash Mark Manag Int J

Langlois A (2013) Luxury goods & China: a case study. J Appl Bus Econ 14(5):83–98

Lingjing Z (2012) Understanding luxury consumption in China: consumer perceptions of best-known brands. J Bus Res 65(10):1452–1460

Pelikánová R (2021) CSR statements in international and Czech luxury fashion industry at the onset and during the COVID-19 pandemic—slowing down the fast fashion business. Sustainability 13(7):3715

Phau I (2009) Devil wears (counterfeit) Prada: a study of antecedents and outcomes of attitudes towards counterfeits of luxury brands. J Consum Mark

Sivakumar S (2012) Luxury China: market opportunities and potential. South Asian J Glob Bus Res

Truong Y (2009) New luxury brand positioning and the emergence of masstige brands. J Brand Manag 16(5):375–382

Yinghan W (2022) Research on the factors influencing the purchasing behavior of young luxury consumers case. In: 2022 7th international conference on social sciences and economic development (ICSSED 2022). Atlantis Press

Research on Information Disclosure of Logistics Corporate Social Responsibility: Response to the COVID-19

Yanrong Li and Jiani Guo

Abstract The logistics industry is a composite service industry integrating transportation, warehousing, freight forwarding, intermodal transportation, manufacturing, trade, information and other industries. It is a basic, strategic and leading industry supporting economic and social development. In the context of the impact of the epidemic on the economy and society, logistics companies actively play their own advantages and assume their social responsibilities. This paper takes China's "Top 50" logistics companies as the research object, and collects and analyzes the release of their social responsibility reports. Further, based on the stakeholder theory, the content analysis method and NVivo qualitative analysis software are used to analyze the epidemic-related content in the social responsibility report, which provides a theoretical basis for logistics enterprises to undertake social responsibility in the post-epidemic era.

Keywords COVID-19 pandemic · Corporate social responsibility · Logistics company · Stakeholder theory

1 Introduction

In early 2020, the COVID-19 pandemic raged, affecting all countries and industries. As an industry in which all operations are based on the "flow" of goods, logistics companies have been greatly impacted. During this process, many logistics companies actively responded to the community, provided transportation guarantees, and actively donated materials, which attracted public attention and won social recognition.

After the outbreak of COVID-19, China attached great importance to the recovery and development of the logistics industry, and proposed several measures to help enterprises resume work and production. Enterprises have every reason to repay

Y. Li · J. Guo (✉)
Beijing Wuzi University, Beijing, China
e-mail: sdguojiani@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_82

the society while serving the society. Fulfilling social responsibility is an important mission in the development process of logistics enterprises. In the fight against COVID-19, transportation, express delivery and other logistics industries have provided important support and guarantee for urban operation and people's living needs during the epidemic prevention and control period. In terms of people's livelihood protection, we actively provide packages and livelihood services for the community, and implement measures such as contactless distribution. The survey report of the China Federation of Medicine and Logistics Branch shows that more than half of the pharmaceutical logistics companies have participated in the anti-epidemic work before the Spring Festival, and 38% of the companies have started to participate in the anti-epidemic work after the Spring Festival. The main content of anti-epidemic work includes transportation. medical supplies, etc.

In the post-epidemic era, logistics companies must give full play to their own advantages, safeguard their important stakeholders, and assume social responsibilities both internally and externally. Therefore, this paper attempts to make two contributions: firstly, based on the social responsibility reports of large logistics companies, describe the overall release situation of them, so as to explain the level of social responsibility report release in the logistics industry; secondly, from the perspective of stakeholder theory, The content analysis method and NVivo qualitative analysis software are used to analyze the epidemic-related content in the social responsibility report, which provides a theoretical basis for logistics enterprises to undertake social responsibility in the post-epidemic era.

2 Theory and Literature Review

2.1 Stakeholder Theory

The stakeholder theory was gradually developed in the 1960s in the United States. Stakeholders are "people who can influence the achievement of an organization's goals or who can be influenced by the organization's process of achieving goals" (Freeman 1984). The main difference from the traditional shareholder-oriented enterprise theory is that this theory believes that the development of any company is inseparable from the input and participation of various stakeholders, such as shareholders, suppliers, employees, customers, and communities. Serve the interests of shareholders, while also protecting the interests of other stakeholders.

2.2 Corporate Social Responsibility

The concept of corporate social responsibility is a generalization or expression of the obligations of enterprises beyond the goal of profit maximization. In recent years,

the concept of CSR has been widely accepted in Chinese business circles and theoretical circles. CSR reports have become an important way for companies to disclose information, and a way to communicate social and environmental actions and strategies to the public. Li and Xiao (2008) integrated and defined the concept of CSR, arguing that CSR refers to the realization of sustainable development of itself and the society, compliance with laws and regulations, social norms and business ethics, and effective management of corporate operations to stakeholders, and the influence of the natural environment, and the pursuit of maximizing the comprehensive value of the economy, society and environment.

The fulfillment of corporate social responsibility has brought many impacts to enterprises, the most intuitive of which is the impact on their own performance. Jones believes that corporate social responsibility is a tool to achieve corporate performance. Based on data from different regions and countries, scholars have conducted empirical research on the relationship between corporate social responsibility and corporate performance and corporate development, and concluded that there is a positive correlation between variables.

Under the background of COVID-19, corporate social responsibility presents new changes and new connotations. Scholars put forward a new connotation of social responsibility in the financial industry (Cai 2020). Kerry and Ken (2021) pointed out that the pandemic has led to changes in the economic environment and work patterns, and emphasized that these changes have a direct impact on the judgment and decision-making of CSR reports. Cui and Peng (2020) pointed out that the corporate social responsibility of multinational companies presents new features that are more inclined to the themes of employee interests, consumer interests, community interests, product responsibility and social interests related to the epidemic.

3 Materials and Methods

3.1 Research Objects and Publications

In November 2020, the China Federation of Logistics and Purchasing released the "Top 50 Chinese Logistics Enterprises in 2020" (hereinafter referred to as "Top 50"). Therefore, this paper will collect and study the social responsibility reports of the "Top 50" logistics companies. Searching through the company's official website and various channels, 23 of the "Top 50" companies have independently released their CSR reports or their affiliated companies. Among the remaining 27 companies that have not released CSR reports, 9 companies only have news related to "social responsibility", and 18 companies have not collected CSR reports and social responsibility-related content.

Jones once pointed out that one of the key features of CSR is that CSR must be voluntary. At present, most of the CSR reports released are policy-driven, mainly compulsory, and voluntary disclosure is insufficient. We distinguish between

different business properties and whether they are listed companies to prove this point.

Firstly, we will study the release of the "Top 50" CSR reports according to the nature of the enterprises. There are 11 state-owned and state-controlled companies, of which 7 companies have issued CSR reports; 23 private companies, of which only 10 companies have issued CSR reports; there are 16 foreign-funded and other enterprises, of which only 6 companies have issued CSR reports. According to the data, state-owned enterprises have well fulfilled their role as role models for social responsibility. Private enterprises not only have the responsibility to promote their own development, but also undertake certain social responsibilities. However, China does not impose requirements on private enterprises as a whole, so most companies do not have a strong sense of voluntary disclosure of social responsibility.

Secondly, we discuss the listing situation of the "Top 50" companies. There are 14 listed companies, of which 10 companies have released CSR reports; 36 unlisted companies, of which 13 companies have released CSR reports. It can be seen that the release situation of listed companies is higher than that of unlisted companies. Previously, a number of exchanges issued guidelines to encourage and guide listed companies to disclose social responsibility reports, but did not require unlisted companies.

3.2 Research Methods

This article will use NVivo qualitative analysis software to analyze the text content of the Social Responsibility Report. Content analysis is a method of organizing the content of a text or an article into different groups based on selected criteria. This technique has been widely used to determine the extent and nature of corporate social reporting.

A total of 14 CSR reports in 2020 have been collected in this article. Among them, 12 CSR reports mentioned the performance and measures taken by companies during the epidemic, and 6 described "anti-epidemic" as a topic. Therefore, this paper selects 12 social responsibility reports, collects the content of the relevant parts of the epidemic, including the title, specific content, cases and other information, and cleans the data for the following content analysis.

In order to mine the topic of the data text, this paper firstly conducts keyword frequency statistics on the text. The word cloud can highlight the keywords that appear frequently in the text. The higher the frequency of keywords, the larger the font size. Analyzing the word frequency of the texts, it is found that these texts mainly focus on the epidemic situation, materials, employees, epidemic prevention, express delivery, security, transportation, etc., that is, the texts reflect the relevant content of logistics enterprises under the epidemic situation, and the text data are consistent with the research theme of this paper (see Fig. 1).

Fig. 1 Word cloud results for text materials

3.3 Analytical Strategy

The first step is open coding, which analyzes the data sentence by sentence and paragraph by paragraph, and uses abstract conceptual sentences and coordinated vocabulary to systematically summarize and refine important concepts. For example, "more than 53,000 new jobs have been added to the entire network", and the initial concept of "increased jobs" can be obtained. Finally, this study extracted a total of 72 initial concepts by systematically summarizing the data.

The second step is associative coding, which systematically and comprehensively screens, summarizes, categorizes and divides the initial concepts, and selects subcategories that are more representative, recognizable and can highly generalize the initial concepts. By analyzing the relevance of 72 initial concepts, after induction and repeated research and comparison, 21 categories were finally extracted.

The third step is core coding. According to the relevance and pertinence between different categories, the 21 categories are classified into 5 stakeholder dimensions of government, employees, customers, community, and environment, as shown in Table 1.

4 Findings

The logistics industry undertakes the basic public service functions of the society and is also a key service industry during the epidemic prevention and control period.

Table 1 Statistics on the number of social responsibility reports related to the epidemic

The dimension	The subcategory	Number of businesses reported
Government	Actively respond to the national call	12
	Donate materials to the government	8
	Increase social jobs	3
	Service area development	2
Employees	Ensure employee health and safety	11
	Active training and education	5
	Support the construction of outlets	4
	Staff commendation	5
	Employee infection numbers announced	2
Customers	Safeguard customer safety	1
	Develop efficient logistics solutions	1
	Guarantee material supply	2
	Reduction and exemption of rent for small and medium-sized private enterprises	2
	Online logistics service platform	2
Community	Material transportation in epidemic areas	9
	Donated materials	7
	Educational assistance	3
	Support community epidemic prevention and control work	1
	Organize employee volunteering	5
Environment	Green office	2
	Product development and innovation	1

Through the analysis of the epidemic-related content in the 2020 social responsibility reports of 12 enterprises, it is concluded that logistics enterprises attach great importance to the protection of stakeholders during the epidemic period, and have made a series of positive responses.

4.1 Social Responsibility to the Government Under the Epidemic

In the face of the outbreak of COVID-19, the Chinese government has responded quickly, directed efficiently, invested a lot of manpower, material and financial resources, and adopted various measures to give enterprises preferential policies

and create a stable atmosphere to protect enterprises, of normal operation. At the same time, logistics enterprises also assume their own responsibilities, and all enterprises actively respond to the national call by complying with the requirements of national documents and implementing epidemic prevention and control measures. Secondly, a number of enterprises have provided support through donations and material donations. Third, under the downward pressure of the economy, the three companies promoted job stabilization and employment expansion, and made positive contributions to stabilizing employment and ensuring people's livelihood. For example, ZTO Express added more than 53,000 jobs, strengthened network construction, and promoted the development of related industries. Finally, two companies, SF Express and Best, helped subsidize and promote agricultural products affected by the epidemic, and stepped up efforts to assist and support agriculture.

4.2 Social Responsibility to Employees Under the Epidemic

Among the elements of enterprise value creation, human capital is the leading element of value creation. Enterprise employees are the core stakeholders of the enterprise, and it is an important part of the enterprise social responsibility system to assume the necessary social responsibility for employees. Protecting the interests of employees is what all logistics companies abide by. Different companies have adopted different mechanisms, such as providing anti-epidemic materials, monitoring and disinfecting workplaces, working from home policies, issuing safety subsidies for resumption of work, and caring for overseas employees.

Enterprises actively carry out epidemic prevention publicity knowledge and psychological education to promote employees to strengthen their own construction. In addition, 5 companies have publicly commended advanced units and individuals. Notably, two companies reported employee infections during the outbreak. They are that Sinotrans reported zero domestic infections, no mass infections overseas, and no overseas import incidents; the material storage and transportation group has no other domestic infections except for one employee of an enterprise in Wuhan in the early stage of the epidemic who was mildly infected.

4.3 Social Responsibility to Customers Under the Epidemic

Logistics enterprises are important hubs connecting upstream suppliers and downstream customers. Its main function is to rely on products from manufacturers and suppliers, and to provide products and services to customers. Logistics enterprises standardize the delivery process, strengthen the elimination of express delivery, and protect the health of customers. Secondly, formulate efficient logistics plans to meet customer needs in a timely manner and ensure material supply. For example, Xiangyu Group supplies raw grain to downstream customers and coal to many provinces,

ensuring that local enterprises resume work and production. At the same time, material storage and transportation and Guangdong Shipping Group responded to national policies by reducing or exempting rents for small and medium-sized enterprises, alleviating their economic pressure.

4.4 Social Responsibility to the Community Under the Epidemic

Logistics enterprises give full play to their own advantages and play a great role in the transportation of epidemic prevention materials. ZTO Express has opened a warehouse and distribution center, and urgently coordinated vehicles to provide public transportation services for the front line of the anti-epidemic; SF Express uses drones to deliver materials to ease transportation pressure; Xiangyu Group and Best Logistics have built international logistics channels to carry out two-way transportation of materials and many more. In addition to the transportation of materials in the epidemic area, logistics companies also deliver living materials for the community. For example, STO Express actively cooperates with local communities and streets, focusing on the delivery of daily necessities. Secondly, some enterprises mobilized employees to join the ranks of volunteers, and Xiangyu Group established a volunteer service team of party members to serve the community. Thirdly, the company's contribution to the community is also reflected in the educational assistance to students. For example, SF Express cooperated with public welfare education organizations to provide online one-to-one tutoring for 328 primary school students. Finally, logistics companies have donated to the community in various ways, including providing anti-epidemic materials to vulnerable groups, sending free luggage for medical teams, etc.

4.5 Social Responsibility for the Environment Under the Epidemic

The relationship between logistics enterprises and the environment is very close. Under the epidemic, the environmental performance of enterprises is mainly reflected in two aspects. One is to promote green office, and employees can work from home through the Internet; the other is to develop and innovate products. For example, SF Express and colleges and universities have carried out cooperative research on antibacterial and degradable plastics.

5 Discussion

This study has made two findings. First, although China has vigorously guided companies to take social responsibility and publish CSR reports since 2006, the top 50 logistics companies have a low disclosure rate and a poor awareness of voluntary disclosure. Second, according to the 2020 CSR Report, it analyzes the social responsibilities of logistics companies in the era of the epidemic to support their important stakeholders, including employees, governments, customers, communities and the environment.

This study has theoretical significance. Firstly, this paper focuses on the information disclosure of social responsibility of logistics enterprises in the Chinese context and the new content presented in the epidemic era, and expands the literature on logistics enterprises' social responsibility in the epidemic era. Secondly, Stakeholder theory has emerged as the dominant paradigm in the literature inspiring CSR. Based on the framework of stakeholder theory, this study analyzes the social responsibilities of logistics enterprises to the government, employees, customers, communities, and the environment, and expands the scope of application of stakeholder theory.

This study has practical significance. Firstly, enterprises must actively undertake social responsibilities and take the initiative to disclose social responsibility reports. When publicizing social reports, we should not only focus on volume, but more importantly, the value of social responsibility reports. Secondly, in the face of COVID-19, no company can stay out of it. As an important pillar of the national economy, the logistics industry should respond to the government's call through various mechanisms, protect the health of employees, continue to provide high-quality customer service, and care for the community through various measures.

References

Bian WJ (2019) Encouraging private enterprises to fulfill their social responsibilities. People's Forum 24:32–33

Cai Q (2020) Theoretical logic and institutional guarantee of financial enterprises' social responsibility—based on the background of the new coronary pneumonia epidemic. Finance Econ 10:83–87

Cui XJ, Peng XH (2020) The new trend of corporate social responsibility of multinational companies under the influence of the new crown epidemic. Int Trade 9:14–21

Francis B, Hasan I, Liu L, Wang H (2019) Employee treatment and contracting with bank lenders: an instrumental approach for stakeholder management. J Bus Ethics 158(4):1029–1046

Freeman RE (1984) Strategic management: a stakeholder approach. Pitman, Boston

Jones TM (1995) Instrumental stakeholder theory: a synthesis of ethics and economics. Acad Manag Rev 20(2):404–437

Kerry AH, Ken TT (2021) Judgment and decision making research on CSR reporting in the COVID-19 pandemic environment. Account Finance 62(1):739–765

Li WY, Xiao HJ (2008) Research on the concept of corporate social responsibility. Econ Manag Z2:177–185

Lin CH, Yang HL, Liou DY (2009) The impact of corporate social responsibility on financial performance: evidence from business in Taiwan. Technol Soc 31(1):56–63
Lu DF (2001) A review of foreign corporate social responsibility definitions. Mod Law 3:137–144
Lu YM, Lu HS, Liu SX (2014) Game analysis of endogenous mechanism for private enterprises to take employee social responsibilities. Soft Sci 28(10):39–42+46
Maja IP, Maria B (2015) Logistics service providers and corporate social responsibility: sustainability reporting in the logistics industry. Int J Phys Distrib Logist Manag 45(5):459–485
Peng JF (2014) New thinking of human resource management in the internet era. China Hum Resour Dev 16:6–9
Xia H, Li Y (2010) Content analysis of social responsibility report of listed enterprises. Finance Account Commun 12:99–102

Research on the Consumer Psychology and Marketing Strategies of Lululemon in the Asian Market

Siyu Li

Abstract Because of the pandemic of Covid-19, many businesses have closure or were negatively affected, especially clothing organizations. Nevertheless, Lululemon achieved its highest sales in 2020, and the fame of this brand was better and better even in Asia marketing as it was a North American brand. Therefore, it was necessary to find out how the brand achieved such high goals in Asia countries and what strategies related to consumer psychology were utilized. This study used the literature review and survey study to acknowledge the preference of Asian people for sportswear and their living habits. As a result, more and more Asian females enjoy a healthy lifestyle. They exercised regularly in recent years and were the target customers of Lululemon as this brand specialized in comfortable and good-looking sportswear. Moreover, the research indicated the issue of Lululemon in recent years was that their influence was not strong as they had just entered the Asia sports market. Useful strategies were suggested that aimed to improve the visibility of Lululemon. Those findings were vital for the sports clothing industry as they revealed female customers' real demand.

Keywords Lululemon · Asian market · Consumer psychology · Marketing strategies

1 Introduction

1.1 Research Background

As time and technology progress, many well-known sports brands are progressively declining or vanishing from the public eye. Simultaneously, new sports brands with contemporary concepts continue to be successful, such as Lululemon. Lululemon is one of the world's most successful companies, with a huge proportion of the

S. Li (✉)
Brain Science, University College London, London WC1E 6BT, UK
e-mail: zcjtsl0@ucl.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_83

sports gear industry. Lululemon took in one billion dollars in revenue in 2011, which was the first milestone of the brand to success (McKinnon 2022). Furthermore, in BrandZ's Top 100, the brand was named the second-fastest rising brand. In 2021, the corporation had grown quickly and had a revenue of $6 billion (Gilliland 2019). When competing with traditional companies like Amazon and H&M, who set product prices relatively low, it was astonishing that Lululemon could differentiate itself by offering high-priced products. Therefore, their success was not by accident.

1.2 Literature Review

The previous literature revealed that one important marketing strategy Lululemon used was combining its brand concept with the mainstream notion of healthy living in today's society (McKinnon 2022). In recent years, an increasing number of individuals in European and American countries are realizing that leading a healthy lifestyle could give people a sense of well-being and relaxation. The prevalence of eating organic foods, yoga training, and different aerobic exercises reveals a certain number of people prioritizing healthy living. Lululemon used their brand to promote this 'healthy living' idea and cooperated with different people with this idea to caster the sports marketing. For instance, they encouraged different people of various ages to join exercising and gain happiness from exercise by organizing sports competitions and running races. According to Michael, an activity held by Lululemon called "sweat collective", a community that invited all people who sweat the most in North America to help sell (Quiroz 2018). Many people were attracted as the slogan of the activity was new and attractive.

Moreover, the community concluded instructors at group exercise studios, heads of running clubs, personal trainers, and professional or Olympic athletes, which also greatly influenced the events. As a result, many people tried to do exercises by following the steps of professionals and realized the happiness of healthy living by exercising. At the same time, Lululemon advertised their sweat-wicking material sportswear. Practically all people in this activity purchased the clothes as those people were the sweatiest and demanded the products with sweat-wicking.

Similarly, Lululemon held free yoga courses to give people chances to experience a healthy lifestyle without paying. Many females started to enjoy their yoga tanning and meditation by chance which corresponded with the idea of being healthy in a happy way. This marketing strategy led to a huge success in North America and Europe marketing and ensured a group of loyal consumers.

Another marketing strategy Lululemon used was constantly technical innovation. Compared with the sameness of other brands, Lululemon never stopped creating advanced products (Quiroz 2018). The high competitiveness of Lululemon is also attributed to a large number of advanced techniques, as the brand has 45 patents on its sporting apparel when it comes to proprietary materials. It includes Luon, VitaSea, Silverescent, Luxtreme, Boolux, Nulux (Light as Air), Luxchange, Power Y, Groove Pant, and so on.

While other brands were still replicating each other's products with old designs, Lululemon had been investigating what customers required in sportswear and utilizing specific materials to make elevated outfits which assisted customers in resolving their concerns. For example, the brand found that girls needed yoga clothes that did not hinder them when they were stretching in yoga. Therefore, they used Luxetreme, a sweat-wicking, four-way stretch fabric that felt like a second skin on the body, to make yoga clothes and helped girls stretch more breeze in yoga training. Furthermore, many people were bothered by sweat-drenched clothes clinging to the skin after exercising. To solve this issue, Lululemon used a unique material called Nulux to make clothes. Nulux was a fabric that used light compression to conform against the skin and dried quickly, so people did not feel weighed down by perspiration. Moreover, Nulux fabric was smooth to the touch and felt cool on the skin. The cloth was knitted in a certain way, making the items light and providing consumers with dry feelings during exercises.

The unwavering focus of the brand by narrowing down narrow products gave customers an impression that the brand was professional, which promoted their sales volume. According to Gilliland, Lululemon had a great reputation because of the positive feedback from real consumers (Gilliland 2019). Wilson, the CEO of Lululemon, said that the object of their brand was to expand brand exposure through 'word of mouth', with customers sharing the word about Lululemon's high-quality products. As a result, Lululemon spent small commercial costs since the brand's quality was high enough, and people were willing to compliment products of Lululemon proactive on the internet or with their friends and families (McKinnon 2022). Instead, Lululemon focused on constantly finding more ways to enhance the quality of their outstanding products and continued improvement. Compared with other sports brands, which tried a large selection of different kinds of products, Lululemon had a very limited series of products. Still, each series had its benefit, and the brand gained a steady stream of repeat customers.

1.3 Research Framework

A large amount of previous literature revealed the reason for the success of Lululemon in North America and Europe counties because the brand originated there, and the marketing strategies mentioned before were focused on people from western counties. However, the brand also reached a huge success in Asia marketing as over 62% of customers in China gave positive brand feedback in the survey about the recent situation of the new lifestyles of Chinese people (Cheryl 2021). Thus, it was essential to investigate how Lululemon could be successful in Asia marketing and what marketing strategies, including consumer psychologies, were applied to reach their goal. This paper used focus groups, interviews, and case studies to collect evidence and analyze further.

2 Method

2.1 Survey Method

The survey research was the method of doing research through surveys sent to survey respondents by researchers. Moreover, the survey data are statistically examined to arrive at relevant study results (QuestionPro 2022). This study used specific surveys to understand the preferences of Asian consumers of Lululemon and the shortcomings of the brand's current products (South China Morning Post 2021). The answers to the survey could directly reflect the opinions of real customers; therefore, Lululemon developed products and changed its marketing strategies.

2.2 Literature Research

Literature research is a kind of methodology that reviews and analyzes pieces of academic writings, including the critical evaluation of the material (The University of Edinburgh 2022). One literature review includes existing research or hypothesis from previous readings and the critical evaluations or discussions of those hypotheses. In this study, several pieces of literature about the marketing strategies of Lululemon were critically analyzed by the researcher to investigate the gap between previous literature and this study.

3 Result

According to the report from Euromonitor International, sportswear was expected to grow at a 7% GAGR from 2019 to 2024, which occupied a large share of clothing marketing as the increasing number of fitness people all over the world (Euromonitor 2020). This report indicated that although North America would continue to lead in terms of sportswear size in sportswear marketing because they had a large and stable consumer base, the Asia Pacific was predicted to record the most growth over the next five years (Euromonitor 2020). Similarly, after investigating the situation of Asia sports clothing marketing in recent years, a result calculated by Global Data proved the whole Asia–Pacific sportswear market value fell by more than 4% during 2019 and 2020 due to the pandemic of covid-19. However, it returned with strong growth in 2021. In addition, the report indicated that womenswear was expected to expand at the fastest rate compared with menswear and childrenswear in future years (GlobalData Report Store 2022).

According to the statistics indicated in the previous paragraph, the demand for sportswear among Asian consumers has been steadily expanding, with women's

sportswear experiencing the highest growth in recent years. Sportswear was exclusively desired by those who exercised, and the statistics revealed that more individuals, particularly women, in Asia began to exercise and purchase sportswear regularly. This idea was also suggested by the Euromonitor's Health and Nutrition survey that over 58% of Asia Pacific consumers who bought sportswear regularly exercised at least once a week (Euromonitor 2020). There was a significant increase in people exercising regularly in Asia compared to ten years before. The idea of healthy living has been spreading in recent years, and more people in Asia started to eat clean food and do sports to keep their bodies fit and healthier. The pandemic of covid-19 also made people seriously aware of how important it was for them to have good health and strong immunity. Another reason that contributed to the high demand for female sportswear was that more and more women were using sportswear as everyday wear as sportswear was comfortable compared with regular suits and high heels. In addition, a small number of women in the survey responded that the good-design sportswear made them look better as the sportswear accentuated their body curves, making them feel confident (Euromonitor 2020).

The main consumers of sportswear in Asia marketing were those who loved exercising to have a healthy lifestyle and those who considered sportswear their daily wear.

Lululemon had its devoted following in Asia marketing since it catered to women who wanted to be comfortable and useful while also looking attractive in their sportswear. The greatest advantage of the sportswear of Lululemon was its high quality as they had the special design of clothes, the utilization of unique materials, and the unique technique of making clothes. Therefore, their sportswear was more comfortable and provided consumers with a better experience than other brands' sportswear. For instance, they alleviated the discomfort caused by perspiration when exercising. As the number of fitness people in Asia rose, the necessity for comfortable sportswear products appeared, making Lululemon instantly attract many consumers in recent years. In addition, Lululemon also targeted people who sought aesthetically pleasing sportswear because they were advertising their distinctive design that provided convenience while still good-looking. Thus, most of the consumers of Lululemon were ladies who pursued beauty and comfort (Canadian Running Magazine 2021). At the same time, this design pleased people who preferred to wear their sportswear as casual wear, as the outfits of Lululemon were both stylish and comfortable for daily wear (South China Morning Post 2021).

Although Lululemon satisfied most demands of consumers, it was not the top-selling sportswear brand in Asia marketing. As a brand from North America, Lululemon lost part of its competitive edge over these businesses due to prevalent cultural variances, such as varied body shapes and cultural attitudes to sports. The most popular overseas sportswear brands from 2015 to 2020 were Nike and Adidas because they had been in Asia marketing for 20 years, so they were famous among people of all ages. Moreover, their successful marketing strategies helped them consolidate their states, including special activities, limited editions, and combined local cultures (GlobalData Report Store 2022). In contrast, Lululemon was a new brand known to the public recently. Therefore, the brand's influence and awareness

among Asia customers were still far from adequate. Moreover, Lululemon had a relatively high price compared with other Asia local brands, making fewer people willing to try the brand's products.

4 Discussion

To improve the visibility and attract more customers in Asia, several strategies may help.

The target consumers of Lululemon are those who love sports and desire comfortable sportswear. This brand promoted the idea that a healthy lifestyle could improve people's happiness. According to the survey, the well-being of most Asia countries is low as people are busy working and studying with no time to exercise. However, it is the nature of people to pursue happiness, and exercising is a good way to relieve stress.

Therefore, to expand its marketing in more Asia countries, Lululemon should try to hold various sports activities to provide people chances to experience the happiness of exercise and publicize the benefits of healthy life to encourage more people to join the exercise actively. This will be effective because more and more Asians are becoming conscious of healthy living (AVENUE ONE 2022). According to Zhongnan, a survey from Lululemon revealed that being proactive positively influenced China. The survey found Chinese had the highest regional Well-being Index of 79, compared to 65 for the world average (Junwei 2021). These results supported that many Chinese people like a proactive and healthy lifestyle, which echoes the concept of Lululemon and promotes more people to know this brand.

Another strategy is to improve the visibility of Lululemon by supporting the big sports activities and making more people who love sports know about this brand. For those who never tried sports before, Lululemon could hold more free activities to give those who never tried sports before a chance to do yoga or running and help them find the fun of exercise. The good experience of doing sports in comfort wearing could help people decompress. A successful example was when Lululemon in Hongkong opened the free yoga courses in 2018, and People showed excessive enthusiasm for yoga and sports because every course was fully booked daily (Junwei 2021). This was a successful activity that attracted lots of people to start doing exercises that made them feel happy; also, most of them became loyal fans of Lululemon after they tried the sportswear of Lululemon.

Cooperating with influential local brands was another way to increase the exposure of Lululemon. In North America, Lululemon worked with some local influencers on YouTube or local gym brands, which led Lululemon to be successful. However, considering the different cultural backgrounds of Asia, it was important for Lululemon to get to know the sports habits that Asian people were familiar with. For instance, over 100 million Chinese people were using a sports APP called Keep, which was a mobile app with different types of exercise instruction videos inside. Therefore, Lululemon would be benefited if they could cooperate with Keep, as all

the 100 million people who used the app were fitness people, and they were the target customers of Lululemon.

Besides the low visibility, another important issue that caused lower achievements for Lululemon than top-seller brands was that the sportswear of this brand was expensive, so some consumers would not even try it when they did not have enough budget. According to the report, over 78% of customers considered Lululemon as expensive as sportswear (Customer Faithful 2016). Therefore, many students and low-salary people never try the clothes from Lululemon as they know they are not affordable, and they are willing to buy the sportswear from local brands which were cheaper than Lululemon. Nevertheless, although there were many cheap and good-looking yoga sportswear from other brands, high quality was Lululemon's most competitive advantage. The experience that Lululemon could provide to people was much better than other normal sportswear. For instance, their star product, yoga pants, could make people feel comfortable as no-wearing due to the specialized fabric and production techniques. Thus, it is important to provide more chances to people chances to try the products as some customers consider those products are low-cost preferences, but they may change their minds after trying. If they find the products are comfortable and unique, most people will be willing to purchase them. This strategy could be supported because Global data found that offline purchases accounted for a large portion of the Asia–Pacific sportswear market. Asian people were more willing to purchase sportswear when they tried them in stores rather than online shopping (Hazan 2018).

In addition, Lululemon could also hold some promotion activities or gift events like sending the outfits of Lululemon as gifts or prizes for sports competitions. This strategy was aimed to attract more people to know the brand of Lululemon as people would gladly devote their time to attending some free or low-cost activities. Although not all people would buy the products of Lululemon, it could still improve the brand's reputation, and those people will be future customers if they believe the products are good (Investopedia 2018).

5 Conclusion

5.1 Research Findings

The research found that female sportswear is the new tendency in Asian clothing marketing in recent years, which indicates an increasing number of Asian starting exercises and understanding the importance of healthy life. Lululemon took advantage of Asia sportswear marketing through its branding concepts and unique design to attract female customers. However, the influence of Lululemon was adequate as it was a completely new abroad brand for Asian customers when the brand first joined the marketing. Nevertheless, several effective solutions were also discussed in this research, including increasing the visibility by cooperating with famous local brands

or holding activities to provide people chances to try their sportswear. These findings were vital to the whole sportswear marketing as they revealed the living attitude of people in Asia and their real demands for clothing. Therefore, more sports brands could set more effective strategies for their expansion in Asia marketing.

5.2 Limitation and Future Studies

Although this research used the survey study and literature review to investigate the situation of Asia marketing, all those reports and surveys were generalized. It was essential to contain some case studies for detailed further analysis of the strategies of a sports brand. In addition, the reliability of this research was not high as most literature and research found were the situation of Chinese marketing. However, this study focused on the success of Lululemon in the whole Asia marketing. Therefore, in future studies, it was necessary to investigate more about the situation of Lululemon in other Asia countries, especially those countries used to their local brands, and go through more useful strategies to achieve more success.

References

AVENUE ONE (2022) 9 sportswear brands that are designed for Asians [EB/OL], 15 Feb 2022. https://avenueone.sg/health-fitness/sportswear-brands-for-asian-bodies/

Canadian Running Magazine (2021) Lululemon survey says that comfort correlates with performance in the workplace [EB/OL], 29 Sept 2021. https://runningmagazine.ca/sections/gear/lululemon-survey-says-that-comfort-correlates-with-performance-in-the-workplace/

Cheryl A (2021) Lululemon bets on China after revenue from mainland more than doubles during coronavirus pandemic [EB/OL]. https://sg.news.yahoo.com/lululemon-bets-china-revenue-mainland-135349587.html

Customer Faithful (2016) Customer experience case study: Lululemon [EB/OL]. https://www.customerfaithful.com/what-we-say/customer-experience-case-study-lululemon

Euromonitor (2020) Sportswear in Asia Pacific [EB/OL]. https://www.euromonitor.com/sportswear-in-asia-pacific/report

Gilliland N (2019) How Lululemon became one of the biggest risers in the BrandZ Top 100 [EB/OL]. Econsultancy, 14 June 2019. https://econsultancy.com/how-lululemon-became-one-of-the-biggest-risers-in-the-brandz-top-100/

GlobalData Report Store (2022) Asia-Pacific (APAC) sportswear market size and forecast analytics by category (apparel, footwear, accessories), segments (gender, positioning, activity), retail channel and key brands, 2020–2025 [EB/OL], 27 Jan 2022. https://www.globaldata.com/store/report/apac-sportswear-market-analysis/

Hazan I (2018) Lululemon's success drives store expansion [EB/OL]. Retail in Asia, 25 July 2018. https://retailinasia.com/in-shops/real-estate/store_development/lululemons-success-drives-store-expansion/

Investopedia (2018) Understanding Lululemon's business model (LULU) [EB/OL]. https://www.investopedia.com/articles/investing/052715/understanding-lululemons-business-model.asp

Junwei W (2021) Lululemon survey shows China leads world in well-being [EB/OL]. https://www.chinadaily.com.cn/a/202102/08/WS6020e238a31024ad0baa814e.html

McKinnon T (2022) Lululemon's strategy for success, 5 things to emulate [EB/OL]. Indigo9 Digital Inc. https://www.indigo9digital.com/blog/lululemongrowthstrategy
QuestionPro (2022) Survey research: definition, examples and methods [EB/OL], 04 July 2022. https://www.questionpro.com/article/survey-research.html
Quiroz MA (2018) A growth strategy for Lululemon 2018 [EB/OL]. Medium, 31 Dec 2018. https://medium.com/@michaelangelo_q/a-growth-strategy-for-lululemon-68819680e511
South China Morning Post (2021) Asian workers want to ditch suits for T-shirts, shorts, yoga pants, survey says [EB/OL], 22 Sept 2021. https://www.scmp.com/business/companies/article/3149589/lululemon-survey-finds-vast-majority-asian-workers-want-ditch
The University of Edinburgh (2022) Literature review [EB/OL]. https://www.ed.ac.uk/institute-academic-development/study-hub/learning-resources/literature-review

Research on the Economic Impact of the Olympics on Host Countries

Yuzheng Li

Abstract The role and value of hosting the Olympics differ from country to country. Going as far back as Greece's 1896 sole bid to host the Olympics, countries worldwide have participated in this rigorous bidding since then to host either the Summer or Winter Olympics, inclusive of the Paralympics. Countries that have won these bids have dedicated billions to this mega event. Even though the literature shows that these countries acquired net losses as opposed to the expected positives, the reasons for hosting aren't only fiscal. These countries do so to create an international profile, improve their image if it has suffered a blow, promote their technology and culture, and create long-term alliances. This paper aims to investigate how much the Beijing 2022 Winter Olympics cost to host and its tangible and intangible impacts on its economy. The results show that China overspent hosting this event, and debt has been incurred. Fiscally, hosting the Olympics seems to be doing more harm than good, with countries being forced to find ways to deal with the bill after winning the bid.

Keywords China · Olympics · Host countries · Economic impact

1 Introduction

1.1 Research Background

With Olympic games falling under the category of international mega sport and one-off events, the host countries are usually selected only through a successful bidding process. According to Nishio, most cities that participate in the bidding process are usually developed countries. At least thirty developed countries manage about 95%

Y. Li (✉)
School of Sport, Tourism, and Hospitality Management, Temple University, Philadelphia, PA 19122, USA
e-mail: tun31171@temple.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_84

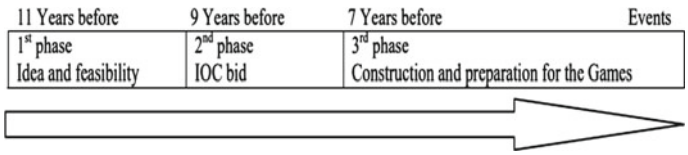


Fig. 1 Phase of economic activities through Olympic games

of these international events, and 86% of the host countries are located in North America or Europe (Nishio et al. 2009). The same scholar notes that the time scale involved in preparing for the Olympic games is an important measure of the economic impact these games have, as seen in Fig. 1 (Nishio et al. 2009). "Typically, the time scale is separated into 3 stages: (i) Pre-Olympic Games—results of the Olympic assignment's constructing stage, extra pre-Olympic Games charges, and assignment traveller effect. (ii) During Olympic Games—impacts on sales and charges related to Olympic Games staging and tourism. (iii) Post-Olympic Games—covers tourism and infrastructure impacts."

At the same time, a review was carried out for the GDP generated by the countries hosting these Games. Tien et al. concluded that by hosting the Games, a positive impact could be brought to the country's GDP. However, this favourable impact only arises prior to hosting (Tien et al. 2011). Furthermore, this study implies that hosting the Olympic Games as a project that requires effort should be actively addressed by the host country earlier on. At the same time, the impact of the former on the GDP of the host country is much higher than that of the latter when comparing the Summer Olympics to the Winter Olympics ($p < 0.01$). The study also demonstrates that the video games and entertainment generated by the Olympic Games also have a significant impact on national GDP.

With the data provided, it is of utmost importance to critically analyze the importance of hosting these mega-events like the Olympics to understand better the economic impact they have on the host country and decipher at what stages they prove to be beneficial (Table 1).

1.2 Literature Review

Hosting the billion-dollar assemblage that is the Olympics is of interest to many countries for several reasons. According to Preuss, host countries use this opportunity to trumpet their latest technology and brilliant culture, foster political alliances, and make headway with secret agendas such as the development of traffic, sports, or any other sector (Preuss 2004). These positives bank on the knowledge that the Olympics is the most significant peace-promoting event with diverse sports and the ability to address several world issues, such as social issues, politics, culture, and ecology. Perhaps a bigger motivation to host is the positive impact on a country's branding or national image. According to the International Olympic Committee Yao, a whopping

Table 1 Cross-sectional time series regression and event study results for GDP performance

Method I: panel regression model

Season	Total		Summer		Winter	
Variable	Coeff.	t	Coeff.	t	Coeff.	t
Intercept	0.0594***	(6.38)	0.0667***	(6.10)	0.0566***	(5.09)
Pre-games phase	0.0148***	(3.55)	0.0198***	(3.36)	0.0085	(1.67)
Games phase	0.0033	(0.79)	0.0108	(1.80)	− 0.0040	(0.79)
Post-games phase	0.0011	(0.24)	0.0085	(1.35)	− 0.0080	(1.53)
Population growth	0.2085	(1.42)	0.1767	(1.16)	1.0647**	(2.23)
Country of origin	0.0273***	(4.57)	0.0204***	(3.36)	− 0.0049	(0.91)
F	4.47***		3.38***		3.70***	
Adj. R^2 (%)	23.05		22.34		28.39	
N	870		580		464	

Method II: event study model

Season	Total			Summer			Winter		
t	N	Mean	T	N	Mean	T	N	Mean	T
− 4	21	0.0140***	(2.54)	10	0.0086	(1.79)	11	0.0190	(1.97)
− 3	21	0.0189***	(3.98)	10	0.0216***	(4.19)	11	0.0165	(2.07)
− 2	21	0.0126	(1.87)	10	0.0202**	(2.66)	11	0.0057	(0.53)
− 1	21	0.0003	(0.03)	10	0.0195**	(2.49)	11	− 0.0171	(1.12)
0	21	− 0.0014	(0.14)	10	0.0108	(2.21)	11	− 0.0125	(0.68)
1	20	− 0.0042	(0.60)	9	0.0037	(0.87)	11	− 0.0106	(0.87)
2	20	− 0.0025	(0.27)	9	0.0118	(1.28)	11	− 0.0141	(0.90)
3	19	0.0028	(0.25)	9	0.0096	(1.12)	10	− 0.0033	(0.16)
4	19	− 0.0109	(1.01)	9	0.0043	(0.38)	10	0.0246	(1.42)

** $p < 0.05$, *** $p < 0.01$

three point nine billion viewers in two hundred and twenty countries watched the 2004 Olympics hosted by Athens (Yao 2011). This highly broadcasted event places the host country in the international spotlight, where reports about them are likely to be positive moving forward with few exceptions (Yao 2011). While there's a significant impact on many sectors for the hosts due to these games, its impact on their economy will be our primary focus.

"Stock Exchanges are companies through which public institutions and industry may obtain long-term money for development initiatives and/or for enterprises to assist growth," according to Nishio et al. (2009). "They offer trading platforms for investors to purchase and sell assets. A stock market index tracks the performance of a collection of stocks." The author also suggests that major sporting events, such as the Olympics, can have a considerable influence on the host country's stock market when combined with extensive transmission. Nishio examines numerous host nations' stock market indices as representations to assess the influence of the host city being

picked on announcement day on stock market yield (Nishio et al. 2009). The study found that companies linked to construction, tourism, and other diverse services would be more amenable to selection announcements and the country hosting the mega event than other fields like chemicals or mining that the Olympic Games do not personally touch on.

Giesecke's examination of the impact of the Olympics in Sydney found a $2.1 billion loss in "Australian real private and public consumption in current value terms." Giesecke indicates that hosting the Olympics is more likely to give a low yield for tangible economic benefits (Giesecke and Madden 2011). Some countries, drawing reference from the London Olympics, do not mind spending up to £2 billion for hosting because of the intangible economic benefits that come with it.

Tien et al. state that countries that host the Olympics may be in it for the long-term benefits of the new relationships they create due to the mega event (Tien et al. 2011). Hosting the Olympic Games is beneficial, as seen in the GDP performance of the host country but only during the pre-games phase, as indicated in the research background. Intending hosts should start preparing the way before time. It also seems that hosting the Winter Olympics isn't as beneficial to the hosts during the pre-games phase as the Summer Olympics are.

1.3 Research Gap

Multiple papers have been published concerning the economic impact of hosting the Olympics locally and nationally. This paper aims to take an in-depth look at what it costs to host the 2022 Beijing Winter Olympics, especially in the face of Covid-19 and its tangible and non-tangible impacts.

1.4 Research Framework

According to Dwyer, "occasions can produce profits and jobs in the short term while also generating extended visits and related financing in the long term (Dwyer et al. 2000)." Events and conventions may also bring about connected social and cultural benefits to a location, embellish the exchange of ideas, create commercial company relationships, provide boards for continuing education and training, facilitate generation transfer, and so on. Since the Olympics began to establish their bids to be hosts, several countries have supported these reasons. The results of the study found that hosting the Olympic Games did not have the desired effect on people. Nevertheless, some events have received a lot of attention. These reasons include good financial analysis, as well as broader reasons. However, some argue that the success of an event is not assessed by its financial contribution, but rather by the amount of intangible assets it provides to the country.

Dwyer offers a number of ways to measure the intangible benefits and wealth of hosting an event. The financial impact is defined by Dwyer as being the income minus the expenditure through the event. This source of income may include funds received through the ticketing of the event as well as taxes. Also, tourism and corporate profits driven by the impact of the event are important revenues. According to Dwyer, government taxation is calculated using tax rates. However, some costs such as maintaining the venue are also part of the expenses for the events held.

Intangible impacts, on the other hand, Dwyer submits that they can be assessed using two considerations: economic and social impacts (Dwyer et al. 2000). The social impacts would be measured by: community development which would highlight the "increased community interest in sport," which "creating obvious community health benefits and increased use of sports equipment" would be a marker of the same. At the same time, civic pride and event production extensions such as youth sports scholarships and social costs such as increased crime rates.

2 Methods

The methods used to acquire the data and analyze the outcomes will be based on secondary data sources. These will include case studies and literature research methods.

With the Covid-19 pandemic affecting countries globally, this pandemic led to the collapse of multiple economies. This was mostly because it led to the abrupt imposing of lockdowns, which led to multiple people being laid off from work and resulted in sectors coming to hold. The most affected sector was the tourism industry due to the imposed lockdowns. China spent at least 8.8 billion dollars to host the Winter Olympics, according to the financial times. A 1.5-billion-dollar budget is to be used to refurbish or construct a dozen venues and the building of Olympic villages at three sites. Due to the Covid-19 pandemic, China put in Rmb32mn to "finance pollution studies and monitoring systems to ensure blue skies" and another Rmb4mn to ensure all canteens have dividers. A reported Rmb10bn was used for converting a mountain valley into an Olympic ski resort and sliding complex. To have artificial snow, Rmb755mn was used to pump water. Projects like the National Speed Skating Oval and constructing the National Cross-Country Skiing Centre cost Rmb1.5bn and Rmb653mn, respectively. The transport sector also incurred several costs: constructing a highway from Yanqing to Chongli for Rmb16.3bn and a high-speed rail track in the same area for Rmb6.7bn.

This paper has also considered a case study on the 2022 Beijing Winter Olympics (Legacy Case Studies n.d.). In the quoted research, since during the winter period, the weather was deemed to be too harsh for some of the competitors, Beijing had to adopt technological innovations that were at "about RMB 423.5 billion by the end of 2019, a 56.8% increase compared with RMB 270 billion in 2015." This was followed by formulating a plan called e High-tech Winter Olympics (2022) Action Plan, which led to one hundred and twelve technological innovations in some of the

projects chosen. Beijing had to try and multiply its funding sources by holding expos to showcase its technology. However, there was a need to build indoor venues to host some of the games in the country (Legacy Case Studies n.d.). This construction of the winter sports venues had to match the governments' requirements to ensure that they would be environmentally friendly. Even though they tried as much as possible to avoid the construction of additional competing venues that needed to be an additional six, this was not possible to avoid. With the additional costs involved, and the country's expectation of revenue from tourism, the Covid-19 pandemic lowered that expectation since people were strictly not allowed to travel (Hoang et al. n.d.). Therefore, this would result in the country taking a very long time before recovering the money put into preparing for these Olympics.

3 Result

According to the financial times, documents show that the $1.5 billion budget for construction projects costs at least $3 billion. However, the Beijing Winter Olympics cost $8.8 billion, as seen in Fig. 2.

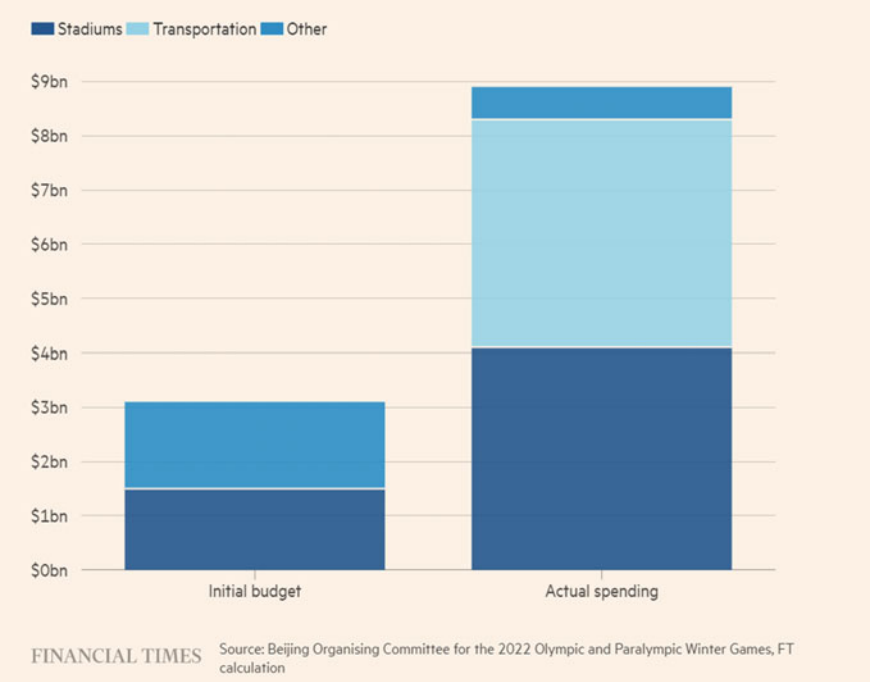


Fig. 2 Expenditures on transportation and stadiums led to high costs in Beijing

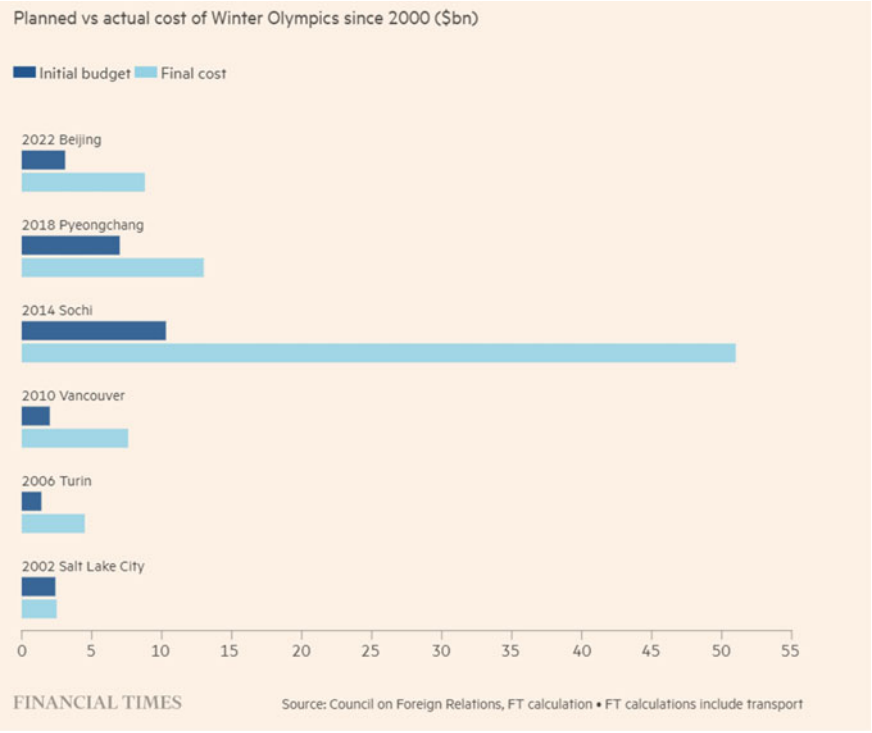


Fig. 3 Overspending on the Winter Olympics has become the norm

While the nation maintains mum on how much was actually spent, a business insider probe revealed a stunning $38.5 billion, as seen in Fig. 3. "With the backing of 94% of Beijing residents to host the Olympic Games in their city, the Chinese government spent massive sums of money both on infrastructure (US $40 billion) and the operations budget (US $2.1 billion)," Lee adds. (Lee et al. 2013).

However, another investigation by the Wall Street Journal into the construction records, procurement notices, and other statements also shows a different figure. The Wall Street Journal indicates an expenditure of $16 billion with $800 million in cost overruns and $13 billion in indirect costs. It also seems that a significant amount of expenditure information is missing, which could be another hundred of million dollars' worth. According to calculations of some procurement documents by the Wall Street Journal, $68 million also seem to have been used to get screening and protective gear as Covid-19 regulation.

4 Discussion

Covid-19 significantly increased the costs since the games would require that the participants be in a close-loop to curb its transmission, which explains some of its costs (Taku and Arai 2020). The Beijing Winter Olympics did not produce a profit, although the benefits may be seen long-term. This might be seen by adapting the 'cheetah' camera to the global market, job opportunities, and tourism.

The study's main conclusions are; first, that the average real outturn cost for Summer Games is USD 5.2 billion (2015 level), and USD 3.1 billion for Winter Games (Xin and Kunzmann 2020). "The most expensive Summer Games are London 2012, which cost USD 15 billion, while the most expensive Winter Games are Sochi 2014, which cost USD 21.9 billion. The figures span the period 1960–2016 and contain just sports-related expenditures, excluding wider capital costs for general infrastructure, which are frequently higher than sports-related costs." This suggests that the host nations will have to spend a lot of money to pay the costs of holding these events, which might lead to a financial catastrophe in these countries (Li and Xu 2021). Furthermore, according to Song, the Olympics have resulted in a good and considerable growth in the countries' GDP due to the increased tourist (Song 2010). Rose adds that "hosting the games tends to strengthen a country's substantive and lasting openness" (Rose and Spiegel 2011).

However, factors such as the pandemic and their effects were not considered as these researches were done; hence such shifts have changed the outcomes (Vaishya 2020). Therefore, to mitigate such a crisis from occurring in the future, it is important for countries to ensure that they have a complete forecast of possible solutions that would help them cover the cost they used in planning for the Olympics and generate additional revenue. According to Xin, many countries opt out of the bidding process early due to the negative experiences that other countries have had previously (Xin and Kunzmann 2020).

5 Conclusion

The results and discussion above show that hosting the Olympics is likely to give profits during the pre-games phase and long-term after the games but put them in debt—the debt results from the overspending that seems to be the norm in most countries. In the long term, the hosts usually benefit from international media coverage, cultural exchange, idea exchange, technology promotion, and facilities if they can reuse them in the coming years. The country will especially benefit from the legacy of having hosted such a mega event through tourism rampant in those countries during these specific periods. Residents can also benefit from the new or refurbished infrastructure such as rail track transportation. It should be noted by countries eager to host the Olympics that it'll cost them billions and might put them in debt, which requires them to plan way ahead of time within budget. While approaching the decision on

whether or not to host, it is of utter importance for the countries to evaluate possible disasters that may happen and try and come up with mitigating solutions so as to ensure that they still have sufficient revenues and their debts are paid off substantially to ensure the country's GDP is high if not stable.

More studies on the quality of life of the host country's residents during and after the Olympics would help other countries determine whether or not participating in the bid is worth it. More so, due to the limitation of accessing primary data while tackling this research, it would be vital to get accurate data so that countries can make sound and rational decisions. These qualitative and quantitative research methods will help fill the research gap identified in this paper.

References

Dwyer L, Mellor R, Mistilis N, Mules T (2000) A framework for assessing "tangible" and "intangible" impacts of events and conventions. Event Manage 6(3)

Giesecke JA, Madden JR (2011) Modelling the economic impacts of the Sydney Olympics in retrospect—game over for the bonanza story? Econ Pap 30(2):218–232. https://doi.org/10.1111/j.1759-3441.2011.00109.x

Hoang VT, Al-Tawfiq JA, Gautret P (n.d.) The Tokyo Olympic games and the risk of COVID-19. https://doi.org/10.1007/s40475-020-00217-y

Lee SB, Lee CK, Kang JS, Lee EY, Jeon YJJ (2013) Residents' perception of the 2008 Beijing Olympics: comparison of pre- and post-impacts. Int J Tour Res 15(3):209–225. https://doi.org/10.1002/jtr.885

Legacy Case Studies of Olympic and Paralympic Winter Games Beijing 2022 (n.d.) Legacy case studies: Olympic and Paralympic winter games Beijing 2022

Li Y, Xu H (2021) Assessment of reductions in emission-driven air pollution during the Beijing Olympic Games, Shanghai World Expo, Guangzhou Asian Games and Wuhan COVID-19 lockdown. Aerosol Air Qual Res 21:200644. https://doi.org/10.4209/aaqr.200644

Nishio T, Lim C, Downward P (2009) Analysing the economic impact of the Olympics using stock market indices of host countries. In: 18 the world IMACS/MODSIM congress. http://mssanz.org.au/modsim09

Preuss H (2004) The economics of staging the Olympics: a comparison of the games, 1972–2008. Edward Elgar Publishing

Rose AK, Spiegel MM (2011) The Olympic effect. Econ J 121(553):652–677. https://doi.org/10.1111/j.1468-0297.2010.02407.x

Song W (2010) Impacts of Olympics on exports and tourism. J Econ Dev 35(4)

Taku K, Arai H (2020) Impact of COVID-19 on athletes and coaches, and their values in Japan: repercussions of postponing the Tokyo 2020 Olympic and Paralympic games. J Loss Trauma 25(8):623–630. https://doi.org/10.1080/15325024.2020.1777762

Tien C, Lo H-C, Lin H-W (2011) The economic benefits of mega events: a myth or a reality? A longitudinal study on the Olympic games economics and finance. J Sport Manag

Vaishya R (2020) COVID-19 pandemic and the Olympic games. J Clin Orthop Trauma 11:S281–S282. https://doi.org/10.1016/j.jcot.2020.05.019

Xin Y, Kunzmann KR (2020) Winter Olympics 2022 in Beijing: a must-be success story. DISP 56(2):78–90. https://doi.org/10.1080/02513625.2020.1794129

Yao J (2011) The effect of hosting the Olympics on national image: an analysis of US newspaper coverage of host countries with reputation problems

Research on the Impact of Nintendo Advertising on Brand Globalization

Tongtong Liu and Tongyu Ouyang

Abstract As a well-known video game company, Nintendo has a great marketing strategy in the Japan market and global recognition. Due to the population and growing economy, China has become a large contributor to global consumption and is estimated to be the largest consumer economy today. However, for various reasons, Nintendo struggled in the entire China market. Given the similarity between Japan and China, including the aspect of culture and part of history. Therefore, this research will be based on the analysis of the Japanese market and come out with suggestions for entering the Chinese market. The research will be based on its positioning in the Japanese and worldwide markets, its target market and audience, and the existing and possible touchpoints. Based on the research, Nintendo may find its shortcomings in time, actively adjust itself, and continue to accompany generations of people and bring them laughter.

Keywords Hina · Nintendo · Advertising · Brand globalization

1 Introduction

1.1 Research Background

Nintendo is a Japanese multinational company founded in 1889 as Nintendo Karuta by craftsman Fusajiro Yamauchi. It began by selling handmade hannafuda playing cards in Kyoto, as shown in Fig. 1.

Authors Tongtong Liu and Tongyu Ouyang contributed equally.

T. Liu
XCL World Academy, Singapore 768038, Singapore

T. Ouyang (✉)
International Business School, Jinan University, Zhuhai 519000, China
e-mail: chickentea@stu2019.jnu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_85

Fig. 1 Hannafuda card games

Since the market was niche, even with a favorable start, the company faced financial struggles, so they changed and extended their market from Kyoto to the whole country. It went into various lines of business and was incorporated into a public company in 1947. Meanwhile, Nintendo started to target the whole world. It distributed the color T.V. games in 1977 and released Donkey Kong and Super Mario Bros. The success of these product launches helped them gain international recognition and build awareness. Now Nintendo has a lot of loyal customers in Japan and abroad and has become one of the wealthiest and most valuable companies in the Japanese market.

Its mission is "to put smiles on the faces of everyone we touch". They create new surprises for people worldwide to enjoy together. To achieve that goal, they establish their brand value. One of the major values of Nintendo is to deliver smiles to our many Nintendo stakeholders, including consumers, business partners, and employees worldwide. That means advancing responsible business practices, supporting human rights, and ensuring they continue to reach ever-higher standards: smile for consumers, the supply chain, and employees.

Nintendo adopting the game console sales ranking reflects its popularity of Nintendo, which means it has high brand awareness. Nintendo Switch is the best-selling game machine in the United States in 2021, with sales equal to the sum of Sony PS5 and Microsoft Xbox. In 2021, the Switch game console sales reached 103.54 million units, officially exceeding Sony PlayStation's 102.5 million sales, jumping to fifth place in the game console history sales list (Alessio 2022).

It is not enough if there is only being well-knowing; but also needs to have loyal customers. Nintendo has a loyal fan base that supports its consoles and games. One is a fan of the console series because the past consoles have given users a good experience, and they are willing to experience the new models. The second is the fans of the game. Nintendo has several intellectual properties, and the new models' game sequels are why users are willing to stay loyal and repeat their purchases.

Japan is the country where the brand begins and where the headquarters is located. Naturally, according to the data of Nintendo's revenue from 2014 to 2021, the company focused on a large portion of its Japanese market, ranking by region (Thomas 2022). Japan contributed 397,443 M$ (Japanese yen). Even though it doesn't reach sales in America and Europe, considering that the population of these two regions is much larger than that of Japan, Nintendo's achievements in Japan are still very impressive.

Due to the population and growing economy, China has always been a large contributor to global consumption and is estimated to be the largest consumer economy today. According to data from Niko partners shared with Bloomberg, "the Nintendo Switch has sold over 1.3 million units in China this year, and nearly 4 million units in China to date" (Valentine 2020). There are two ways for Nintendo to sell their product in China. One is the company in Hong Kong, Nintendo (Hong Kong) Ltd., and the partnership with Tencent Holdings Ltd. This means that Nintendo has no company on China's mainland and has not officially entered the Chinese market yet.

1.2 Literature Review

Based on the selection of research, there is some previous research. Le found that the market of console gaming systems has more female customers than expected. Also, Southeast Asia seems to be dominated by computer gaming (Le 2018). He used the search of the gender of all gamer respondents, nationality of gamer respondents, and gaming platforms to get the result and establish the source of customer data.

The other research by Steenkamp found that a culture can be validly conceptualized at the national level if there is some meaningful degree of within-country commonality and between-country cultural differences (Steenkamp 2001). Also, it analyzes the role of national culture in international marketing research.

Consalvo suggests that Japanese companies have successfully created cross-cultural products through careful localization to ensure their international flavors are not foreign to non-Japanese. And these have contributed to the dominance of Japanese video games in the gaming market.

As we can see, there is much research exhibiting how Japanese video games market themselves and get the success they have today and the role of culture. However, no research shows other factors due to culture contribute to a brand's likelihood of success in entering a market and the relationship between the sale and advertising in the different markets of the same brand.

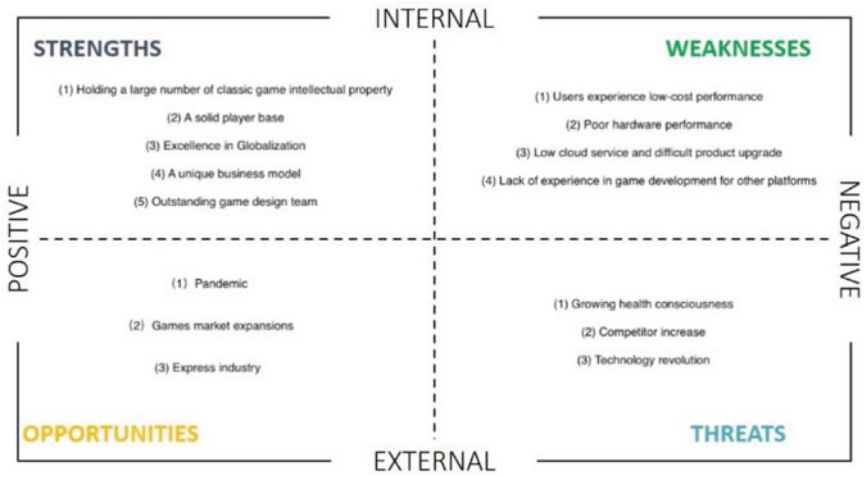


Fig. 2 SWOT analysis

2 Method-SWOT Analysis

SWOT analysis can help you identify the advantages and disadvantages of internal or external areas, as shown in Fig. 2. These can provide further information on elements that support Nintendo's success in the Japanese market and how to seize the opportunities arising from the changing world to enter the China market (Aditya 2021).

3 Result

3.1 Nintendo's SWOT Analysis

Nintendo's SWOT analysis shows its internal and external strengths and weaknesses. Its strength lies in its uniqueness, even if its features stand out from all its competitors. As we saw above, it has a large collection of classic I.P.s that have made them internationally recognized. When people think of video games, at least one game comes to mind from Nintendo. This globalized the Nintendo brand and helped it build a solid player base, ensuring that the product had a certain amount of sales to get past the break-even point and profit. A unique business model and an excellent game design team also played a major role in shaping success. It provides a suitable model to run their company, and the game is designed so that they can be recognized and attract more potential customers.

Regarding weaknesses, it has more to do with its management and technical parts. Due to the lack of related technologies, the hardware performance is not as good as that of competitors. It is manifested in the user experience of low cloud services, difficult product upgrades, and low performance. In addition, there is also a lack of game development experience for other platforms such as mobile phones. These may cause Nintendo to lose some customers.

Opportunity is a factor from uncontrollable circumstances. The epidemic has caused huge damage to many industries, but it has also brought opportunities to the gaming industry. The expansion of the game market and the development of the express delivery industry have also provided strong support for Nintendo.

The growth of the gaming market has also led to an increase in competitors and heightened health awareness. At the same time, due to the fierce competition, technological innovation has become very fast, and old technologies are easily outdated. This may lead people to choose to offer more satisfying game brands or stop buying games, which will cause Nintendo's sales to decline.

3.2 Feature Analysis: Positioning and Differentiation

It is necessary to have a point of differentiation for a successful brand. The difference between Nintendo and other game consoles is that console development is not technology-driven but relies on the product's user experience and experience to find what users need. Nintendo's discovery put is the simple operation of the game console. Players can quickly get started.

Nintendo launched the Wii physical game console in 2006. Compared to other game consoles for the complex operation of the game characters' action, Wii game console operation simple, once launched in the market won a big victory. Wii, through the concept of physical and family entertainment mode, the first year of sales reached 20 million units. As of April this year, the Wii game console global sales have reached 116.63 million units, ranking seventh on the total console sales worldwide. Furthermore, differentiation can help the brand position itself. They claim themselves as all-age game positioning—against violence and pornography and insist on developing games for both men and women, young and old.

Nintendo firmly believes that quality games are the root of success by relying on game content to bring players a happy and comfortable gaming experience. They do not pursue the most innovative top technology but focus on building the game content. For example, the new version of the Nintendo Switch screen resolution is still only 720p, and access to the T.V. can only support 1080p, compared to Sony PS5's exquisite 4K screen can be said to be no match. Still, the Switch has become the highest-selling home game console and has been at the top of the sales list for five consecutive years.

3.3 Customer Analysis

Customers play the main role of a business, to define its target audience and understanding their needs is very necessary. Therefore, customer persona has been used in this research to create a sample of customers of Nintendo (Fig. 3).

As a high school student, she must face a lot of work and study. Life is always stressful when many exams are coming up every day. Also, in a collectivist country, it is very important to be in the community and have a social life with other people. Like other teenage girls, she fears being alone and needs friends. In this generation, online social is also one of the main parts of daily life more many young people just like her. They need to use social media platforms to support the influencers they like, see what other people their age are doing, and build up their network image. It can keep her having something in common with other high school girls around her and not being behind the time. Therefore, she buys a Nintendo video game, which can bring her closer to her school mate by having fun on it together. Also, provide her with a way to free herself from learning that doesn't require too much brainpower. Because her only income is from her parents, which is very less to buy a Nintendo device, her parents decide to pay a part of the money for her. As the parents of a high school student, it is difficult to get close to their daughter anymore. They need to face the fact that their daughter has her community now. At the same time, they

Fig. 3 Japanese high school buyer Akasuki

Fig. 4 Chinese college customer Yi Li

do not want to see their daughter have a stressful high school life, and they know few games may make her happy. Therefore, they promise they will pay a part of the price (Fig. 4).

Compared to the last persona, he can be defined as semi non-causal player. Like many young adults, he like games, music, films, television, and animation. Since he has various game experiences, he also came out with many opinions as a senior player. His ideas influenced his determination of goal when he chose and purchased the console and video game. For example, it demands high-quality game content, exquisite game design, eye-catching game-playing methods, and innovation opportunities. Due to his demand for games, choosing a game that meets the requirement isn't easy. Nintendo games can meet his needs. It provides quality games and portable models, and convenient game console storage protection suits. Protection and convenience are important factors for a game console.

Buying a game console is to bring him and his friends closer and make him a deeper participant in the social group. He also sees playing video games as one of his habits, and he needs to carry the games console and video games around. If it does not have enough protection and is not convenient, it may be a concern that makes him decrease the desirability of that product. Due to the Chinese policy, social media is used by this buyer persona. He used Q.Q. to communicate with people he knows, Weibo to know the news or what happened to the world, and Bilibilil to watch the

video he was interested in. With the social media mentioned above and the official launch, enthusiasts collated information to provide a platform where they could gain information about Nintendo.

3.4 Touchpoint

Chinese Market. These years, social media has become one of the important daily necessities. It is the biggest platform for people to communicate with each other and get information about the world. Baidu is the biggest Chinese search engine. Due to Chinese policy, the Chinese are not allowed to use some global search engines, 97.3% of Chinese use Baidu as their search tool. Nintendo's official website and Nintendo Switch (Hong Kong) Ltd.'s official website can be founded on this engine. Weibo is one of the biggest social media platforms in China and is used to facilitate community exchanges. It combines the functions of Instagram, Twitter, and Facebook, which provide a platform for people to communicate by posting or commenting on images, videos and words. Nintendo Hong Kong Branch Ltd. had an official website on Weibo, which mainly used to post information about their promotion, activities, and latest news.

Japanese Market. Japan has less political resistance to search rights than China, so the social media platforms of Japan and China will be different. Nintendo has its official account on popular social media platforms like Twitter, Instagram, and Facebook. Those accounts provide a more efficient way for Nintendo to communicate their message to their potential customers and appeal to their attention. Also, this facilitates the user to give feedback so that Nintendo can get ideas from customers promptly. Besides, they have their official website on google, which provides a direct way for customers to purchase products.

Advertising. China and Japan have similar cultural dimensions. The geographical proximity and high frequency of cultural exchanges lead to a certain mutual influence between cultures in Southeast Asian countries. Unlike most countries in the west, Japan and China are collectivist rather than individualistic. This indicates that they emphasize the need and goals of the group (Hofstede). Therefore, there are many family and friend groups elements in Japanese advertising, which creates an image of making a stronger connection between users and their family or friends. In addition, Japan and China are recognized as long-term orientation countries, which means the member of these two countries is more likely to focus on the future (Hofstede). When people in these two countries buy goods and services, they value their long-term benefit instead of their immediate use.

3.5 Summary

Expect of social media, the slogan and logo are also the main part of the touchpoint. They can help a brand establish its international recognition and shape its image (Fig. 5).

Nintendo's slogan is "there's no play like it". This slogan can make Nintendo stand out from its competitors. It shows its uniqueness and tells people that only Nintendo can give them the experience that no other game can (Fig. 6).

Nintendo world championship is a nationwide video game competition video game tournament series organized by Nintendo of America. As a company known for its wonderful games and game console, they organize many competitions for the global user to increase their awareness and interactivity and pursue more interaction with their consumer (Fig. 7).

Fig. 5 Nintendo's current logo

Fig. 6 Nintendo slogan

Fig. 7 Nintendo world championship

4 Discussion: Nintendo's Problems in Mainland China

4.1 The History of Brand Entry

In March 2017, Nintendo released a new game console, Switch. Since the Switch was on sale, it has been welcomed by players worldwide, selling more than 14 million units in just three months after its launch. But despite having been on sale globally for nearly two years, it has been slow to go on public sale in mainland China until December 10, 2019. The Switch was officially sold by Tencent's agent, announcing that Nintendo has once again marched into the mainland Chinese market.

In 1994, Nintendo officially entered the Chinese market for the first time as the Hong Kong Wanxin Toy Agency Limited agent. Still, this entry ended badly due to translation problems caused by Nintendo's lack of attention to localization and the rampant piracy of game consoles at the time. However, Nintendo did not give up on the mainland China market but instead increased its investment and continued to have the GameBoy series of consoles represented by Wanxin. Nintendo put much effort into advertising and promotion, inviting the very popular Aaron Kwok to shoot at the time. Eventually, due to Wanxin's ignorance of piracy issues, Nintendo terminated its contract with Wanxin.

In 2002, Nintendo founded Shen Yu in mainland China in a joint venture. From 2003 to 2007, Shen Yu took Chinese games as its main product, but it gradually declined because of its high price and endless piracy. Finally, due to the policy reasons at that time (console ban: issued in June 2000 to prevent young people from being addicted to games and stop all production, sales and business activities about consoles), the game content was difficult to pass the government's examination, and finally, Nintendo gave up the mainland China market here (Sina 2013).

At this time, Tencent's agent of the national version of the Switch the sale before, Nintendo, also wanted to re-enter the mainland market. Since the ban on game

Fig. 8 GameBoy packaging and complimentary cards endorsed by Aaron Kwok

consoles was lifted in 2014, the mainland game market has risen rapidly, but Nintendo has never found a suitable time until this cooperation in 2019 (Huang 2019) (Fig. 8).

4.2 Analysis of the Chinese Product Market

Unlike other countries, China is a monstrous game market. On the one hand, from the early hot-end game to today's climbing hand game market, from manufacturers to gamers, online games in mainland China have become the world's number one game market after nearly 20 years of development. The market size in 2016 was more than 24 billion USD, occupying a quarter of the world game market. On the other hand, limited by the ban's impact on the sale of gaming devices in 2000, Chinese families have been insulated from home entertainment devices for a long time. Although the state lifted the ban in 2014, the country has long lost the soil for the growth of the single-player market, and in the face of the dominant end-game and hand-game market, everything can only start from zero (Shu 2017).

After the ban on game consoles was lifted, the e-sports industry entered a period of rapid explosion in mainland China. According to the 2020 China Gaming Industry Report, China's e-sports revenue reached 71.936 billion yuan in the first half of 2020 alone, up 54.69% year on year (Songzhu and Qiaorong 2020). In the console game market, according to the 2021 China Game Industry Report, the actual sales revenue of China's console game market reached 2.580 billion yuan in 2021, up 22.34% year-on-year (China's Game Industry Report 2021). There is still a great potential for growth in the mainframe market (Fig. 9).

Fig. 9 Actual sales revenue and growth rate of China's console game market

4.3 Differences and Problems

After conducting point-of-contact research and interviews with users, the study found that even though Nintendo had entered the mainland China market, advertising still had problems.

The problems of target users and promotion channels are, respectively.

First of all, the target customers, in July 2021, Nintendo's Chinese version launched a new advertising film, which showed a father coming home after work to play the Nintendo Switch console with his young daughter. However, the ad received a lukewarm response in mainland China, and there were even interviews with new Nintendo users who said they hadn't seen the spot. Still, the spring 2022 ad launched by Nintendo's Japanese version received more attention and reviews. In the Chinese version of the commercial, the main characters are the father and a young girl who seems to be young, which is a big gap with the largest number of user groups (20 ~ 25 years old) as reflected in the current survey. The perspective of the commercial is mainly placed on the father's point of view, which is difficult to arouse the children's interest and somewhat conflicting with the cultural background and concept of Chinese parents who are more concerned about their children's learning. However, it shows a family having fun with Nintendo products and does not impress more potential consumers.

The second issue is the problem of publicity channels. In Japan, the smartphone penetration rate is 39%, much lower than the 58% in mainland China (Xi 2022). This means that Chinese consumers, especially younger ones, rely more on their cell phones for information.

We found that most of the information for many users came from reprints on video sites, recommendations from bloggers and blogs on social media platforms, etc. There was less direct contact with Nintendo officials, and they rarely paid attention to the commercials. So in the Chinese market, the traditional T.V. advertising format no longer serves the purpose of better promotion. The channel difference makes the brand and its users rub shoulders with each other's communication (Fig. 10).

Fig. 10 Nintendo's Chinese version of advertising

5 Conclusions and Recommendations

5.1 Conclusions

Nintendo is a century-old brand that has been at the forefront of the industry for nearly half a century and continues to bring joy and happiness to its customers, just as it says it does. After analyzing Nintendo's strengths and weaknesses and its target market and customers, we found that even such a long-lived brand has its weaknesses and vulnerabilities in the face of the new generation. We hope that Nintendo will find its shortcomings in time, actively adjust itself, and continue to accompany generations of people and bring them laughter.

5.2 Recommendations

Nintendo has repeatedly failed due to its past attempts to enter the mainland Chinese market due to its lack of understanding of the Chinese market. From the beginning, with its lack of regard for localization and indifference to piracy, the past problems are being solved as the times develop. The relevant copyright protection laws in China are gradually improving, and Nintendo's localization is gradually being taken seriously (the Switch language can be changed to Traditional Chinese and Simplified Chinese). However, as we mentioned earlier, we found that there are still some problems with Nintendo in terms of advertising, for which we make some suggestions:

For the Definition of Advertising Targets. Nintendo should still have a more accurate understanding of its target customers, conduct certain surveys on new markets

and users, accurately grasp the characteristics of users, and then grasp their needs so that advertising can achieve greater publicity.

For Publicity Channels. Nintendo should follow up on the new habits of users; the moment of the decline of traditional T.V. advertising is also the moment of the rise of new media. For new forms of communication to learn and use, actively change the form of advertising based on the situation and increase the linkage between brands (such as co-branded blocks with Lego). In addition, cooperation with short video bloggers (advertising, live games) increases contact with users on social platforms so that the message can reach more users.

References

Aditya S (2021) Extensive SWOT analysis of Nintendo—detailed explanation & highlights. https://iide.co/case-studies/swot-analysis-of-nintendo/. Accessed 30 May 2022

Alessio P (2022) Xbox expected to gain console software market share over PlayStation & Nintendo by 2026, 25 Mar 2022. https://wccftech.com/xbox-expected-to-gain-console-software-market-share-over-playstation-nintendo-by-2026/. Accessed 30 May 2022

China's Game Industry Report (2021)

Huang Z (2019) Tencent acts as an agent for switch, and Nintendo has made great efforts to enter the Chinese market for 25 years. https://baijiahao.baidu.com/s?id=1632128873516647924&wfr=spider&for=pc. Accessed 30 May 2022

Le HTN (2018) Nintendo vs. its competitors in marketing efforts: from the point of view of customers

Shu W (2017) The ice breaking road of the home game market. Internet Weekly 10:41

Sina (2013) Cancellation of the ban on game consoles? Difficult to achieve in the short term. https://baike.baidu.com/reference/12602535/9b43Ljk_I7hIAfyhN7iHah4p3Tm132cAjsASSq2YynWuxQreew1q3-Fwv8OWWvmqfpaEZmJn6En1gIfh3dWiibYDNpBKXx8r. Accessed 30 Jan 2013

Songzhu B, Qiaorong L (2020) Digitalization of cultural industry Guangzhou has great potential. http://www.cnwest.com/a/2020/11/25/19313393.html. Accessed 30 May 2022

Steenkamp J-BEM (2001) The role of national culture in international marketing research. Int Mark Rev 18(1):30–44

Thomas A (2022) Nintendo revenue 2014–2021, by region, 8 Feb 2022. https://www.statista.com/statistics/216627/revenue-of-nintendo-by-region/. Accessed 30 May 2022

Valentine R (2020) The Nintendo Switch sold over 1.3m units in China this year, 10 Dec 2020. https://www.gamesindustry.biz/articles/2020-12-10-the-nintendo-switch-sold-over-1-3m-units-in-china-this-year. Accessed 30 May 2022

Xi C (2022) China's smartphone penetration rate of 58% while Japan is 39% India only 17%. http://www.diankeji.com/shuju/26287.html. Accessed 30 May 2022

Research on the Indicator for Measuring Nitrous Oxide Emission from Crop Residue

Leshan Song, Shuching Yang, Kexin Wang, and Yixuan Huang

Abstract Nowadays, global warming has become a great challenge faced by human beings and it is believed that the emissions of the greenhouse gases is the main cause of global warming. Therefore, it is essential to take immediate action to control the emission of greenhouse gases, including the nitrous oxide (N_2O). The objective of this research is to create a new indicator to compare the performances of different countries in controlling the nitrous oxide emission caused by crops' residues. It will also produce a ranking of the countries based on the indicator. Datasets showing the production of various crops and the amount of nitrous oxide produced are explored by using exploratory data analysis and cluster analysis. Data is also visualized by drawing maps to see the score distribution all over the world. The main programming language applied in this research is R.

Keywords Nitrous oxide emission · Crop residues · Global warming · Greenhouse gases · Environmental protection

1 Introduction

Nitrous oxide (N_2O) is an important anthropogenic greenhouse gas and agriculture represents its largest source (Reay et al. 2012). It absorbs radiation and traps heat

L. Song
Department of Statistics, The Chinese University of Hong Kong, Hong Kong 999077, China

S. Yang
Shenzhen College of International Education, Shenzhen 518017, China

K. Wang (✉)
Dornsife College of Letters, Arts and Science and Viterbi School of Engineering, University of Southern California, Los Angeles, CA 90007, USA
e-mail: kexin_arya@163.com

Y. Huang
Tippie College of Business, University of Iowa, Iowa City, IA 52240, USA

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_86

in the atmosphere. With a lifespan of an average 114 years, longer than most of the short-term pollutants, it is sort-of middle ground of super pollutants. Nitrous oxide can even pose a second threat to the environment. While nitrous oxide is exposed to sunlight and oxygen in the stratosphere, gas is converted into nitrogen oxides, causing the ozone layer which help to prevent most of the sun's ultraviolet from reaching the earth's surface to be damaged (Shankman 2019).

Based on the data shown on the FAO website, the emission of nitrous oxide caused by crop production accounts for about 10% of the total nitrous oxide emission, and the percentage is increasing every year. And agricultural sectors emitted almost 60% of the total anthropogenic N_2O emissions. The N_2O emissions are predicted to increase nearly 35–60% by the end of 2030 to meet the increasing global food demand. Issues concerning the environment are still on the rise. In the face of such a complex situation, immediate actions ought to be taken, or else this planet might no longer endure human inhabitation in the future.

Yale University had already created the Environmental Performances Index (EPI), which include several indicators to determine whether a country is environmentally-friendly in most of the aspects. There are also many articles and website discussing the huge emission caused by the crop's residues.

This research focuses on the emission of nitrous oxide caused by crops residues in different countries. It aims to create an objective indicator to compare the performances of different countries in being environmentally-friendly. Crop residues is the part of plants which is left in the agricultural field after they are harvested, for example, stalks, stems or seed pods. Nitrous oxide emission is produced when the microorganisms discompose the nitrogen left by the crop's residues in the managed soil (Taylor & Francis n.d.). This research uses the website of FAO as the main data source and mainly adapted two data sets. 11 crops are included in this research. A score is given to each of the country measuring its performance in controlling the emission of nitrous oxide, and a ranking of the countries is produced based on their scores. Section 3 includes the exploration and the analysis of the data, Sect. 4 includes the conclusion, discussions of this research and several limitations that need to be further studied, last section is citations of all the websites and articles this research uses for references.

2 Data Analysis

2.1 Data Overview

Two main datasets are adopted in this research. The source of the data is the Food and Agriculture Organization of the United Nations (FAO).

The first dataset includes the production of 11 kinds of maincrops in 200 countries from year 1981 to 2018. The unit of the production is ton.

The second dataset includes the emission of N_2O from the residues of 11 kinds of main crops in 199 countries from year 1981 to 2018. The unit of the N_2O emission is kiloton.

The websites are provided below:
FAOSTAT main website: http://www.fao.org/faostat/en/#data.
Emission > Crop Residues: http://www.fao.org/faostat/en/#data/GA.
Production > Crops: http://www.fao.org/faostat/en/#data/QC.

2.2 Data Preprocessing

I. Only the needed columns (Area, Year, Value) in the dataset are kept. Meaningless columns (Domain, Domain. Code, Flag etc.) are deleted.
II. The data from 2001 to 2018 are selected. This period of time is selected because the data are relatively more complete with few NA values and can show a recent trend of the indicator, which is much concerned.
III. The dataset of the crop production and the N_2O emission of crop residues are merged together. Then the column names of the dataset are revised.

The final dataset includes the N_2O emission and production data for 11 crops in 189 Countries from year 2001 to 2018.

2.3 N_2O Emission Efficiency Indicator

N_2O Emission Efficiency Indicator Construction

Raw Indicator Construction. Total amount of N_2O emission from crop residues largely depends on the number of crops that the country plant. But crop production should not be considered into a country's efforts of reducing food emission because a country's agriculture structure works for its population and highly depends on the geographical feature which cannot be controlled. Therefore, using emission-per-ton of produced crop instead can remove the impacts of the uncontrollable factor mentioned above. The formula for calculating emission-per-ton is shown below and the variable is added to the dataset generated in Sect. 3.

$$EmissionPerTon = N_2O_Emission \div Production$$

Formula 1: Calculation of emission per ton

The information of the dataset used for constructing the indicator is shown in Table 1.

To give an example for explaining the indicator construction process, the whole dataset is split into 18 separate datasets for each year, and the one for 2018 is selected.

Table 1 Information about the reorganized dataset

Variable	Description	Unit	Range		Average
Country	Name of country	/	/		/
Year	The year this row of data shows	/	/		/
Item	Type of crop produced	/	/		/
N_2O_Emission	Total N_2O emission caused by crops residues	Kiloton	0	− 61.9727	0.707337
Production	Production of each type of crop	Ton	1	− 364,262,150	3,696,831
EmissionPerT	N_2O emission caused by a ton of production	Kiloton per ton	0	− 5.933e−06	2.32e−07

Then the data of one typical crop item Barley is taken as an example for explaining the indicator construction process.

The histogram of the original emission-per-ton of this crop is shown in Fig. 1. Similar to this crop, the emission rate for most crop items are also skewed. Besides, there exist some extremely large or small outliers which are far from the majority of data. Therefore, some transformation on the raw data is considered.

The information of the dataset used for constructing the indicator is shown in Table 1.

To give an example for explaining the indicator construction process, the whole dataset is split into 18 separate datasets for each year, and the one for 2018 is selected. Then the data of one typical crop item Barley is taken as an example for explaining the indicator construction process.

The histogram of the original emission-per-ton of this crop is shown in Fig. 1. Similar to this crop, the emission rate for most crop items are also skewed. Besides, there exist some extremely large or small outliers which are far from the majority of data. Therefore, some transformation on the raw data is considered.

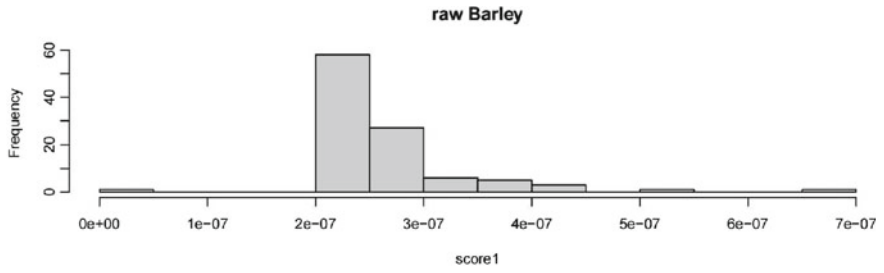


Fig. 1 Histogram of emission-per-ton of Barley in 2018 (raw)

Log Transformation. Firstly, natural log transformation on all the emission rates is applied to reduce the skewness of the original data. To avoid the error caused zero values in log transformation, a non-zero value—the smallest non-zero rate—is added to all the points.

Standardization. To be noticed, the emission rates of different crops vary a lot. Some crops emit in the magnitude of e−8 on average while some emit in the magnitude of e−7. Such difference is also reflected in the log-transformation result. So a fair comparison of emission reducing efforts should consider the difference of each crop. Therefore, the level of each country's emission rate of each crop should be standardized to the same scale. For each crop, the indicator needs to be transformed to the scale of 0–100, from worst to best performance.

However, as is shown by Fig. 2, outliers still exist after log transformation. To reduce the influences of outliers on data scaling, we map the 0–100 scale to 1–95% of the distribution and snap those extreme points to the margins of the regular data. In other word, the top 1% to the top 95% values are assigned from 100 to 0. Then 100 is given to the points higher than the top 1% while 0 are given to the points lower than 95. The margin values are set by observing the distribution of each crop.

In the graph, the green line marks the top 1% margin while the red line marks the 95% margin. They can exclude the outliers for both cases.

The standardized histogram after fixing the outliers is shown in Fig. 3. The problems of skewness and outliers are much improved compared with the raw histogram.

Weighted Sum. A fair comparison should also consider the agricultural structure—the proportion of different types of crops to the total crop production in the whole country. Therefore, weights is added to the emission indicators of each crop that has been transformed and standardized through the process above. The weights denote the proportion of the weight (in tons) of certain type of crops to the total production of this country. Then the final N_2O emission rate indicator of a country equals to the sum of weighted score of each crop planted in that country. The formula is shown below.

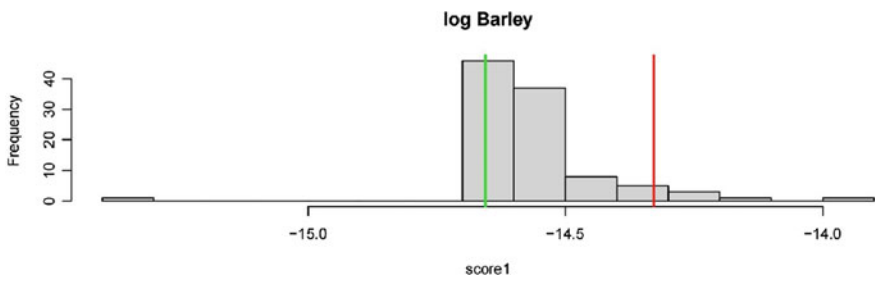


Fig. 2 Histogram of emission-per-ton of Barley in 2018 (log-transformed)

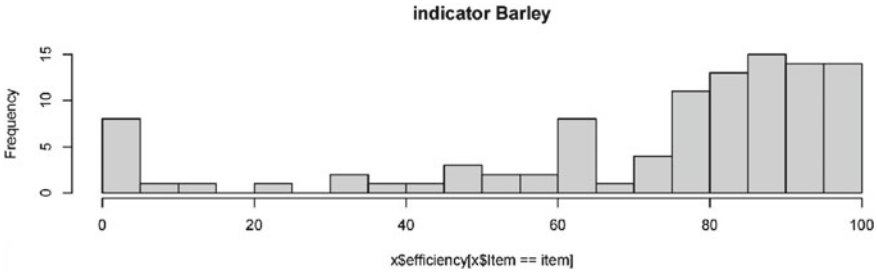


Fig. 3 Histogram of emission-per-ton of Barley in 2018 (standardized)

$$Indicator_Country_i = \sum_{j=1}^{n} indicator_crop_{i,j} \times weight_crop_{i,j}$$

Formula 2: Construction of indicator for each country

Missing Values. A few countries seem to get 100 score according to the final emission rate indicator, which all have small population and area. The emission values of every single crop planted in these countries are zero. Any type of crops with non-zero production will emit some gas even if the magnitude is very small. Therefore, these zeros might not stand for real zero but missing values or extremely small values. Thus the data for these countries are removed from the dataset.

N_2O Emission Rate Indicator Results. The names and the final N_2O emission rate indicators (NER) of the best and worst 5 countries in 2018 are shown in Tables 2 and 3.

Table 2 Best 5 countries

Rank	Country	Total
1	Kuwait	99.93045
2	United Arab Emirates	99.32768
3	New Zealand	98.89664
4	Ireland	97.35114
5	UK	96.38847

Table 3 Worst 5 countries

Rank	Country	Total
1	Vanuatu	0
2	Djibouti	0.94552
3	Democratic Republic of the Congo	3.14362
4	Mozambique	10.31628
5	Liberia	12.45723

N_2O Emission Indicator Visualization. The indicators from 2001 to 2017 are calculated based on the indicator construction process in 4.3.1. To visualize the tendency and features throughout 18 years, the world map showing the indicator of each country by different colours is plotted. To merge the score data with the 'world' data from R package 'maps', the names of the countries in two datasets are revised to be identical. In these maps, dark green stands for the highest 100 score while red stands for the lowest 0 score. And the correspondence between the colours and indicators in the middle range are shown in the legend in the maps below.

Due to the limitation of space, only the maps of year 2001 and 2018 are displayed in Figs. 4 and 5.

It can be inferred that the overall colour distributions of the two years are quite similar. Most of the European, American and Asian countries perform well in N_2O emission from crop residues. The performances of African countries are relatively poorer, but some countries in North-West Africa have made some progress in the 18 years.

Cluster Analysis. To divide the countries into clusters based on the 30 EPI indicators and the NER indicator, the K-means Cluster Analysis is applied.

The newest 30 basic indicators for the Environmental Performance Index (EPI) are merged with the NER indicator we have constructed.

For some indicators, a lot of NA values appear because the performance in some aspects of the countries are not measurable. For example, the MPA indicator is constructed based on the performance in marine protection, but there are many land-locked countries in the world. To avoid the potential problem may be caused by NA

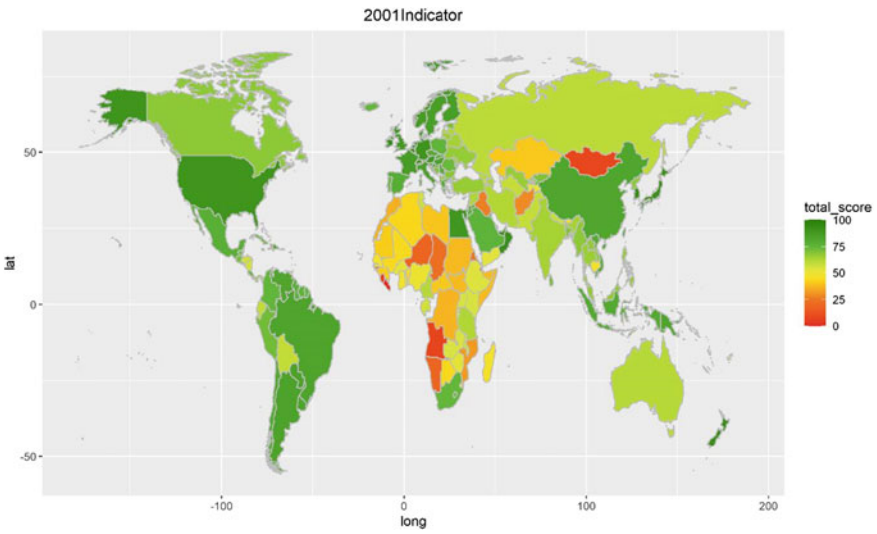


Fig. 4 World map showing the N_2O emission rate indicator in 2001

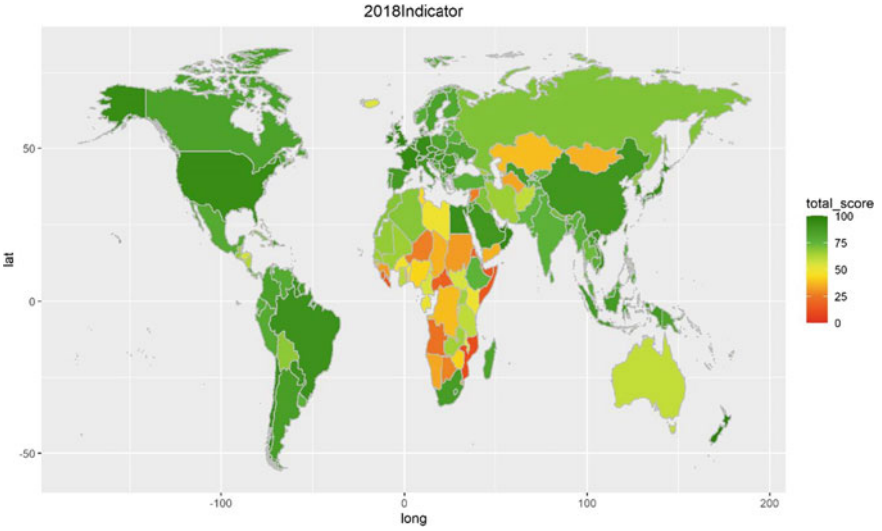


Fig. 5 World map showing the N_2O emission rate indicator in 2018

values in cluster analysis and ensure the fairness, the NA values are replaced by the mean value of the column.

The number of clusters is set to be 4 and the number of random sets for the starting center is set to be 100.

The result of the K-means clustering is that there are 38 countries in the first cluster, 43 countries in the second cluster, 50 countries in the third cluster and 39 countries in the fourth cluster. The list of the clusters of countries is shown in Table 4.

2.4 A Subsection Sample

The center values of the indicators for each cluster are shown in different colours in Fig. 6. It can be inferred that each cluster has some specific features. The 2nd cluster performs the best in most of the indicators while the 1st and 3th cluster performs worse in most of the indicators.

Figure 7 shows the positive linear correlation between the log-transformed GDP per capita and the NER indicator. The correlation coefficient between them is 0.61. Therefore, the GDP per capita is combined with the clusters and NER indicator in Fig. 8 for further analysis of each cluster.

In Fig. 8, the countries in different clusters are plotted in different colors.

The countries in the 1st Cluster are mainly developing countries located in Africa, Middle East and East Asia. Most of their GDPs per Capital are below 20,000$, with one outlier Qatar. More than half of their NER indicators are above 60 while the others are between 0 and 50.

Table 4 Clusters of the countries

1st cluster	2nd cluster	3rd cluster	4th cluster
Afghanistan	Australia	Angola	Albania
Algeria	Austria	Bangladesh	Argentina
Azerbaijan	Belgium	Benin	Armenia
Bosnia and Herzegovina	Canada	Bhutan	Bahamas
Cape Verde	Chile	Burkina Faso	Belarus
China	Croatia	Burundi	Belize
Djibout	Cyprus	Cambodia	Bolivia
Egypt	Czech Republic	Cameroon	Botswana
El Salvador	Denmark	Central African Republic	Brazil
Eritrea	Estonia	Chad	Brunei
Faroe Islands	Finland	Comoros	Bulgaria
Fiji	France	Ethiopia	Colombia
Gambia	Germany	Ghana	Costa Rica
Georgia	Greece	Guatemala	Cuba
Grenada	Hungary	Guinea	Dominican Republic
Guyana	Iceland	Guinea-Bissau	Ecuador
India	Ireland	Haiti	Gabon
Iran	Israel	Honduras	Jamaica
Iraq	Italy	Indonesia	Kuwait
Jordan	Japan	Ivory Coast	Malaysia
Kazakhstan	Latvia	Kenya	Mexico
Kyrgyzstan	Lithuania	Laos	Morocco
Lebanon	Luxembourg	Liberia	Namibia
Lesotho	Malta	Madagascar	New Caledonia
Libya	Netherlands	Malawi	Nicaragua
Mauritania	New Zealand	Mali	Panama
Mauritius	Norway	Mongolia	Paraguay
Micronesia	Poland	Mozambique	Peru
Moldova	Portugal	Nepal	Philippines
Montenegro	Romania	Niger	Russia
Myanmar	Slovakia	Nigeria	Serbia
North Korea	Slovenia	Rwanda	South Africa
Oman	South Korea	Sao Tome and Principe	Sri Lanka
Pakistan	Spain	Senegal	Suriname

(continued)

Table 4 (continued)

1st cluster	2nd cluster	3rd cluster	4th cluster
Papua New Guinea	Sweden	Sierra Leone	Taiwan
Qatar	Switzerland	South Sudan	Thailand
Saudi Arabia	UK	Tajikistan	Trinidad and Tobago
Solomon Islands	United Arab Emirates	Tanzania	Venezuela
Somalia	USA	Timor-Leste	
Sudan		Togo	
Syria		Uganda	
Tunisia		Zambia	
Turkey		Zimbabwe	
Turkmenistan			
Ukraine			
Uruguay			
Uzbekistan			
Vietnam			
Yemen			

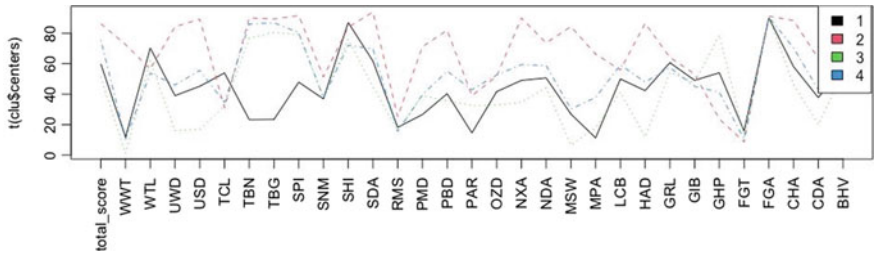


Fig. 6 Cluster centers

The countries in the 2nd Cluster are mainly developed countries located in Oceania, Europe and North America. The countries have high GDP per Capita, ranging from 20,000$ to 120,000$. And most of their NER indicators are above 70.

The countries in the 3rd Cluster are mainly developing countries located in Africa and Asia. The GDP per Capita of these countries are less than 10,000$, which is rather low. The NER indicators range from 10 to 80 uniformly.

The countries in the 4th Cluster are mainly developing countries located in South America and Asia. Most of their GDPs per Capita are below 20,000$ while some are around 40,000$. And most of their NER indicators are above 60.

It can be inferred that the countries may tend to have higher NER indicator and go into the cluster with an overall better performance as the income increases. However,

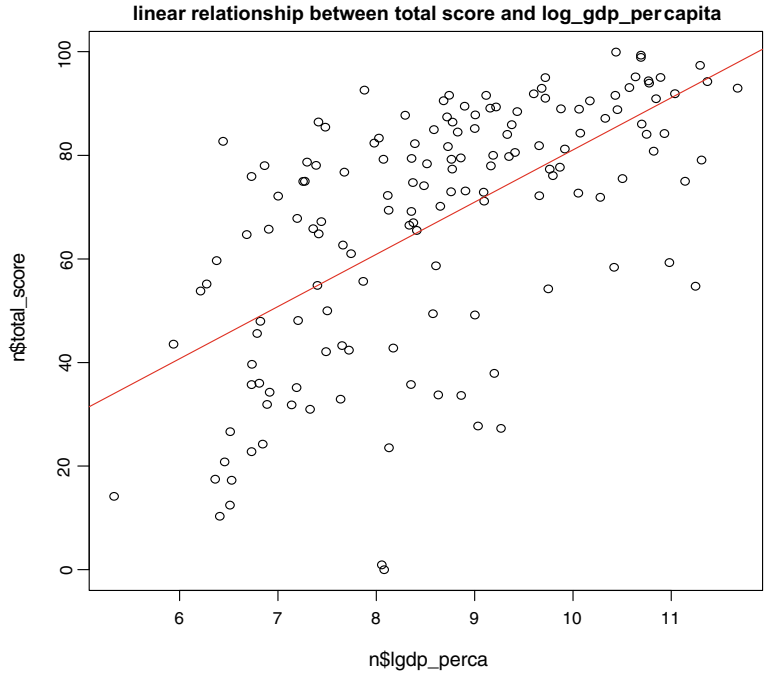


Fig. 7 Scatterplot of log-transformed GDP per capita and NER indicator

some countries with lower income even perform much better than the wealthier countries.

3 Limitation and Discussion

This research creates an indicator by giving each countries a score measuring the amount of nitrous oxide emission caused by the crop residue. Although the exploration has already gained some evidence to show which countries act more environmental-friendly, and which do not by ranking the scores of the countries. There are still some limitations which need to be further studied:

1. This research uses FAO website as the only data source, since the data set which shows the nitrous oxide emission of various kind of crops in each country only include 11 crops, this research only does some exploration of these 11 crops. These crops include 6 of the 10 leading crops in the world: Cassava, maize, plantains, potatoes, rice, sorghum, soybeans, sweet potatoes, wheat, and yams are some of the leading food crops around the world (National Geographic Society 2014).

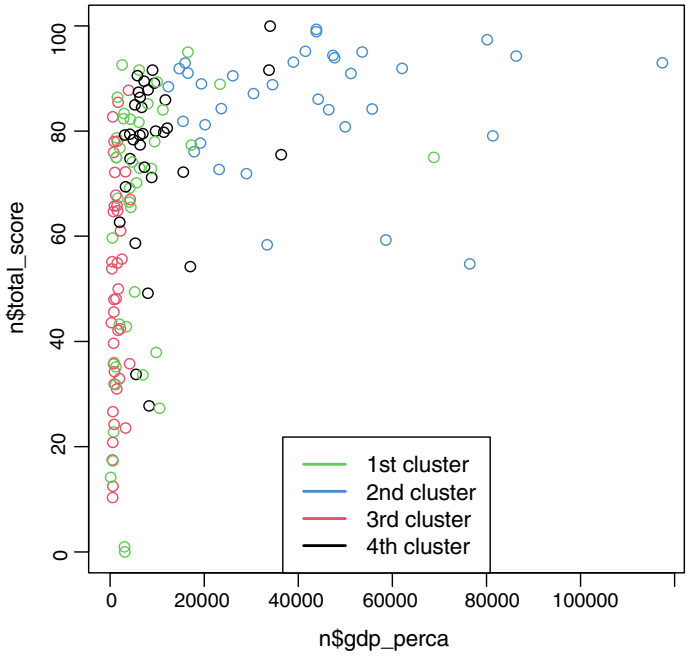


Fig. 8 Scatterplot of GDP per capita and NER indicator of countries in different clusters

- Although most of the countries produce at least one or a few types of crops, there are a few countries such as Greenland, which do not produce any at all, due to the improper environment to plant crops. And this means that they are not included in this research.
- In addition, different countries have favour of various main crops, some countries' main crops may not be included in this research. Several countries included in the research only produce one of the eleven crops. Although the emission produced by planting the other crops may represent their emission in some degree as they represent the countries' crop-growing techniques and people's attitude toward diminishing the emission of global warming gases, this may also cause the result to be biased.
- Furthermore, eight countries are deleted from the data set in this research: Antigua and Barbuda, Bahrain, Barbados, Dominica, French Polynesia, Maldives and Puerto Rico. In the data set, those countries' nitrous oxide emission for growing crops are shown 0, which is believed to be impossible. The emission of nitrous oxide when planting crops can only be controlled but inevitable, "It's mostly produced by microbes in soil and naturally released" according to the information on the website Civil Eats (Wozniacka 2020). So, it is implied that zero emissions may be caused by the small amount of production of the crops, which cause the measurement of emission to be inaccessible.

- As a result, the ranking this research produces cannot be considered to be a rigorous world ranking.

2. This research focuses on the nitrous oxide emission caused by the crop residues and the production of different crops, but does not include the effects to the environment cost by handling the redundant production. Several countries are given considerably higher scores due to the huge production of crops.

One of the most common way for managing the redundant production of crops this is to burn the crop residues. Based on the information on the website Greenhouse Gas News, "Burning of agricultural waste also produces significant amounts of nitrous oxide due to its generally high-water content", a large proportion of the emission of nitrous oxide is produced when dealing with the wasted crops (Greenhouse Gas n.d.). The data showing the emission of nitrous oxide caused by burning the crop residues is also available on the FAO website. In this case, a country may produce a large amount of nitrous oxide emission even if it is given a considerably high score.

On the other hand, it is also suggested that other ways to deal with the redundant production of crops may be beneficial for the environment, according to the information on the article "Crop Residue Removal Impacts on Soil Productivity and Environmental Quality", one of the benefits of leaving crop residues is "mitigating global climate change by sequestering SOC and off-setting emissions of CO_2 and other greenhouse gases" (Taylor & Francis n.d.).

To conclude, the amount of abundant crops production in different countries and their strategies to treat them may have serious effect on the emission of nitrous oxide. But this is not reflected by the scores given to the countries.

3. This research uses the data of the nitrous oxide emission caused by the crop residues. However, nitrogenous fertilizer is a common fertilizer being used all over the world. It is hard for the data collectors to exclude the emission caused by the nitrogenous fertilizer and only measure the amount of nitrous oxide caused by the residues.

4 Conclusion

In this research, the NER indicator measuring the N_2O emission caused by crop residue is constructed. The indicator has some significance in evaluating a country's performance in environmental protection. According to the ranking and clustering results, there is an urgent need for some developing countries in Africa and Asia to make some efforts in both improving the agricultural production technology and reducing the emission. The main limitation of this research is the missing data of several countries and crops. And the nitrous oxide data may also be affected by the various types of fertilizer used. In the future, more countries will be included in the research to give a more credible world ranking. And more factors affecting the NER indicator will be studied to help find a solution to reduce the N_2O emissions. For

example, using nitrification inhibitors is an option for decreasing fertilizer N use and additionally directly mitigating N_2O emissions (Mosier et al. 1996).

References

Greenhouse Gas (n.d.) Nitrous oxide sources—biomass burning. http://www.ghgonline.org/nitrousbioburn.htm

Mosier AR, Duxbury JM, Freney JR, Heinemeyer O, Minami K (1996) Nitrous oxide emissions from agricultural fields: assessment, measurement and mitigation. In: Van Cleemput O, Hofman G, Vermoesen A (eds) Progress in nitrogen cycling studies. Developments in plant and soil sciences, vol 68. Springer, Dordrecht, pp 589–602

National Geographic Society (2014) Staple food crops of the world. https://www.nationalgeographic.org/maps/wbt-staple-food-crops-world/

Reay D, Davidson E, Smith K et al (2012) Global agriculture and nitrous oxide emissions. Nat Clim Change 2:410–416

Shankman S (2019) What is nitrous oxide and why is it a climate threat? https://insideclimatenews.org/news/11092019/nitrous-oxide-climate-pollutant-explainer-greenhouse-gas-agriculture-livestock/

Taylor & Francis (n.d.) Crop residue removal impacts on soil productivity and environmental quality. https://www.tandfonline.com/doi/abs/10.1080/07352680902776507

Wozniacka G (2020) The greenhouse gas no one's talking about: nitrous oxide on farms, explained. Civil Eats. https://civileats.com/2019/09/19/the-greenhouse-gas-no-ones-talking-about-nitrous-oxide-on-farms-explained/

Research on the Influence of L'Oréal Paris's Marketing Strategies on Chinese Consumers

Tianjun Yang, Kaiyi Yuan, and Zhe Zhang

Abstract With the rapid growth of China's economy, its huge population base, and a diversified cultural environment, the increase of the cosmetics industry is on the rise. L'Oréal Paris is a famous cosmetics brand with a history of 120 years; it entered China in 1997, so the brand has a certain market foundation and has some fixed consumer group. Thus the team thinks research on the influence of L'Oréal Paris's marketing strategies on Chinese consumers is essential investigate. Then the team made use of two methods, including SWOT analysis and the Survey method, because the team members would like to study the problems of L'Oréal Paris and explore the characteristics of the brand's users to precisely identify the brand's target customers. In the third step, the result is made up of current analysis and problem analysis. In the current analysis, the teammate made a questionnaire to find personal demographic information and buying behavior. In the problem analysis, due to the COVID-19 pandemic, the team decided to ask how to sell the products using the social platform since there are many benefits to letting the brand out of the crisis. In the discussion, this paper compared the scale of online and offline consumption from 2018 to 2021 and found that online shopping has become popular and has some risks. Consequently, the paper indicates that the content has an important role and positive significance in developing L'Oréal Paris in China.

Keywords L'Oréal Paris · Chinese consumers · Influence · Marketing strategies

Authors Tianjun Yang, Kaiyi Yuan and Zhe Zhang contributed equally.

T. Yang
School of Tourism Science, Beijing International Studies University, Beijing 100024, China

K. Yuan
Fowler College of Business, San Diego State University, San Diego, CA 92182, USA

Z. Zhang (✉)
School of Chemical Engineering, Dalian University of Technology, Dalian 116081, China
e-mail: zzcorinna@mail.dlut.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_87

1 Introduction

1.1 Research Background

L'Oréal Paris is a cosmetics brand from France. Since then, several leaders have improved and changed the products of L'Oréal, expanding the brand equity and values in the global market. Nowadays, it has become the No. 1 in the cosmetics industry. So, it's necessary to introduce the background of this brand.

French chemist Oren Schuller founded a hair dye company in 1907, and in 1939 the name of the manufacturer was changed to L'Oréal Paris, which belongs to the L'Oréal group. Nowadays, L'Oréal group has been chosen as the most popular company and has been selected as one of the world's top 500 several times (Mengying 2015). In addition, L'Oréal is known as a beauty company. It was classified into numerous fields, including skin care, hair care, make-up, and perfumes. Up to now, the headquarters of L'Oréal is located in Paris, and there are 80,000 staff, 283 stores, 39 factories, and 150 sales centers worldwide.

Through the group discussion, research on the influence of L'Oréal Paris's marketing strategies on Chinese consumers confirmed that it's the final title. The main reason is that L'Oréal Paris entered China in 1997, so the brand has a certain market foundation in China, and it also has some fixed consumer group; moreover, due to the COVID-19, a large number of brands are facing a down-turn in revenue. However, the profit of L'Oréal Paris is rising (Meng 2021). Based on two cases can prove that L'Oréal Paris has sufficient ability to resist the pressure. This paper can help people better understand the marketing strategy of L'Oréal Paris for Chinese consumers and provide suitable customer service. Therefore the team considers this topic which is worth investigating.

1.2 Literature Review

Li analyzed that as people pursue a high quality of life and pay more and more attention to health and skin care, cosmetic brands' strategies have begun competing fiercely with each other, including brand creation, brand management, and brand promotion. To gain a foothold in the skincare industry, whether a new cosmetic brand or an established product, a cosmetic promotion campaign is essential to gain a certain level of visibility in the market and boost sales. The cosmetics industry is a highly competitive and homogenized market. In today's information explosion, the key issue for cosmetic brands is how to gain a foothold in consumers' minds in the online economy (Jingjing 2022). Wu proposed that women have become the main consumers and are playing an increasingly important role in the economic market, especially in the cosmetics market, where women account for most of the market share. In particular, women account for the majority of the market share in the cosmetics market. Therefore, cosmetic companies must fully study women's

consumption behavior in formulating marketing strategies and make the marketing content more relevant to women's consumption psychology. Stimulating women's consumption desire to the greatest extent possible, thereby effectively increasing the company's economic benefits. It is also important to give women a better shopping experience, which will help increase their stickiness and make them think of the brand first when they next buy cosmetics, thus contributing to the long-term stability of the cosmetics business (Min 2021). In the context of the booming ecommerce industry and the advent of the "face economy" trend, cosmetics e-commerce has become a highly popular consumer goods sub-sector on e-commerce platforms. Many domestic and international brands set up e-commerce sales channels, and the cosmetics online shopping market is continuing to heat up. Chinese consumers are now increasingly focused on their own sensory and experiential content, with the focus shifting from products and services to the overall experience of the shopping process. If companies limit themselves to traditional services and do not focus on the customer experience, customer satisfaction and brand loyalty will likely decrease. Losing loyal customers will have a huge impact on the company's profits. Therefore, during fierce competition, cosmetic companies have naturally started to use experiential marketing to attract and retain customers and are using it to strengthen their competitive advantage and enhance customer loyalty. The Internet emphasizes interactivity, which is in line with the characteristics of experiential marketing, so it is an inevitable trend for cosmetic companies to carry out experiential marketing in the e-commerce environment (Xingyu 2022).

1.3 Research Framework

L'Oréal Paris, a reputable brand, entered the Chinese market in 1997. It is necessary to understand the marketing strategy of its brand. Many industries are facing a blow due to the factors of the epidemic. The outbreak of COVID-19 inevitably hit the beauty industry. The main objective is to examine what marketing measures L'Oréal Paris has taken in the face of the epidemic and how it stands out from the competition in the beauty industry. Many local brands are sprouting in the Chinese market. How is L'Oréal Paris adapting its strategy to cope with the competition from local brands L'Oréal Paris knows that people love beauty. During the epidemic, many people bought things online but took a long time to receive them. People in the aftermath of the epidemic started shopping with a vengeance. By following the trend of online shopping, L'Oréal Paris has also received considerable revenues from live streaming on major platforms. With more and more people supporting the local brand, L'Oréal Paris's marketing strategy should also make changes and be more competitive. By adjusting the price, changing the packaging, improving the products to make them more suitable for local skin, and respecting local culture, L'Oréal Paris needs to adjust.

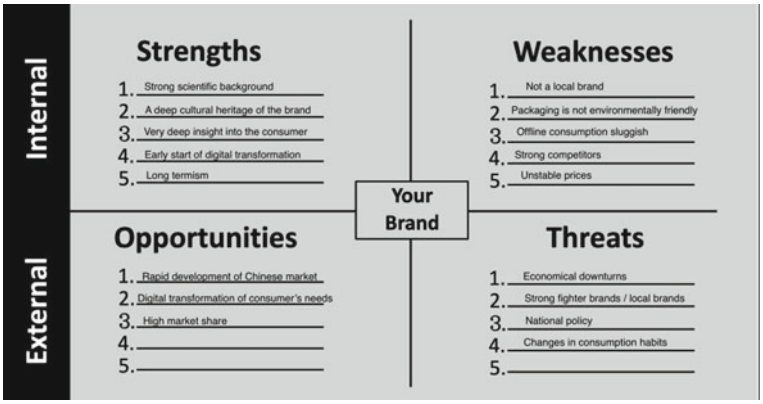


Fig. 1 SWOT analysis

2 Method

2.1 SWOT Analysis

In this part, according to the SWOT analysis of L'Oréal Paris, we found that L'Oréal Paris still has many problems that need improvement. The first one is that the brand needs to be more localization. The brand can be more integrated into the local market to understand the local culture. We can know what customers want by communicating with customers and collecting feedback. The second point is that individual environmental protection awareness will increase, and L'Oréal Paris can change its packaging. For example, in 2019, L'Oréal Paris released the initial paper packaging with Albéa, aiming to reduce the use of plastics in the cosmetics industry (Bei 2019). The third problem is that fewer and fewer people are shopping in brick-and-mortar stores. Due to the COVID-19 pandemic, numerous stores were closed, so people tend to shop online. The fourth point is how L'Oréal Paris can stand out from the competition of many beauty brands. Many brands are entering the market, and L'Oréal Paris needs to consider making its products different from other brands (Jun 2016). Thus, the above improvement measure is not an easy challenge for L'Oréal Paris (Fig. 1).

2.2 Survey Method

Investigation and research method refers to obtaining relevant materials directly through investigating and understanding the objective situation and analyzing these materials. In this paper, we will analyze and synthesize the characteristics of the

brand's users to precisely identify the brand's target users. Targeted marketing strategies will be designed for the target user groups. Specific marketing plans and implementation steps will be developed in conjunction with the actual situation to achieve good interaction between products and consumers. In this process, firstly, we need to understand the target customers' needs; secondly, we choose the appropriate communication means and methods according to the target customers' needs. Finally, we use the corresponding tools to provide information support for the target customers and help them complete their purchase behavior.

3 Result

3.1 Current Analysis

The performance of L'Oréal Paris in the aftermath of the epidemic was a pleasant surprise. The brand focused heavily on the online live stream. Various beauty industries are responding to the situation shift and saving themselves in the e-commerce channel. L'Oréal Paris joined an event in partnership with Douyin Super Product Day called "The hall of beautiful gifts, two stores open together," which brought over 22 million RMB. The two stores are an offline flagship store in Shanghai and an E-commerce store on the Douyin platform (Chinese TikTok). The success of L'Oréal Paris on the Jitterbug platform means that users on Jitterbug are likely to be exposed to the brand. TikTok will recommend the videos to relevant people. Many items are available to customers at discounts price and other promotions. By launching the brand on the Douyin platform, L'Oréal Paris can also bring continuous exposure to the brand and attract previous customers. The integration of online and offline will also bring certain benefits. Online will improve shopping efficiency. The web can also help brands acquire users. Online can also have one-on-one customer service to help customers solve problems and find the right products. The benefit of offline is that customers have a better shopping experience and can try out the products they want and are interested in.

Except for the social platform that L'Oréal has adopted to generate more revenue, it is also important to understand the core customers. To better understand buyers, the questionnaire we conducted and sent to 16 participants gave us some valuable information. Questions included personal demographic information, buying the product in-store or online, the price sensitivity, purchasing the product at the reference price or discount price, the satisfaction of the service in-store, willingness to buy L'Oréal Paris products, and from which channel the customers notice our brand. There are 13 participants between the ages of 19 and 29. Another 3 participants are between the age of 30 and 46. The target audience we investigated is females in the workforce and aged between 30 and 46. People in this age group are usually married, employed, and have a stable income. Our interview results show that three people over the age of 30 have an income of more than 10,000 RMB. People in this age

group are usually employed and have a stable income. Our interview results show that three people over 30 years old have an income of more than 10,000 RMB. They are more aware of the brand of L'Oréal Paris. The way that they gain brand awareness is through their friends, social media, and website pop-ups. They can distinguish the differences between L'Oréal Paris and L'Oréal Group. This survey shows that L'Oréal Paris's audience is female university students. L'Oréal Paris could develop more products for this customer group and explore more people to be part of this group. The above results are important because integrating online shopping and offline stores can increase brand awareness and provide a better shopping experience to customers. The target customers are in an essential position for the brand. The income generated from the marketing activity can be used to invent more products or improve certain products suitable for the core customers.

3.2 Problem Analysis

According to the above statement, a question that needs to be discussed is how to sell the products using the social platform. With the development of the Internet, online shopping is related to our daily life; In addition, thanks to the COVID-19 pandemic, it has led to the sales industry has been greatly affected. Hence, online shopping or a combination of offline and online has a percentage to help brands survive the crisis. There are some benefits of online sales in the following statement.

First, actively interact with customers. Online sales make full use of the interactivity of the network to make the communication between business-owner and consumers faster and easier. On the Internet, the merchants face not only the common customers but also the customers with specific purposes. Buyers and potential customers through the Internet take the initiative to find business websites and online stores and put forward their own material needs of goods and services. Thus manufacturers can provide more adequate services based on the personality of consumers.

Second, extend infinitely. On the social platform, the location of sales is also not limited. The Internet can extend enterprises' business to all parts of the world. It can be operating without national and regional boundaries and real economic local protection, trade barriers, and enterprise strength. As long as consumers have a computer, visitors can visit virtual stores anytime and select the goods they want.

Third, more colorful promotional methods. In the physical store, limited by time, venue and personnel, it's impossible to simultaneously hold multiple promotions in the same store. Still, individuals can simultaneously see dozens of promotional activities in an online store. Although too many activities will affect or distract some consumers, we can also see more consumers are looking for suitable products for their taste sales plan. For manufacturers, online sales can sell their goods and services to the world at the least cost, making small businesses bigger and local companies become global enterprises.

Fourth, reduce costs and increase revenue. Through the Internet, the business of an enterprise is carried out in a "virtual market" network environment to buy and sell goods. By saving market and channel costs, enterprises have low-cost competitive advantages. Network marketing strengthens the information exchange between enterprises and suppliers by reducing purchasing costs, establishing a direct connection between enterprises and consumers, reducing transaction links and sales expenses, completing the sharing and communication of internal information, realizing unified management, and reducing management costs.

New tools will inevitably replace the old tools. E-commerce is the biggest development trend in the twenty-first century. In the next three to five years, we believe that L'Oréal Paris will create a huge business miracle of ten times or even one hundred times speed. And the first brand to enter the trend will also gain massive commercial benefits.

4 Discussion: Strategies Analysis

The turnover of L'Oréal Paris on TikTok Super Product Day is 22 million RMB (Haining 2022). L'Oréal Paris opened an offline flagship store in Shanghai using the online platform. This result means that L'Oréal Paris's marketing strategy was successful. The integration of online and offline will also be a way for brands to learn from. Yang et al. suggest that consumers search for the products online and purchase them offline. In China's market, the economy has developed rapidly. More and more people would make purchases online (Yang et al. 2020).

Figure 2 shows that offline consumption in 2018 was higher than online shopping. Beginning in 2019, online shopping is skyrocketing. This shows that L'Oréal Paris is sensible to choose to bring goods on TikTok. TikTok has people with different incomes and careers. TikTok will use big data to push the suitable shopping live streams to the relevant people. The income earned by L'Oréal Paris can not show the specific strategy the seller has used for promoting the products. It is important to hire sealers which are experienced and familiar with the products. TikTok shopping platform may become the way people shop in the future. But buying things on top of TikTok is also risky. People cannot see or touch the product but only buy based on the sellers' description. So, there will be a contrast between what you think in your mind and what you have received. More research should be done on what people want and what they get the match. This may require more people to keep an eye on quality and raise brand requirements on the Douyin platform.

Our brand customers are mostly women who are students. According to a case study based on Chinese female university student consumer behavior, "Among all the consumer groups, female college students in China have achieved rapidly increasing consumption" (Bingchan et al. 2021). Students generally have no or low income, but they are essential to our sales. The case study claims, "The female students in college in Shandong, China spent 15.1% of their monthly expenditure on cosmetics." This data shows that most female college students are willing to spend their money

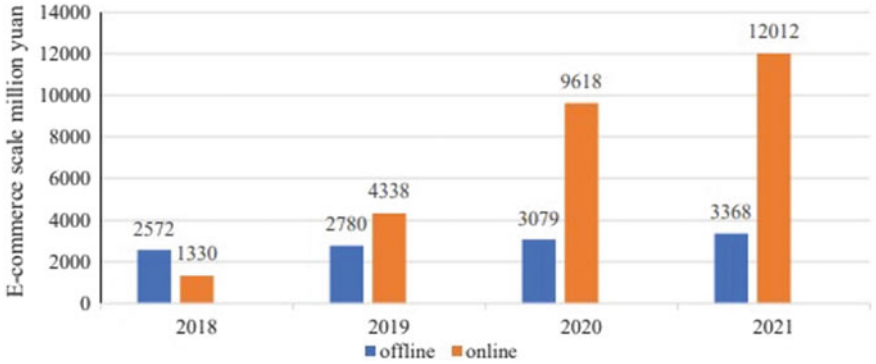


Fig. 2 Comparison of the scale of online and offline consumption from 2018 to 2021

on beauty products. It is also possible that we can use the precise promotion to attract more customers and make college females become our primary customers. Compared with our interview, we asked 16 females. 13 were students, and three were in the workforce. Students are sensitive to the price, but 14 consider the price reasonable, and two people think the price is a little high. The case study shows that "Only L'Oréal Paris got a rate of more than 50%" (Bingchan et al. 2021). This proves that the usage rate of L'Oréal Paris is much higher than other brands.

This proves that the usage rate of L'Oréal Paris is much higher than other brands.

As shown in Fig. 3, the results indicate those female college students are the core customers for L'Oréal Paris. After the brand knows its customers, it can know more about their wants and what price range they are comfortable with.

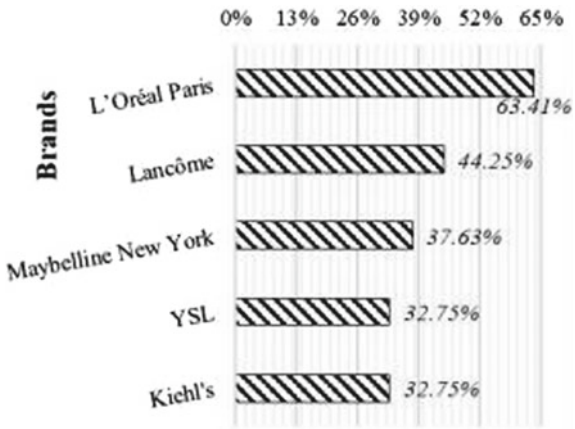


Fig. 3 The proportion of female college students choosing each cosmetics brand

5 Conclusion

5.1 Research Findings

Through the questionnaire and investigation, the team found that the core customers are spread widely from 19 to 29 years old, and people in this age group are employed without a high income, so it's complex for them to afford the luxury, such as YSL. Hence, L'Oréal Paris has become their main choice in the cosmetics list. In addition, thanks to the pandemic in 2020, numerous physical stores were closed. The online store works as the main source of income. Therefore the team members are willing to know how to sell the products via social media after the individual obtained the information about the advantages of the online store, so the teammates think it's a good channel for the brand. In the discussion, the team analyzes the strategies and trends of selling. L'Oréal Paris has already sold the goods on TikTok and achieved great marks because TikTok has people with different incomes and careers, so the brand has expanded the sales range. However, people only know the products by the business owner's description; it also has some risks. As a result, it requires more people to keep an eye on quality and raise brand requirements on the social platform.

5.2 Research Significance

The study provides insights into the brand's marketing mix and consumer preferences in China, which has contributed to the development of the brand L'Oréal Paris. This research can provide strategic principles for business growth, forecast trends, innovate products, find new markets, help companies identify, analyze, evaluate, select and seize market opportunities and open up new growth spaces. This promotes business growth, guides companies to establish the right market concept, organizes market production and distribution, and fundamentally addresses the key issues in business growth.

5.3 Limitations and Future Studies

This paper has methodological limitations in that it lacks a section on parallel comparisons of L'Oréal Paris with other brands. Also, as an important sub-brand of the L'Oréal Group, the strategy of L'Oréal Paris is relevant to the group and other subsidiaries. Further research could focus on the remaining brands with a larger market share in the Chinese market and the rapidly growing local brands. Specific recommendations for future development and implementation of strategies can be provided.

References

Bei S (2019) L'Oréal group has launched the first paper packaging, pp 4–5

Bingchan X, Minxuan H, Yunxi Z (2021) Experiential marketing of L'Oréal in China: a case study based on consumer behavior of Chinese female university students. Atlantis Press. https://www.atlantis-press.com/article/125965999.pdf

Haining L (2022) Rapid development of Douyin will have a great threat to Taobao and subvert the industry pattern. Atlantis Press. file:///C:/Users/Kaiyi/Downloads/125971817%20(1).pdf

Jingjing L (2022) Analysis of the marketing strategies of cosmetic brands in the context of the internet celebrity economy. Dazhongshangwu 2022(2):203–204. https://doi.org/10.12309/j.issn.1009-8283.2022.02.073

Jun H (2016) L'Oréal cosmetics marketing status-based on SWOT analysis, pp 2–3

Meng Z (2021) L'Oréal and Shiseido marketing strategy comparison in China, pp 15–16

Mengying S (2015) Analysis on L'Oréal's company's brand marketing strategy in China. J Econ Bus Manag 9–10

Min W (2021) Talking about cosmetic marketing strategies from women's consumer behaviour. Consum Guide 2021(16):91. https://doi.org/10.12229/j.issn.16725719.2021.16.071

Xingyu L (2022) Research on the impact of experiential marketing on customer loyalty in the cosmetic industry under the E-commerce environment, 21 Apr 2022

Yongqing Y et al (2020) Understanding the effects of physical experience and information integration on consumer and information integration on consumer use of online to offline commerce. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0268401219304827

Research on the Influencing Factors of Shipping Industry Based on Linear Regression Model

Ruixing Liang

Abstract The epidemic in the past two years has caused considerable fluctuations in the global economy. At the same time, it has also had a great impact on the stock market. People's income continues to increase, and the stock market receives many investors' investment due to its high rate of return. But the stock market also has high risks. Based on the Golar shipping company as the main research object of the shipping industry, this paper also selects the S&P 500 index, consumer price index, interest rate and other influencing factors as the main influencing factors. When the U.S. and European exchange rates fall, the company's stock will rise, but this factor is not as significant as the CPI and S.P. 500.

Keywords Multiple linear regression model · S&P 500 · Consumer price index · Golar shipping

1 Research Background

With the development of the times and the rise of residents' income, people can freely mobilize funds more and more abundant, the pursuit of high-yield and high liquidity has become the investment target of most people today, and the stock market, which is highly suited to this characteristic and has a low investment threshold, has been sought after by the general public, but the stock market will be due to the emergence of fundamental news and other factors resulting in large ups and downs, resulting in investors facing high returns or huge losses, which is not conducive to the construction of the stock market.

Since 1980, global deflation has created a rising path for stock markets. Post-war Japan is in the second period of rapid economic development, the world's five major economic powers signed the "square agreement", the rapid appreciation of the yen, so there has been a speculative boom in Japan, because of the "land will not depreciate"

R. Liang (✉)
New Channel School, Beijing, China
e-mail: liangruixing177@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_88

land myth, Japan's land prices rose rapidly, banks continue to Appreciation of land as a guarantee to debtors a large number of loans, the national continued to buy stocks, but at this time the value of assets can no longer be supported by industry, Japan's bubble economy began to decline, speculators lost the desire to speculate, stock prices fell, losses more intense, The Japanese financial has been greatly affected.

The 1997 Asian financial crisis caused a sharp fall in Asian stock markets, with only Chinese mainland and Taiwan unaffected across the region. As Thailand's change of exchange rate system caused the disorder of Thailand's foreign exchange and surrounding financial markets, soros-based international speculators seized the loopholes in the system to snipe at the Thai baht, triggered the financial turmoil, Malaysia, Indonesia, Singapore and other countries were involved, Hong Kong's Hang Seng Index fell sharply, as low as 6600 points, the ruble also depreciated by 70%, the Russian stock market fell sharply, the stock market of various countries fell.

Since 2001, the U.S. housing market has continued to boom, with the U.S. subprime mortgage market growing rapidly due to low U.S. interest rates, and with the rise in short-term U.S. interest rates, subprime mortgage repayment rates have risen sharply, adding significantly to the repayment burden on home buyers. At the same time, the cooling housing market has also led to buyers to sell their homes or refinance through mortgage housing became extremely difficult, the situation also led to a large number of subprime borrowers can not repay loans on time only to be mortgaged back to the bank, and banks can not recover houses but can not sell high prices by large losses, triggering the subprime crisis, U.S. stocks fell sharply, with the S. and P. S. index down 48%, Fannie Mae and Freddie Mac down 97% and 98% respectively, and AIG recording the biggest losses in U.S. corporate history. The new crown outbreak, which began in 2019, has been the biggest recession since World War II, disrupting the way listed companies issue bonds for share buybacks, damaged stock valuations, a sharp rise in the risk premium paid by listed companies, and a liquidity crisis in global financial markets triggered by the collapse in crude oil, which has led to a plunge in U.S. stocks, heavy losses in U.S. and European stock markets, and a policy of isolation between countries that has led to the destruction of the global trading system, with major economies such as Europe, Japan and the United States suffering heavy losses. It can be seen that the changes in financial markets are closely related to people's daily lives, and how to study the changes in financial markets has become a topic of discussion.

The epidemic has a huge impact on various industries in China. According to the revenue data of the aviation industry in the first half of the year, it can be seen that the three major airlines of Air China, China Eastern Airlines and China Southern Airlines have suffered serious losses. Among them, Air China it even lost more than 10 billion yuan last year. On the other hand, the shipping industry has also received a huge impact. The epidemics in many countries, including many epidemics in China, are related to cold chain transportation. Many shipping companies will carry cold chain transportation and other businesses. The emergence of the epidemic has made it impossible for these companies to carry out their shipping business, and many ships

have been idled, causing many shipping industries to suffer losses. The global shipping market is in chaos! The serious imbalance between supply and demand, shipping companies have repeatedly raised prices, various congestion charges, surcharges, and astronomical freight rates of more than 20,000 U.S. dollars make the industry can not help but sigh the huge impact of the epidemic on the shipping industry. Fortunately, with the recovery of the epidemic in China and the recovery of the economy. On August 30, COSCO Shipping Holdings, the leading container shipping company, disclosed the 2021 semi-annual report. From January to June 2021, the company achieved operating income of 139.264 billion yuan, an increase of 88.06% over the same period of the previous year; net profit attributable to shareholders of listed companies was approximately 37.098 billion yuan, an increase of 3162.31% year-on-year; net profit after recurring gains and losses was 37.02 billion yuan, an increase of 4096.43% year-on-year. In 2021, due to the continuous outbreak of the new crown epidemic, international logistics capacity has declined, and container ship freight rates have risen sharply. Although the increase in logistics costs will reduce the profit margins of export companies, it is not a small benefit for companies engaged in container shipping. Therefore, studying the shipping industry has great significance and influence in the current epidemic.

Golar LNG Limited was founded on 10 May 2001 in Hamilton, Bermuda, which is the owner and operator of an independent LNG carrier and floating storage gasifier carrier. Golar LNG Limited was listed on the NASDAQ Stock Exchange on 12 December 2002, and is a typical maritime company whose Ship Operations Department rents vessels to clients on a fixed terms. Golar is in a leading position in the shipping industry and has innovated in many businesses. Therefore, the research of Golar is of great significance to the industry.

2 Literature Review

So far, many scholars at home and abroad have carried out in-depth research and analysis on the financial stock market, and have made more remarkable research results Chen based on the intuitiveness and importance of price to financial markets, based on the data of China's stock market from January 2004 to June 2020 as a sample, to explore the price factors on the Maxim effect caused by the pursuit of upward behavior, concluded that: investors' courage to catch up is obviously affected by price, The smaller the index or volatility that reflects the overall price level of the market, the more happy investors are to chase up stocks with high extreme returns, and the Max effect becomes significant (Sun 2021). Yuan et al. proposed a method to quickly extract investor trading characteristics in the massive stock trading details, and based on the logic regression, decision tree and random forest and other machine learning algorithms to find the main factors of the stock market inflection point, while predicting the trading characteristic variables on the stock market large inflection point of the time range, with the Shanghai and Shenzhen stock indices as experimental samples, with six months of test results proved the effectiveness of the model

(Yuan et al. 2021). Zheng et al. used the factor analysis model and the multiple regression linear model to analyze the correlation between the performance of A-share real estate listed enterprises and stock price data in 2019, and concluded that the profitability and operational ability of A-share real estate listed enterprises are positively affecting stock prices, while the operational capacity is greater, and the correlation between A-share real estate listed enterprises' solvency and growth capacity and stock prices is very small (Zheng et al. 2021). Sun takes the stock market as the starting point of China's market economy and an important part of China's financial market, studies the five negative factors such as economic growth, inflation, monetary policy, interest rate, exchange rate, etc., establishes a multi-linear regression model, and draws the influence of five aspects of macroeconomic factors on stock prices (Chen 2021). Li used the main component analysis and five-factor model to study the impact factors of the new three-board stock pricing, empirically analyzed the scale, market value, profitability, foreign investment, macro-environment five factors on the new three-board stock pricing, and concluded that the profit factors on the new three-board stock price is the largest degree of influence, macro-environmental factors are moderate, and the impact of scale, market value and foreign investment is small, It is also suggested that price setters should evaluate the value of the company and stock prices according to the main influencing factors (Li 2018). Zhao collected Shibor monthly economic data from 2006 to 2017 as the research object, used government expenditure, exchange rate, money supply M2, fixed asset investment, inflation rate and stock price index as a sample of explanatory variable data, established a cointegration equation and error correction model, using pulse response analysis, variance decomposition to study the impact of various variables on China's market interest rate, the impact degree. This puts forward the view that more attention needs to be paid to the positive impact of government expenditure on interest rates in order to better promote the reform of interest rate marketization in China (Zhao 2018). Ma selected the Shanghai Composite Index as the data base, measured the return status of China's stock market by its first-order differential pair, and constructed a multi-linear regression model, which was based on macro-macroeconomic factors such as China's GDP, exchange rate, CPI, total social investment and fiscal government expenditure from 1996 to 2015 (Ma 2018). Wang and Yang by means of empirical analysis, selected the transaction data of 20 brokerage stocks listed on China's A-shares in 2012–2014 to establish a regression model, and found that the overall β coefficient of the brokerage sector stocks is high, The characteristics of strong speculation and sensitive and violent response to information are the weather vane of China's stock market, and the weak applicability of CAPM model and three-factor model in the brokerage sector is verified, β coefficient, book market value ratio, price-earnings ratio and other indicators and individual stock yield are significantly related. It has a certain ability of interpretation, and makes up for the shortcomings of existing research through research. Based on the multifactor theory of asset pricing and the macro multifactor pricing model (Wang and Yang 2019). Wang and Meng explain the role and position of using macro factor as an explanatory variable in the empirical asset pricing model, study the method of constructing risk factors in the multifactor pricing model using macroeconomic variables, summarize the application scope of

macro multifactor pricing theory, and put forward the research direction in this field in the future (Wang and Meng 2018).

To sum up, many scholars have chosen the factors affecting the stock market as the research object when studying the financial market, and after collecting a lot of data, they have established financial models for in-depth analysis, and used machine learning algorithms and big data and artificial intelligence as the analytical methods to enhance the accuracy and persuasiveness of the data.

3 Theoretical Model

This article applies the arbitrage pricing model to study the factors affecting stocks. The arbitrage pricing model is developed based on the capital asset pricing model. In the research process of this article, the Standard and Poor's 500 index is selected as one of the main research factors. The Standard and Poor's 500 index is usually used to express the volatility of the entire stock market. The Standard and Poor's 500 index is also a very important data indicator in the capital asset pricing model. However, if we only study the impact of the Standard and Poor's 500 index on the stock market, we cannot fully summarize the influencing factors of Golar's stock market. Therefore, more influencing factors need to be considered for the impact of Golar. In this way, in addition to the Standard and Poor's 500 Index, when other relevant influencing factors change, investors and individuals can make reasonable purchases and sales.

The arbitrage pricing model was proposed by Ross in 1976. The arbitrage pricing model is a further supplement and development to the capital asset pricing model. The capital asset pricing model can calculate the volatility of the stock return rate for the Standard and Poor's 500 index, that is, the entire stock market. However, in addition to the impact of the entire stock market, the return rate of a stock or an industry will also have various comprehensive factors, such as consumer price index and exchange rate fluctuations. Moreover, both systemic risk and non-systemic risk have an impact on the return rate of stock prices or a certain industry. The assumptions underlying the arbitrage pricing model:

1. Investors have the same investment philosophy.
2. Investors expect to bear lower risks, avoid risks, and pursue maximum utility.
3. Completeness of the market.

The arbitrage pricing model is an equation of asset prices and equilibrium derived on the basis of the return rate of a given influencing factor and the corresponding beta coefficient. The basis of the arbitrage pricing model is the law of price, and the result is the rate of return of the corresponding asset. At the same time, the arbitrage pricing model is an equilibrium model used to study how the price and yield of securities are determined and affected. The arbitrage pricing model assumes that the rate of return is affected by both systemic and non-systematic risks. In the process of estimating

the rate of return, there are more influencing factors than the capital asset pricing model, which is more in line with the actual situation.

4 Influence Factor

4.1 S&P 500

The 500 companies in the Standard and Poor's 500 index are all traded on the two major U.S. stock exchanges, the New York Stock Exchange and NASDAQ. Nearly all of the companies in the Standard and Poor's 500-stock index are the nation's top 500 stocks traded, and they are among the best in the self-market, accounting for about 75% of the U.S. market value. And the S-P 500 index is market-weighted, which better reflects the actual importance of corporate stocks in the stock market. In the past, financial markets have become increasingly complex, and the independent and rigorous analysis of the S.P. 500 Index and its extensive information coverage have been trusted by the industry, and the S.P. 500 Index has become a major part of the global financial base. At the same time, the S-P 500 is an important reference for analyzing stock price movements. The rise of the index reflects the broad prospects of the industry, people's investment enthusiasm has risen, the stock market is active, stock prices have risen; On the other hand, the decline in the index reflects the poor outlook for the industry, people's enthusiasm for investment is declining, stock market enthusiasm is declining, stock prices will also fall, such as due to the outbreak of the new crown, S.P. 500 created the lowest point during the outbreak of 2237.40 points low, and because of the epidemic under control, the index from the low start to rise about 100%, market sentiment sensitivity rose, stock market passion was reactivated, stock prices rose sharply.

Therefore, the Standard and Poor's 500 index is a crucial factor in analyzing the factors affecting the stock market. The Standard and Poor's 500 index can be used to indicate the volatility of the entire stock market. At the same time, it will also affect people's stock investment psychology.

4.2 Consumer Price Index

The Consumer Price Index is a macroeconomic indicator that reflects the changes in the price level of consumer goods and services that households can generally purchase, and is also an important indicator of national economic accounting for macroeconomic analysis and decision-making, referred to simply as CPI. Generally speaking, CPI directly affects the introduction and strength of macro-economic control measures, such as whether the central bank raises interest rates, whether to adjust the reserve requirement ratio, etc., is an important reference indicator of

market economy activities and government monetary policy. Inflation refers to a general and sustained rise in price levels, and the level of CPI can reflect the severity of inflation to some extent. In general, CPI rise is price increases, stock prices rise, conversely, CPI falls, prices fall, stocks fall. But beyond that, share prices are still affected by the purchasing power of money, which refers to the number of consumer goods and services that a unit of money can buy, the rise in CPI indicates a decline in the purchasing power of money, and the decline in CPI indicates a rise in the purchasing power of money, which is a countdown. But CPI is a relatively lagging data, CPI rise, consumers can use to invest in the amount of idle funds decreased, the stock market therefore enthusiasm fell, stock prices fell, the opposite CPI fell, consumers can be used to invest in the amount of idle funds increased, stock market enthusiasm rose, stock prices rose. The rise in the consumer price index will not only lead to inflation, but raise prices as well. However, due to the lag effect of wages, people's real wages may fall in the short term, thereby reducing investment in the stock market.

4.3 Exchange Rate

Exchange rate is the exchange rate between the two currencies, which is the price of another currency expressed in one country's currency. The size of the exchange rate is influenced by the inflation of interest rates, the country's political policies and national economic factors. It is an important lever for international import and export trade, so the exchange rate rise will promote imports; in developed markets, if the exchange rate is relatively low, asset prices will be low, which will lead to capital outflow. If the exchange rate is relatively high, asset prices will be high, conducive to capital outflow. For example, by the time the exchange rate was changed to the beginning of 2013, the yuan had risen by 35% against the dollar, and although it eased the trade imbalance between China and the United States and narrowed China's trade surplus. It had significantly reduced China's export competitiveness and hit the Chinese economy hard, but China's foreign exchange reserves did not fall back, mainly because the sharp appreciation of the yuan led to a large flow of international capital into China for speculative profits. It can be said that the impact of exchange rates on international financial markets is enormous.

5 Empirical Study

In this paper, the stock data of Golar Shipping from August 31, 2020 to July 31, 2021 and a series of data such as S-P 500, CPI and exchange rate are selected to analyze and study the volatility and influencing factors of stocks in the shipping industry.

The research in this paper firstly classifies and analyzes the influencing factors of the shipping industry. For example, there are many systemic risks affecting the

Table 1 Golar's beta coefficient spss analysis results

Factor	Beta
EUR/USD	− 0.292
CPI	− 0.046
S&P 500	0.998

shipping industry. The three major stock indexes related to the entire market are the Standard and Poor's 500 Index, the Dow Jones Index and the Nasdaq Composite Index. In addition to the factors affecting the three major stock indexes, the shipping industry will also be affected by residents' consumption. The current global epidemic is spreading. Although China and other countries have effectively contained the epidemic, there are still sporadic cases. The normalization of the epidemic has greatly affected the recovery and stability of the economy. The following is the data based on the multiple linear regression model through spss software. The following is a data regression analysis based on the multiple linear regression model through spss software (Table 1).

From this table, it can be concluded that the β coefficient of CPI to its company's stock price is − 0.046, indicating that CPI is a systemic risk factor for the company's share price, volatility has an inverse relationship with its share price, the US CPI rises, and the company's share price falls under its influence; The decline in the U.S. CPI, the company's share price rose under its influence, and its share price has a significant impact, and the S-P 500 has a positive β coefficient of 0.998 for the company, indicating that if the S-P 500 rose, the company's stock rose; If the company's shares fall, the company's shares will fall, and the S.P. 500 will have a significant impact on its share price. The exchange rate of the European and American currencies has a reverse β coefficient of − 0.292, indicating that the exchange rate of Europe and the United States is also a systemic risk factor for the stock, when the exchange rate of Europe and the United States rises, the company's stock will fall under its influence; When the U.S. and European exchange rates fall, the company's stock will rise, but this factor is not as significant as the CPI and S.P. 500.

6 Conclusion

This paper analyzes the stock influence factors of Golar Shipping by analyzing the data of SPSS, establishing a linear regression model, taking the S-P 500, CPI and exchange rate as the influencing factors, and finds that the stock index of S-P 500, as the stock index of 500 listed companies in the United States, is an important index to reflect the wide range of market changes. Golar Shipping's stock price will change accordingly, and gonorn's shares as representatives of the shipping industry, you can know that the stock price of international shipping companies will be due to exchange rate changes, so when choosing to invest in shipping companies, according to the

status of the S.P. 500 and the direction of the exchange rate as a reference point since the gains.

Although the arguments selected in this paper are representative, but we still need to choose more influencing factors for the study object, so we need to make more correlation research to understand the volatility factors of the maritime market stocks, so that the maritime market and financial markets can have better development.

At present, with the rapid development of Internet technology, big data analysis can be performed when processing data. At the same time, many scholars have begun to use artificial intelligence models, such as self-encoding networks for supervised and unsupervised learning of data. In this way, collecting a large amount of data for research and analysis of beta coefficient and arbitrage pricing model will make the results more accurate. Therefore, in the subsequent research process, in addition to collecting more influencing factors for research in the shipping industry and other industries. Big data and artificial intelligence and other related models will also be incorporated into the financial model for data analysis and model optimization, so as to obtain a more accurate structure.

References

Chen W (2021) Research on the influencing factors of MAX effect in financial market—based on price perspective. Finance Econ Theory Pract 42(03):49–57. https://doi.org/10.16339/j.cnkihdxbcjb.2021.03.007

Li H (2018) Influencing factors of stock pricing in the new third board: empirical analysis based on principal component analysis and five-factor model. J Hubei Second Norm Univ 35(10):43–48

Ma H (2018) An empirical analysis of the influencing factors of my country's stock return—based on the research of econometric methods. Times Finance 08:202–204

Sun J (2021) The impact of macroeconomic factors on stock price volatility. Qual Mark 16:110–113

Wang Q, Meng Q (2018) Research on the impact of macroeconomic factors on the stock return rate of my country's A-share market—based on the application of macro multi-factor model. Price Theory Pract 07:91–94

Wang Y, Yang K (2019) Research on the applicability of the CAPM model of listed securities companies and the influencing factors of earnings. J Chongqing Univ Technol (Nat Sci) 33(01):193–200

Yuan Y, Li G, Zhao Z, Xu L (2021) Research on influencing factors of stock market turning point based on machine learning. Comput Sci 48(S1):165–168+177

Zhao Y (2018) Analysis of the influencing factors of my country's interbank offered rate—an empirical study based on the VEC model. J Changchun Coll Finance 05:30–42

Zheng H, Rui L, Chen S (2021) A research on the correlation between stock price and corporate performance—based on an empirical analysis of 102 A-share listed real estate companies. J Liaoning Univ Technol (Nat Sci Ed) 41(03):201–205. https://doi.org/10.15916/j.issn1674-3261.2021.03.015

Research on the Market Development Strategy of Sports Apparel Companies Based in Canada

Wenman Jia

Abstract Canadians are willing to pay more money on Sports related things such as wear and equipment. Studying how local Canadian sportswear companies promote and introduce their product to the market is crucial to understanding how companies can survive and get higher market share. The research will mainly discuss how Canadian local athletic apparel companies promote their brand and provide recommendations for their future development. This paper will use comparative analysis and case studies to help explain the topic more specifically. Moreover, the research will mainly focus on the problems of Canadian local sports companies and why they have those problems. Through analyzing the current situation, this paper will provide some advice and possible strategies for local Canadian companies.

Keywords Canada · Sports apparel company · Market · Development strategy

1 Introduction

1.1 Research Background

Sports is the activity that people like to do during leisure time. There are different kinds of sports that people can play and satisfy different needs of people. Athletic leisure apparel is crucial to support sports activities. In North America, many people like to do sport during leisure time. Many people like to play snowboarding or skiing during winter and rugby during spring in Canada. This article will mainly focus on the athletic apparel market in local Canadian brands and how they introduce their products to the market. According to the Canada apparel yearbook data, Canadians will consume about $4.3billion in 2020 on sportswear and products (Ttighe 2010, 2019). Canadian athletic leisure apparel market value will continue to increase to

W. Jia (✉)
Kings Edgehill School, Windsor B0N 2T0, Canada
e-mail: wenmanjia23@kes.ns.ca

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_89

$4.8 in 2022 based on Canada's market value. In addition, the research on the Canadian average annual household expenditure on sports shows an increasing trend from $133 in 2017 to $208 in 2019 (Yearbook (Canada) 2021). All those data imply an increased trend in Canadian expenditure on sportswear and equipment. This implies that Canadian are willing to pat more money on Sports related things such as wear and equipment. Studying how local Canadian sportswear companies promote and introduce their product to the market is crucial to understanding how companies can survive and get higher market share. In addition, this research can provide a framework for new athletic leisure apparel companies to survive in this highly competitive market.

1.2 Literature Review

Dore analyzed that many sports equipment that Canadian purchase comes from other countries, such as China and the United States, and Canada also exports more than 76% of their sports apparel to the US. Those sports apparel is mainly for playing golf, hockey, soccer, snowboarding etc. The report also mentions that with the development of the internet, athletic apparel companies in Canada are more likely to promote their product by using the internet. Magazines are also a very important promotion channel in Canada. More than 2 million youth and adults read sports magazines in Canada (Dore). Linchpin indicates that a new sports company normally likes to create engaging content by letting some celebrities deliver a good brand image to customers. The company will have a more specific target audience to focus on as time passes. People can use an appropriate market mix during this time based on different target audiences. In addition, new sports companies may choose to work with sports marketing firms to promote their brands (Linchpin). And Deshpande mentions that with the increase in the diversity of athletic apparel, customers have more choices, pushing sports apparel companies to have some unique selling points. This can help them to stand out and distinguish themselves from their competitors. Many famous sports companies like Adidas and Nike like to increase brand recognition and sales revenue. Increasing brand recognition of companies can let customers choose their products when they are not very familiar with the market. People might purchase their products in the long run because they are very famous and popular.

Furthermore, celebrity endorsement is an expensive and effective way to encourage customers to buy athletic apparel. People who admire or like those celebrities will buy those clothes or pants to strengthen their bond with celebrities (Maharashtra). Mahapatra proposed that lululemon is one of the best Athleisure Wear brands of 2020. It is a local Canadian brand that focuses on female customers. They use social media very efficiently and have their tag on Twitter. The Twitter tag #thesweatlife lets customers know the diversity of lululemon. During the COVID 19, Lululemon reacted very fast to the pandemic and opened an online yoga class on YouTube to strengthen their bond with society. This local Canadian company mainly expand a

product into the various dimension to expand their market and continue to be more globalized (Scheplitz 2020).

1.3 Research Gap

Most of the articles focus on athletic apparel companies' strategies and how those strategies influence companies' sales revenue. They mention sponsorships and different kinds of advertising that the company can use. Applying those strategies can help the company increase its sales revenue more efficiently and build up its brand image in the long run—those articles research many famous companies and the market leadership of athletic apparel. In contrast, only a few articles discussed athletic apparel brands with low market share and local brands in Canada.

1.4 Research Framework

This article will first discuss the Canadian market's background, which can provide basic knowledge for readers. Then, the paper will mainly focus on different kinds of strategies that local athletic apparel use and how efficient those strategies are. It will also include some data and case studies to help readers understand deeply. Finally, this article will comment on those promotion strategies and conclude.

2 Method

2.1 Comparative Analysis

The comparative analysis method is a methodology that enables the analysis of multiple cases in a complex situation. It can help explain why change happens in some cases but not in others (Simister and Scholz). This paper will use the comparative analysis method to compare the strategies of Canadian athletic apparel companies and different achievements by using different promotion strategies. In addition, it will also compare different tactics that American athletic apparel companies use with local companies in Canada to see how Canada attracts their customers from international competitors. Comparing the loss and profit accounts of Canadian local athletic apparel companies with their competitors shows how much money companies invested in research and development. This method can help compare the differences and similarities between different companies and how it affects their market shares and sales revenue. Besides, it can show which kinds of development and promotion strategy is better for Canadian companies to become more successful. Based on

the result of the conclusion, the article analyzes what factors cause the difference between two different groups that have been compared.

2.2 Case Study

A case study refers to an intensive study about a person, a group of people, or a unit, aiming to generalize over several units (Roberta). This research will apply the case study method to study some examples of Canadian companies that improve their economic condition and have high market growth by using promotion strategies. It is also a way to know how Canadian companies can differentiate their product from rivals and develop a unique selling point. Applying the case study method in the paper can provide evidence for arguments in this article. To explain further, a case study helps to reduce the bias. It encourages readers to view things in diverse aspects, and it is more objective to compare with information on companies' official websites. Case studies report things based on companies' data and facts. Case studies also provide a holistic view of the whole market or specific companies. There is both background information on companies and up-to-date action of athletic apparel companies.

3 Results

3.1 Data Analysis of the Canadian Local Athletic Apparel Market

As a developed country, Canadian have more leisure time and have more ways to spend their leisure time. Canadians like to play ice hockey since it is Canada's national sport. Besides, more Canadian women like to do Yoga during their free time. Hence, the increase in popularity and diversity of sports helps increase the sales revenue of athletic apparel companies. According to research by Statista, the value of the athletic apparel market in Canada is more than $4.8 billion. And trade value of exercise equipment imported to Canada is about $487.41 million. The pandemic has less influence on Canadians in 2021 since the Canadian government published a new Covid policy and more Canadian inject vaccines. That improvement of covid helped increase 12.5% of retail sales in Canada and produce $198 million in profit for Canada (Tighe). This increase implies that more Canadian have a healthier lifestyle and are more likely to spend money on athletic apparel. Based on the research on favorite athletic apparel and sportswear brands among consumers in Canada in 2020, over 25% prefer to buy Nike, and more than 15% of Canadians would like to buy Adidas.

In contrast, only 11% of Canadian prefer to purchase Lululemon, and 4.7% may purchase Roots products- the local brand in Canada (Prodege 2020). As the market

leader in the athletic apparel market, Nike and Adidas gain economies of scale from suppliers and have the price-setting ability. They can produce athletic apparel with lower prices and better quality. Besides, they have a high customer loyal base and brand recognition compared with local Canadian brands. There are more than 190 stores of Nike in Canada, but there are only 62 Lululemon stores in Canada. Lululemon's sales in Canada increased from $447 million in 2016 to $672 million in 2020 since they 'invest more money in promotion to attract potential customers (Tighe 2020). However, Nike and Adidas dominate over 30% of the local Canadian market.

In conclusion, the trend of Canadian help to increase the sales of the athletic apparel market. It lets local Canadian brands sell more products than before. This means that local Canadian brands improve their sales, and other brands in the market achieve high sales.

3.2 Issues that Canadian Local Athletic Apparel Companies Have

Under this circumstance, local brands in Canada can't get much market share and have less opportunity to become the market leader in Canada. US companies occupy most of the Canadian athletic apparel market. Canadian local companies can dominate the market and face fierce competition from international businesses. To explain further, Canadian local athletic apparel companies own fewer brands than Nike or Adidas. They only have one or few brands in their company, the failure of one brand may cause huge financial damage to the company. Besides, most local Canadian brands, such as lululemon and roots, have a smaller size than Nike and Adidas. They have less money to invest in promotion and expand their market.

3.3 Analysis of Issues

The size history of local Canadian companies is shorter than the dominant player in the market. To take examples of Canadian brand local brands Lululemon and an American brand Columbia, lululemon faced a decrease in revenue between 2014 and 2015 and started to increase since it changed its promotion strategy and improved its products. Thus, their sales will increase to 672 in 2020. Even with the pandemic in 2019, Lululemon's sales still increased by more than $70 million compared with 2018. Their target customer is youth female and people who play Yoga or fitness. In some aspect, Covid 19 help them to boost their sales since Yoga and fitness are indoor activities with less restriction on the environment. The Covid force people to stay home. This trend encourages more people to do fitness or Yoga in their homes, which helps increase Lululemon sales.

In contrast, another local Canadian brand called Columbia's net sales decreased from $203.1 to 174.4 from 2019 to 2020. According to their report, their global sales fell 4% year over year. It declines from $945.9 million to $915.7 million (Guyot). Even if Lululemon's sales are higher than Columbia's, the owner of Columbia- the Portland, Oregon-based company- decides to use a market development strategy to increase their sales revenue and have another brand in another market. Thus, the failure of Columbia will let the company use another brand to replace Columbia and minimize the financial damage to the company. Columbia also announces that it will "unlock China's full potential", which may help to increase Columbia's sales by between 18 and 20% in its annual net sales. In addition, American brands such as Nike and Adidas have more revenue streams than local brands in Canada. They also have more ways to promote their brands since they have much financial support. Nike and Adidas sponsor to support other products to increase their sales. It can help increase brand awareness and sell more products since people are more likely to buy the brand they are familiar with. Nike sponsors some of the clubs that play World Cup. When the team sponsored by Nike wins the game, it can help improve Nike's brand image and increase its sales revenue of Nike indirectly.

Some local Canadian brands face financial issues since they have much current liability. To take an example of lululemon, it is true that its sales increased year by year, but its revenue decreased between 2014 and 2015. This is due to the high current liability of Lululemon, which can cause a short-term liquidity problem. Their current ratio increases to 9.3 (ideal between 1.5 and 2.0) after 2014 (Sharma 2014). In the same year, their products have low quality, which decreases the sales of Lululemon. In the same year, Nike's current ratio is 2.5, which is much better than Lululemon. Hence, some local Canadian athletic companies lack financial management, which causes a liquidity problem.

4 Discussion

4.1 Be More Active in a Niche Market of the Athletic Apparel Market

Based on the Canadian athletic apparel market research, Nike and Adidas are the dominant players in the market that have the price-setting ability and have more sales than local Canadian companies. Those companies have a larger size and financial support than companies such as Lululemon or Roots. Hence, it is hard for local Canadian brands to compete with the market leader in the athletic apparel market. They should develop in a niche market since they have fewer competitors and a more loyal customer base. For example, Lululemon's target customers are females. Developing a more specific market segment and focusing on minority market customers can let the company increase its market share easier. Besides, they also create unique selling points to differentiate themselves from competitors. Lululemon has a team

program to build long-term relationships with athletic teams and yoga studios. This strategy can let Lululemon set up a better brand image in Canada since they involve more in society. By differentiating from their competitor, they concentrate on female customers who have often been neglected by the market and develop a stable customer base. Developing in the niche market can let them get a stable customer base in a low, competitive market. To explain further, Nike and Adidas are developed in the mass market with more potential customers and benefits from an economic scale. In contrast, firms that don't have a high market share in the athletic apparel market can't get an economy of scale since customers' demand is less than the dominant market player. As a result, involvement in more niche markets can let local Canadian companies get more customers who ignore by the mass market.

4.2 Using Branding More Efficient

Branding is a way to let Canadian local athletic apparel companies distinguish from their international competitors. Promoting a company's brand can let the company take much advantage and earn more profit. To explain branding by using the product life cycle, when the product is in the introduction stage of the cycle, the company starts to promote it as a brand, and a small number of people start to try this new brand. As the sales revenue increases, the company inter the growth stage, and more customers know about the brand and can recognize the brand when they see the logo. Since the brand has been successfully promoted in the athletic apparel market, the product published by the company has entered the phase of maturity, which means many people know about the brand, and some people are loyal to the brand. For local Canadian companies such as Roots, branding can help them have a more loyal customer base and expand the life cycle of products. Roots can set up a good brand image and loyal customer base by promoting their brand when their products are in stages before the decline. Promoting products in the launch, growth, and maturity stage can let them use product extension strategy easier. To explain further, customers are more likely to purchase the brand they are familiar with. When Roots' products enter the decline stage of the product life cycle, the firm can sell out its products by reducing the price easier. If they decide to redesign or repackage the product, it is easier for customers to accept the change if they successfully promote the brand. Besides, local Canadian brands such as Lululemon are more popular than Roots and have a bigger size compared with Roots. So, promoting the brand can help them get a price advantage. Lululemon's loyal customers buy their products because they like the brand. So, even if Lululemon decides to increase the price of their products a little bit, loyal customers will still purchase products.

4.3 Brand Collaboration

There are many types of brand collaboration that local Canadian companies can use. First, Canadian athletic sports brands can collaborate with local sports teams. With geographical conditions and cultural factors, hockey is very popular in Canada. Different places have different hockey teams. According to the research, Toronto Maple Leafs are the most popular team in Canada, occupying over 27% of the market (Battle). To collaborate with local hockey is easy for both fans and Canadian athletic apparel companies to find social belonging. Since hockey is part of Canadian culture, collaborating with local sports apparel companies is easier to boost the sales of products. More specifically, most Canadians are patriotic and like to purchase local goods. Besides, many Canadians will watch hockey which is a good opportunity to promote the brand and increase brand awareness. Secondly, local Canadian sports apparel brands can collaborate with an international brand. It might be a popular brand that wants to expand its market in Canada. It can help local Canadian brands to attract some potential customers and attract people's attention.

5 Conclusion

5.1 Summary of Main Findings

In conclusion, based on this research, the major area that local Canadian companies need to improve is the small size of the athletic apparel company compared with the market leader and the lack of finance to promote their brands. Few ways can help Canadian local athletic apparel companies to have better growth in this highly competitive market. Those companies can involve more in the niche market of the athletic apparel market. The niche market has fewer competitors and can help the company with that loyal customer base. Besides, local Canadian companies can use branding more efficiently and do some brand collaboration. Both methods can help them increase brand awareness and help to attract potential customers.

5.2 Research Significance

This paper is important to help Canadian local sports apparel companies to see the potential problem of companies. It can also help companies see the condition of the Canadian athletic market. By analyzing the market share of the market, Canadian companies have a clearer idea about the position of their own company. Case studies and data analysis help companies know what kinds of promotion strategy their competitor uses and how efficient it is. All the research helps local Canadian

companies know which types of strategies are useful to their condition and how they can improve that strategy.

5.3 Limitations and Future Study

However, there are some limitations to this paper. All the data that use during research are secondary. It may be out of data which makes it can't be perfectly applied to the current trend of the market. Besides, those secondary data might have a different purpose to use. This might also cause the data can't apply to this paper very well. The future study may focus on Canadian athletic companies that already apply those strategies mentioned in the paper and how it works. In addition, further research needs to use more primary data to ensure the precise result of the research.

References

Battle C, Infographic: Canada's favorite NHL team by region, generation, sex. SportsNet. https://www.sportsnet.ca/hockey/nhl/infographic-canadas-favourite-nhl-team-region-generation-sex

Dore L, Canada: the sporting goods market. U.S. Commercial Service. http://files.export.gov/x_5960549.pdf

Guyot O (2020) Columbia Sportwear posts 18% drop in sales in 2020. Fashion Network. https://us.fashionnetwork.com/news/Columbia-sportswear-posts-18-drop-in-sales-in-2020,1280389.html

Linchpin T, Sports marketing guide to effectively market teams and athletes. Linchpin SEO. https://linchpinseo.com/sports-marketing-guide

Maharashtra P, The advertising power of sports personality-impact on sports brand (Adidas). NVEO. http://nveo.org/index.php/journal/article/view/2183

Prodege MR (2020) Favorite athletic apparel and sportswear brands among consumers in Canada as of August 2020. Statisa. https://www.statista.com/statistics/943425/favorite-athletic-apparel-and-sportswear-brands-canada

Roberta, What is a case study, evidence-based nursing. https://ebn.bmj.com/content/21/1/7

Scheplitz S, A look into Lululemon's Marketing Strategy 2020. The Content Spa. https://www.contentspa.com/the-secret-behind-lululemons-marketing-campaigns

Sharma A (2014) Why lululemon's Stock is down over 33% in 2014. The Matley Fool. https://www.fool.com/investing/general/2014/07/14/why-lululemons-stock-is-down-over-33-in-2014.aspx

Simister N, Scholz V, Qualitative comparative analysis (QCA)-Intrac, intrac for civil society. https://www.intrac.org/wpcms/wpcontent/uploads/2017/01/Qualitativecomparative-analysis.pdf

Tighe D (2020) Lululemon athletica: revenue Canada 2020. Statista. https://www.statista.com/statistics/485785/revenue-of-lululemon-canada

Tighe D, Sporting goods in Canada. Statista. https://www.statista.com/topics/2974/sporting-goods-in-canada/#dossierKeyfigures

Ttighe D (2010–2019) Annual household expenditure on sports and recreation equipment Canada 2010–2019. Statista. https://www.statista.com/statistics/437242/household-expenditure-on-sports-recreation-equipment-canada/

Yearbook (Canada) (2021) Trendex North America. https://www.trendexna.com/can-apparel-yearbook

Research on Fast Fashion Industry Under Sustainable Development Model: Based on ZARA's SWOT Analysis

Yijia Zhu

Abstract With the introduction and popularity of fast fashion under the rapid development of the economy, the modern demand for fashion and dressing has increased significantly. However, it is debatable whether the development of companies in the fast fashion field can cater to the concept of sustainable development. Based on the performance of fast fashion brand ZARA in China, this paper uses SWOT analysis to explore the strengths, weaknesses, opportunities and threats of fast fashion under the sustainable development model. The research results show that ZARA still has essential advantages and disadvantages in China, and facing the requirements of sustainable development and the increasingly competitive fashion circle, ZARA still needs to change some strategies to cater to the market. In addition, by understanding the position of their brand in the market and combining their own strengths and technological advances, it can help ZARA's sustainable development in the future.

Keywords Fast fashion · ZARA · SWOT · Sustainability · Internet era

1 Introduction

With the rapid development of China's economy, consumers' standard of living and quality of life have significantly improved, and thus their sensitivity and demand for daily wear and fashion trends have also increased. ZARA is a typical brand under the Inditex Group and has the characteristics of fast fashion, which has been popular among young people in China in recent years and has made considerable gains. However, there are still many controversies and threats on how to achieve sustainable development of fast fashion brands. Therefore, this paper will take ZARA brand as the research object, analyze its advantages, disadvantages, opportunities and threats in the sustainable development model and give the corresponding strategies, hoping

Y. Zhu (✉)
Fordham University New York, 113 W 60Th Street, New York, NY 10023, USA
e-mail: z469645967@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_90

that this research can help the benign and prosperous development of fast fashion industry.

2 Literature Review

Relevant research with ZARA as a case study has been a hot research topic in the academic field. Zeng analyzed the marketing strategy of ZARA in China and used the internal and external interview method based on the construction of the corresponding influence factor system, and conducted factor analysis and IPA analysis on the influence factors to analyze the degree of influence of each factor of ZARA brand marketing on customer satisfaction in the Chinese market (Zeng 2021). Liu and Wang compared various aspects of ZARA and Metersbonwe to explore the marketing strategies belonging to Chinese apparel brands, in order to provide some references for the future acceleration and development of fast fashion apparel products in China (Chen and Nan 2021). Zeng adds a new case study on inventory management in the apparel industry. The study of ZARA as a case study can not only dig deeper into the strengths and weaknesses of the enterprise's inventory management model and promote the improvement of the enterprise's financial performance, but also the suggestions made have some reference value for the improvement of management efficiency of other apparel enterprises (Ying 2020).

Focusing on the value chain and supply chain, Yin analyzed and studied the successful model of ZARA based on the value chain and supply chain management, and proposed feasible suggestions for the future value-added points of ZARA in terms of "independent online order service", "application of sustainable fabrics", "optimization of internal structure of supply chain" and "optimization of product quality", aiming to promote the healthy and orderly development of ZARA and the apparel industry (Hong et al. 2021). Yin analyzes the supply chain management model of world-renowned apparel brand ZARA by combining the elements of supply chain management and the current problems of China's apparel industry, hoping to give some reference to China's apparel industry (Yin 2019).

For the whole fast fashion and apparel industry related research, Gao uses the knowledge related to intellectual property and enterprise intellectual property management to put forward shallow analysis and suggestions on the operation and development of fast fashion apparel brand enterprises (Gao 2019). Luo and Kong analyzed the value chain of the apparel industry and corroborated that a reasonable combination of value chains helps companies find their own positioning and form competitive advantages (Xin and Yue 2021).

Based on the above existing literature, the possible contributions of this paper are mainly the following four points. Firstly, in terms of research topic, although there are many research papers on the selected topic of ZARA, the topic of ZARA's strengths, weaknesses, opportunities and challenges under the concept of sustainable development is very novel. The research content of this paper, based on the development strategy of ZARA under the concept of sustainable development, is

exactly what the existing research literature is still lacking. Secondly, in terms of research methodology, this paper explores the strengths, weaknesses, opportunities and threats of ZARA by using SWOT analysis, and also takes into account the opportunities brought by the Internet era and technological environment to the fast fashion brand ZARA in the context of sustainable development. Thirdly, the research sample is supplemented by real and authoritative data in this paper's argument, and the data is comprehensive and new, which helps to draw more accurate, objective and time-sensitive economic conclusions. Fourthly, this paper proposes targeted and personalized policy recommendations for the sustainable development of the fast fashion industry, and provides Chinese cases, Chinese facts, and Chinese experiences for the development of the fast fashion industry in other developing countries around the world.

3 SWOT Analysis

In 1987, the United Nations World Commission on Environment and Development released the study "Our Common Future", which defined the concept of sustainable development as development that meets the needs of the present without jeopardizing the ability of future generations to meet their needs, and the concept is most widely recognized globally. However, scholars from different disciplines or different fields define sustainable development differently. This also indicates that sustainable development cannot be viewed from a single, isolated perspective, but must be understood from a holistic, systematic, and dynamic perspective as an evolving, all-encompassing process of social change that involves political, economic, cultural, and social aspects, and has different manifestations at specific stages.

Fast fashion, also known as fast fashion, originated in Europe at the end of the twentieth century and is characterized by tight trend-following, affordable prices, high frequency of new products and fast update. The business strategy of ZARA, as a subsidiary of the Spanish Inditex Group, is both a clothing brand and a retail chain brand specializing in ZARA brand clothing, and a typical representative of fast fashion. The differentiated positioning of its value chain is "fashion", "affordable" and "fast", which is different from the linear value chain of traditional garment industry, where each link is connected to the other. In order to realize the three elements of fast fashion, ZARA has deeply integrated the four major links of organization, design, production and distribution of its products.

The research method of this paper, SWOT analysis, was first proposed by Professor Wyrick of University of San Francisco in the early 1980s, and gradually developed and improved with the development of international corporate competitive strategy theory. It is then used to make accurate judgments about the environment and to formulate strategies and tactics for the development of the enterprise, which are then applied to project risk management for strategic decision making and systematic analysis of the project.

The next part of this paper is based on the SWOT analysis and the study of ZARA, a representative of the fast fashion industry under the concept of sustainable development.

3.1 Advantages

Conforming to the concept of sustainable development. ZARA, as one of the global leaders of fast fashion brands, has conformed to the development and call of the times, put forward the concept of sustainable development, and tried to cultivate a more "green" image. For example, the company has carried out recycling of used clothes, reduced carbon emissions and published sustainability reports. As a leading fashion company, ZARA's attitude towards social responsibility will make customers feel better about the company.

Used Clothes Recycling Program. ZARA has already covered 24 countries and regions and collected 34,000 tons of used clothes, and equipped all stores with used clothes recycling bins, part of which is donated to poor areas and part of which is remanufactured into fiber. For example, ZARA is working with the European Institute of Design in Madrid to develop the recycling of used clothes and fabrics for fashion production. The development of this recycling project has effectively improved the embarrassing situation that old clothes have nowhere to be used but discarded.

Research and development of environmentally friendly materials. ZARA has started to encourage its designers to design sustainable fashion through eco-friendly or natural materials, such as its first sustainable fashion collection (Glossy), which is a new clothing line made with eco-friendly materials to try to deal with the issue of sustainability in clothing materials.

3.2 Disadvantages

It is easy to be questioned as a marketing tactic. ZARA as a fashion company means it will make profit from it. Therefore, many people think that sustainable development is a marketing tactic proposed by ZARA, not really doing environmental protection. The move to redeem a bag of used clothes for vouchers is just a disguised means of consumption to promote consumers' desire to buy. The recycling program does collect a lot of used clothes, but it promotes the production and sale of more new clothes.

The concept of "fast" is always contrary to sustainability. ZARA, as a fast fashion brand, is always contrary to the concept of sustainability with its fast pace of new products and low cost materials. Because the strategy of the company is to sell fast, sell more and sell at a lower price, which causes huge environmental pollution and energy consumption, which are the essential contradictions for ZARA to achieve sustainable development.

The meager degree of spreading the concept of sustainable development. the ZARA brand is actually not high in spreading the concept of sustainable development. For example, Zara's used clothes recycling program can only be recycled in some stores nationwide, and although the scope of recycling is slowly increasing, there is no publicity and the promotion effort is small. In addition, research studies have found that only a very small number of consumers will participate in ZARA's used clothes recycling activities.

3.3 Opportunities

Media boost in the context of the Internet era. The number of Internet users can reflect the scale of Internet development of a country in general, and whether ZARA's sustainable development has Internet opportunities. Figure 1 shows the development trend of the number of Internet users in China from 2000 to 2020. According to Fig. 1, it can be seen that from 2000 to 2020, the number of Internet users in China shows an obvious upward trend, especially after 2005, the development speed is further improved, and the number of Internet users is nearly 1 billion by 2020. This shows that with the passage of time, the progress of technology, and the popularity of the Internet era, more and more people in China are using the Internet. Further, Table 1 shows the descriptive statistical analysis of the number of Internet users in China from 2000 to 2020, where the standard deviation is as high as 300 million, i.e. the number of Internet users in China is highly discrete and fluctuating, further reflecting the high speed of Internet development in China; by comparing the maximum and minimum data, the highest number of Internet users is as high as one billion, and the lowest number of Internet users is also up to 22.5 million, the Internet has become the mainstream trend of the times.

Under the background of high-speed development of Internet, media has become a platform to focus on the hot spots of the times and has the characteristics of

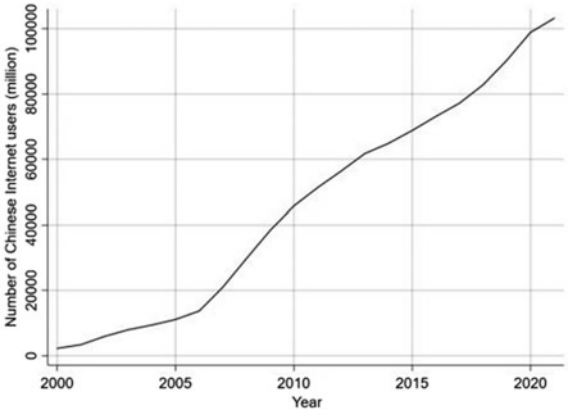


Fig. 1 Number of people accessing the Internet in China, 2000–2020 (million)

Table 1 The descriptive statistical analysis of the number of Internet users in China from 2000 to 2020

Variable	Obs.	Mean	Std. Dev.	Min	Max
Internet access (million people)	22	46,246	33,593	2250	103,200

timeliness, interactivity and low cost. zara, as a fast fashion brand, if it can respond to the concept of national sustainable development based on media and conform to the background of the development of the times, then it is very likely to get strong support from the state or government and get some preferential policies as well as publicity. At the same time, ZARA can create brand accounts in self-media platforms and upload their sustainable clothing and other information, so that the brand and its support for sustainable development can spread quickly among consumers and bring the distance between consumers and the brand closer. These are extremely beneficial for the development of brands.

Support from the scientific and technological environment. Along with the development and improvement of the level of clothing design, sustainable regeneration and other comprehensive use of environmental protection technology methods of clothing products have been gradually developed. For example, Anta brand comprehensive training category launched a new environmentally friendly clothing products-"training with plastic" to evoke energy technology and environmental protection series, the series using recycled waste plastic bottles as raw materials, health and environmental technology research and development made of recycled polyester fabric. At the same time, according to the American Cotton Company's 2010 environmental survey, 36% of consumers claim they are willing to pay a higher price for technology-enabled eco-friendly clothing, and consumers expect manufacturers and brands to produce and sell in a way that is beneficial to the environment. Thus, the evolving technological environment and consumer demand can help ZARA to challenge eco-friendly clothing design one by one.

3.4 Threats

Threats from other brands. Levi's has used a new water-saving and environmentally friendly process for the production of jeans, which has reduced the water consumption of the whole process by an average of 28%, while the manufacturing cost is comparable to that of ordinary jeans. "Love fashion, love the earth" is the attitude of UNIQLO brand, and its Denim Innovation Center has developed innovative water-saving technology for jeans, practicing the sustainable development concept that the apparel industry needs to use water resources wisely. In addition, UNIQLO also launched the green brand logo of "The Power of Clothing" to convey its commitment to sustainable development activities.

The market is becoming saturated. The designers of fast fashion brands cannot make ends meet due to the need to design a variety of styles in a short period of time, resulting in a significant homogenization of products across brands. Each element, style, and fabric of clothing have similar parts, which not only make fashion brands lose their uniqueness, but also hit the fast fashion market. Coupled with the rapid rise of small and medium-sized brands in the fast-fashion apparel category on e-commerce platforms, and with cheaper cost prices and faster product uptake as a competitive advantage, it has brought an impact on the larger fast-fashion apparel brands in the industry. Several fast fashion brands Topshop, New Look, Forever21, and Esprit faced performance crises in 2018, and the three giants of fast fashion brands Uniqlo, ZARA, and H&M were also hit by slowing sales and sluggish performance. The convergence of goods not only leads to consumer boredom, which greatly affects the market, but also does not help to realize the subsequent value of clothing products. Only special, unique or classic style and good quality apparel products can better achieve sustainable development.

4 Conclusion and Policy Recommendations

This paper has explained and analyzed that under the concept of sustainable development, ZARA has the advantages of conforming to the concept of sustainability, carrying out recycling programs for used clothes and developing environmental protection materials; however, it has the disadvantages of being easily questioned as a marketing tool, the concept of "fast" always contradicts with sustainable development, and the meager degree of spreading the concept of sustainable development; in addition, In addition, ZARA's sustainable development can be based on the opportunities brought by the media and the technological environment in the context of the Internet era, but also faces the challenges of threats from other brands and the saturation of the market.

The implications of the conclusions of this paper are the following three points:

Firstly, using sustainable raw materials to produce ZARA's clothes and at the same time improving the quality of raw materials. This will effectively avoid the problem of low quality found by customers. Based on the long-term and stable spending power of a regular customer base, it ensures that ZARA has the ability to reduce the risk of losing customers through low quality.

Secondly, you can publish some sustainability-related tweets on the platforms where the country or government launches the concept of sustainability, and attach the clothes made of sustainable raw materials to the weblebrities and models, and then promote your own sustainable style and products, which can not only give customers and potential customers the impression of green brand, but also make them feel a sense that buying ZARA clothes can always respond to sustainable development.

Thirdly, it is recommended to launch co-branded products with better developed brands under the development concept of sustainability. For example, UNIQLO

launched the slogan "Love fashion, love the earth." In addition, its Denim Innovation Center has developed an innovative water-saving technology for jeans, and at the same time, jointly launched co-branded jeans with Uniqlo, which will not only increase sales but also raise brand awareness.

References

Chen L, Nan W (2021) The inspiration of Spanish brand ZARA on the marketing strategy of Chinese apparel brands-Taking Metersbonwe brand as an example. Sci Technol Inf 19(08):227–229

Gao Y (2019) Intellectual property management strategies and insights of fast fashion apparel brand companies-in the context of ZARA and Uniqlo. Law Soc (18):163–164

Hong Y, Yue L, Sun C (2021) Research on ZARA brand operation model based on value chain and supply chain management. China Bus (08):72–74

Xin L, Yue K (2021) The application of value chain analysis in the apparel industry, the case of ZARA. China Bus J (09):49–51

Yin J (2019) Optimization of supply chain management model in China's apparel industry, the case of ZARA. Mall Modernization (13):1–2

Ying Z (2020) Research on the impact of inventory management on financial performance of apparel companies. Nanjing Univ Inf Eng

Zeng J (2021) Research on the impact of ZARA's brand marketing on customer satisfaction in China market. Jiangxi University of Finance and Economics

Research on Industry and Carbon Emission Gradient Under the Background of Carbon Emission Peak in the Beijing-Tianjin-Hebei Region

Zijian Zhou, Borui Cui, and Huichun Che

Abstract Through the Index Decomposition Analysis method of spatial perspective, this paper analyzes the characteristics of the industrial and Carbon Emission Gradient of subdivided industries and studies the interaction between the Beijing-Tianjin-Hebei region Industrial Development and carbon emission by using the correlation coefficient matrix of Industrial Gradient and Carbon Emission Gradient. The results show that the relative carbon emission intensity in some high-end manufacturing regions in Beijing is prominent, and the Carbon Emission Gradient still has room to decline; Tianjin's overall carbon emission efficiency is relatively low, offsetting the decline in carbon emission intensity caused by the increase of capital productivity; Hebei is affected by the siphoning effect of Beijing, and the negative impact of labor productivity on carbon emission efficiency is more significant, but it shows the characteristics of low-carbon transfer when undertaking high pollution and high carbon emission industries. Finally, based on the above conclusions, the paper proposes to put forward targeted carbon emission reduction countermeasures and suggestions for the "Carbon Emission Peak" with coordination of the region from three perspectives: the transformation of high-end manufacturing industry, scientific and technological innovation, and promoting the flow of production factors.

Keywords Regional cooperation · Carbon emission peak · Gradient coefficient · Index decomposition analysis

1 Introduction

According to the Global Energy Review, China was the only major economy to experience economic growth, and its carbon emission rose by 5% in 2021, while the United States and European Union both registered increases of around 7%. (The Global Energy Review of IEA 2022) The Beijing-Tianjin-Hebei region is one of

Z. Zhou · B. Cui · H. Che (✉)
Beijing Wuzi University, Beijing, China
e-mail: chehuichun@126.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_91

the largest China's economic engines, and it plays an important role in leading the way in the process of national industrial development and transformation. In recent years, in response to a series of environmental problems, the region has begun to transfer Heavy Pollution Industries intra–region and inter-regions. In 2016, the "Beijing-Tianjin-Hebei Industrial Transfer Guide" mentioned that the coordinated development of the region's industries should fully use the comparative advantages of regions and guide the orderly transfer of industries (Ministry of Industry and Information Technology of the People's Republic of China 2016). Obviously, under the background of the Carbon Emission Peak and Carbon Neutrality, realizing carbon emission reduction through the coordinated development of regional industries will be one of the most important contents of future regional development.

However, in the realization process of the Carbon Emission Peak and Carbon Neutrality, the current focus of carbon dioxide emission reduction is still "Carbon Emission Peak", and there is still a lack of basic conditions to achieve "Carbon Neutrality". The main reasons are as follows. Firstly, China's current main source of carbon dioxide emissions is the energy industry, while economic development is highly dependent on energy input, resulting in a sharp increase in carbon emission reduction pressure. Secondly, due to the advantages of thermal power generation, it is difficult to use clean energy to completely replace traditional fossil energy with the current technology, the rigid energy demand may lead to rigid carbon emission (Wang 2020). In addition, although Beijing has achieved a peak reduction in carbon emission after 2012, as an organic unit, the region has high coupling in its regional economic development. The region is still under pressure to achieve the overall Carbon Emission Peak, and the environmental effects within the urban agglomeration are obvious (Zhang 2017).

Therefore, this paper focused on the analysis of the industrial development and carbon emission status of the region's industrial sub-sectors under the background of Carbon Emission Peak, relying on the Industrial Gradient Coefficient after index decomposition, exploring the internal relationship between industrial gradient and carbon emission transfer in the region. It will provide a scientific and feasible action plan for the green development of the region and the coordinated completion of the Carbon Emission Peak goal.

2 Literature Review

After reviewing the existing research literature, it shows that carbon emission are mainly affected by factors such as economic level, urbanization, technology, population, industrial structure, and energy structure (Tang et al. 2017). Empirical studies have found that the economic growth of developing countries has a strong positive correlation with the growth of carbon emission, while developed countries show a Kuznets curve relationship. The Beijing-Tianjin-Hebei region has always been one of the important modern manufacturing bases in China, showing an obvious convergence effect between the growth rate of total industrial output value and the overall

economic growth. The industrial energy consumption of the region accounts for a large proportion, and the decline in carbon emission is not obvious, which has led to greater pressure on the decoupling of economic development and carbon emission in the region. Therefore, realizing the regional Carbon Emission Peaking through the optimization and adjustment of industrial structure has become one of the main points for the coordinated development of the region (Li and Lu 2022).

Firstly, an industrial transfer is a key way for regional economic development to reach a certain level. The industrial structure change caused by industrial transfer affects the process or mode of regional economic development, which in turn has an impact on carbon emission (Li et al. 2017). Furthermore, industrial transfer means labor transfer, and our system determines that industrial enterprises are highly tied to labor, while the population has been proved to be one of the main factors contributing to carbon dioxide emissions during economic development (Gong et al. 2020). Secondly, there are phased-out industries transferred from relatively developed areas to relatively underdeveloped areas. It will improve the level of agglomeration in the industry that is inherited, and lead to changes in the utilization efficiency of capital factors through the scale effect (Zhang and Lin 2017). Finally, it will promote the utilization efficiency of energy input by the technology spillover effect (Gu et al. 2020), then have an impact on China's regional total factor carbon emission efficiency.

In the study of industrial transfer, the Industrial Gradient Coefficient method is one of the more commonly used methods, which has been relatively completed, including the message of industrial structure (Yu 2021), labor force (Dai 2006), capital (Lu et al. 2015), and production efficiency. However, there are relatively few studies using the Industrial Gradient Coefficient to study the impact of industrial transfer on carbon emission issues. At present, the researches applied the Industrial Gradient Coefficient, discussed the emission reduction strategies (Yuan and Li 2015) and the allocation of carbon emission quotas (Li et al. 2015), combined with the industrial synergy in the region and carbon emission efficiency.

However, the existing studies generally only consider the industrial transfer effect of isolated spatial distribution at the national or regional level, while ignoring the impact of nested industrial distribution heterogeneity intra-region and inter-regions on carbon emission efficiency. Therefore, this paper attempts to decompose the existing Industrial Gradient Coefficient into intraregional and interregional through the Index Decomposition Analysis, from the two spatial dimensions, analyzes the effects of industrial transfer and industrial re-agglomeration on the carbon emission intensity, and puts forward a more targeted countermeasures for the region collaborative carbon emission reduction.

3 Methods and Data Sources

3.1 Industrial Gradient Coefficient

The paper uses the Industrial Gradient Coefficient as an indicator to measure the development gradient level of the region's industrial subdivision industry. However, when measuring the industrial synergy and the driving force of industrial transfer within a region, the traditional Industrial Gradient Coefficient is easily limited by the scope of the observation area. The situation of other regions outside the observation range is ignored, and the industrial gradient between regions cannot be reflected. Therefore, using the idea of the IDA method for reference, the paper decomposes the three indicators of the national Industrial Gradient Coefficient of each industrial subdivision industry in each province from the two levels of intra-regional and inter-regional, and finally recombines them into intra-region industrial gradient and inter-region industrial gradient. The specific decomposition method is as follows:

$$IGC_{ij} = LQ_{ij} \times CLP_{ij} \times CCP_{ij} \tag{1}$$

$$LQ_{ij} = \frac{q_{ij}/\sum_{i\in r} q_{ij}}{\sum_{i\in r,j} q_{ij}/\sum_{i\in r} q_{ij}} \times \frac{\sum_{i\in r,j} q_{ij}/\sum_{i\in r} q_{ij}}{\sum_j q_{ij}/\sum q_{ij}} \tag{2}$$

$$CLP_{ij} = \frac{(Y_{ij}/L_{ij})}{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} L_{ij})} \times \frac{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} L_{ij})}{\sum(Y_{ij}/L_{ij})} \tag{3}$$

$$CCP_{ij} = \frac{(Y_{ij}/K_{ij})}{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} K_{ij})} \times \frac{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} K_{ij})}{(\sum Y_{ij}/\sum K_{ij})} \tag{4}$$

After recombining the decomposition items of each indicator, we get:

$$IGC_{intra} = \frac{q_{ij}/\sum_{i\in r} q_{ij}}{\sum_{i\in r,j} q_{ij}/\sum_{i\in r} q_{ij}} \times \frac{(Y_{ij}/L_{ij})}{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} L_{ij})} \times \frac{(Y_{ij}/K_{ij})}{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} K_{ij})} \tag{5}$$

$$IGC_{inter} = \frac{\sum_{i\in r,j} q_{ij}/\sum_{i\in r} q_{ij}}{\sum_j q_{ij}/\sum q_{ij}} \times \frac{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} L_{ij})}{\sum(Y_{ij}/L_{ij})} \times \frac{(\sum_{i\in r,j} Y_{ij}/\sum_{i\in r,j} K_{ij})}{(\sum Y_{ij}/\sum K_{ij})} \tag{6}$$

Among the formulas, the subscripts i and j represent the city and the industry, respectively; LQ is the Location Quotient, CLP is the Comparative Labor productivity, CCP is the Comparative Capital Productivity; the subscripts *intra* & *inter* mean intra-regional and inter-regional respectively; r is the range of the selected observation, includes Beijing, Tianjin, and Hebei.

3.2 Carbon Emission Gradient Coefficient

At present, in terms of total carbon emission accounting, the data is usually obtained through the apparent energy consumption in various yearbooks such as the "China Energy Statistical Yearbook". However, different initial data sources, formula simplification methods, and emission factor selections will lead to differences in the final accounting values of carbon emission. In order to unify the data and avoid the influence of errors in the carbon emission accounting process, this paper decided to use the relevant data in an open database called "China Carbon Accounting Database" (Zheng 2022), to replace the original self-calculated carbon emission data.

Considering the common carbon emission indicators usually have comparability only in the time dimension of a single observation object, the paper uses the idea of Industrial Gradient Coefficient to design the Carbon Emission Gradient Coefficient, uses Carbon Emission Quotient as an intensity indicator, and the Comparative Carbon Emission Output Ratio as efficiency indicator, to enhance the comparability of the horizontal and vertical spatial dimensions of carbon emission data between cities and industries.

$$CEGC_{ij} = CEQ_{ij} \times CCEOP_{ij} \tag{7}$$

$$CEQ_{ij} = \frac{ce_{ij}/\sum_{i\in r} ce_{ij}}{\sum_{i\in r,j} ce_{ij}/\sum_{i\in r} ce_{ij}} \times \frac{\sum_{i\in r,j} ce_{ij}/\sum_{i\in r} ce_{ij}}{\sum_{j} ce_{ij}/\sum ce_{ij}} \tag{8}$$

$$CCEOR_{ij} = \frac{(ce_{ij}/Y_{ij})}{(\sum_{i\in r,j} ce_{ij}/\sum_{i\in r,j} Y_{ij})} \times \frac{(\sum_{i\in r,j} ce_{ij}/\sum_{i\in r,j} Y_{ij})}{\sum(ce_{ij}/Y_{ij})} \tag{9}$$

After recombining the decomposition items of each indicator, we get:

$$CEGC_{intra} = \frac{ce_{ij}/\sum_{i\in r} ce_{ij}}{\sum_{i\in r,j} ce_{ij}/\sum_{i\in r} ce_{ij}} \times \frac{\left(ce_{ij}/Y_{ij}\right)}{\left(\sum_{i\in r,j} ce_{ij}/\sum_{i\in r,j} Y_{ij}\right)} \tag{10}$$

$$CEGC_{inter} = \frac{\sum_{i\in r,j} ce_{ij}/\sum_{i\in r} ce_{ij}}{\sum_{j} ce_{ij}/\sum ce_{ij}} \times \frac{(\sum_{i\in r,j} ce_{ij}/\sum_{i\in r,j} Y_{ij})}{\sum(ce_{ij}/Y_{ij})} \tag{11}$$

Among the formulas, the rules are as same as the index decomposition of IGC.

3.3 Data Sources and Outlier Processing

The relevant data of the industrial development in the "China Industrial (Economic) Statistical Yearbook 2021". Then, since the carbon emission data of the CEADs database in 2020 has not yet been released, the paper decided to use the data in 2019, combined with the industrial gradient data of the same year, to analyze the impact

mechanism and conduction path of industrial gradient advantages on carbon emission intensity and efficiency. Regarding the outlier processing, this paper excludes the Tibet province from the analysis sample. Then, Considering the comparability of the data, the paper also made some adjustments and consolidations to industry classifications.

4 Analysis on the Influence of Industry and Carbon Emission

4.1 The Results and Analysis of Beijing

From Table 1, the correlation coefficient between CEGC and IGC indicates that the more obvious the gradient advantage in Beijing, the better the comprehensive situation of carbon emission. Secondly, the correlation coefficients between LQ and CEQ, CCEOR are positive, indicating that with the improvement of the level of industrial agglomeration, Beijing's carbon emission intensity will increase and the carbon emission efficiency will decrease. Among them, the impact of industrial agglomeration level on the former is far greater than the latter. According to the relevant theories of environmental economics, it shows that Beijing's major industries are still on the left side of the Environmental Kuznets Curve. At this time, the industry is in the stage of rapid development and expansion, and its potential technology level may not completely decouple industrial development from carbon emission. Therefore, though Beijing's economic growth and carbon emission have been decoupled, this situation shows that Beijing still has room for industrial optimization to achieve relative decoupling in the region.

Table 1 Correlation coefficient matrix in Beijing

Factors	CEGC	CEQ	CCEOR	LQ	CLP	CCP	IGC
CEGC	1						
CEQ	0.3697	1					
CCEOR	0.9489	0.3041	1				
LQ	0.1145	0.6263	0.0216	1			
CLP	−0.0932	−0.0993	−0.1217	−0.2025	1		
CCP	−0.1878	−0.1968	−0.2436	−0.3295	0.7391	1	
IGC	−0.1189	0.1891	−0.1712	0.1717	0.6807	0.5435	1

Table 2 Correlation coefficient matrix in Tianjin

Factors	CEGC	CEQ	CCEOR	LQ	CLP	CCP	IGC
CEGC	1						
CEQ	0.7561	1					
CCEOR	0.8692	0.5305	1				
LQ	0.0362	0.3389	−0.1726	1			
CLP	0.1948	−0.0509	0.2996	−0.2258	1		
CCP	−0.1149	−0.054	−0.1017	−0.1849	0.2785	1	
IGC	−0.1790	0.0874	−0.2487	0.4028	0.3343	0.5894	1

4.2 The Results and Analysis of Tianjin

From Table 2, there is a certain convergence between Tianjin and Beijing, and the situation was, that the higher IGC, the lower CEGC, and the impact is more significant than in Beijing. However, there are also some noteworthy differences. Firstly, with the improvement of industrial agglomeration level in Tianjin, the carbon emission intensity of Tianjin increases, but the carbon emission efficiency is improved. Moreover, the impact of the former is more significant than that of the latter, so the impact of LQ and CEGC finally shows a positive correlation. Secondly, the impact of CLP on CCEOR in Tianjin is positive, while the impact on CEQ is negative. Similarly, the impact of the former is more significant than the latter, so the impact of CLP on CEGC is positive. Generally, the improvement of production efficiency can reduce the carbon emission intensity of Tianjin industry, but if measured from the aspect of carbon emission efficiency, the carbon emission quality of industries with labor productivity advantage is not high. The negative impact of low carbon emission efficiency will cover the decline of carbon emission intensity caused by the improvement of capital productivity in other industries, which will eventually lead to a relatively small decline in Carbon Emission Gradient in Tianjin.

4.3 The Results and Analysis of Hebei

From Table 3, in general, the CEGC is negatively correlated with the IGC in Hebei, and the degree of interaction is equivalent to that in Beijing. But the internal factors are obviously different from that in Beijing and Tianjin. Firstly, there is a certain negative correlation between LQ and CCEOR, resulting in a weak negative correlation between LQ and CEGC. However, there is still a strong positive correlation between LQ and CEQ. It shows that the industries with high industrial agglomeration level in Hebei have high carbon emission intensity, but have high energy input–output ratio. At the same time, the correlation between and among CLP, CCP, and CEQ in Hebei shows similar characteristics to LQ. If we take the productivity of

Table 3 Correlation coefficient matrix in Hebei

Factors	CEGC	CEQ	CCEOR	LQ	CLP	CCP	IGC
CEGC	1						
CEQ	0.4595	1					
CCEOR	0.9566	0.2218	1				
LQ	−0.0701	0.6068	−0.2153	1			
CLP	−0.2161	0.4199	−0.3361	0.4829	1		
CCP	−0.111	0.0649	−0.1357	−0.2237	0.3281	1	
IGC	−0.1107	0.5409	−0.2598	0.587	0.7921	0.5127	1

labor and capital as the embodiment of technological progress, it shows that with the improvement of the production efficiency of various industries in Hebei, the energy utilization efficiency and carbon emission efficiency of the production process are improved, which is likely to be achieved through industrial transfer and agglomeration. That means, when the production scale is expanded, the CEQ representing the regional carbon emission intensity will also increase. And the results of carbon emission reduction brought by the improvement of carbon emission efficiency will cover the growth of carbon emission brought by the rapid expansion of industries. Finally, with the improvement of production efficiency, the comprehensive situation of carbon emission has improved.

4.4 The Results and Analysis of the Inter-regions

From Table 4, when the region as a whole is investigated at the national level, the industrial gradient and Carbon Emission Gradient between regions are consistent with those of Beijing, which shows that the region, as the "capital economic circle", occupies a leading position in the process of industrial development, and its industrial scale and industrial model have a profound impact on other regions of the nation. Firstly, the correlation coefficient between IGC and CEQ between regions is positive, then the correlation coefficient with CEEOR is negative, and the significance of the former is slightly higher than that of the latter. It shows that the industries with greater industrial gradient advantages in the region have higher carbon emission efficiency, but also greater carbon emission intensity. This regional internal heterogeneity leads the correlation between the total impact of IGC and CEGC to week obvious between regions. Secondly, the impact of LQ between regions on CEGC with its sub-indicators is positive, in which the impact on CEQ is more significant, but the impact on CCEOR is not significant. It shows that the industrial agglomeration level of the region has not been decoupled from carbon emission. With the continuous increase of industrial scale, the indicators of carbon emission intensity and carbon emission efficiency will deteriorate to varying degrees. Finally, the correlation coefficients of CLP and CCP

Table 4 Correlation coefficient matrix in Hebei

Factors	CEGC	CEQ	CCEOR	LQ	CLP	CCP	IGC
CEGC	1						
CEQ	0.4595	1					
CCEOR	0.9566	0.2218	1				
LQ	−0.0701	0.6068	−0.2153	1			
CLP	−0.2161	0.4199	−0.3361	0.4829	1		
CCP	−0.111	0.0649	−0.1357	−0.2237	0.3281	1	
IGC	−0.1107	0.5409	−0.2598	0.587	0.7921	0.5127	1

between regions on CEGC with its sub-indicators are negative, but except that the comparative labor output has a significant impact on the CCEOR, other effects are less significant.

5 Conclusions and Policy Implications

5.1 Conclusions

The correlation matrices between the Industrial Gradient Coefficient and Carbon Emission Gradient Coefficient with the sub-indicators show the interaction mechanism of industrial development and carbon emission preliminarily. And the main conclusions of this study are as follows:

From the LQ, Beijing has completed the industrial transfer of most high pollution and high carbon emission industries, focusing on the development of high-end manufacturing. Moreover, after the industrial transfer, Beijing has large-scale industries and high production efficiency, which is the basis of Beijing's low absolute carbon emission level. However, the CEQ in Beijing also reflects that the carbon emission of the light textile industry, petroleum medical and chemical industry, high-end manufacturing, and public services significantly impact the region's carbon emission intensity. As many industries in Beijing have low regional carbon emission rates, it shows that overall carbon emission efficiency is relatively high. The above situation will eventually lead to the increase of Beijing's carbon emission intensity with the process of industrial scale, but the increase in production efficiency caused by the process of industrial agglomeration will promote the increase of industrial carbon emission efficiency, and finally cause Beijing's decouple between the absolute carbon emission level and economic development.

In terms of industrial development, Tianjin has undertaken the high-level part of Beijing's transfer out industries, and most of them form a dislocation development with the existing industries in Beijing and Hebei. And some industries are also driven by Beijing, which has almost the same level of industrial agglomeration.

However, in terms of production efficiency, Tianjin only has labor advantages in the petroleum medical, and chemical industry and low-end manufacturing industry, and only a few high-end manufacturing industries have capital advantages. This reflects the regional differential allocation of labor and capital production factors. Tianjin cannot have the production efficiency advantages of labor and capital at the same time as most industries with industrial gradient advantages in Beijing. Therefore, in terms of carbon emission, most of the industries with prominent carbon emission problems in Tianjin have the double negative performance of high carbon emission intensity and low carbon emission efficiency. At the same time, some industries with high production efficiency in Tianjin are labor-intensive industries, and carbon emission are not optimistic. Generally, the overall carbon emission efficiency of Tianjin is relatively low, offsetting the decline in carbon emission intensity caused by the improvement of capital productivity, resulting in a relatively insignificant decline in Carbon Emission Gradient.

The industries with obvious agglomeration effect in Hebei are the food and beverage processing industry, light textile industry, petroleum medical industry, and low-end manufacturing industry. Then, due to the strong population siphon effect in Beijing, the overall labor production efficiency of Hebei shows low, and the industries with high agglomeration level in Hebei generally have high capital use efficiency at the same time. In terms of carbon emission, Hebei is at the lower location of industrial gradient transfer in the region, mainly undertaking backward or highly polluting industries transferred from the other two cities. In addition, the industries with high Carbon Emission Gradient in Hebei are not clustered in backward or highly polluting industries only, but scattered in the whole industry, and have the problems of high carbon emission intensity and low carbon emission efficiency at the same time, so there is great pressure on emission reduction. Based on the above situation, however, it is worth noting that Hebei has digested the carbon emission transfer brought by the industrial transfer of the region, which is mainly reflected in the decline of carbon emission production efficiency in Hebei with the rise of industrial agglomeration level, indicating that Hebei is undertaking Low-Carbon Transformation and upgrading of these industries while undertaking industries. This shows that it is feasible to achieve carbon emission reduction and carbon peak through the coordinated development of the region.

5.2 Policy Implications

High-End Manufacturing Industry with Low-Carbon Transformation, Accelerate to Cross the Inflection Point of the Environmental Curve. High-end manufacturing industry is the worst-hit area with concentrated carbon emission intensity in Beijing. At present, the high-end manufacturing industry in Beijing and Tianjin is facing the problems of rapid industrial expansion and high concentration, but high carbon emission intensity, which is at the left end of the turning point of Kuznets environmental curve. According to the theory of the Technology Spillover Effect,

the Low-Carbon Transformation of high-end manufacturing industry in Beijing can promote the carbon emission efficiency of high-end manufacturing industry in Tianjin, and force the low-end manufacturing industry in upstream of Hebei to carry out the transformation and upgrading simultaneously. Therefore, under the background that Beijing has initially achieved the peak of absolute carbon emission, further achieving carbon neutralization and the transformation of high-end manufacturing industry to low-carbon is a key that cannot be bypassed in any case.

Scientific and Technological Innovation Optimizes Carbon Emission Efficiency by Promoting Production Efficiency. Empirical analysis shows that production efficiency has a significant impact on carbon emission intensity and carbon emission efficiency. The essence of production efficiency is the external embodiment of the level of production technology. Therefore, promoting the improvement of production efficiency through scientific and technological innovation has become the key to the optimization of carbon emission efficiency. First of all, Beijing should give full play to its scientific research resource endowment, increase the R & D cooperation of low-carbon technologies in the region, and provide intellectual support for Industrial Re-agglomeration and Low-Carbon Transformation in the industrial transfer process. Secondly, the improvement of production efficiency should be adjusted to local conditions. Beijing's capital investment has a more significant impact on carbon emission reduction, indicating that Beijing's talent advantage has not been brought into full play; Tianjin should increase the transformation and upgrading of labor-intensive industries and reverse the negative impact of labor productivity on carbon emission efficiency; The case of Hebei is that the improvement of production efficiency can improve carbon emission efficiency, but the impact on carbon emission intensity is distorted by the energy consumption characteristics of the industry itself, which it is necessary to focus on the development and utilization of relevant technologies to reduce the absolute carbon emission level.

Increase the Mobility of Production Factors and Promote Achieving the Carbon Emission Peaking of the Region with Coordination. The carbon emission reduction progress of cities is not uniform in the region. Specifically, Beijing is far ahead, Tianjin is closely followed, and Hebei has a large burden and struggles to catch up. To realize the carbon emission in the region, collaborative emission reduction is the only solution. Among them, the dilemma of the Carbon Emission Peaking with coordination in the region is mainly reflected in the obvious siphon effect of Beijing on production factors in Tianjin and Hebei, which makes it difficult to achieve the agglomeration of capital in Tianjin, and causes serious loss of high-quality labor force in Hebei. Therefore, it is necessary to encourage more flows of talents and capital to the "two wings" of the Beijing-Tianjin-Hebei region through policy incentives, to promote the capital flow of Beijing to the capital deficient industries that Tianjin needs. At the same time, the region should also increase infrastructure investment and construction, unblock the flow channels of production factors, enable high-end people to stay in Hebei for a long time and provide intellectual support for industrial low-carbon transformation and upgrading. On the one hand, the agglomeration of industrial capital promotes the flow of talents; On the other hand, the innovation and

Entrepreneurship of high-end talents will attract capital, because the inflow of talents will further bring more capital inflows. Finally, talent and capital will form a benign spiral growth and promote the coordinated realization of the Carbon Emission Peak goal in the region.

References

Dai H (2006) Industrial gradient, two-way industrial transfer and the development of China's manufacturing industry. Econ Theory Econ Manage 12:45–50

Gong Q, Wang Y, Tong Y (2020) Population pressure on carbon emissions in Beijing, Tianjin and Hebei: spatial pattern and change analysis. J Capital Univ Econ Trade 22:56–67

Gu J, Zhan Y, Li M (2020) Research on the dynamic effect of total factor carbon emission efficiency in inter-regional industrial transfer in China. J Southwest Normal Univ 45:40–47

Li G, Lu S (2022) Research on the optimization of Beijing Tianjin Hebei industrial structure from the perspective of "double carbon" goal. J Hebei Univ of Econ Trade 43:81–89

Li J, Xiao J, Wang Q (2015) Research on carbon emission reduction quota based on industrial gradient transfer in Beijing Tianjin Hebei region. Resour Environ Arid Areas 29:1–7

Li Y, Sun L, Zhang H, Liu T (2017) Impact of inter-regional industrial transfer between Beijing, Tianjin and Hebei on carbon emission intensity of energy consumption. Resour Sci 39:2275–2286

Lu J, Liu Y, Yang Z, Sun J (2015) Research on the transfer of manufacturing industry in Beijing Tianjin Hebei region. Res Sci Technol Manage 35(11):86–89, 94

Ministry of Industry and Information Technology of the People's Republic of China (2016) website Homepage. https://www.miit.gov.cn, published on 2016/06/13

Tang Z, Liu X, Li B, Qu X (2017) Study on key driving factors of carbon emission in Beijing Tianjin Hebei region. J Tianjin Univ 19:514–519

The Global Energy Review of IEA (2022) website. https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2. Last accessed 2022/07/04

Wang Y (2020) Aggregate carbon intensity of China's thermal electricity generation: the inequality analysis and nested spatial decomposition. J Clean Prod 247:119–139

Yu Q (2021) Industrial transfer of manufacturing industry in Beijing under the background of coordinated development of Beijing, Tianjin and Hebei—from the perspective of location entropy. China's Circ Econ 35:70–78

Yuan Q, Li X (2015) Analysis of Beijing Tianjin Hebei cooperative emission reduction based on industrial gradient. Res Sci Technol Manage 35(225–229):235

Zhang Y (2017) Beijing Tianjin Hebei market integration process and its impact on carbon emissions. J China Univ Geosci 17:65–75

Zhang J, Lin Q (2017) Research on the impact of industrial transfer on China's regional carbon emission-based on the comparison of international and regional industrial transfer. J Fujian Normal Univ 72–80

Zheng H (2022) Research on the embodied carbon metabolism intensity of Beijing-Tianjin- Hebei urban agglomeration based on ecological network analysis. J Environ Sci 42:487–496

Research on Intelligent Digital Management Model of Metropolitan Museum of Art in the Era of "Cloud Exhibition-Visit"

Danyue Zhou

Abstract In recent years, affected by the impact of the COVID-19 epidemic, the museum has gradually begun to develop the online exhibition mode, displaying the collection through large-screen simulation, VR and other forms, and gradually forming the era of "cloud exhibition-visit". That is, you can watch the exhibition without going out. The epidemic situation has made the offline exhibition unable to proceed normally, which has caused an upsurge of online exhibition viewing. This paper analyzes and summarizes the digital management mode of the Metropolitan Museum of Art during the epidemic period, and brings certain reference significance for the development of China's digital intelligent museum under the era of "cloud exhibition-visit".

Keywords Cloud exhibition-visit · Intelligent digitalization · Management model · Metropolitan Museum of Art

1 Introduction

During the epidemic period, the offline exhibition was very difficult, and the digital online exhibition became the current social trend. The combination of museum and digitalization played a vital role in the development of museum. Affected by the epidemic, a large number of visitors have lost, which has affected the normal development of the museum to a certain extent, and also promoted the online development of the museum. That is, the exhibition can be moved online. Many museums have launched various forms of "cloud exhibition", including live cloud exhibition and online cloud exhibition. These various kinds of cloud exhibition-visit enable the audience to understand the history and culture without leaving home. This form of exhibition mainly relying on the Internet platform can also be called a digital museum.

D. Zhou (✉)
Xi'an University of Architecture and Technology, Uncompares East Caosi Road, Yi District, Xi'an 710100, China
e-mail: 1207337292@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_92

Digital museum is an information service system based on the entity museum and established on the information internet platform (Nan et al. 2021). It is the reappearance and reflection of the entity museum in the digital internet space. It has various advantages and characteristics, such as networking, intelligence, virtualization, etc.

At present, the establishment of a digital virtual museum in the information space is the current development trend of the museum. Whether it is used for exhibition and preservation of exhibits or interactive experience of viewers in the museum, it can make the management more intelligent and convenient. In other words, it can make the cultural relics "live". It can not only make the exhibits no longer hidden in the warehouse and can not be appreciated directly, but also combine with VR, AR and other modern intelligent technologies, making viewers more intuitively and clearly understand the historical background contained in the cultural relics collection (Xi 2020; Zhang 2021).By analyzing the digital management mode of Metropolitan Museum, this paper shows that Metropolitan Museum fully combines images, music, media, virtual construction and multimedia technology in the aspects of resource sharing and exhibit information integration on the Internet, which greatly improves the interest of viewers. Science and technology enable a large number of cultural heritage to break through the space restrictions, store and remember through digital ways, and share the digital resources of the Metropolitan Museum of Art, which greatly shortens the viewing distance, improves the viewing efficiency, publicizes the museum's history and culture, and provides meaningful value and reference for other museums with immature digital management system (Yue 2021; Liu 2020).

2 The Metropolitan Museum of Art in the Era of "Cloud Exhibition-Visit"

As the largest encyclopedia art museum in North America, the Metropolitan Museum of Art has an exhibition area of more than 20 ha and is divided into 17 departments, in which more than 2 million exquisite works of art from all over the world are displayed. During the epidemic period, the Metropolitan Museum of Art not only removed the barriers of space constraints, but also broke the limitations of access to content. While inviting all parts of the world to share museum resources, it also hopes that other public and private art institutions can learn its sharing concept and strive to build an era of sharing digital art exhibits (Nan et al. 2021; Jingjing and Jialing 2020).

Although the Metropolitan Museum of Art has profound cultural heritage and great influence, the epidemic still caused irreversible losses to the museum. The epidemic has greatly reduced the number of tourists. Although the Metropolitan Museum of Art has also suffered heavy losses, the complete management system has made the museum still strong and stable. As the Metropolitan Museum of Art is a non-profit organization that rarely receives government funding support, the epidemic has led to the closure of offline exhibitions and a significant decrease in ticket revenue. In

order to keep the museum's development unaffected, offline layoffs have been made and the focus has been shifted from offline to online. The online digital exhibition viewing model has been well opened. Through online publicity, the influence of the Metropolitan Museum of Art has been expanded, more people have been attracted to visit it, and offline restoration has greatly increased the original number of participants (Ruan 2021). Although the economy is under threat, the Metropolitan Museum of Art still holds the view that the sharing of exhibit resources is the priority and interests are complementary. Recently, the Metropolitan Museum of Art celebrated its 150th birthday. Although the offline annual exhibition was cancelled due to the impact of the epidemic, the chief executive officer of New York Metropolitan Daniel Weiss and the curator Max Hollein still released a video about the 150th anniversary of the pandemic. Hollein said that in the era of the epidemic, metropolises will use digital and online social media channels to provide more opportunities for people who can not come to the museum to visit and learn (Liu 2020; Lee et al. 2019).

3 The Importance of Museum Intelligent Digital Management

In the face of the severe epidemic situation, the digital protection and management of museums are also continuously developing and advancing. Digital products derived from the digitalization are the protection and collection units of physical collections, and are also important nodes for the integration of social history and scientific and technological innovation. The digitalization of museums includes the collection, preservation, research (Tu 2019), display, education, market and other work of cultural relics. It leads the museum to the change of management concept and mode. For collections, the storage of digital information can be reproduced continuously, so as to obtain the most fundamental security continuation and guarantee, without worrying about the irreversible damage caused by force majeure factors such as the outside world, so that the security and history of the collections can be displayed repeatedly without any loss or damage. Digital management can also improve the viewing efficiency of the audience, allow the audience to freely choose the collections they are interested in, enhance the interactive experience of users through the immersive experience of images and audio, and truly achieve the immersive effect (Villaespesa 2019; OreaGiner et al. 2021).

3.1 Sharing and Display of Collections

The Metropolitan Museum of Art has adopted a brand-new exhibition method since its self-styled line, that is, collecting and digitizing the collection information by using 3 DMAX technology, and displaying the collection in all directions, which not only

breaks through the space limitation, but also further ensures the exhibition security and information reproduction of the collection. The digital exhibition method overcomes the situation that the real cultural relics and collections can not be displayed normally due to external factors such as capital, site size and other factors, while the digital exhibition method can introduce the exhibits displayed on the internet in more detail by using scientific and technological innovations such as virtual space, images and sound (OreaGiner et al. 2021). The collection initially unveiled 375,000 pictures of about 200,000 pieces, mostly in high definition with a horizontal resolution of 4000 pixels. For the museum, the original problem that some exhibits could not be displayed offline was solved. For example, on the occasion of the 150th anniversary of the founding of the People's Republic of China, the museum had to cancel the offline exhibition because of the epidemic. The Metropolitan Museum of Art adopted the virtual online exhibition mode and applied the digital technology to the online exhibition. The viewers can not only watch the exhibition with the help of audio navigation, but also understand and watch the exhibition through operation (Fig. 1), and sell and publicize the digital exhibits. This not only reduces the space barrier, but also can enable people who are interested in the collection to avoid the crowded crowd, thus solving the problem of limited viewing distance. Even if the cultural relics cannot be unfolded externally at the protection stage, viewers can also enjoy the cultural relics in the collection anytime and anywhere and understand the value contained therein (OreaGiner et al. 2021). The high-definition digital collection display also enables more teenagers to observe and learn more carefully, and improves self-cultural accomplishment (OreaGiner et al. 2021; Jiawen 2019).

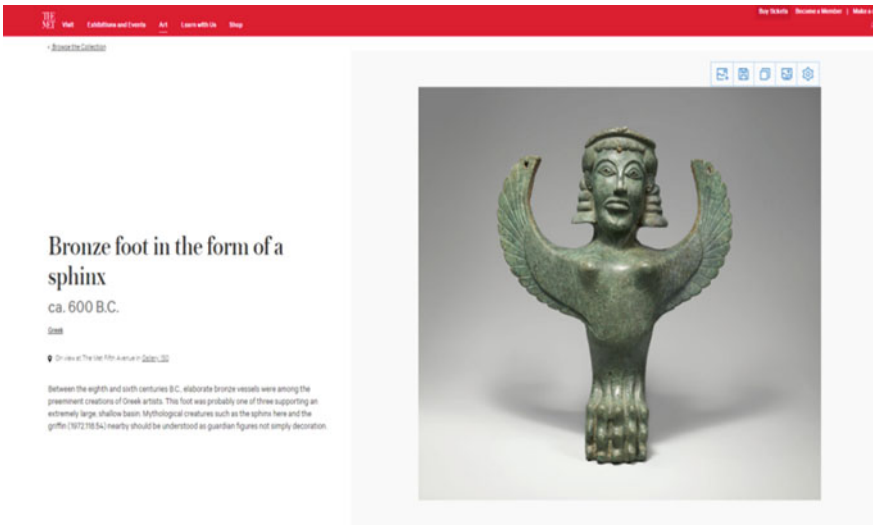


Fig. 1 Exhibition of an exhibit at the 150th anniversary of the Metropolitan Museum of Art

3.2 Improving the Efficiency of the Audience

The sharing of information resources realized by the digital management of the museum provides great convenience for the audience. People can use mobile phones to scan the two-dimensional codes of different collections to get to know the social information of the collection, and use pictures, words, even music and other forms for people to watch and understand (Residents: The Case of Thyssen-Bornemisza National Museum 2021; OreaGiner et al. 2021). To a certain extent, the efficiency of viewing exhibitions by the audience is improved, the time for people to search for collections is reduced, and the audience's deeper understanding of exhibits is deepened. The digital management of museum collections not only enables offline viewers to avoid viewing obstacles and limitations caused by congestion, but also provides an opportunity for those who are not convenient to get to the site to stay at home, i.e. to use the network to query collection information, thus realizing the function of viewing collections in high-definition details for many people at the same time, improving viewing efficiency and providing advantages for collection and protection of collection files.

3.3 Enhancing User Interaction Experience and User Information Collection

The museum itself has an advanced development track and history and culture. It represents the image of a city and an era. In the digital construction of the museum, great attention is paid to the audience's digital interactive experience in the viewing process. It not only enhances the museum's own strength, but also promotes the image of the city. Although affected by the epidemic, a large number of museums have to face the situation of closed museums, but online exhibitions always occupy a strong position in the development of museums. Therefore, great efforts should be made to develop the online operation of museums, and creating a zero-distance, immersive experience is the preferred strategy for many museums. In recent years, major museums are rapidly updating their digital intelligent management technology, aiming at higher definition and convenience to attract the public to visit online. Visitors do not have to look at cultural relics through glass windows or standing at a fixed distance, thus avoiding the distance feeling that may arise from viewing exhibitions offline, and thus obtaining a more comfortable viewing and interactive experience (OreaGiner et al. 2021). For example, VR, AR, projection somatosensory display and other scientific and technological innovations are combined with museum management to truly realize information dialogue between people and collections (Fig. 2). Immersive experience can not only give people the feeling of being personally on the scene, but also, most importantly, it can greatly stimulate the interest and exploration spirit of the exhibitors. The audience has changed from a "passive state" to a "spontaneous experience" by being led to visit and study, emphasizing the audience as

Fig. 2 VR intelligent viewing method

the main role, exploring museums according to their own interests and hobbies, and learning and understanding various aspects of knowledge. In the era when "cloud exhibition-visit" was in vogue, it was also one of the important means for the museum to improve the exhibition effect and attract the audience.

At the same time, the museum is gradually adopting digital collection of information such as users' personal interests and preferences, so as to facilitate better segmentation and division of work of museum services. Considering the diversity of different exhibitors, i.e. to provide them with appropriate services, and according to the number of people to choose different services, the museum will also learn which method is the most popular at the moment, and obtain which aspects of audience experience number and experience time are the most prominent. It can also collect visitors' opinions through online information collection. Compared with offline interviews, online collection is faster and more convenient, and it is easier to screen out useful information for integration and summary.

4 Analysis on the Intelligent Digital Management Model of Metropolitan Museum of Art

In the era of epidemic, as the largest art museum in North America, the Metropolitan Museum of Art, in order to make up for the loss that can not be carried out offline and attract more visitors, has opened hundreds of thousands of collections on its official website. Through different online exhibitions, all viewers can watch and learn. After

online exhibitions, millions of people can be attracted to visiting online every day and sharing information resources (Lee et al. 2019; Grincheva 2020). Digital management enables viewers to visit the museum anytime and anywhere. In the face of different levels and levels of audiences, digital management also provides more flexible and convenient information choices for different crowds. The Metropolitan Museum of Art adopted the management method of online resource sharing before the epidemic. The epidemic undoubtedly accelerated the process of digital development. The mere display of exhibits would be a bit monotonous and boring, and it would be easier for people to lose the desire and interest of exploration. The Metropolitan Museum of Art has improved and innovated the digital management and adopted a brand-new online management and operation mode (Villaespesa 2019).

4.1 Metropolitan Museum of Art's Innovative Model in Intelligent Digitalization

Using Digital Online to Realize Resource Sharing. European and American museums are committed to combining scientific and technological innovation, following a brand-new management model. The Metropolitan Museum of Art is where all visitors can download, search and use official website's pictures for commercial and non-commercial purposes. They can search official website for information about their collections that they are interested in and want to know for free. The Metropolitan Museum of Art has released nearly one million high-definition images and the cultural background of its collections. Many of its open collections have never been displayed offline because of their vulnerability. This has caused inconvenience in obtaining much information. However, digital resource sharing completely avoided such problems (Fig. 3).

Thomas P. Campbell, curator of the Metropolitan Museum of Art, said although this kind of behavior will cause some copyright problems, the museum pays more attention to sharing the museum's resources with the public than making money. It can also provide inspiration for more contemporary artists through digital means and channels. This is what the Metropolitan Museum of Art, as a non-profit organization, should do. This kind of behavior is also called the outstanding "leader" in the process of digitalizing resources (Residents: The Case of Thyssen-Bornemisza National Museum 2021). No matter the quality or scale of shared resources, other organizations are incomparable.

Combining with Innovation and Technology to Trigger Community Discussion. The Metropolitan Museum of Art displays and explains the pictures in its collection on its official website. If you are interested in the museum, you can get to know it online at any time. You do not have to come to the museum in person. In addition to the graphic display, the Metropolitan Museum of Art also has a 3D reproduction of the exhibits, which can be displayed in an all-round and three-dimensional way. In addition, the public can find out about the name, artist, size and other relevant

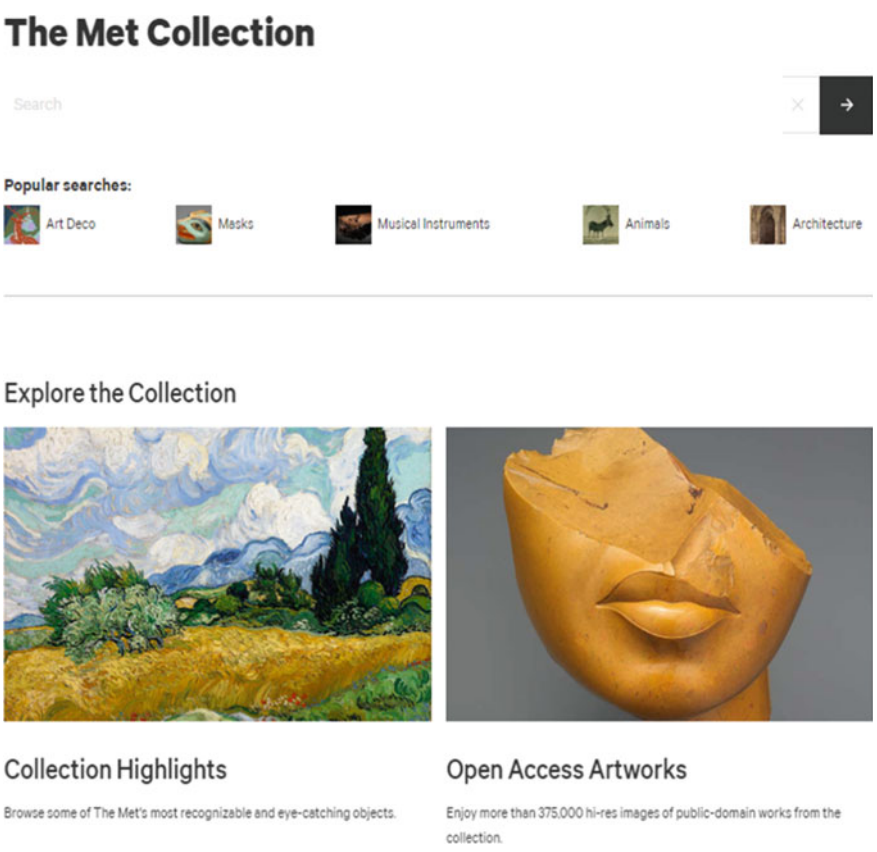


Fig. 3 Art online official website display form

information of the works themselves, and understand the relevant data of the works of art (Figs. 4 and 5).

Because the museum has a large collection of cultural relics and contains a profound cultural background, the museum is regarded as a second classroom for students to learn, and the Metropolitan Museum of Art has always taken imparting knowledge as one of the main purposes of handling it. Therefore, in order to better impart knowledge, the museum has carried out a new digital innovative management in official website, # met kids. This is a learning project specially developed for children to visit online. Because the applicable objects are young, the operation is convenient and simple. The operation can be performed by clicking on "Explore the map" on the page. Thumbnails and 3D high-definition live-action maps of corresponding positions can be displayed as long as you click on different orientations (Figs. 6 and 7). Through animation, the museum aims at children's curiosity and creativity (Tu 2019; OreaGiner et al. 2021). Apart from audio presentations and 3D live scenes, the museum also has the choice of self-creation. Even for children with

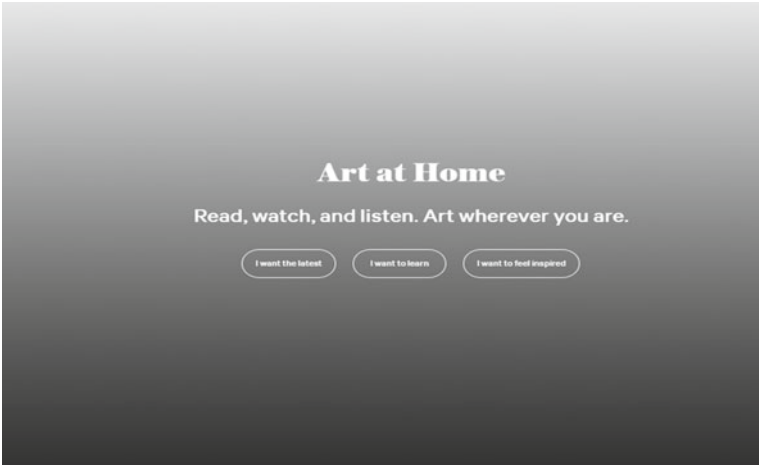


Fig. 4 Metropolitan museum of art "art at home" official website

Fig. 5 Metropolitan museum of art online exhibition collection

Fig. 6 Metkids interface

strong learning ability, the museum also prepares digital teaching to enable children to make self-innovation and enhance their practical ability (Fig. 8).

In addition to the experience items mentioned above, #Metkids also has a time shuttle service, i.e. selecting different time periods or themes to learn about the collections of interest, such as the collections between 1400 and 1600 A.D. in the Middle East. Clicking on the collections you want to know can quickly locate them on the map, and the whole design is innovative and interesting. Through the modeling of the time machine, the audience will have an immersive and interactive experience (Fig. 9). In addition to the exploration part, the Metropolitan Museum of Art has also prepared video materials for children to learn after watching, aiming at self-exploration and invention through what they have learned from the museum (OreaGiner et al. 2021).

In order to develop its own digital management, the museum carries out different innovations and reforms. The metropolitan museum of Art is designed entirely from the perspective of students, and is perfectly combined with scientific and technological innovation. Through simple operation, it can be placed under the line. Compared with the simple construction of a real-life model, targeted innovation is more likely to attract the corresponding crowd, get rid of the original boring and boring of the museum, and enhance the interest and innovation (OreaGiner et al. 2021). It is also because of the rise of relevant innovative models that more people are attracted to visiting the museum and sharing relevant consultation and experience in the public community. The museum will also have a certain degree of discussion through the

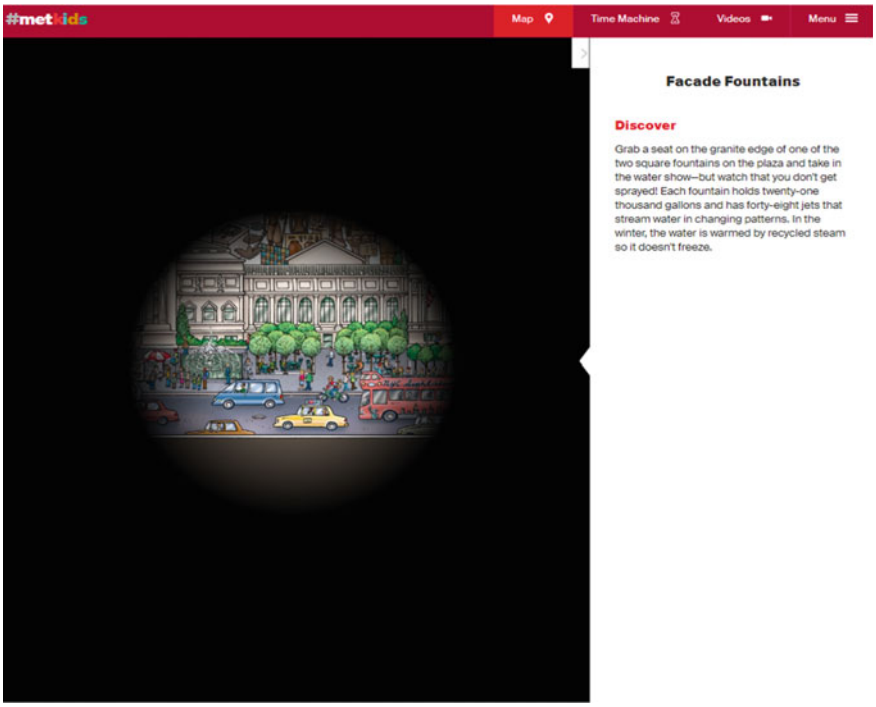


Fig.7 Thumbnail of David H. Koch Plaza

influence of social networking, which has attracted more attention from relevant people and promoted the Metropolitan Museum of Art to a certain extent.

While sharing resources, the Metropolitan Museum of Art also cooperates with international non-profit organizations. The Metropolitan Museum of Art itself is non-profit in nature. Cooperation with organizations such as Artsor, DPLA and Pinterest can expand the collection volume of the Metropolitan Museum of Art, and can also use cooperative organizations to integrate content sources. Collections provided by the Metropolitan Museum of Art can also be re-integrated, making it convenient for the public to find resources and integrate information (Residents: The Case of Thyssen-Bornemisza National Museum 2021).

The Metropolitan Museum of Art not only limited cooperation to international organizations, but also further promoted the online development of the Metropolitan Museum of Art through cooperation with the community, such as the cooperation between the Metropolitan Museum of Art and the Wikipedia community, which made all images available to the public in Wikipedia, so that the public could search and learn (OreaGiner et al. 2021; Wiedemann et al. 2019). The Metropolitan Museum of Art was authorized free of charge to use the searched images and information whether for commercial or non-commercial use. Because of its large collection resources, it was more convenient for artists, designers and other outstanding talents to provide

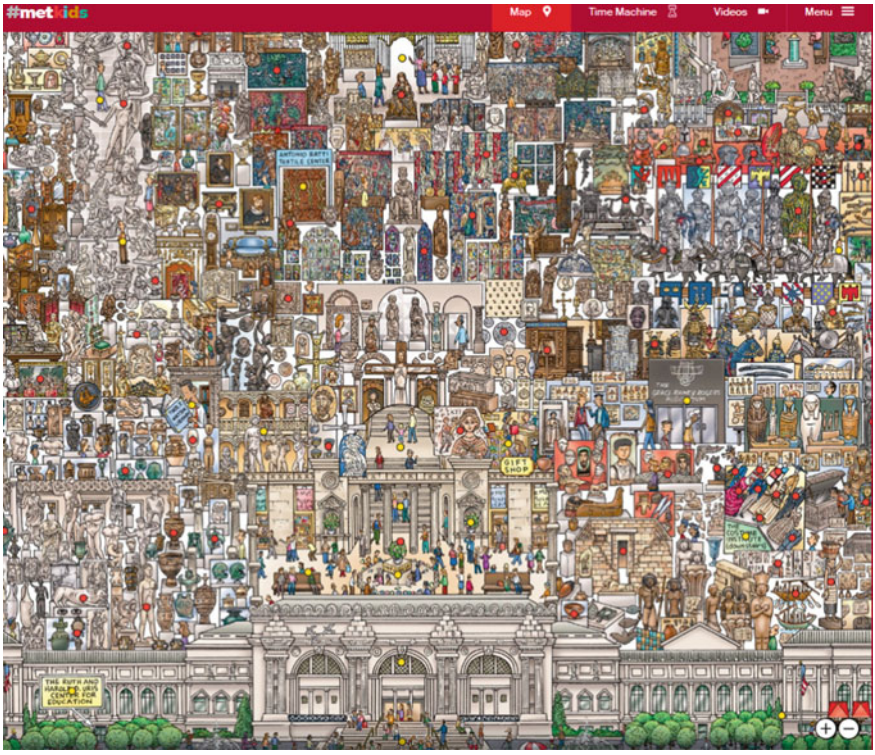


Fig. 8 Panorama of Metkids animation

brand-new inspiration. The inspiration from creators will also be applied to life practice in a wider range. For example, the European Digital Library borrowed the artistic style of the Metropolitan Museum of Art, and Louis Comfort Tiffany designed a brand-new stained glass window for it (Fig. 10).

The Metropolitan Museum of Art will not confine its knowledge to the classroom framework and academic publishing (Villaespesa 2019; Wiedemann et al. 2019). It will cooperate with different community groups to share the resources in the museum around the world, so that students around the world can find the digital resources they need. The Metropolitan Museum of Art will support the digital resources of the global education community to contribute to different communities, encourage the teaching and rise of culture and art, inspire students' talents and inspiration, and enable students to get rid of the traditional learning model and rethink the artistic value. It can be seen from this that the management of museums is gradually moving away from the monotonous offline operation. Instead, it is combining with other communities, organizations and social life in a more diversified way. In addition to spreading knowledge and sharing resources, it is also better to combine and utilize art with real life, providing inspiration for artists and improving the influence of museums.

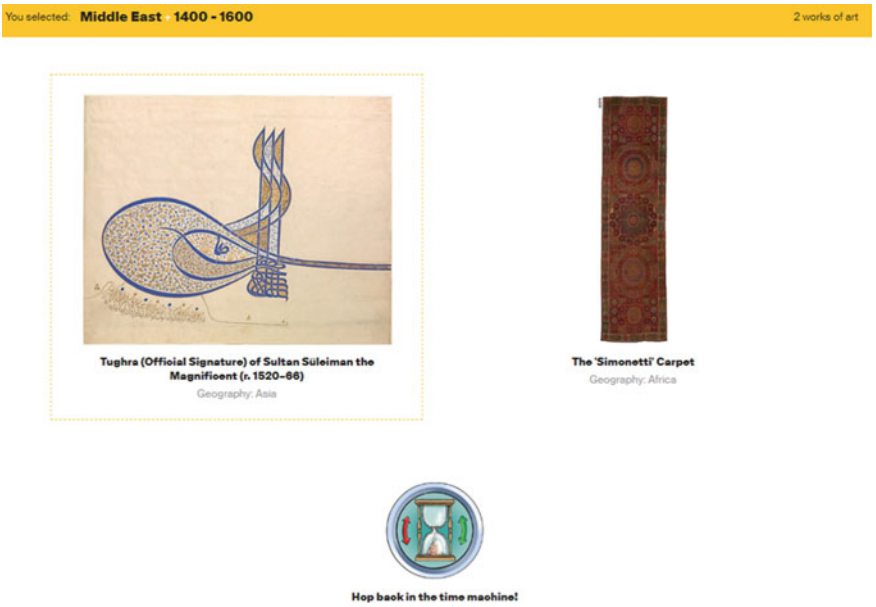


Fig. 9 Display of collection between 1400 and 1600 A.D. in the Middle East

Fig. 10 Stained glass windows of European Digital Library

4.2 Problems in Digitalization of Metropolitan Museum of Art

Limited Technical Capabilities and Unsatisfactory Results. Metropolitan Museum of Art embodies the concept of "people-oriented" in its management innovation. The newly developed #metkids is the best proof. However, most of the exhibits are still limited to sharing pictures and models, and the #metkids' age range is limited, so they can not give other kinds of viewers a good interactive viewing experience (Liu 2020; Lee et al. 2019). The Metropolitan Museum of Art pays more attention to the management of offline exhibitions and has some limitations on online exhibitions. It does not perfectly combine technology with innovative ideas. The digital museum has been developed for several years, but it still can't get out of the inherent propaganda mode, that is, to display the resources solely by pictures, texts and audio, to combine the online museum with digital information technology, to make the display effect more vivid and vivid, to do a good job in the education of the museum while promoting itself, and to better exert the influence of the museum.

Unable to Understand the Needs of Viewers and Conduct Data Information Screening and Induction. Due to the fact that the Metropolitan Museum of Art is too focused on resource sharing, it does not integrate and summarize the data and information after the exhibition. For example, METKIDS does not provide relevant services such as feedback, and pays little attention to the information collection after the exhibition. It is also unable to accurately and quickly understand the service needs of the audience. The collection of user information is extremely important to the digital museum (OreaGiner et al. 2021). The digital museum focuses on providing the audience with more efficient and convenient demand services. Therefore, summarizing and integrating the audience's post-viewing experience can better understand the audience's viewing preferences. It has different significance for both online exhibition-visit and offline experience.

Insufficient Brand Effect. The Metropolitan Museum of Art has cooperated with international organizations and communities sharing resources, which have produced certain influence to a certain extent. On the basis of having extensive influence, the museum can try to create some brand derivatives with museum characteristics through brand cooperation, combine with digital information, and better promote and improve museum revenue. At present, popular and interesting publicity and display, such as modern and innovative packaging of the museum's inherent characters as museum brand derivatives to attract viewers, can also better enrich the museum's connotation (Residents: The Case of Thyssen-Bornemisza National Museum 2021).

4.3 Optimization of Intelligent Digital Management Mode

Strengthening Advanced Technology Learning and Talent Introduction. The Metropolitan Museum of Art is very creative and interesting in the development of #metkids. The museum should innovate other types of functions according to the management form of #metkids. Taking #metkids as an example. After the museum determines the applicable object as a child, it mainly transfers the focus of viewing the exhibition from the exhibition to the child itself, which mainly enhances the interest and interactive experience of the child's operation. The results generated by the combination of digital information are more suitable for the corresponding crowd. Designed from the perspective of reference objects, so as to achieve the effect of immersive experience (OreaGiner et al. 2021), the museum can also adopt more advanced technology to develop and innovate functions for different categories of people, and at the same time, it should also introduce corresponding talents. During the epidemic period, the Metropolitan Museum of Art will lay off some of its staff for economic reasons, and can continue to introduce more excellent talents after resuming offline exhibitions, so as to achieve both online and offline development.

Enhancing the Collection and Collation of User Information, the Interactivity Between Museums and Audiences, and the Sense of Experience. In the offline exhibition, it is difficult to collect information for a large number of people, while online information collection is more convenient and efficient. Museums should pay attention to the information integration of users, which can make it easier to understand the audience's preferences and innovate the museum's functions according to the audience's interests. Through questionnaires, online service evaluation and user experience, the corresponding information is analyzed and summarized. In recent years, science and technology have played an important role in museums. For example, the audience's viewing mood can be obtained by analyzing the audience's facial expressions, so as to summarize the popularity of exhibits. The museum should make good use of the functions generated by the combination of digitalization and museums to make better contributions to the publicity and development of museums (Villaespesa 2019; OreaGiner et al. 2021).

Combining Brand Effect with Scientific and Technological Innovation. The museum should expand its audience, and should not limit its publicity to people who are interested in the art of cultural relics. It should combine the history of cultural relics on display with popular brands, such as cosmetics, stationery, jewelry and other brand derivatives (Liu and Lu 2020; Lee et al. 2019), which can not only enhance the influence of the museum, but also promote the social and historical value of the museum. The museum should publicize the collections so that the public can understand and experience the advanced technology of the museum and realize the connotation of the museum to a greater extent (Villaespesa 2019; Choi and Kim 2021).

5 Enlightenment and Reference: The Application of Scientific and Technological Innovation and Digitalization

As an influential museum in North America, the Metropolitan Museum of Art's outstanding digital management model is worthy of our reference. At present, there is still a big gap between domestic and foreign digital museums. In view of the more advanced and perfect innovation system in foreign countries, our museums should learn from its excellent management model, make up for the deficiencies and improve it. The museum is not only a treasure house of cultural relics, but also represents the rich historical image of a city or even a country (Hu 2019; Choi and Kim 2021). Only by learning from each other's strong points and improving the management system can the cultural output and the cultural image of a city be better managed.

5.1 Digital and Technological Push

Digitalization blurs the museum's original sense of boundary. As a result of the development of advanced technology, "cloud exhibition-visit" has become the norm for us to watch museums and learn knowledge. Through digitalization, the exhibition has gone out of the limited museums, out of the cities, out of the country and into the world, truly realizing when, where and where it is everywhere. Through the innovation of science and technology, the exhibits that could not be displayed in front of the audience can be better restored, not only for the restoration of cultural relics, but also for the function improvement of museums. Museums should be based on the audience and combine the innovation with digital technology according to the audience's perspective. In recent years, China has also been continuously adopting different kinds of online digital exhibitions, such as live broadcasts and 3D live scenes, to attract a large number of viewers to watch, and has made some achievements. Taking the "theatre of dreams" of Shanghai Science and Technology Museum as an example. It is a theme theatre using different digital multimedia means. Through the innovative ways of phantom imaging, real-world virtual interaction, classic reproduction and so on, the museum enables the audience to experience the interesting and interactive features of the museum combined with digitalization. It not only stimulates the audience's interest in cultural knowledge, but also generates more understanding and learning about science and technology. However, this way is only focused on superficial display. Without the function of making the audience deeply understand, the museum should adopt more diversified methods and science and technology to make the audience understand the content and meaning that the digital intelligent museum wants to express (Jiawen 2019).

5.2 New Ways of Interactive Experience

The correct operation has narrowed the distance between the museum and the audience. For example, metkids in the Metropolitan Museum of Art has used animation, interaction and other means to strengthen the communication and exchange between the viewers and the exhibits. Due to the backward digital development of many domestic museums, they can only display and introduce the exhibits in simple images with poor interactivity. Many museums can not follow the development pace of museums due to inadequate funds and lack of management personnel. The most important thing about online museums is the interactive feeling between the exhibits and the audience. While relying on information technology, museums should combine innovative strategies. While solving economic problems, museums should also (Villaespesa 2019; OreaGiner et al. 2021; Wiedemann et al. 2019; Hu 2019; Choi and Kim 2021), It is also necessary to introduce more talents to strengthen the interactive experience, and try to design exhibits that are interactive and experience-oriented, so that online viewers can feel as if they are on the scene, which is more conducive to the audience's immersion. At the same time, some online exhibition platforms should also be used for the virtual exhibition carried out by online operation, such as Tik Tok, Weibo and other applications with large number of users and wide audience. In recent years, museums under the epidemic situation are more likely to share resources by means of online live broadcast and other means. Audiences can also learn about the current situation of museums by leaving messages and watching in real time. At the same time, a large number of museums have also registered their accounts on different public platforms to interact with the masses online, which shortens the distance between museums and the audience, and also breaks the boring and stereotyped original impression of museums, giving viewers a sense of intimacy and interactive communication.

6 Conclusion

Cloud exhibition-visit is the trend of the times. In the current era, digitalization is particularly important. Only by combining digitalization with museum innovation can museum online development be better carried out and costs be reduced to operate museums in the current era. This paper analyzes the Metropolitan Museum of Art's digital innovation management model, which brings some reference to our national museum management model (OreaGiner et al. 2021; Hu 2019).Compared with foreign countries, our national museum is not mature enough and has a lot to learn and improve. We need to do a good job of introducing talents, develop the function of combining science and technology with the museum, focus on our own system, transfer the innovation perspective to the audience, pay more attention to the audience's exhibition experience, enhance the audience's interactive experience, and better present the digital museum to the viewers. At the same time, we should

also make more reference and summarize the innovative ideas of foreign excellent museums. Online is only one of the operating ways under the development of the times. Offline is still the mainstream of museum development. We should focus on both online and offline to truly realize the diversity brought by the combination of museums and digitalization (OreaGiner et al. 2021; Wiedemann et al. 2019; Hu 2019).

References

Choi B, Kim J (2021) Changes and Challenges in Museum Management after the COVID-19 Pandemic, pp 148–148

Grincheva N (2020) Museum diplomacy in the digital age. 200

Hu J (2019) Exploration on the development direction of museum management in the new period, pp 109–112

Lee YY, Lee JH, Ahmed B, Son MG, Lee KH (2019) A new projection-based exhibition system for a museum, pp 1–17

Liu M (2020) Research and exploration of museum online education model based on the concept of "diversity and inclusion"-analysis of online education practice of Chinese garden museum. Chin Gard Mus 11(9)

Liu J, Lu J (2020) "Looking for an Opportunity in Danger": Response and Optimization of Digital Culture Service in Public Museums under the COVID-19 Epidemic. Public Service for Cultural and Tourism. 165. 2020.04.35–40

Nan F et al (2021) On the optimization of museum Online service experience based on audience needs. Sci Educ Mus 7(3):216–232

OreaGiner A, CaleroSanz J, DePablosHeredero C, VacasGuerrero T (2021) An exploratory analysis of museum attributes from the perspective of tourists and residents: the case of Thyssen-Bornemisza National Museum, Madrid, Spain, p 64

Ruan L (2021) On-line communication strategies of museums in the new media environment. Cultural relic identification and appreciation 7(1):135–137

Tu S (2019) Analysis on the development trend and application technology of digital museum. 2019-07-12. 151–154

Villaespesa E (2019) Museum collections and online users: development of a segmentation model for the Metropolitan Museum of Art, pp 233–252

Wiedemann J, Schmitt S, Patzschke E (2019) Responding to Open Access: how German Museums use digital content, pp 193–209

Xi Z, Ying Z (2020) Museum online operation in special period–museum in COVID-19 epidemic period. Xinxiang Mus 2020.03 (2):133–135

Yue H (2021) "cloud exhibition-visit" is in vogue. What is the advantage of museum online exhibition? Chin Fine Arts 2021.64–68

Zhang L (2021) On the development trend of history museum from "cloud exhibition". Nanjing Institute of Art, 0318.1–50

Research on Renewable Energy Supplement in DC Data Center

Langzhou Jin

Abstract Data center is an excellent power-consuming load in current public service. According to the rapid upgrading rate, the traditional power supplement based on fossil fuels have some side effects like efficiency and environmental influence. Because of its feasibility and low environmental impact, renewable energy is regarded as an ideal substitute for fossil fuels, and it is used as the energy of the data center. This paper aims to explore the application potential of renewable energy in data center operation, which is mainly based on solar energy. The current generated by the photovoltaic panel and the working current of the data center is both direct current (DC). With the application of solar energy, power loss during the conversion between the power grid and data center could be avoided. The second part of this paper is the application example of solar energy utilization in the Tencent T-Block data center.

Keywords Renewable energy · DC data center · DC grid · Solar energy · T-block data center

1 Introduction

1.1 Background

Energy is regarded as one of the most important resources for humans to survive. To meet the development requirements, the application of energy has gone through several stages from the prehistoric era to today. During the process, energy revolution occurs as the symbol of energy efficiency zooming. After the initial control of fire, several energy resources were adopted sequentially. Currently, fossil fuels are the dominant occupation in energy supplement (Mansuri et al. 2020). Based on the

L. Jin (✉)
Colorado State University, Fort Collins, CO 80523, USA
e-mail: davidjin@colostate.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_93

extensive application of fossil fuels and environmental problems, with the energy consumption, almost all industrial and economic development depends on energy supplements. According to the BP Statistical Review of World Energy data, 2020 could be a year with much uncertainty. In 2020, solar power generation increased by 1.3 EJ, reaching a record level, which shows the great potential of renewable energy development. Another aspect we need to pay attention to is the increment of installed capacity of renewable energy to 2799.1 GW and the decrement of fossil fuel installed capacity to 60 GW from 66 GW in 2019 (bp global 2020; Apata et al. 2021). The advantages of renewable energy adoption compared with traditional fossil fuels must be discussed. Renewable energy applications can provide electricity without emitting greenhouse gases. Also, it has a relatively low cost and reasonable energy price, which would be beneficial to customers (Ayadi et al. 2021). It is clear to observe the trend that renewable energy is replacing the share of fossil energy with apparent benefits.

The data center is an integrated system with heterogeneous hardware and software, providing various Internet services to private and public users (Ferreira et al. 2020). The main structure of the data center consists of IT equipment such as servers and storage equipment, and other corresponding cooling infrastructure. Essentially, the data center is a direct current (DC) load consuming considerable energy. With the rapid development of cloud computing and market demands, the data centers are faced with the challenge of updated efficiency requirements, increasing cost, and potential environmental problems caused by the surge of energy consumption. It is estimated that there will be 5.5 billion mobile users and 12 billion mobile connections by 2021 and 28.5 billion networked devices by 2022 (Failed 2021; Ahmad 2020). There are several concerns about the adoption of the data center. One is that the high dependence of data centers on the grid could damage operation stability. Because uncontrollable factors, including bad weather, may damage standard power transmission. Specifically, because the ambient temperature dramatically influences the efficiency remarkably, and data centers usually have to deal with the peak flow times during the operation, the high energy demand for cooling is significant for the energy cost of the data center (Kumar et al. 2020; Baccour et al. 2019). This research discussed the advantages of renewable energy supplement to direct current (DC) data center, the DC data center architecture, and relative necessary support. In addition, an example of renewable energy adoption in the DC data center was analyzed.

1.2 Introduction to Data Center Energy Consumption

Generally speaking, data centers are regarded as customers with appreciable energy demands. Two main factors are contributing to the rapid energy growth of data centers. One is the nature of data center operation. The data center is the essential infrastructure for extensive Internet service. It involves many units, mainly the servers, to realize the extensive data computing functions and keep running, and it needs enough energy support. Another is the updating requirements for data center

functions due to the development of IT and data computation services in economy and engineering fields. In addition, due to the pandemic, telecommuting is becoming more and more necessary for global companies, which increases the demand for data exchange and conversion based on virtual platforms. To approach the expected computing performance as much as possible, the energy demands of data centers are constantly expanding, which leads to the corresponding energy supplement and operation efficiency lagging. Typically, data center consumption could be equivalent to the total energy demands of 25,000 families and surpass 100 times the standard office space equivalence (Diouani and Medromi 2019).

Furthermore, data centers also occupy approximately 2% of the global carbon footprint, which is not consistent with the requirements of sustainable development (Bhattacharya and Qin 2020). With this situation, the importance of energy conservation for data centers has become apparent. Based on the potential of renewable energy exploitation, it could be possible to introduce renewable energy into the energy supplement for data centers.

1.3 The Attempt at Renewable Energy Adoption

Some attempts were adopted to mitigate the power issues of the DC data center. Importing renewable energy into the DC data center is a concept to create extra-energy support rather than mains electricity based on traditional fossil fuels. In addition, this concept will improve operation stability by reducing the dependence on the power grid. Using solar energy as an energy supplement is considered a standard method, is mainly based on this photovoltaic system. The initial electricity energy generated from the photovoltaic panel is direct current. Under normal circumstances, the inverter needs to convert DC electric energy into alternating current and then transmit the alternating current as commercial power to the power grid.

However, since the DC data center operates under a DC environment, the power accumulated by the photovoltaic panel can be consumed by data centers directly without the participation of the inverter. This is one main advantage for renewable energy, especially solar energy, adopted by DC data centers. At present, some of the largest cloud service providers (CSPs), including Google, Microsoft, and Amazon, have provided a hybrid supplement for their data center by adopting renewable energy and fossil fuels (Islam 2019). Specifically, photovoltaic systems have been utilized in several data center programs, such as Flexenclosure's Centre, Tencent's T-block, etc.

2 The Adaptation of Renewable Energy in DC Data Centers

2.1 Overview of Current Renewable Energy

For a long time, fossil fuels have been used as the power source and still account for a large proportion of primary energy consumption. Even though the current reserves of fossil fuels are considerable, it is still impossible for fossil fuels to be sustainable support to enduring development in the future. On the other hand, the widespread and extensive fossil fuel application also causes environmental problems, which is not conducive to achieving the goal of carbon neutrality in the future. Thus, the urgency and necessity for finding alternatives to fossil fuels are apparent and renewable energy could be an ideal plan to be the replacement gradually. In the environment, most renewable energy sources have relatively low pollution and greenhouse gas emissions during the adoption, which is ideal for sustainable requirements. In addition, because of its feasibility and abundance, renewable energy, especially solar and wind energy, has great potential for utilization.

On the other hand, many kinds of renewable energy are derived from nature, including sunlight, wind, and tide, easy-going sources. With the reduction of excessive dependence on fossil fuels and the demand for pollution control, many governments have promulgated relevant regulations to encourage renewable the development and application of renewable energy. Over 100 countries had planned to accomplish a reasonable proportion of energy from renewable energy resources in the total energy consumption in 2018 (Kurbatova and Perederii 2020). Furthermore, domestic attempts at renewable energy application and the international consensus were formed. The Paris Agreement on Climate Change was adopted in 2015 to limit the global warming trend.

2.2 The Challenge of Energy Transition

Although the consensus of renewable energy application to replace fossil fuels has reached an agreement, some challenges still hinder the energy transformation. The essential issue is intermittent. And solar energy and wind energy are the most common renewable energy sources in utilization, and available sunlight and wind energy are used to generate energy. However, both solar and wind power cannot supply steady energy due to the weather, atmospheric pressure, and temperature variability. These problems are based on the natural properties of the sun and wind, and any one of these issues may change suddenly. Thus, the primary power generated by the solar or wind source has many peaks with high magnitudes. But the data center needs a stable environment for operation in a reasonable power range. This initial power with extremely high peaks is harmful to the data center operation (Peng and Qin 2020). In addition, the downtime cost of the data center is very high. Still, during

the shutdown period, the computing demand does not decrease, so it is necessary to solve the problem of sufficient power supply at night or in no wind. The other issue is transportation. To maximize energy collection efficiency, both utility-scale solar and wind energy extension equipment of power plants is required to be concentrated in specific locations with large areas. And sites with plentiful energy sources tend to be secluded, far away from the residential areas. Therefore, due to location limitations, these power sources may need to transfer large amounts of power from remote locations that are not convenient to the grid. As a result, there will be considerable power loss in long-distance transmission.

2.3 The Feasibility of Renewable Energy for Data Centers

As a kind of renewable energy with abundant sources and wide applications, solar energy has several advantages in the power support of DC data centers. Compared to the AC distribution plan, DC distribution in data centers is more attractive to customers since the direct adoption of DC power can eliminate at least one power inversion stage, which results in higher efficiencies. This power inversion stage is typical to observe in AC distribution. Solar energy collection depends on the photovoltaic cells, which directly convert solar energy into electrical energy by the photovoltaic (PV) effect. During the converting process from solar energy to electricity, no greenhouse gas emissions, noise, or air pollution will be caused. The low degree of emission and pollution of solar energy collection is ideal for environmental friendliness and carbon neutrality. On the other hand, unlike coal, petrol, or other fossils, sunlight is free and does not need to be prepared to complicate mining processes. In this way, a solar energy plan could save plenty of costs in preliminary preparation. At present, the DC data centers are mainly powered by the grid. To minimize power loss during transportation, the current in the power grid is alternating, which means that the DC data center cannot directly utilize the power from the grid. Thus, the power from the grid has to be converted by the rectifier from AC to DC to meet the requirements of the DC data center. During this process, a considerable amount of power loss occurs, apparently increasing the energy application cost. However, since the current generated by the photovoltaic panel from solar energy is direct, the power from the photovoltaic panel could be supplied to the DC data center without any conversion. In summary, the solar energy supplement is reasonable. It is possible to use it in the DC data center as a partial or even complete replacement of the grid powered by fossil fuels.

2.4 Effects of Solar Energy Development

Some effects have been adopted to solve the issues in solar energy collection. The most critical issue is the intermittent use of solar energy. The amount of generated

solar energy mainly depends on solar irradiance, influenced by time and weather factors. The interruption of the power supplement will cause downtime or even malfunction of the regular operation. The energy storage system can save the remaining energy when the power generation exceeds the typical demand and release the stored electric energy to the terminal (Shrivastava et al. 2021) when the photovoltaic panel system is in low energy collection. Thus, the energy storage system is necessary for the DC data center to operate continuously. Energy storage methods mainly include batteries. This method helps the grid better integrate solar power, enhances the power grid's flexibility, and avoids abandoning light. Then, the efficiency of solar energy collection could also be an issue worthy of attention. Even though the total amount of solar energy is considerable, the energy density is relatively low due to the location limits, which means the photovoltaic system needs a large area to generate enough energy from sunlight. The Concentrator Photovoltaic (CPV) is a reasonable attempt to improve the efficiency of solar energy collection. The CPV focuses the incident sunlight by optical modules on photovoltaic panels directly to increase the high energy density of the concentrated light beam (Tobias et al. 2020). Also, Maximum PowerPoint Tracking (MPPT) is another method to improve efficiency from a mechanical perspective. When the incident sunlight direction is normal to the photovoltaic panels, energy conversion efficiency meets the maximum. So, with the help of MPPT, photovoltaic panels can track the sun automatically to ensure the perpendicular position relative to incident sunlight. Another aspect that needs to be concerned is the stability of the power supplement. Primary solar energy has vibration because of the time in a day. Generally, the initial power converted from solar energy has a wide range of peaks, which is undesirable for stable operation. The Uninterruptible Power Supply (UPS) is used to solve this issue. UPS can eliminate the power peaks in a short period, which ensures the stable power input for the DC data center. Also, UPS blocks the extra-power supplement from the photovoltaic panels to avoid downtime caused by overloading.

2.5 Energy Storage Adopted in Data Centers

To preserve the energy for the urgent need of data centers, and energy storage system must be adopted. Specifically, a concept named Power Usage Effectiveness (PUE) was developed for data centers to determine electricity consumption. PUE is a ratio, as shown in (1) below.

$$PUE = \frac{Data\ center\ energy\ consumption}{IT\ equipment\ energy\ consumption} \tag{1}$$

In an ideal case, PUE equals 1, which means the IT computation system is the only energy consumer in the data center. Minimizing the PUE of the data center during the operation is also an essential task for the energy storage system.

Several ideas are generated, and some of them are applied later. The most basic design is focused on renewable energy storage. Peak shaving is used widely in this design to ensure power stability, especially for solar energy. However, this design is monotonous and isolated from other parts of the data center, canceling the possibility of energy exchange. Thus, the UPS has come up with a possible plan to tap the potential of the energy storage system. UPS is usually combined with the storage battery. With the help of inverters, UPS can make connections with battery DC power and grid AC power. The various power sources of UPS increase the robustness of the energy supplement. To deal with the power transients caused by solar energy intermittent, ultracapacitors are adopted and then smooth the power peaks. In typical cases, the UPS system is in charge. When an emergency occurs, the uninterruptible power supply can switch to supplementary mode and keep the DC data center running for a limited time.

Also, thermal energy storage is a possible method. The DC data center has large power consumption and releases considerable waste heat. In the past, waste heat was regarded as a hazardous factor to the DC data center, and most of the effects focused on cooling down the temperature in the engine room. However, recent research has realized that the waste heat could be collected as energy recycling. The cooling pipes were distributed in the engine room, and the recycle pump pushed the coolant moving in lines to absorb waste heat then transport it to the heat exchanger. Thus, the waste heat produced by the DC data center will be saved as available energy in the heat storage (Niu et al. 2019). This thermal energy could be used as the leading power supplement to cogeneration, as shown in Fig. 1. In addition, superconducting magnetic energy storage (SMES) is the most advanced and efficient data center energy storage plan. Small and medium-sized enterprises could be likened to an advanced uninterruptible power supply system because they can immediately switch to the charging/discharging modes (Kang et al. 2021). Another outstanding advantage of SMES is the low energy loss during the powering process. Due to the platform of superconducting technology and corresponding zero-resistance effect, the energy loss issue caused by the waste heat can be alleviated or avoided obviously.

3 DC Data Center Architecture Analysis

3.1 DC Data Center Basic Architecture

The DC data center is complex with multiple units, as shown in Fig. 2. The teams could be divided into several functions: power supply unit (PSU), computation, cooling, and energy storage. In the DC data center, the energy source for PSU is various. Either solar energy via the photovoltaic system or grid is available for the DC data center to apply. One thing that needs to be concerned is that because the primary power from the grid is in AC, the rectifier is indispensable to convert the AC into DC power for the DC data center. Plenty of server cabinets is combined as

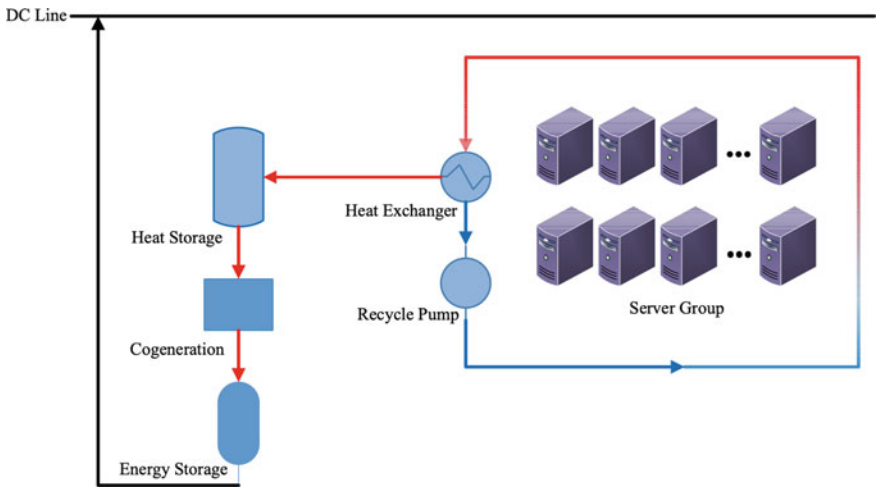


Fig. 1 Waste heat recycle process

a unified server group to fulfill the computation function. The server group is the core consumer of DC power in the DC center. The wire is directly connected with the server group to send the DC power. Coolant is adopted in the cooling system to remove the waste heat from the server group then transfer it to the heat exchanger. The cooling system aims at creating the proper temperature for the computation. Then, the energy storage system saves energy from the PSU and collects thermal energy from the heat exchanger. Preserved energy is ideal for the UPS power supplement in an emergency. Generally speaking, the DC data center arranges the technical framework with an overview and designs the architecture and method from the top level to ensure that the numerous units with various functions constitute an organic whole.

3.2 DC Data Center Voltage Level

The increasing voltage level is a noticeable trend of DC data center development. Since the power provided by the PSU is constant, according to (2) below, with the constant power input, increasing the power distribution voltage lowers the current. Also, from (3), the power loss during the operation is related to the current and resistance. The resistance in the wire and load is relatively stable. So, the current is the essential factor in the power loss. With the increasing voltage distribution, the current, I, is decreasing. Thus, the power loss proportional to the current could be minimized.

$$P = UI \tag{2}$$

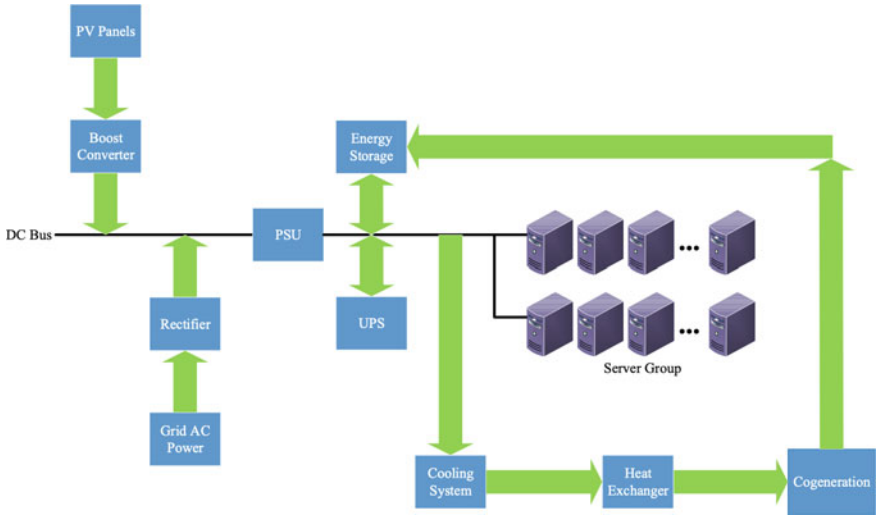


Fig. 2 DC data center basic architecture

$$P_{loss} = I^2 R \tag{3}$$

Due to the disadvantages of former UPS based on AC power, such as complicated systems and inefficiency, DC communication power supplies have come up. The 48 V was adopted as voltage level in the DC data center in the early stage and accepted after actual application and comparison. However, the 48 V DC power has some vital weaknesses, including the extensive current and correspondingly insufficient efficiency. Therefore, the demands for high voltage DC power supplements solves these issues. Thus, the 380 V level supplement has been adopted worldwide (Ariyarathna et al. 2019). Since the 380 V level supplement sends DC power, the transmission loss between the grid AC power and the DC data center will be avoided. Also, 380 V level can also minimize the power loss during the distribution based on Eq. 3. From the perspective of the photovoltaic system, the 380 V level is an ideal plan to make the concise connection without considering the rectifier or inverter because both photovoltaic and 380 V power supplement is in DC.

3.3 The Categories of the DC Data Center Architecture

Even though the DC data center is a load based on a DC electric power source, the primary power supplement does not need to be limited to DC power. In other words, the gird AC power is also suitable to be the power supplement to the DC data center. Thus, DC data center architecture has several kinds, including DC, powered, AC powered, and hybrid powered by DC and AC, distinguished by the primary

power supplement. However, in the case involving mains electricity based on AC, the current conversion between the DC data center and mains electricity should be necessary. The integral architecture of a pure DC power system has the advantage of simplicity to accomplish the function of the DC data center with an equivalent tier-level system. In addition, applying the characteristics of the DC power supply makes the seamless connection with the photovoltaic system possible. On the other hand, the hybrid architecture could adapt to the grid-based utility system, supplement the AC power supply, and reduce the intermittent influence caused by solar energy collection. The adoption of hybrid power supplements of DC and AC could also be a possible but still reliable plan to spend the period of transition before the thoroughly refined power supplement technology based on renewable energy (Wang et al. 2019).

4 The Example of Renewable Energy Supplement in the DC Data Center

As a revolutionary attempt of the data center, many innovations have been adopted in T-Block, Tencent. One of the most attractive innovations is mobilization. Compared with former data centers on a large scale, T-block adopted the modularized structure to ensure assembly efficiency. The modularized structure is made up of containers with multiple interfaces, which is beneficial to transportation and preserves versatility for locations with various areas and terrain conditions. Customers do not need to remain considerable redundancy for the civil engineering works aimed at infrastructure. On the contrary, leveling the construction field becomes the only necessary preparation for the data center building. Thus, the system delivery time and equipment quality will be ensured firmly. On the other hand, the position collocation between the IT equipment room and photovoltaic systems is ingenious. It is worthwhile to pay attention to the fact that the photovoltaic panels are placed on the top of the server room, which can block part of the sun and can insulate, slow down the temperature rise of the data center, and achieve the purpose of energy saving by reducing the air conditioning requirements. Solar power generation can be imported into the energy input of the data center, which can be used as a supplement to central power to reduce the damage to the grid data, save costs, reduce dependence on the grid, and improve the continuity and reliability of the data center operation. Also, a high degree of freedom for the power supplement plan is regarded as the practical attempt of renewable energy application. The power accumulation from the photovoltaic system is acceptable for T-Block to exploit, a considerable amount of power addition. With the help of solar power, a part of the cost to purchase the mains electricity will be saved, which increases the economic benefits. The mains electricity could be utilized as the High Voltage Direct Current (HVDC). The power supply based on HVDC transmission is powerful. When intermittent problems seriously affect the photovoltaic system, they fill these gaps. Furthermore, the distribution-friendly design provided the T-block with relatively independent deployment. The portable

container unit makes it possible for T-Block to operate independently with few units or combine with numerous container units to make up an integral data center with ultra-computation service.

5 Conclusion

Renewable energy, the best alternative for the energy crisis in the future, is also considered the efficient and environment-friendly plan for replacing fossil fuels to power the DC data center. The application of renewable energy could reduce the power loss during the traditional transformation process from the grid to the data center. In addition, some innovations in the hardware of the DC data center, such as uninterruptible power supply and waste heat recovery, have created a more friendly environment for the future use of renewable energy. Even though the renewable energy represented by solar energy still has some disadvantages to be adopted on a large scale, the attempts of renewable energy application still prove the potential of renewable energy to combine with the DC data center operation.

References

Ahmad S (2020) A review on edge to cloud: paradigm shift from large data centers to small centers of data everywhere. In: 2020 International conference on inventive computation technologies (ICICT). IEEE

Ahmed KMU, Bollen MHJ, Alvarez M (2021) A review of data centers energy consumption and reliability modeling. IEEE Access

Apata O, Adebayo AV, Ainah PK (2021) Renewable energy systems and the fourth industrial revolution. In: 2021 IEEE PES/IAS PowerAfrica. IEEE

Ariyarathna T, Kularatna N, Alistair Steyn-Ross D (2019) Supercapacitor assisted data center power architecture for 380 V DC-microgrid. In: 2019 IEEE Third international conference on dc microgrids (ICDCM). IEEE

Ayadi F et al (2021) Targets of countries in renewable energy. In: 2020 9th International conference on renewable energy research and application (ICRERA). IEEE

Baccour E et al (2019) Green data center networks: a holistic survey and design guidelines. In: 2019 15th International wireless communications & mobile computing conference (IWCMC). IEEE

Bhattacharya T, Qin X (2020) Modeling energy efficiency of future green data centers. In: 2020 11th International green and sustainable computing workshops (IGSC). IEEE

bp global (2020) Statistical review of world energy | Energy Economics | Home. Bp Global, 2020, www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html. Last accessed 2020/11/10

Diouani S, Medromi H (2019) How energy consumption in the cloud data center is calculated. In: 2019 International conference of computer science and renewable energies (ICCSRE). IEEE

Ferreira L et al (2020) Standardization efforts for traditional data center infrastructure management: the big picture. IEEE Eng Manage Rev 48(1):92–103

Islam MdS et al (2019) Renewable energy aware cost assessment for green data center with hybrid energy sources. In: 2019 International conference on robotics, electrical and signal processing techniques (ICREST). IEEE

Kang W-T et al (2021) A novel LVDC superconducting power distribution system for data center with power quality improvement and loss reduction. IEEE Trans Appl Supercond 31(8):1–4
Kumar R, Khatri SK, Diván MJ (2020) Effect of cooling systems on the energy efficiency of data centers: machine learning optimisation. In: 2020 International conference on computational performance evaluation (ComPE). IEEE
Kurbatova T, Perederii T (2020) Global trends in renewable energy development. In: 2020 IEEE KhPI week on advanced technology (KhPIWeek). IEEE
Mansuri MF, Saxena BK, Mishra S (2020) Shifting from fossil fuels vehicles to H2 based fuel cell electric vehicles: case study of a smart city. In: 2020 International conference on advances in computing, communication & materials (ICACCM). IEEE
Niu G et al (2019) A novel integrated energy station by merging data center with energy storage: system constitution, collocation and application. In: 2019 IEEE 3rd International electrical and energy conference (CIEEC). IEEE
Peng X, Qin X (2020). Energy efficient data centers powered by on-site renewable energy and UPS devices. In: 2020 11th International green and sustainable computing workshops (IGSC). IEEE
Shrivastava A et al (2021) Control of solar-battery storage based Micro-grid. In: 2021 Innovations in energy management and renewable resources (52042). IEEE
"Tencent Cloud Global Infrastructure | Tencent Cloud." (2021) Tencent Cloud, 2021, intl. cloud. https://www.tencentcloud.com/jp/global-infrastructure/sustainability. Last accessed 2021/11/15
Tobias RR et al (2020) Design and construction of a solar energy module for optimizing solar energy efficiency. In: 2020 IEEE 12th international conference on humanoid, nanotechnology, information technology, communication and control, environment, and management (HNICEM). IEEE
Wang F et al (2019) A coordinated control scheme to realize uninterruptible power supply for AC-side system in AC/DC hybrid distribution grid. In: 2019 IEEE 8th international conference on advanced power system automation and protection (APAP). IEEE

Research on the Influence and Countermeasures of Third-Party Payment on Commercial Banks—Evidence from China

Muhan Liu

Abstract Third-party payment emergencies improve people's lives, while also having both positive and negative effects on commercial banks. The study finds that the influence of third-party payment platforms on the core business of commercial banks is heterogeneous due to variances in business content and economic policy situations by evaluating the financial data of China's commercial banks over the past eight years. The adaptability and convenience of third-party financial services diversify the number of clients and funding sources of commercial banks, which has a certain negative impact on banks' liabilities and intermediate businesses. Although the bank's asset-side business has fluctuated greatly, the popularity of third-party payment has played a positive role in promoting financial disintermediation. Based on this, this paper puts forward suggestions for strengthening cooperation between the two parties, innovating financial products, improving user experience, and enhancing risk monitoring. Provide suggestions for commercial banks to carry out Internet integration reform and the future development of third-party platforms.

Keywords Third-party payment · Commercial banks · Online banking

1 Introduction

1.1 Background

The combination of the Internet and finance has not only penetrated all aspects of people's life, work and study, but also subtly changed people's consumption behavior and way of thinking. The traditional model of banking transactions and services cannot meet the demands of the public anymore, thus, third-party payment

M. Liu (✉)
Capital University of Economics and Business, No.121 Zhangjialukou, Fengtai District, Beijing 100070, China
e-mail: 19180100038@stu.xidian.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_94

platforms have emerged. The dramatic expansion of third-party payment has led to the continuous emergence of Internet financial wealth-management products and multiple Internet financial credit platforms. While people enjoy the convenience of third-party payment, it brings obstacles and new development opportunities to the original commercial banking business. Recently, the epidemic and policy restrictions in the real estate industry have affected commercial banks and third-party payment businesses to varying degrees, which also brings new challenges to commercial banks and third-party payments.

As an important part of a country's financial industry, banks are related to the stability and development of the country's economy. Understanding the influence and development direction of the banking industry and third-party payment platforms is vital for the healthy development of the financial sector and the transformation and reform of commercial banks.

1.2 Related Research

Scholars have started research on third-party payments since the 1990s, and the topics of discussion mainly focused on the concept, development model, and security of the third-party platform. Cynthia Cotritore provided a comprehensive definition of third-party payment, that is, third-party payment creates an intermediary platform between consumers and e-commerce platforms, and realizes a direct connection between them by establishing trusting relationships (Cynthia et al. 2003). Qi classified the third-party payment business and analyzed that the third-party payment business is dominated by prepaid card business, Internet payment, and bank card acquisition in China. Among them, the business concentration and regional concentration of the Internet payment business are relatively high (Qi 2013). Jin emphasized that while promoting financial innovation, third-party payment also brings financial and regulatory risks. In the Internet environment, due to the openness and virtuality of the network, Internet financial transactions need to bear greater network risks, such as reputation risks and network security risks. The imperfection of the existing legal system can easily lead to the emergence of regulatory problems, which is not conducive to its development (Jin 2016).

There are some scholars stated that third-party payment has a positive effect on commercial banks, bringing opportunities for win–win cooperation between Internet finance and traditional finance. Allen et al. focused on how electronic payment systems are used and how financial markets and firms operate. They emphasized that Internet finance enhances the innovation of the traditional financial industry, and plays an important role in financial disinter-mediation, promoting banking mergers, and obtaining loans (Allen et al. 2002). Through research on the development history of Internet finance in the USA, Duffie, D. stated that Internet finance is an incremental revolution and a Pareto improvement, which will have a positive impact on the scale of deposits and loans in the entire indirect financing financial system (Duffie 2008). Chen and Li also emphasized that the active development of third-party payment will

boost banks' profitability. The development of this payment business narrows the net interest margin of commercial banks, rises the scale of bank loans, and reduces the non-performing loan ratio (Chen and Li 2017).

Some scholars also argued that third-party payments have negative impacts on banks due to security risks, low barriers to entry, diversion of commercial bank customers, etc. Shen and Guo examined the technological spillover effect of Internet finance on the traditional banking industry. The results were conducted by 36 commercial banks' total factor productivity data from 2003 to 2012, and it shows that Internet finance's spillover effect has different degrees of impact on different types of commercial banks (Shen and Guo 2015). Some scholars found that there are credit risks, money laundering risks, network security technology risks, and other financial shock risks in third-party payments. These risks adversely affect the fairness and risk prevention of the payment market (Wang 2017; Liu et al. 2020). Yan pointed out that third-party payment has greatly lowered the barriers to entry in the financial sector. These low entry barriers have caused some customers of commercial banks to be diverted, the payment and settlement business has been squeezed, the growth of intermediary business income has lagged, and the demand for reserves of large commercial banks has decreased (Yan 2019). Shahrokhi et al. also believed that although Internet finance has a positive side, that is, it can reduce loan interest rates and loan costs, it will have an impact on the credit business of traditional banks (Shahrokhi 2008).

1.3 Objective

As mentioned above, the existing research mainly discussed the positive or negative effects of commercial banks by third-party payment platforms, and there are few analyses about the two sides of this issue. Therefore, this paper wants to make a comprehensive discussion and focuses on the analysis of countermeasures.

2 First Characteristics and Development of Third-Party Payment Platforms and Commercial Banks

2.1 Characteristics and Development of Third-Party Payment Platforms

Third-party payment is defined as a transaction intermediary, which directly connects buyers and sellers and cooperates with banks to complete fund payment and settlement. With the development and maturity of Internet technology, there are more and more participants in the payment system. Participants are mainly consumers, merchants, service providers, and regulatory authorities, among which service

providers are composed of third-party payment platforms, banks, and clearing institutions.

Third-party payments were first proposed in the United States in the 1980s, and the existing third-party electronic payment systems consist of three different payment systems. The three payment systems are based on credit, debit, and digital currency, respectively. China's third-party payment has started to develop since the establishment of Taobao in 2003. After entering a stable development period in 2018, it began to use big data, cloud computing, etc. to seek secondary development. The third-party payment transactions scale in China amounted to US$2496.5 billion in 2020, accounting for 45.6% of the global total.

Third-party payment has the characteristics of strong adaptability, low transaction cost, guaranteed credit, and efficiency. First, third-party payment has high adaptability to the market environment under its network technology advantages. To improve the user experience, Alipay launched quick payment in cooperation with several banks as early as 2011 to meet the different needs of users. Second, the cost is low. By binding a bank card on a third-party payment platform, consumers can complete the payment on the mobile terminal with a lower handling fee, which reduces the time cost required for convenient banking services and intermediate transaction fees for transfers and other services. For merchants, the transaction process of docking with banks is simplified, payment time is shortened, and labor costs are saved. Third, third-party payment can assume a good credit guarantee function during the transaction process. Xie and Luan emphasized that in the transaction process, the third-party payment platform, as a credit intermediary independent of merchants and consumers, has intermediary and transparency, and can effectively avoid transaction denials and various other disputes that may occur between the transaction parties (Xie and Luan 2017). Fourth, third-party payment is convenient and efficient. Third-party payment platforms can cooperate with different commercial banks to establish payment interfaces under the authorization of commercial banks. Consumers only need to complete the corresponding registration on the platform, and then they can directly bind their bank cards to conduct transactions. There is no need to open a separate bank account or operate at a bank counter. At the same time, the operating procedures are more simplified, and the business processing and payment are more efficient.

2.2 Business Composition and Development of Commercial Banking

Commercial banks' business consists of basic business and characteristic business, among which basic business includes deposit and loan business and intermediary business. Deposits are the main way for banks to obtain funding sources, the basis for bank business development, and an important factor in determining bank profitability. The absorption of deposits creates conditions for commercial banks to realize the

functions of credit intermediary, payment intermediary, and credit creation. Loans are the most basic and vital asset business of commercial banks. For Chinese commercial banks, the interest difference between deposits and loans is an important source of profit for commercial banks. Chen pointed out that since the 1990s, driven by deregulation and the rapid development of information technology, the US banking industry has achieved a transition from traditional deposit and loan business to a balanced development model that places equal emphasis on traditional business and emerging business. Investment banking, fund custody, and asset service have become important forces driving the transformation of the U.S. banking industry's profit model. The development of the intermediary business of Chinese commercial banks started late, and there is still a lot of room for development (Chen 2015).

3 The Impacts of Third-Party Payment on Commercial Banks

There are many types of banking business. For the convenience of research, this paper draws on Chen and Li's research and divides the business into asset side, liability side, and intermediary business (Chen and Li 2017). The asset side mainly refers to the loan business, the liability side mainly refers to the customer deposit business, and the intermediary business refers to the handling fee and commission business.

3.1 Impact on the Asset Business

As shown in Fig. 1, generally speaking, the income of commercial banks' asset business is in a growing stage. However, since 2017, the growth rate of loans issued by commercial banks has declined rapidly, and the growth rate of total loans has slowed down. The main reason for the decline in the growth rate is that with the development of Internet technology, lending is no longer the only situation for banks. Many Internet companies have also launched lending products, such as Ant Borrowing, JD Finance, etc. These products are mainly based on the personal credit of users and are mostly used to issue small loans for personal consumption or small cooperates. No mortgage is required and fast disbursement is suitable for users who urgently need money. Although banks have strong funds, the loan procedures are complicated, the waiting time is long, and there are certain thresholds. This leads to the preference for third-party payment platforms when users need to use small funds, and this tends to lend will lead to the loss of small transactions in the bank loan business.

To adapt to the trend of mobilization of financial services, Chinese banks have adjusted their strategic direction and organizational structure accordingly and launched mobile banking APPs. In 2019, 16 banks including ICBC and Bank of China released the first batch of mobile banking. Among them, several banks have

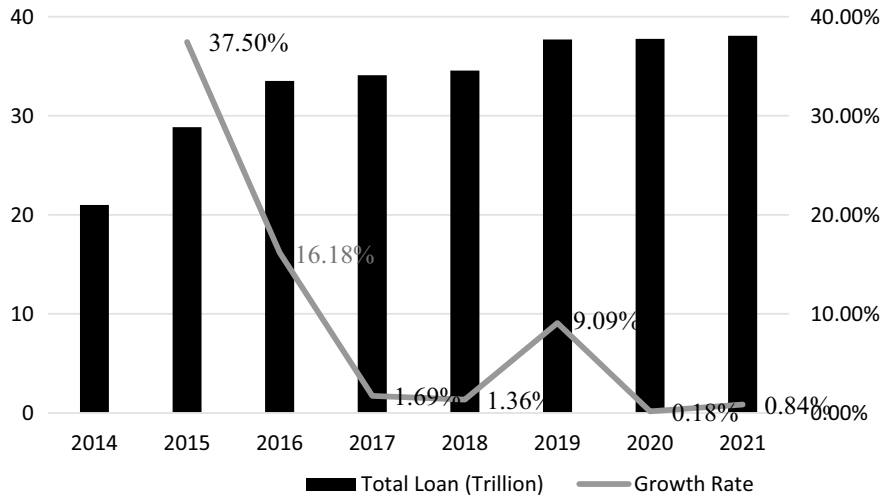


Fig. 1 Total commercial bank loans and growth rate from 2014 to 2021

proposed an "open" strategy, using application programming interfaces (APIs), software development kits (SDKs), and other means to embed banking financial services into third-party institutions, covering various life scenarios. This is the main reason for the higher growth rate of commercial bank asset business in 2019.

Because the total amount of commercial bank loans has achieved a relatively large increase in growth rate in 2019, the author believes that the low growth rate in 2020 and 2021 is partly caused by the economic shock brought by the epidemic, and the other is due to the tightening of policies in the real estate industry. Real estate credit is an important source of bank profits. Taking China's four major banks as an example, real estate credit accounts for more than 30% of bank loans. Since 2020, the government has begun to regulate the real estate industry and introduced policies headed by the "three red lines". As a result, the number of mortgage loans from local banks continued to tighten. Third-party payment platforms cannot replace large-scale real estate loans provided by banks to companies or individuals, which is one of the reasons for the low growth rate of commercial banks' asset-side growth since 2020.

The impact of the asset side of commercial banks will be partly compensated by the online bank launched by the commercial bank. As long as the commercial bank can adjust its strategic direction in time, the influence on the bank's asset side will be minimal, and the third-party payment actively promotes financial disintermediation. This is consistent with the research findings of Allen et al. that Internet finance can promote innovation in the traditional operating mode of banks (Allen et al. 2002).

3.2 Impact on the Liability Business

As shown in Fig. 2, the total deposits of commercial banks kept rising, while the growth rate showed a trend of decline first and then rise. It experienced −5% growth in 2017, and has not recovered to the level of 2015 growth until 2020. One of the reasons why the growth rate has not been able to rise again quickly after the decline may be that the bank loan interest rate has not been able to keep up with the speed of inflation, and the central bank has lowered the interest rate to promote economic development. Second, the development of Internet finance has made people's funds have more investment options, and it is easier to compare prices. Taking Alipay's deposit interest rate as an example, the annual interest rate of Yu'e Bao demand deposit is about 1.82%, however, the average one-year interest rate of commercial banks is 0.35%. In contrast, third-party payment is not only more flexible in terms of fund deposit and withdrawal methods, but also has advantages in deposit interest rates. Therefore, when consumers have idle funds, they will give priority to purchasing wealth management products on third-party trading platforms or placing them in Yu'e Bao, rather than depositing them in banks. Accordingly, this paper believes that third-party payments harm banks' liability business by diversifying the deposits of commercial banks.

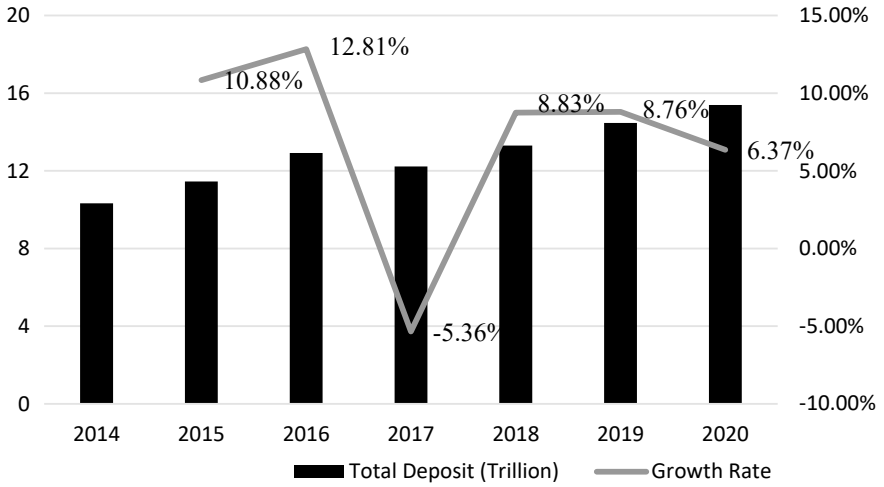


Fig. 2 Total commercial bank deposit and growth rate from 2014 to 2020

3.3 Impact on the Intermediary Business

Intermediary business is one of the main incomes of the bank, mainly referring to the fee charged by the bank through the intermediary role, including payment and settlement, bank card, guarantee, and other services.

As shown in Fig. 3, the total commission and service charge of commercial banks in China rise continuously from 2014 to 2019. Except for fluctuations in 2017 and 2018, the growth rate fell to about 1%, and the rest of the growth rates were greater than 5%. In 2020, due to the impact of the epidemic, the bank's customer flow has dropped significantly, and the total income of intermediary business has dropped by nearly 14%, which is the first negative growth in the past seven years. Bank intermediary business takes a long time to process, most of them need to be handled at the bank, and charged a certain handling fee. In contrast, third-party payments have an independent platform that can be associated with multiple banks on one platform. Real-time transfer with no or low handling fee can be realized, and the operation is convenient. Secondly, the purchase threshold of high-interest rate products of banks is relatively high, and there are quota restrictions. Banks' products prefer existing customers with certain deposits, while the purchase of products on the third-party payment platform is mainly based on the user's risk assessment and personal preference. Moreover, the yield of idle funds of third-party platforms is much higher than the bank deposit rate and could realize ultra-short-term deposits. Therefore, when people face distance constraints, people are more willing to use third-party platforms to conduct business. This also reflects future preference trends. People are more likely to complete payments through third-party platforms anytime, anywhere, and the bank's intermediary business income will be further reduced.

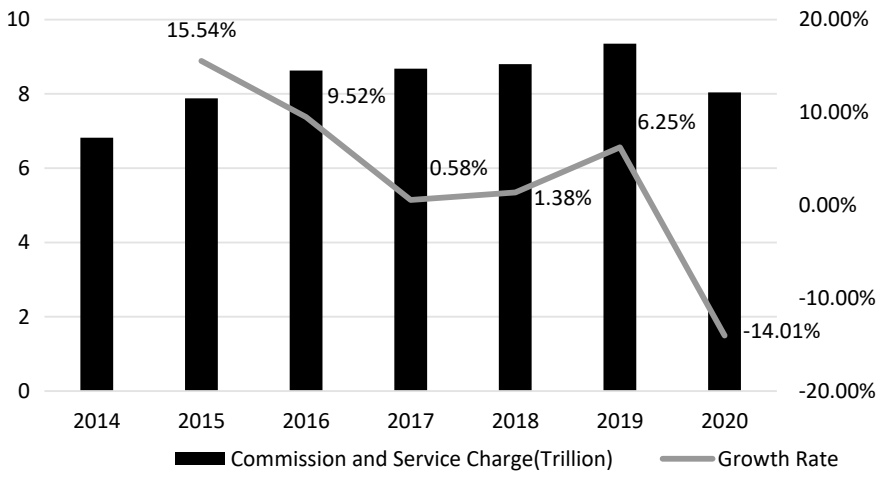


Fig. 3 Total commercial bank's commission and service charge and growth rate from 2014 to 2020

4 Countermeasure

4.1 Strengthen Cooperation with Third-Party Payment Platforms

The third-party payment platform ultimately needs to implement operations such as transfer and remittance through the bank, and the amount of funds is not as sufficient as that of the bank. In this regard, banks can provide preferential treatment for third-party payment platforms, attract third-party platforms to cooperate with themselves, expand business channels, and introduce Internet users. Besides, banks create in collaboration with third-party payment platforms in terms of data. Third-party payment institutions have a cross-platform nature, which makes the user data they master more dimensional. Third-party payment platforms could analyze user transactions and operation behaviors. If commercial banks can connect and integrate data with third-party platforms, it is more likely to create new financing models and better understands users' transaction preferences.

4.2 Create Special Products Based on Banks' Advantage

The bank has sufficient funds and high credit. When faced with a large demand for funds, users will give priority to bank loans. For large loans involving some specific industries, such as real estate, users can only choose to borrow from banks. Therefore, on the asset business side, commercial banks can combine this advantage to launch special financial products. For example, cooperating with developers to issue loans to enjoy a certain amount of house purchase discounts; cooperating with car dealers to issue car purchase loans to enjoy preferential insurance or services, etc. On the intermediate business side, banks could pay more attention to user needs and cooperate with online and offline stores. For instance, by issuing co-branded credit cards to enjoy joint discounts; offline stores could enjoy preferential credit card discounts, etc., which could strengthen their publicity channels to attract more users. In addition, commercial banks could also develop installment payment services for daily transactions based on their financial strength and customer resource information advantages to gain the favor of users.

4.3 Improve Online Banking Using Experience

Commercial banks need to actively promote the operational upgrading of online banking APPs. Commercial banks still need to use U-key for verification of large-value transfers now. However, carrying a U-key and facing complex operations are inconvenient for people nowadays. Moreover, for the various business of different

banks, sometimes customers need to download the corresponding APP of each bank to operate, which not only consumes the user's mobile phone memory but also causes the loss of users. Therefore, bank online APPs need to integrate the functions and absorb the convenience of third-party payment. Establish cooperation between multiple banks, and realize the transfer of funds from multiple banks and the transaction of various products by downloading only one App. Finally, on the premise of ensuring transaction security, improve the experience of the system, such as reducing advertisements and convenient operation.

4.4 Strengthen Risk Supervision

Commercial banks need to pay attention to the possibility of changes in the asset structure and corresponding countermeasures. Since China's real estate loans are mainly bank loans, which account for a high proportion of bank loans, the real estate loans may have an impact on the commercial banks' systemic risks. In recent years, China has become more and more strict with the macro-control of the real estate industry. Therefore, to maintain the stability of bank assets, we must ensure the quality of real estate loans and have more flexible solutions. First of all, for real estate development loans and business loans of enterprises, commercial banks need to establish cooperation and information exchange with credit rating agencies and develop more flexible collateral value evaluation standards to better determine the quality and value of the real estate as collateral. Even if some borrowers are unable to repay the loan, the bank can recover the loan funds by selling the value-added collateral to reduce the bank's operating risk. In addition, commercial banks should improve their risk assessment according to their capabilities, and may reduce loan issuance under appropriate circumstances, to avoid large-scale defaults by individual and corporate borrowers, and to make banks bear credit risks and the value of real estate collateral recovered by banks cannot make up for the loan gap. This leads to the run-on commercial banks, which eventually leads to the occurrence of systemic risks in commercial banks.

5 Conclusion

This paper firstly analyzes the characteristics, present status of development, and business composition of commercial banks and third-party payment platforms. It is found that the third-party payment platform, with its strong adaptability, low transaction cost, and convenience, has dispersed part of the business of commercial banks and changed people's consumption behavior in just 40 years. Further, through the existing data analysis on the asset side, liability side, and intermediary business of

commercial banks, this article found that the impact of third-party payment platforms on commercial banks is heterogeneous due to different businesses. The negative effect of the third-party payment platform on the asset side of commercial banks can be compensated by the launch of online banking by commercial banks, and the emergence of third-party payments can promote the financial disintermediation of commercial banks. The low growth rate in recent years is mainly because China's commercial banks have not recovered from the impact of the epidemic and the government's loan restrictions on the real estate industry. In contrast, the liability side and intermediary business of commercial banks face a relatively large negative impact. Due to the high-interest rate and flexibility of third-party payments, consumers will give priority to them when they have idle funds. The third-party payment diversifies the deposits of commercial banks and weakens the liability-side business and intermediary business.

To better solve the above problems, the author believes that commercial banks should focus on enhancing cooperation between the two parties and improving the online banking experience. Besides, according to the uniqueness of its loan entity, it creates special products. In the face of changes in the real estate industry, focus on self-risk supervision and improve the collateral evaluation mechanism. How to quantitatively determine the influence of third-party payment on commercial banks and the compensation of different policies and reform measures is the further research direction of this paper.

References

Allen F, Mcandrews J, Strahan P (2002) E-finance: an introduction. J Fin Serv Res 22(1–2):5–27

Chen Y (2015) Research on the development performance of intermediary business of large city commercial banks in China. South China Finance 2:6

Chen Y, Li S (2017) Why does the net interest margin of commercial banks decrease-based on the perspective of third-party payment. Finance Account Monthly 9:107–111

Cynthia L, Beverly K, Susan W (2003) On-line trust: concepts, evolving themes, a model. Int J Hum Comput Stud 58(6):737–758

Duffie D (2008) Innovations in credit risk transfer: implications for financial stability. SSRN Electron J

Jin S (2016) On the mode and development of Internet finance. Market Modernization 24:2

Liu S, Bai X, Wu D (2020) Research on "current generation" transactions and risks of non-bank payment institutions. J Fin Dev Res 9:6

Qi H (2013) The current situation and future trend of third-party payment development in China. Accountants 11:3

Shahrokhi M (2008) E-finance: status, innovations, resources and future challenges. Manag Financ 34(6):365–398

Shen Y, Guo P (2015) Internet finance, technology spillover and total factor productivity of commercial banks. J Fin Res 3:16

Wang L (2017) Research on the risk of third-party payment under Internet finance and its development exploration. J Commercial Econ 17:154–156

Xie Y, Luan F (2017) Current situation, risks and control countermeasures of third-party in China. Finance Account Monthly 13:41–45
Yan L (2019) The impact of third-party payment on the payment and settlement business of commercial banks. Wuhan Finance (01), 61–64+9

Review of Economic Impact of COVID-19 on China's Economy: Positive and Negative

Zhan Chen

Abstract The COVID-19 had affected global economies essentially, causing disasters on public health and a variety of industries. The epidemic first broke out in China, but due to effective prevention and control, the epidemic in China has been effectively controlled. Studying the comprehensive economic impacts of COVID-19 on China's economy can bring valuable insights for researchers from the rest of the countries to study the economic aspect of COVID-19. This paper is a review that organizes and summarizes literature from many perspectives in terms of the economic impacts of COVID-19 on China's economy. It was found that the impacts are broad and complicated, existing in both positive and negative ways. This paper also found blank areas that can be future research directions.

Keywords COVID-19 · China · Economy · Dual circulation

1 Introduction

The new type of coronavirus pneumonia, referred to as the COVID-19, was first discovered in Wuhan, China, and has now spread to all parts of the world. The World Health Organization (WHO) claimed on March 11, 2020 that the COVID-19 was a pandemic. As of August 12, 2021, more than 203,295,170 people were infected and more than 4,303,515 people died from the crisis, making it a global disaster. During the crisis, governments from different nations implemented various strict measures to prevent the spreading of the virus. Some of the measures were effective, but some of them were feeble. Despite those strict measures, COVID-19 had strong impacts on countries' economies: Countless SMEs went to bankruptcy, multiple countries experienced severe inflation, and numerous nations faced difficulties importing and exporting goods.

Z. Chen (✉)
Pepperdine University, Malibu, CA 90263, USA
e-mail: allenchen.chen@pepperdine.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_95

China was the first country to discover the new virus and was also the country that has done very well in epidemic prevention so far with the fact that China has about 1.4 billion population. The number of new daily cases in China had always been below 150 cases/day for 15 consecutive months. Malls, restaurants, etc. were reopened; people were allowed to do their activities without quarantines and face-masks; multiple vaccines such as Sinopharm BIBP and Sinovac-CoronaVac were proved to be safe and effective by the WHO. Therefore, studying the impact of the epidemic on China can serve as a comprehensive reference for other countries in the post-epidemic era.

This paper is a literature review on the impact of the epidemic on China's economy. Based on the perspective of dialectical thinking, this article divides the relevant literature into two categories: "study on the negative impact of the epidemic on China's economy" and "study on the positive impact of the epidemic on China's economy". In each category, this article further divides the relevant documents based on the different affected objects, and expounds on the relationship between them, thus showing the thinking logic and research framework of the existing literature on this issue.

Organizing and concluding related literature have essential significance: It can let people know the current situation of COVID-19 comprehensively, which can help researchers and scholars to reinforce the understanding of COVID-19. Especially for scholars and researchers other than China, understanding the impacts of COVID-19 on China can provide valuable information for post-pandemic research. Then it can promote the society to better respond to the epidemic and reduce the losses caused by the epidemic. Also, it can facilitate the discovery of new research directions and provide an important reference for future research.

The structure of the paper is organized as follows: Sect. 2 describes the negative impacts of COVID-19 on China's economy and environment. Section 3 describes the positive impacts of COVID-19 on China's economy and environment. Finally, Sect. 4 is the conclusion.

2 The Negative Impact of the Epidemic on China's Economy

2.1 Impacts to Individuals

In this epidemic, tons of factories were forcibly closed, countless workers were quarantined, and many factories were facing capital chain rupture, causing many workers to lose their jobs. Eventually, the unemployment rate largely increased. A study consisting of 71 million mobile phone data concluded that the unemployment rate increased from 27% in January 2020 to 63% by the end of September 2020 (Barwick et al. 2020). As the unemployment rate largely increased, the income was affected as well. According to an online national survey conducted in China during

the pandemic, different groups of people lost different amounts of income: 48% of the respondents reported partial income losses, and about 11% of the respondents reported they lost all of their income. People with higher education backgrounds, greater family income, CCP memberships, state-owned enterprises employment are protected partially, or even completely from income losses. Also, people with urban Hukou (household registration) have a lower risk of losing income than people with rural Hukou (Qian and Fan 2020).

Unemployment, income losses, quarantines, etc. all can cause psychological issues in people's mentality. A nationwide questionnaire was conducted in China and showed that COVID-19 has caused a high prevalence of symptoms of depression, anxiety, insomnia, and distress among groups. Especially in Hubei province where people lost a higher amount of income and assets. This implied that people who live in areas with more severe situations of COVID-19 tend to have a higher prevalence of psychological issues (Li et al. 2020).

Besides the above impacts, COVID-19 has affected personal education as well. Study shows that it has become much easier for students to undermine their academic integrity, such as direct copying of others' work, using web resources during a test, asking surrogates to finish assignments or even tests, and etc. (Jose 2021). TOEFL iBT is a universal English proficiency test that is required by nearly all universities and colleges of the U.S. for international students. Around 200,000 Chinese students took the exam per year in order to study abroad. Due to the COVID-19, the examination was moved to an online modality due to the coronavirus. The average score of 2020 is unprecedented and abnormally boosted by 8 points during the year of the epidemic, which immediately implies that students performed much better on the examination in online modality than in-person modality (TOEFL). Besides the academic integrity side, research also shows that the quality of courses is decreased with online teaching modality. Courses of universities became shorter and more sporadic, which can hinder the learning performance of students (Tejedor et al. 2021).

2.2 Impacts to Enterprises

COVID-19 had strong impacts on individuals, but it also posted many cumulative impacts on enterprises. China employed extremely strict measures to prevent the spreading of COVID-19, thus countless enterprises were affected by not only the virus itself, but also the harsh policies. Since quarantines happened often, the operation of enterprises became difficult. SMEs (small to medium enterprises) were unable to resume normal operations mainly due to the inability of employees to return to work, the stringent government lockdown requirements, the decreased market demand, the lack of variety of materials, and the forced closure of factories and enterprises (Lu et al. 2021). In addition, a study found that women migrants were less likely than men migrants to return to the cities and also less likely to return to paid work after the pandemic outbreak (Yueping et al. 2021). The operation cost was increased because of the cancellation of orders, delayed delivery, and production stagnation. And market

expansion was limited due to the inability to visit sites and meet face to face (Zou et al. 2020). All the above factors lead to a large decrease in the productivity of factories and enterprises.

Domestic consumption is also declining. The epidemic through containment measures and transmission channels has significantly slowed production and domestic consumption between China and its economic partners. The decreased consumption is due to the decreased income of people, forced closure of stores, quarantines, etc. (Baldwin and Mauro 2020). Tourism was one of the most affected industries. Many domestic and international airlines are forced to close due to insufficient passengers as people are becoming panicked about the spread of COVID-19. Also, the shutdown of certain cities is another reason for the cancellation of flights (Hoque et al. 2020). The loss of urban tourism is more severe than rural tourism because of the high concentration of people and the quarantine policies, especially for hotel and accommodation providers (Li et al. 2021).

Employees unable to return to work, forced closure of enterprises, material shortages, and largely decreased consumption and production all can lead to bankruptcy of enterprises. A study has shown that the expected bankruptcy rate of SMEs due to liquidity problems caused by COVID19 is 16.4% for the whole of China. However, debt is a more pressing issue for SMEs in Gansu, where 35.1% cite debt repayment as their main cost pressure, more so than in other provinces. Among the Gansu province entrepreneurs surveyed, 56.4% revealed that their cash flow could not support their business for more than three months. More than a quarter of SMEs (27.7%) will most likely run out of cash before reopening. SME bankruptcies were likewise at a significant risk in Henan province (23.2%) (Dai et al. 2020).

2.3 Impacts to the Macroeconomy

COVID-19 had numerous impacts on China's macroeconomy, and this can be shown by the GDP growth rate. The growth rate of China's GDP in 2019 is 5.82%, and it fell to 2.27% in 2020 due to the COVID-19 (Statista 2021). Other financial indicators such as policy uncertainty also increased (Njindan Iyke 2020).

China was taking extremely stringent measures to prevent COVID-19 from outside: they not only imposed restrictions on the total amount of goods that can be imported but also applied a strict COVID-19 test for every batch of goods imported. Thus directly reducing the total amount of goods that can be imported. The inability to import goods will have negative effects on China's economy. For example, with soybean consumption averaging 103.9 million tons over the past three years but low self-sufficiency rate (15%), China needs to increase soybean acreage if epidemics such as COVID19 are to be prevented. China imports soybeans (Yao et al. 2020).

COVID19 may also hamper China's domestic manufacturing operations. Unreasonable restrictions block the output channels of agricultural products, impede necessary production inputs, destroy the production cycle, and ultimately weaken production capacity (Pu and Zhong 2020). Once the production cycle is hindered internally,

exports are also blocked. According to data released by the General Administration of Customs of China (GACC 2020), China's exports fell by 17.2% in January–February 2020 year-on-year as an export economy. the world's largest. The impact of COVID19 on China's agricultural exports is crucial not only for the Chinese economy but also for the sustainability of the global food supply chain (Xi Lin and Zhang 2020).

COVID-19 also posted negative impacts on the country and its environment. The epicenter, Wuhan city, produced over 200 tons of medical waste, which is nearly 4 times the maximum medical waste disposal ability of the city. So medical waste disposal had become an important issue within the period of COVID-19 (Bashir et al. 2020). Ocean China, one of the leading NGOs, found that the coastal environment of Hong Kong was severely damaged by medical waste. They further explained that originally the percentage of medical waste was low, but now a wave full of medical waste was arriving with every current of the sea.

3 The Positive Impact of the Epidemic on China's Economy

3.1 Impacts to Enterprises

COVID-19 not only had negative impacts on the macroeconomy, but also posted positive impacts in multiple aspects. In order to hedge the impact brought by COVID-19, as well as meet the market's needs, enterprises in China invested more in research and creativities. The R&D of listed companies from China significantly increased during COVID-19 period. This implies that the innovation ability increased. Increased innovation ability allowed companies to create or improve more advanced technologies and technologies (Bashir et al. 2020). In addition, multiple innovations had greatly improved our life during the pandemic: (1) e-gaming (2) healthcare wearables (3) big data analytics (4) flexible manufacturing system (5) e-learning (6) 3D printing (7) video conference (8) internet streaming (9) e-commerce and home delivery (10) cashless payment (Brem et al. 2021). The increasing R&D is strongly connected with the digitalization of Chinese enterprises. Therefore, the crisis had highlighted the importance of digital technologies in the response to COVID, and SMEs were trying to transfer towards digitalization, which contributes to improvements of SMEs' performance through the pandemic era (Guo et al. 2020).

Apart from the development of innovations and technologies that COVID-19 had brought to us, COVID-19 also has created unprecedented demand for several products and services, from ventilators and face masks to online shopping and home delivery. The positive impact of the epidemic on certain industries is also reflected in the capital market, making related companies' stock prices surging (Laure et al. 2020).

Human capital is also one of the important elements in the production process of enterprises. COVID-19 also affected the human capital of certain industries in a positive way. On the medical aspect of business, a study concluded that the COVID19 epidemic can have a positive impact on career choice by strengthening students' confidence and choice to become a career. become a good doctor and reduce the choice regret and dropout rate of those who follow. generation of physicians. Therefore, the human resources of China's medical industry have been strengthened (Hu et al. 2020).

3.2 Impact to the Macroeconomy

The rapid control of the epidemic in China has benefited from the effective policies of the Chinese government. On the other hand the epidemic has also improved the Chinese government's comprehensive management capabilities and its ability to respond to disasters, prompting Chinese governments to better prepare for the future incoming climate crisis (Abi Younes et al. 2020).

The epidemic has also promoted the optimization of China's economic development model. A study demonstrated that the unique market environment created by the epidemic has provided the opportunity for economic transformation, urging China to adopt a "dual circulation" development pattern and speed up its digital economy (Ba and Bai 2020). Dual circulation allows China's economy to "turn inward" and eventually lead to a realization of an economy that relies little on external exports and imports by improving and developing the domestic supply chains (Javed et al. 2021).

Another positive macro impact of COVID-19 is the environmental issue: COVID-19 leads to the closure of many factories. The air pollution decreased. It is conservatively estimated that the delayed reproduction of enterprises will reduce PM2.5 by 6.93 $\mu g/m^3$ and AQI by 5 points (Ming et al. 2020). Another study also found that there were significant short-term health effects, with an increase of about 2100 ozone-related but a reduction of about 60,000 in PM2.5-related morbidity, with a reduction of about 5000 BP. In addition, from early January to mid-February, China's NO_x emissions fell by 36%, with more than 80% of the reduction occurring after these plants were shut down in most regions (Miyazaki et al. 2020).

4 Conclusions and Discussion

This review summarizes literature from numerous aspects about the economic impacts of COVID-19 on China's economy. Through organizing and analyzing these literatures, it is found that this epidemic has a comprehensive and extensive impact on China, not only positive, but also negative. Some impacts are for individuals and some are for enterprises and the macro economy.

Although the research has been rich and in-depth, there are still some blanks that are worthy of further in-depth research: most research currently only exists on the negative level, and there is a lack of research on the positive level of COVID-19. Since the epidemic, people spend more time at home, so they have more time to stay with their families. Thus leads to different family relationships than pre-pandemic times. So one of the future research directions can be the family relationships during the pandemic. In addition, the impact of the epidemic on China's exports and China's position in the global industrial chain is also an important research direction. The concepts and regulations are mainly proposed during the COVID-19 due to the unstable imports and exports between countries. The dual circulation is China's current economic strategy which takes the domestic cycle as the main body. Under the situation of high uncertainty in the external environment, China uses the characteristics of its strong industrial foundation, complete industrial chain, and super-large market scale to smooth production, distribution, circulation, and consumption to promote the realization of internal self-circulation. Therefore, the impact of the epidemic on China's exports and China's position in the global industrial chain is also an important research direction.

References

Abi Younes G, Ayoubi C, Ballester O, Cristelli G, de Rassenfosse G, Foray D, Gaulé P, Pellegrino G, van den Heuvel M, Webster E, Zhou L (2020) Covid-19: Insights from innovation economists. Science and Public Policy 47(5):733–745

Ba S, Bai H (2020) Covid-19 pandemic as an accelerator of economic transition and financial innovation in China. Journal of Chinese Economic and Business Studies 18(4):341–348

Baldwin R, di Mauro BW (2020) Economics in the Time of COVID-19. CEPR Press, London, UK

Barwick PJ, Deng Y, Huang X, Li S, Li T (2020) "Covid-19 pandemic and unemployment: Evidence from mobile phone data in China," SSRN Electronic Journal

Bashir MF, Benjiang MA, Shahzad L (2020) A brief review of socio-economic and environmental impact of COVID-19. Air Qual Atmos Health 13(12):1403–1409

Brem A, Viardot E, Nylund PA (2021) Implications of the coronavirus (COVID-19) outbreak for Innovation: Which Technologies will improve our lives? Technol Forecast Soc Chang 163:120451

Dai R, Feng H, Hu J, Jin Q, Li H, Wang R, Wang R, Xu L, Zhang X (2020) The Impact of COVID-19 on Small and Medium-sized Enterprises: Evidence from Two-wave Phone Surveys in China. Washinton, DC: Center for Global Development

Guo H, Yang Z, Huang R, Guo A (2020) "The digitalization and public crisis responses of small and Medium Enterprises: Implications from a COVID-19 survey," Frontiers of Business Research in China, vol. 14, no. 1

Han H, Qian Y (2020) "Did enterprises' innovation ability increase during the COVID-19 pandemic? evidence from Chinese listed companies," Asian Economics Letters

Hoque A, Shikha A, Hasanat MW, Arif I, Hamid ABA (2020) The Effect of Coronavirus (COVID-19) in the Tourism Industry in China, vol. 3. Asian Journal of Multidisciplinary Studies

Hu L, Wu H, Zhou W, Shen J, Qiu W, Zhang R, Wu J, Chai Y (2020) Positive impact of covid-19 on career choice in Pediatric Medical Students: A Longitudinal Study. Translational Pediatrics 9(3):243–252

Javed SA, Bo Y, Tao L, Dong W (2021) "The 'dual circulation' development model of China: Background and insights," Rajagiri Management Journal, vol. ahead-of-print, no. ahead-of-print

Jose AS (2021) "Academic integrity during COVID 19 pandemic. A student perspective," GRIN, 2021. [Online]. Available: https://www.grin.com/document/1012391, 2021.
Laure A, Pinto Ferreira JJ, Torkkeli M (2020), "Coronavirus: A catalyst for change and Innovation," Journal of Innovation Management, vol. 8, no. 1
Li X, Lu P, Hu L, Huang T, Lu L (2020) Factors associated with mental health results among workers with income losses exposed to COVID-19 in China. Int J Environ Res Public Health 17(15):5627
Li Z, Zhang X, Yang K, Singer R, Cui R (2021) Urban and rural tourism under covid-19 in China: Research on the recovery measures and tourism development. Tourism Review 76(4):718–736
Lu L, Peng J, Wu J, Lu Y (2021) Perceived impact of the COVID-19 crisis on smes in different industry sectors: Evidence from Sichuan, China. International Journal of Disaster Risk Reduction 55:102085
Ming W, Zhou Z, Ai H, Bi H, Zhong Y (2020) Covid-19 and air quality: Evidence from China. Emerg Mark Financ Trade 56(10):2422–2442
Miyazaki K, Bowman K, Sekiya T, Jiang Z, Chen X, Eskes H, Ru M, Zhang Y, Shindell D (2020), "Air Quality Response in China linked to the 2019 novel coronavirus (Covid-19) lockdown," Geophysical Research Letters, vol. 47, no. 19
Njindan Iyke B (2020) "Economic policy uncertainty in times of COVID-19 pandemic," Asian Economics Letters
Pu M, Zhong Y (2020) Rising concerns over agricultural production as covid-19 spreads: Lessons from China. Glob Food Sec 26:100409
Qian Y, Fan W (2020) Who loses income during the covid-19 outbreak? evidence from China. Research in Social Stratification and Mobility 68:100522
Statista (2021) "China GDP growth rate 2011–2024," Statista, 20-Oct-2021. [Online]. Available: https://www.statista.com/statistics/263616/gross-domestic-product-gdp-growth-rate-in-china/
Tejedor S, Cervi L, Pérez-Escoda A, Tusa F, Parola A (2021) Higher education response in the time of coronavirus: Perceptions of teachers and students, and open innovation". Journal of Open Innovation: Technology, Market, and Complexity 7(1):43
TOEFL Test and Score Data Summary for TOEFL iBT® Test. www.ets.org
Xi Lin B, Zhang YY (2020) Impact of the COVID-19 pandemic on agricultural exports. J Integr Agric 19(12):2937–2945
Yao H, Zuo X, Zuo D, Lin H, Huang X, Zang C (2020) Study on soybean potential productivity and food security in China under the influence of covid-19 outbreak. Geography and Sustainability 1(2):163–171
Yueping S, Hantao W, Xiao-yuan D (2021) Zhili W (2021) "To return or stay? The gendered impact of the COVID-19 pandemic on migrant workers in China." Fem Econ 27(1–2):236–253
Zou P, Huo D, Li M (2020) "The impact of the COVID-19 pandemic on firms: A survey in Guangdong Province, China," Global Health Research and Policy, vol. 5, no. 1

Review of Research on Employee Innovation with AMO Theory

Tian Xintong

Abstract Employee innovation has a strong connection with the competitiveness of enterprises, thus has become a hot topic of academic discussion. However, the logic in relative research needs to be sorted out. Through systematically reviewing past articles which have been published in top journals, this article attempts to summarize the influencing factors of employee innovation and point out the relationship between them. Besides, it establishes a theoretical framework about the influencing mechanism of employee innovation to help us understand the process of innovation more comprehensively. In addition, this article also points out the shortcoming of existing research and offer specific guidance for future research.

Keywords Employee innovation · AMO theory · Literature review

1 Introduction

With the development of the knowledge economy and Internet era, as well as the urgent need for innovation-driven development under the new normal, innovation has become the core competitiveness for enterprises. Although organizational innovation includes individual, group, and organizational factors and their interaction, at the micro-level, employees of an organization are the subject and executor of innovation, and their innovative behavior affects the innovative behavior and innovative performance of the organization. Therefore, how to increase employees' innovative behavior and improve their innovative performance has always been a hot issue in theoretical and business circles. However, compared with some innovative developed countries in the world, the innovation vitality of Chinese employees is still insufficient as a whole, and innovative activities are limited to the minority. Therefore, it is necessary to explore the influence mechanism of employee innovation

T. Xintong (✉)
Northwest University, Xi'an, China
e-mail: 1183237024@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_96

to help enterprises improve the level of employee innovation to enhance their core competitiveness.

At present, the topic of employee innovation has been widely concerned by scholars, especially the influence of external environmental factors on employee innovation. Such as leadership behavior, characteristics of organizational management and work stress. Secondly, the influence of individual factors on innovation is also involved, such as age, gender, and employee personality traits. Despite the rapid development of research on employee innovation in the past decade, the number of relevant results is gradually increasing, but few papers summarize the origin and development of employee innovation or research development from a theoretical perspective. Given this condition, based on AMO theory, this paper reviews the research from foreign top journals. From the perspective of ability, motivation, and opportunity, this paper sorts out the influence mechanism of individual factors and external environmental factors on the innovative performance of employees and presents the research status in this field. At the same time, this paper analyzes the shortcomings of existing research and points out the feasible direction for future research to provide reference for the follow-up development of this topic.

2 Antecedents and Results of Employee Innovation

2.1 Results of Innovation

Through a systematic review of relevant literature, it is found that employee creation results can be divided into creativity, innovative behavior, and innovative performance. Therefore, this paper discusses these three aspects as the outcome variables of the employee innovation mechanism.

Creativity refers to the production of ideas about products, practices, processes, or procedures that are novel and potentially useful to the organization. If employees are equipped with creativity, the probability of innovative behaviors is higher. Innovative behavior can be conceived as a searching process that includes at least three stages: "variation" or generating new ideas; "selection" or evaluating ideas to reject poor outcomes and identify the most promising novelties; and "retention" or implementing and adopting ideas. This behavior would result in innovative performance which refers to a kind of situational performance. Employees create something beneficial to the organization, such as products, processes, methods, and ideas.

2.2 Antecedent Variables

By summarizing relevant research in recent years, factors affecting employee creation results can be divided into two categories: one is the situation that employees are in and the other is their characteristics.

Personal Factors. Early research on employee innovation focused on finding out who was the most creative and tended to study individual factors such as age, gender, and employee personality and work attitude. The main purpose is to solve the problem of creativity differences between people. From the perspective of individual factors of employees, the age of employees will affect their creativity (Guillen and Kunze 2019). At the beginning of an employee's career, creativity may be at a lower level due to little experience. With experience accumulation, creativity improves. But with increasing age, some problems may come up, such as memory loss, which in turn affect employees' cognitive ability and problem-solving ability, both of which adversely affect employees' creativity. Therefore, the overall relationship between employees' age and creativity presents an inverted U-shape. Secondly, gender, as a factor that cannot be changed by an individual, can also influence employee creativity, but mainly through employees' self-perception of gender (Luksyte et al. 2018). There is no gender difference in creativity, but better creativity is often associated with men because of gender stereotypes. Therefore, when employees perceive themselves as male, they tend to have more positive psychological implication and are more likely to exhibit innovative behaviors.

Environmental Factors. Subsequent studies have realized that the impact of individual factors on employee innovation is relatively stable and difficult to change, while external environmental factors will have a key impact on employee innovation, which can also answer the question of how to change the results of employee creation. Therefore, existing studies increasingly focus on external environmental factors. In this paper, the external environmental factors mentioned in existing research are divided into three levels for explanation, which are company level, team level, and situation level in sequence.

Company Level. Organizational policy, as a feature of the top-level environment, has a direct impact on individual innovation. If an organization is good at creating an innovative environment and forming a high-commitment work system, it can give employees a higher sense of belonging and stimulate their creative passion (Chen et al. 2018). In addition, the establishment of an effective reward and punishment mechanism is also conducive to employee innovation. When employees can get rich organizational rewards from innovation, they are willing to invest in it, thus having a positive impact on their innovative behavior.

Team Level. Team scenario is the central link of employees' work and is influenced by leaders and colleagues. Therefore, their behavior, attitude, and relationship with employees directly affect employee innovation. First of all, the impact of leadership on employee innovation can be reflected in the leader's attitude, behavior, and type

of leadership. When the leader's attitude is positive and mild, it can eliminate the worries of employees' innovation, and enable employees to make innovations fearlessly. On the contrary, rejection by leaders will worsen the innovation environment for employees and is not conducive to their innovation. In addition, leaders should support employee innovation and actively respond to employee innovation (Eva et al. 2019), which can improve employees' innovative behavior. Some studies have also compared transactional leadership with transformational leadership, pointing out that compared with transactional leadership, transformational leadership encourages employees to question the status quo and allows personal development and growth, so it is more beneficial to employee innovation (Pieterse et al. 2010). Secondly, role models will provide learning opportunities for employees and help them improve their innovation in a form of competitive learning. For example, the presence of coworkers that have great creativity can help other employees to recognize and learn the characteristics of the situation of creativity (Madjar et al. 2011) and improve their creativity.

Situation Level. The work itself will have an impact on employee innovation. Employees are more likely to engage in their work when the job content matches their interests or abilities. When the work is complicated and difficult, it will bring pressure to employees and has a negative influence on the generation of innovative behavior. However, some studies have shown that pressure does not necessarily negatively affect employees' innovative behavior, and the utility of pressure will change according to specific situations, presenting an inverted U-shaped relationship (Montani et al. 2019). In other words, appropriate difficulty and pressure are more conducive to employee innovation. Moreover, help from others and accurate information will reduce the difficulty of work, keeping employees' pressure in an appropriate range and also having a positive impact on employee innovation. In addition, the relationship between employees and their surroundings will have an impact on innovation. When an employee has a good social network, it means that he can get more information, which contributes to innovative behavior. While, studies have shown that different social network strength will have different impacts on employee innovation. When an employee has strong out-group ties, it will negatively affect the communication with leaders and colleagues within the organization (Wang et al. 2015), exerting an adverse influence on innovative behaviors. On the contrary, strong in-group ties will be beneficial to the innovation of employees. And when employees are in a multicultural communication environment, they can also get rich information to enhance their creativity. In addition, the unilateral attitude or behavior of others in a certain environment has an impact on innovation as well. For example, trust from customers will give employees a stronger sense of responsibility and push them to improve service quality through innovation to pay back to customers (Campbell et al. 2015).

3 Mediating and Moderating Variables

3.1 Mediation Mechanism from AMO Perspective

The core of AMO theory is that when we analyze a person's behavior, we usually explore the forming factors of the behavior from the perspective of ability, motivation, and opportunity. Therefore, based on the theory, this paper summarizes the formation process of employee innovation from these three aspects.

Ability. This part mainly explains what factors can push employees to master and improve innovation-related abilities and to help managers create an environment conducive to improving their innovation ability.

Job engagement is closely related to the innovation ability of employees, which encourages employees to actively mobilize their resources in their work and helps them to solve problems at work (Montani et al. 2019). Investment in innovative work, in particular, motivates them to question, identify problems, come up with more innovative ideas and solutions, and develop habits conducive to innovation, such as proactivity, persistence, and tenacious problem-solving ability on the other hand, through communication between different cultures, different viewpoints on similar things are learned and further integrated into self-concepts (Lu et al. 2017). This process can cultivate employees' creative thinking and help them improve their creativity.

Motivation. This part mainly explains what factors prompt employees to innovate and carry out innovative behaviors. If managers can grasp the factors that promote employee innovation, they can enhance employees' creative motivation by creating relevant situational factors.

The innovative motivation of employees may come from themselves or the organizational environment. When employees are faced with an innovation task, the factors affecting their motivation can be roughly divided into the following three points: "whether they want to do it well", "whether they can do it well", and "whether they have conditions to help them do it well". First of all, if an employee is trusted and supported by others, such as customers or leaders, it is beneficial for the employee to improve promotion-focused (Campbell et al. 2015), thus generating the motivation to return the trust and support of customers and leaders by completing their work well. In addition, employees who like to imagine the benefits brought by the completion of work are more willing to take risks, challenge new things, and explore new methods (Yuan and Woodman 2010). On the contrary, if employees tend to assume risks at work, like avoiding uncertain factors, they tend to choose safe and capable strategies and solve problems conventionally. But if employees think they are capable of innovation, they will have stronger self-efficacy, which motivates them to overcome uncertain factors and complete the innovation tasks. Moreover, when an employee completes an innovative task, they will look for whether there are enough resources to help them complete the task. For example, if an employee's organization has a good working atmosphere, which means coworkers can help

each other actively overcome difficulties and face work, etc. Under such conditions, employees are apt to generate harmonious passion for work and thus stimulate positive emotions towards work (Dong et al. 2011). This kind of harmonious relationship between each other also enables employees to feel a sense of belonging and support, and they tend to actively seek help from coworkers and leaders so as to attain more resources which help them solve problems Besides, organizational support can provide psychological resources for employees. For example, organizational support for innovation can create a psychological climate for employees (Scott and Bruce 1994), so that employees can reduce their worries about failure and better invest the saved psychological resources into innovative activities.

Opportunity. This part mainly explains what factors affect employees' innovation opportunities, and helps managers create innovation opportunities for employees by taking advantage of relevant factors to improve the probability of creative output.

Employees' innovation opportunities can come from three aspects: leadership, personal will, and external environment. When an employee has a strong social network within the organization, the employee will enhance communication with the leaders within the organization. Such communication is conducive to the formation of LMX between the employee and the leader. When leaders take a positive attitude towards employees, they will be given more work resources (Kwan et al. 2018), which include job information, job opportunities, and interpersonal resources to help employees find new ideas from new things. Furthermore, willingness to take risks, as a personal trait, can influence innovation outcomes through opportunities. Studies show that employees who are willing to take risks are more courageous in face of risks, and to meet their demands for challenges and excitement, they will seize every opportunity that can be created, thus prone to innovative behaviors and innovative results (Madjar et al. 2011). On the contrary, an uncertain working environment allows employees more incline to assuming the risks of challenging work and reduces their willingness to take risks. As a result, even when confronted with innovation opportunities, employees may choose to ignore them.

3.2 Regulated Variables

The causal mechanisms associated with employee creative outcomes are not without theoretical boundaries and are influenced by other constraints that cannot be ignored and may amplify or weaken the effects of the antecedent variables mentioned above on employee innovation. Therefore, this paper further discusses the boundary conditions involved in existing studies and divides them into individual factors and situational factors to specifically explore which boundary conditions have a moderating effect on employee innovation results, so as to have a more comprehensive and deeper understanding of the causal mechanism.

Situational Factors. If there are additional external conditions that can help employees, they will strengthen the positive impact of other environmental factors on

employee innovation or weaken the negative impact. For example, when the team is cohesive, if the organization gives employees a high commitment to work, there will be a greater positive impact on employees' innovation performance (Madjar et al. 2011). And helping employees to understand the strength of HR management can enhance the positive impact of performance rewards on employees' innovative performance (Sanders et al. 2018). Weakening the negative influence can be reflected in the older worker's help. Interdepartmental collaboration helps older workers work with others (Guillen and Kunze 2019), which broadens their understanding of complex organizational issues and using their experience, and helps an organization determine the most promising solutions to the situation. In contrast, if external conditions threaten employees, the impact of other positive factors on employee innovation will be weakened. If there is routine work and less discretion is given to employees, the perception of organizational support will be weakened (Scott and Bruce 1994) and as a result, the efforts of the organization will be in vain. Besides, although there is an inverted U-shaped relationship between stress and employee innovative performance, if employees feel threatened by social evaluation, it will enhance the negative impact of stress on employee innovative performance (Byron et al. 2010), weaken the positive impact, and change the relationship between the two.

Individual Factors. People vary in the same organizational environment. Due to different personality traits, different employees have different cognition of the same thing, resulting in different behaviors. Therefore, personality traits themselves can also magnify or reduce the influence of an external factor. For example, employees with proactive personalities will weaken the negative impact of age on innovation. In addition, for employees who tend to have psychological collectivism, the positive impact of organizational support on their innovation is enhanced (Lucianetti et al. 2016). Moreover, employees with an open experience personality tend to communicate with others, share experience, and make progress together, which can also enhance the positive effect of organizational support. However, self-construals employees, have independent self-constructs and are reluctant to give feedback to others to preserve their interests, which will weaken the positive impact of organizational support (Brown and Baer 2015). On the other hand, employees' mindfulness and anxiety have different moderating effects on job stress. When employees have mindfulness towards work, they will be more engaged in work and actively accept the status quo, thus weakening the negative impact of stress on employee innovation (Montani et al. 2019). But if employees always face work with an anxious attitude, the negative impact of stress on innovation will be amplified.

4 Conclusion

By reviewing the relevant literature in top journals, the relationship and differences between literature are sorted out, and the theoretical framework of influencing mechanism of employee innovation results is established. Firstly, the factors affecting

employee innovation are summarized from two aspects of individual and situation. Based on the theoretical framework of AMO, the mediating process of this mechanism is pointed out to further improve the understanding of the employee innovation process. In addition, the boundary conditions of the mechanism are explained to form a complete theoretical framework. Moreover, through this framework, the blank field of current research and the direction of future research are pointed out.

5 Future Research

(1) There is a problem of research inequality in current studies. Existing research mostly adopts the factors of employee motivation as the mediating process influencing employee innovation. Less research talks about the ability and opportunity of employees. However, employees' innovation ability and innovation opportunities can positively affect the results of employee innovation, which is as important as motivation. Therefore, future research on the mediation mechanism can further involve aspects of employees' ability and motivation to form a balanced and comprehensive theoretical framework. In addition, when selecting antecedent variables affecting employee innovation, most studies tend to explore the influence of environmental factors on employee innovation and pay insufficient attention to individual factors. If we can master the influence of more individual factors on innovation, it can help managers to carry out targeted recruitment and training and also has important practical significance.

(2) Many studies have mentioned that there is an inverted U-shaped relationship between stress and employee innovation, but there is no in-depth classification of stress and how different stress affects employee innovation besides its conversion mechanism, that is, which is challenging stress and which is obstructing stress, how these two types of stress converse, and whether other conditions are affecting the conversion of interests are not clarified and need further research.

(3) Currently, we are still in the post-pandemic era. In response to national policies, we still need to conduct online office work in special periods, which means that changes in the workplace, working hours, communication modes, and other aspects may affect employee innovation. For example, using the network to work from home enables employees' working hours to be more flexible and saves commuting time. Employees can have more fragmented time to complete work, which may affect work quality and efficiency. Compared with the previous office work that needs employees to focus for a long time, which way for work is more conducive to employees' innovation and whether the process will be restricted by different factors are worth further research and discussion. In addition, the network, as a major communication medium, also has a significant impact on employee innovation. While providing employees with a lot of information, the network also tends to make them fickler. As a double-edged sword, how to achieve the advantages and avoid disadvantages to maintain and improve the innovative performance of employees needs further research.

References

Brown G, Baer M (2015) Protecting the turf: the effect of territorial marking on others' creativity. J Appl Psychol 100(6):1785–1797

Byron K, Khazanchi S, Nazarian D (2010) The relationship between stressors and creativity: a meta-analysis examining competing theoretical models. J Appl Psychol 95(1):201

Campbell EM, Zhou J, Liao et al (2015) Fostering employee service creativity: joint effects of customer empowering behaviors and supervisory empowering leadership. J Appl Psychol 100(5):1364–1380

Chen Y, Jiang JJ, Tang GY et al (2018) High-commitment work systems and middle managers innovative behavior in the Chinese context: the moderating role of work-life conflicts and work climate. Hum Resour Manage 57:1317–1334

Dong L, ChenXP, Yao X (2011) From autonomy to creativity: a multilevel investigation of the mediating role of harmonious passion. J Appl Psychol 96(2):294–309

Eva N, Meacham H, Newman A, Schwarz, G, Tham TL (2019) coworker feedback more important than supervisor feedback for increasing innovative behavior. Hum Resour Manage 58(4)

Guillen L, Kunze F (2019) When age does not harm innovative behavior and perceptions of competence: testing interdepartmental collaboration as a social buffer. Hum Resour Manage 58(3):301–316

Kwan HK, Zhang X, Liu J, Lee C (2018) Workplace ostracism and employee creativity: an integrative approach incorporating pragmatic and engagement roles. J Appl Psychol 103(12)

Lu JG, Hafenbrack AC, Eastwick PW, Wang DJ, Maddux WW, Galinsky AD (2017) "going out" of the box: close intercultural friendships and romantic relationships spark creativity, workplace innovation, and entrepreneurship. J Appl Psychol

Lucianetti L, Ng TWH (2016) Within-individual increases in innovative behavior and creative, persuasion, and change self-efficacy over time: a social-cognitive theory perspective. J Appl Psychol

Luksyte A, Unsworth KL, Avery DR (2018) Innovative work behavior and sex-based stereotypes: examining sex differences in perceptions and evaluations of innovative work behavior. J Organ Behav 39:292–305

Madjar N, Greenberg E, Chen Z (2011) Factors for radical creativity, incremental creativity, and routine, noncreative performance. J Appl Psychol 96(4):730–743

Montani F, Vandenberghe C, Khedhaouria A et al (2019) Examining the inverted u-shaped relationship between workload and innovative work behavior: the role of work engagement and mindfulness. Hum Relat 73(1):59–93

Pieterse AN, Knippenberg DV, Schippers M, Stam D (2010) Transformational and transactional leadership and innovative behavior: the moderating role of psychological empowerment. J Organ Behav 31(4)

Sanders K, Jorgensen F, Shipton H, Rossenberg YV, Dysvik A (2018) Performance-based rewards and innovative behaviors. Hum Resour Manage 57(1)

Scott SG, Bruce RA (1994) Determinants of innovative behavior: a path model of individual innovation in the workplace. Acad Manag J 37(3):580–607

Wang XH, Fang Y, Qureshi I, Janssen O (2015) Understanding employee innovative behavior: integrating the social network and leader-member exchange perspectives. J Organ Behav 36(3):403–420

Yuan F, Woodman RW (2010) Innovative behavior in the workplace: the role of performance and image outcome expectations. Acad Manag J 53(2):323–342

Review of the Effect of Family Ownership on Capital Structure

Zehao Chen, Siyuan Zhang, and Jiaqi Wang

Abstract Family-owned companies occupy a large proportion of enterprises all over the world. It is meaningful for people to understand how family ownership may affect firms' financing strategies. This paper tends to summarize the results of previous studies. However, different scholars reach different results of the correlation between family ownership and debt levels. Some scholars get the result of positive correlation, some get the negative correlation, and others conclude that the correlation does not exist. We apply corporate finance theories such as the pecking order theory, the agency cost theory, and the trade-off theory to previous studies to explain the differences. In the empirical analysis, we find that sample selection bias and omit variable bias exist in previous works. One significant reason that leads to the collisions among previous researchers is the ambiguous definition of family businesses and the disagreement about the definitions. Hence, we conclude several identities of family businesses and make some suggestions to future researchers.

Keywords Family ownership · Capital structure · Corporate finance theory

1 Introduction

Undoubtedly, family businesses make up the majority of enterprises internationally (Porta et al. 1999). They account for about 75–95% of all registered corporations in Western Europe and 73% of all firms in the UK (Smyrnios and Walker 2003). In addition, as reported by European Commission 2009 (Commission 2009), family

Z. Chen (✉)
International Business School Suzhou, Xi-an Jiaotong Liverpool University, Suzhou 215123, Jiangsu, China
e-mail: Zehao.Chen18@student.xjtlu.edu.cn

S. Zhang
Cangzhou No.1 Middle School, Cangzhou 061014, Hebei, China

J. Wang
Beijing 21st Century International School, Beijing 100036, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_97

corporations form about two-thirds of the private sector employment and create around 45% of GNP (Gross National Product) in the UK, 70% in Spain and Norway. In the USA, approximately 80–90% of the wealth, along with 64% of the labor, can be credited to family firms (Shanker and Astrachan 1996). Families control the majority of companies worldwide: over 50% of all public enterprises in the USA and Europe, and greater than 60% in Asia (Croci et al. 2011). In addition, around one in three of either the S&P 500 or the Fortune 500 enterprises are considered family-owned (Anderson and Reeb 2003a; Shleifer and Vishny 1986). Furthermore, Business in the blood 2014 (Economist 2014) points out that families control 19% of the Fortune Global 500, four percent more than in 2005, reported by Mckinsey, which also forecasts that this trending will be maintained down the road.

People do not reach a consensus on how to define family firms. Generally, family firms are identified in three ways of family involvement (Villalonga and Amit 2006; López-Gracia and Sánchez-Andújar 2007): family management (Holderness and Sheehan 1988), family ownership (Littunen and Hyrsky 2000), and family control (Allen and Panian 1982). Businesses operated or owned by an individual or several partners is also considered family firms, though they are not biologically related (Cronqvist and Nilsson 2003). In addition, said by the European Commission 2009 (Commission 2009), a firm can be considered a family firm if: (i) most of the voting rights are possessed by the founders, owners of the firm's shareholdings, or their family members; (ii) most of the voting rights are direct or indirect; (iii) at least one delegate of the family officially controls the business; (iv) listed firms are defined as family businesses if the founders, the owners, or their relatives own 25% of the voting rights authorized by their shareholdings. Paul Westhead and Marc Cowling (Westhead and Cowling 1998) illustrated that the proportion of family businesses in the UK is notably different regarding several distinct criteria: around 80% of the companies with regard to two of the four criteria, and 15% using the four.

Clearly, researchers and practitioners attach increasing importance to family businesses, a significant component of the modern economy. This paper begins with three theories that may explain the incentives for family firms to adopt a unique capital structure compared with non-family firms. Then, the following section analyzes previous regression results about the effect of family ownership on leverage ratio and answer questions like why authors come up with different results. This survey paper refers to papers in the Journal of Finance, Journal of Financial Economics, Family Business Review, Small Business Economics, etc.. This rest of this paper will be structured as follows: Theory Analysis, Reason Analysis and Future Research Suggestions, and Conclusion.

2 Theory Analysis

2.1 Pecking Order Theory

According to Pecking order theory (Myers 1984; Myers and Majluf 1984), companies tend to have a ranked sequence of financing methods: firstly, they raise money through internal financing from insiders, friends, and relatives; when internal financing resources are exhausted, they tend to issue more debt than equity to outsiders. This hierarchical order of financing decisions is due to the asymmetric information between the insiders (e.g., managers) and outsiders (e.g., potential investors). In most family enterprises, the information asymmetry is more severe compared with that in non-family firms due to a lack of transparency in families (Ramalho et al. 2009). Family members invest a great amount of personal wealth in their firm and keep the ownership for decades, so they have more incentives for monitoring the actions and maintaining the sustainability of their firm; thus, large family shareholders tend to have a more comprehensive interpretation of their businesses than outside temporary investors or speculators (Kwak 2003; Anderson and Reeb 2003b). This phenomenon confines the businesses to limited external financing options. Furthermore, one main goal of family businesses is to bequeath this asset to the next generation instead of consuming it in their lifetime (Brenes et al. 2011). Hence, family firms tend to perform conservatively by taking less external finance to maintain a concentrated family control, thus protecting their future successors (Blanco-Mazagatos et al. 2007). Therefore, internal financing resources (e.g., retained earnings, personal savings, etc.) come first when capital is in demand, and then families will choose to issue debt instead of equity to outsiders. This pecking order of financing options helps families avoid a dilution of family ownership and, thus, lower possibilities of losing control.

2.2 Agency Costs Theory

As to the agency costs theory, the optimal leverage ratio depends on the debt value that reduces conflicts between managers and shareholders, or between shareholders and debt holders (Jensen and Meckling 1976).

One group of scholars think agency costs will lead families to use less debt. In family firms, the manager-owner agency costs are trivial mainly due to the alignment of the owners' and the owner-managers' interests (Kwak 2003). Thus, the inducement for borrowing money as a way to keep down the free cash flows under managers' hands is less significant. Furthermore, this intimate alignment, the consequent extra fluidity, and better access to consume perquisites deteriorate the creditor-owner conflicts in family firms by increasing monitoring costs because of self-control problems, parental altruism, etc. (Schulze et al. 2001). Therefore, creditors are likely to impose on family borrowers a higher interest rate and stricter collateral requirements,

which will deter family businesses from borrowing as much money as non-family businesses do.

On the other hand, said by many scholars, creditors consider family-owned firms as a stable, continue organizational structure which efficiently protects debt holders' interests (Daily and Dollinger 1992). Thus, family-owned firms enjoy easier access to debt (Bopaiah 1998), with the lower expense of borrowing (James 1999; Anderson et al. 2003). Hence, the negative effect imposed by family ownership on debt utilization may be mitigated.

2.3 Trade-Off Theory

The trade-off theory states that firms maximize the value of tax shield on debt interests (Modigliani and Miller 1958) minus the costs of bankruptcy resulted from extravagant leverage (Kraus and Litzenberger 1973). Existing references imply that family enterprises utilize resources with greater efficacy than non-family counterparts (Anderson and Reeb 2003a; Lee 2006; Maury 2006; Chu 2009), which denotes they may better take advantage of debt to relax the tax burden. Nevertheless, Haynes et al. (1999) point out that families transfer the firm's earnings to the family to lessen the net income, thus reaching the same tax deduction effect. Yet, the bankruptcy costs are higher for family businesses due to family owners' closer involvement (Blanco-Mazagatos et al. 2007) and specific factors related to family firms such as self-esteem loss, self-employment, private assets, etc. (Ramalho et al. 2009). The trade-off theory generally implies that family enterprises may adopt a unique optimal target leverage ratio, but whether families will choose more or less external finance is still equivocal.

3 Reason Analysis and Future Research Suggestions

The previous three different results from scholars raise our interest. We try to find out the underlying reasons that lead to the difference. Focusing on the empirical part on previous studies, we picked out the following two tables which can reflect general characteristics of different scholar's empirical analysis. Table 1 is from Ramalho's work (Ramalho et al. 2018). Model 1 is set to test whether the family ownership is relevant for the firm's financing decision. Part I relates to a binary choice whether the firm will issue debts or not. Part II stands for the proportion of debt to total assets when the firm choose to issue debt. The results show that family firm is positively affect the debt ratio and the amount of debt issued. Table 2 is from Anderson and Reeb's work (Anderson and Reeb 2003a). They use the same classification as Ramalho's (Ramalho et al. 2018). The results of this table shows that family ownership is irrelevant of the usage of debt. We find three points are worth mentioning.

First, the definition of family ownership corporation is quite ambiguous. We conclude the concept of family ownership into three categories: family control, family

Table 1 The results from Ramalho's work [Ramalho et al. 2018]

Variable	Model 1	
	Part 1	Part II
Constant	0.347***	−0.008
	(0.055)	(0.058)
Size	0.334***	−0.071***
	(0.010)	(0.007)
Profitability	−1.618***	−3.313***
	(0.183)	(0.174)
Tangibility	1.155***	0.522***
	(0.070)	(0.0466)
Growth	0.101***	0.253***
	(0.039)	(0.051)
Age	−0.003***	−0.009***
	(0.001)	(0.001)
Liquidity	−2.453***	−1.522***
	(0.109)	(0.093)
Family ownership	0.159***	0.128***
	(0.041)	(0.025)

Ramalho et al. (2018)
*Statistically significant at the 0.10 level, **Statistically significant at the 0.05 level, ***Statistically significant at the 0.01 level

management and family ownership. According to González, M. et al. (González et al. 2013) family control means that family members control the board of directors of the firm but they do not involve day to day decisions. Family management means that departments of a corporation are in charged by the family members. Family ownership means that family members who have great proportion of shares have different voting power and formally control the company, but they do not run the firm a lot. The investigated subjects of most previous papers are of those three kinds, but those authors haven't distinguished between these three concepts, leading different variable setting and results in their regression. Considering Table 1, Ramalho's (Ramalho et al. 2018) set the control variables into size, profitability, tangibility, growth, age, liquidity. Size is the logarithm value of firm's total revenue. Profitability is the EBIT ratio. Tangibility stands for the proportion of fixed asset divided by total assets. Growth rate stands for the percentage change in total asset every year. Age stands for the length of the time since the start of the firm. Liquidity stands for the ratio between the value of cash and cash equivalent and total assets.

Considering Table 2, besides some financial indicators, Anderson and Reeb (2003a) use some indicators of CEO to take the factor that whether the family member's involvement in their company into consideration. This is the criteria used to distinguish the characteristics of the family firm whether the firm is belonged to the

Table 2 The results from Anderson and Reeb's work [Anderson and Reeb 2003a]

Regression results of leverage and family ownership						
Firm leverage: long-term						
	Debt/total assets			Levered firms binary variable		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.23 (0.34)	0.035 (0.50)	0.018 (0.27)	14.311** (3.78)	15.000** (2.79)	15.033** (2.88)
Family firms	−0.002 (0.19)	…	…	−0.169 (0.44)	…	…
CEO founder	…	−0.016 (0.52)	…	…	−0.871 (1.02)	…
CEO descendant	…	−0.007 (0.35)	…	…	−0.798 (1.38)	…
CEO hire	…	−0.001 (0.03)	…	…	0.265 (0.67)	…
Family control to ownership	…	…	0.001 (0.20)	…	…	0.006 (0.17)
Blockholders	0.062 (1.56)	0.060 (1.49)	0.064 (1.60)	1.425 (1.34)	1.165 (1.09)	1.544 (1.45)
Hoard Independence	0.015 (0.48)	0.012 (0.38)	0.018 (0.58)	0.465 (0.49)	0.201 (0.21)	0.662 (0.75)
Diversification Dummy	0.013 (1.18)	0.012 (1.07)	0.013 (1.23)	0.476 (1.47)	0.417 (1.24)	0.513 (1.58)
In(total assets)	0.009 + (1.70)	0.008 (1.63)	0.009 + (1.71)	0.434** (2.35)	0.398 + (1.92)	0.443** (2.39)
R&D/sales	−0.611** (3.54)	−0.611** (3.52)	−0.613** (3.55)	−7.617 (1.48)	−7.807 (1.51)	−7.782 (1.51)
Profitability (ROA)	0.001 + (1.67)	0.001 + (1.37)	0.001 + (1.68)	0.012 (0.55)	0.015 (0.74)	0.11 (0.53)
Total risk	0.327** (4.25)	0.330** (4.30)	0.329** (4.24)	4.213 (1.78)	4.731* (1.96)	4.360** (1.83)
In(firm age)	−0.002 (0.16)	−0.004 (0.27)	−0.002 (0.71)	0.020 (0.04)	−0.065 (0.12)	0.013 (0.03)
Cash ratio	−0.289** (4.37)	−0.289**(4.32)	−0.290** (4.38)	−6603** (3.38)	−6.837** (3.30)	−6.641** (3.40)
Adjusted R^2	0.341	0.340	0.341	0.367	0.386	0.375

Anderson and Reeb (2003a)

+Statistically significant at the 0.10 level, *Statistically significant at the 0.05 level, **Statistically significant at the 0.01 level

property of family controlled or family management or family ownership. Comparing Tables 1 and 2 we can see the different results of two tables. Many reasons may lead to the difference. The obvious one is that Ramalho et al. (2018) hasn't described the specific characteristic of the family firm as Anderson and Reeb do (Anderson and Reeb 2003a). Whether the family members get involved into the daily management of the corporation may directly affect the company's financing strategy (González et al. 2013). Hence, we suggest that in future research, scholars should classify the characteristic of firms into family control, family ownership or family management. Under these three tracks, the empirical analysis can explain the correlation between family ownership and debt level in a more precise way.

Second, there may exist sample selection bias in their empirical work, leading to endogeneity to some extent. The sample of the first table comprises middle-stage 20,174 family firms and 4274 non-family counterparts in 2007 (Ramalho et al. 2018). The sample excludes financial firms, firms with zero sales or negative EBITDA, firms in the bankruptcy process (Ramalho et al. 2018). The data set of the second table includes data of 319 S&P firms from 1993 to 1999, discarding financial firms and the utility industries (Anderson and Reeb 2003a). Each country breeds its family enterprises. Because of differences among countries, these firms react in their unique way. Thus, data sets that only comprise samples in a single country are likely to engender sample selection bias problems. Moreover, the two authors focus on listed companies (Anderson and Reeb 2003a; Ramalho et al. 2018). However, a tremendous amount of family businesses remains private. Listed family companies are usually examples of successful family operations, but examples of family operation failures or bankruptcy threats may exist in unlisted firms. Different firm status engenders distinct financial policies. Therefore, those out-of-scope unlisted family businesses may result in sample selection bias. Instrumental variable is suggested into empirical study in future research to offset the impact brought by the data in specific country or source if the scholars cannot get the data from various countries or sources.

Third, these empirical works may suffer from omit variable bias. Some important variables are not all taken into consideration in previous empirical work. For example, the dummy variable of different countries. Besides the selection bias, the location of the firm is paramount determinant. Family firms are strongly affected by the location because family businesses often have strong local roots and have stronger ties of historical, social and cultural events (Bird and Wennberg 2014). Another vital variable is the firm size. Then, the time difference between the two samples may give rise to sample selection bias. Graham et al. (2015) find a wide economic phenomenon that corporate capital structures are unstable and that the debt usage of firms of all sizes increased a lot in the last century and fluctuated in recent decades in the USA. Hence time dummy also should take into consideration. From Table 2 we can see that Anderson and Reeb haven't take firm size into consideration, which may lead to the non-significant of the result (Anderson and Reeb 2003a). Myers and Majluf (1984) suggest that firm size may affect the firm's financing strategy inversely, which is consistent with the result of Ramalho's work (Ramalho et al. 2018). Hence, it is suggested that future research should take into consideration of some determinative

characteristics of companies at the same time to be the control variable, for example, the location of the firms, the time period or the firm size.

4 Conclusion

Family businesses are of great importance for scholars and practitioners to understand a huge part of the economy nowadays. This paper summarizes several previous studies with distinct results. In the Theory Analysis section, we explain pecking order theory, agency costs theory, and trade-off theory, and relate them to different results about the effects of family ownership on corporate capital structure. In the Reason Analysis and Future Research Suggestions section, we focus on two empirical studies and find that previous results are imprecise because of sample selection bias, omitted variable bias, and, most importantly, a lack of consensus on the definition of family businesses. Finally, we recommend future studies: (i) avoiding sample selection bias; (ii) considering more variables; (iii) reaching a consensus on defining family enterprises.

References

Allen M, Panian S (1982) Power, performance, and succession in the large corporation. Adm Sci Q 27(4):538

Anderson R, Reeb D (2003a) Founding-family ownership, corporate diversification, and firm leverage. J Law Econ 46(2):653–684

Anderson R, Reeb D (2003b) Founding-family ownership and firm performance: evidence from the S&P 500. J Financ 58(3):1301–1328

Anderson R, Mansi S, Reeb D (2003) Founding family ownership and the agency cost of debt. J Financ Econ 68(2):263–285

Bird M, Wennberg K (2014) Regional influences on the prevalence of family versus non-family start-ups. J Bus Ventur 29(3):421–436

Blanco-Mazagatos V, de Quevedo-Puente E, Castrillo L (2007) The trade-off between financial resources and agency costs in the family business: an exploratory study. Fam Bus Rev 20(3):199–213

Bopaiah C (1998) Availability of credit to family business. Small Bus Econ 11:75–86

Brenes E, Madrigal K, Requena B (2011) Corporate governance and family business performance. J Bus Res 64(3):280–285

Chu W (2009) The influence of family ownership on SME performance: evidence from public firms in Taiwan. Small Bus Econ 33(3):353–373

European Commission (2009) Overview of family-business-relevant issues: research, networks, policy measures and existing studies. http://ec.europa.eu/enterprise/policies/sme/promoting-entrepreneurship/familybusiness/family_business_expert_group_report_en.pdf

Croci E, Doukas JA, Gonenc H (2011) Family control and financing decisions. Eur Financ Manag 17(5):860–897

Cronqvist H, Nilsson M (2003) Agency costs of controlling minority shareholders. J Financ Quant Anal 38(4):695

Daily C, Dollinger M (1992) An empirical examination of ownership structure in family and professionally managed firms. Fam Bus Rev 5(2):117–136
González M, Guzmán A, Pombo C, Trujillo MA (2013) Family firms and debt: risk aversion versus risk of losing control. J Bus Res 66(11):2308–2320
Graham JR, Leary MT, Roberts MR (2015) A century of capital structure: the leveraging of corporate America. J Financ Econ 118(3):658–683
Haynes G, Walker R, Rowe B, Hong G (1999) The intermingling of business and family finances in family-owned businesses. Fam Bus Rev 12(3):225–239
Holderness C, Sheehan D (1988) The role of majority shareholders in publicly held corporations. J Financ Econ 20:317–346
James H (1999) Owner as manager, extended horizons and the family firm. Int J Econ Bus 6(1):41–55
Jensen M, Meckling W (1976) Theory of the firm: managerial behavior, agency costs and ownership structure. J Financ Econ 3(4):305–360
Kraus A, Litzenberger R (1973) A state-preference model of optimal financial leverage. J Financ 28(4):911–922
Kwak M (2003) The advantages of family ownership. MIT Sloan Manag Rev 44(2):12
La Porta R, Lopez-de-Silanes F, Shleifer A (1999) Corporate ownership around the world. J Financ 54(2):471–517
Lee J (2006) Family firm performance: further evidence. Fam Bus Rev 19(2):103–114
Littunen H, Hyrsky K (2000) The early entrepreneurial stage in Finnish family and nonfamily firms. Fam Bus Rev 13(1):41–53
López-Gracia J, Sánchez-Andújar S (2007) Financial structure of the family business: evidence from a group of small Spanish firms. Fam Bus Rev 20(4):269–287
Maury B (2006) Family ownership and firm performance: empirical evidence from Western European corporations. J Corp Finan 12(2):321–341
Modigliani F, Miller M (1958) The cost of capital, corporation finance and the theory of investment. Am Econ Rev 48(3):261–297
Myers S (1984) The capital structure puzzle. J Financ 39(3):574–592
Myers S, Majluf N (1984) Corporate financing and investment decisions when firms have information that investors do not have. J Financ Econ 13(2):187–221
Ramalho JJS, Rita RMS, da Silva JV (2018) The impact of family ownership on capital structure of firms: exploring the role of zero-leverage, size, location and the global financial crisis. Int Small Bus J: Researching Entrepreneurship 36(5):574–604
Ramalho JJS, Rita RMS, Silva JV (2009) The impact of family ownership and firm size on capital structure decisions
Schulze W, Lubatkin M, Dino R, Buchholtz A (2001) Agency relationships in family firms: theory and evidence. Organ Sci 12(2):99–116
Shanker MC, Astrachan JH (1996) Myths and realities: family businesses' contribution to the US economy—a framework for assessing family business statistics. Fam Bus Rev 9(2):107–123
Shleifer A, Vishny RW (1986) Large shareholders and corporate control. J Polit Econ 94(3):461–488
Smyrnios K, Walker R (2003) Australian family and private business survey
The Economist (2014) Business in the blood. http://www.economist.com/news/business/21629385-companies-controlled-founding-familiesremain-surprisingly-important-and-look-set-stay
Villalonga B, Amit R (2006) How do family ownership, control and management affect firm value? J Financ Econ 80(2):385–417
Westhead P, Cowling M (1998) Family firm research: the need for a methodological rethink. Entrep Theory Pract 23(1):31–56

Risk Management in Shipping Industry

Xiaoxiao Dou

Abstract The goal of risk management is to balance the level of risk and return to optimize shareholders' value. One fundamental method of risk management is to utilize financial instruments, including derivatives. In this paper, specific risks and solutions of the shipping industry are studied, taking the Matson company as an example. Risks in the shipping industry are featured as such: fluctuation in fuel prices, which affects significantly the operating expenses; difficulty to obtain capital as well as changeable debt ratios; unstable freight rate, which influences income. Some applicable hedging methods are analyzed accordingly, including borrowing a mix of fixed rate debts and floating rate debts, longing crude oil futures, and entering Forward Freight Agreements. Some suggestions based on analysis are then given in response to new conditions in the year 2022, including entering into crude oil futures at different prices and different maturities and focusing more on domestic logistics.

Keywords Derivatives · Risk management · FFA · Oil futures · Currency forwards

1 Introduction

Operations in the shipping industry are always vulnerable and difficult to control due to their nature. Bad weathers, natural disasters, and maritime accidents are all potential risks that will interfere with the company's routine operations. Normally, under these situations, a company will not be able to provide its services on schedule, which might cause an increase in expenses and a decline in business. The company may as well go through loss or damage of vessels, containers, car-go, and other equipment, which is a considerable cost on financial statements. Although some of these losses can be insured, some others are not secured by insurance. In this case, the company may experience a negative influence on financial statements.

X. Dou (✉)
Bayes Business School, London EC1Y 8TZ, UK
e-mail: Xiaoxiao.Dou@bayes.city.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_98

In the meantime, the shipping industry also holds a limited entry barrier, especially in international tradelines. Existing shipping companies are facing a threat of new entrants to the market. Because the entry of new competitors or vessels could significantly increase the shipping capacity and re-balance the demand and supply relationship. Therefore, a company's own operating volumes and rates may be adversely affected.

Facts of the industry suggest that a shipping company should utilize a hedging strategy to smooth its risks. Adland et al. in their article provide several reasons (Adland et al. 2019). Firstly, shipping is an capital-intensive industry, which requires massive debt financing. Lenders will set their interest rates based on the credit rating of the borrowing firm. The lower the risk, the lower the interest expenses. Relatively, the costs of bankruptcy will also be reduced since ships are often used as collateral to borrow from banks. In addition, hedging can be a solution, especially for those private or family-owned shipping companies, when they disagree or are not capable to di-versify their portfolios.

As for other risks, hedging strategies will be similar as they are adopted in other businesses.

In the following parts of this article, the background of an American shipping and navigation firm named Matson will be introduced. Each of its risks and strategies against risks will be analyzed respectively, and finally, a comment will be given on this firms hedging strategy, followed by suggestions in face of 2022's new market condition.

2 Company Profile

2.1 Background

Matson, Inc., listed on NYSE as "MATX", is a US transportation company (MATSON 2021). It has been a leading shipping company in the Pacific since 1882. Matson is now formed up into 2 divisions, Ocean Transportation Segment and Logistics Segment.

2.2 Business Area

Ocean Transportation: Matson Navigation Company, known as MatNav is 100% owned by Matson. Its business includes both domestic and international services, from China and Japan to California, Alaska, and islands in the South Pacific. It owns fleets ranging from various purposes containerships, containers, to vessels that can carry vehicles. MatNav also owns subsidiary sectors that pro-vide loading/unloading services, refrigerated cargos, and transportation on inland waterways.

Table 1 Consolidated operating results

(Dollars in millions)	Year Ended December 31			
	2021	2020		Change
Operating revenue	$3925.3	$2383.3		$1542.0 64.7%
Operating expenses	(2737.8)	(2103.0)		(634.8) 30.2%
Operating income	1187.5	280.3	907.2	323.7%
Interest expenses	(22.6)	(27.4)	4.8	(17.5)%
Other income/expense, net	6.4	6.1	0.3	4.9%
Income before income taxes	1171.3	259.0	912.3	352.2%
Income taxes	(243.9)	(65.9)	(178.0)	270.0%
Net income		$927.4	$193.1	$734.3 383.3%

Logistics: Matson Logistics is 100% owned by Manav. This subsidiary was founded in the year 1987. It provides logistic services through ship, rail, truck, and warehouse throughout North America and Asia.

2.3 Financial Situation

According to the Company's Consolidated Results of Operation (Table 1), Operating Revenue for the year 2021 increased by $1542.0 million (64.7%), owing to a $1278.9 million increase in MatNav and $263.1 million in Matson Logistics. The increase can be explained by booming business in China, Alaska, and Hawaii, increasing fuel-related surcharges, and higher brokerage for transportation and supply chain management.

Operating Costs and Expenses also increased, by $634.8 million or 30.2%, including a $386.0 million increase in MatNav and a $248.8 million increase in Matson Logistics. Interest Expense was $22.6 million in the year 2021, decreased by $4.8 million, compared previous fiscal year, due to less outstanding debt during 2021.

2.4 Stock Information

General Information: Matson is listed on the NYSE under the symbol "MATX".

Stock Prices: The Company's stock price is generally maintained at a level of 30–40 with minor fluctuations from the year 2015 to 2019. After the stock price

Table 2 Dividends declared per share of common stock

(Dollars in millions)	Year Ended December 31		
	2021	2020	2019
1st	$0.23	$0.22	$0.21
2nd	0.23	0.22	0.21
3rd	$0.30	$0.23	$0.22
4th	0.30	0.23	0.22

Dividends declared per share by quarter, *Source* Matson 2021 Annual Report 10 K: https://investor.matson.com/static-files/bac2609c-daaf-4f57-8c5a-e7be05eadc8d

reached a bottom of below 30 in May, it started to increase steadily ever since. Price nearly doubled at the beginning of 2021, and tripled in January 2022.

Dividends: Dividends declared, in quarters, for the fiscal year 2021, 2020, and 2019 were as shown in Table 2.

3 Risk Management

3.1 Risk Factors

Listed below are several risks recognized by the company as material, extracted from the company's 2021 statement of risk factors.

Risks from Company's Operations. Changes of business due to economic conditions and government policies.

The Company's operation of transportation business can be impacted by economic shifts or market instabilities, such as inflations and recessions, as well as changes in regulations, policies across the regions where the Company or its clients operates; and political relations between regimes. These altering of factors may simultaneously affect clients' needs, requests, and business abilities. Take the US as an example, weakening economy in Hawaii and Alaska, including inflation and changing exchange rate, caused tourism downstream, cut in military spending, an increase of unemployment rate, and consequently affected inland and ocean transportation in an adverse direction, in both volumes or rates. In addition, regarding the company's operation in China, imposition of tariffs, uncertainties in tariff rates, and possible changes in bilateral trading policies could negatively influence freight volumes and rates.

Change in fuel price:

As a shipping company, fuel is one of the Company's major operating expenses. The supply of fuel is volatile and beyond control. Therefore, the fuel price is as well unpredictably fluctuating. Increases in the fuel price will bring a drop to the Company's

operational income, by either directly increasing fuel expenses or indirectly raising other costs, on transportation services outsourcing, or energy, for instance.

Financial Risks. Debt and Interest Rate Risks.
Operating in a capital-intensive yet unstable industry, shipping companies are facing a massive amount of debt (Talley 2012). The Company exposes itself to interest rate risks, from its borrowings to support its daily business operations or maintain financial liquidity. However, the Company needs to manage its debts well and retain the ability to repay its debts. Otherwise, the credit rating of the Company will be passively affected, thus causing difficulties for the Company to access outside capital.

3.2 Hedging Strategy

Oil Futures. Transportation is its main area of operation, fuel is a significant operating expense. Fluctuation in oil prices is a main factor of risk. In the year 2020, the IMO (the International Maritime Organization) newly imposed regulation on the sulfur percentage of shipping fuel oil, limiting sulfur content for fuels used by all ships to a maximum of 0.5%, indicating that the Company will select the majority of LSFO (low sulfur fuel oil) and HFO (heavy fuel oil) as fuel for its vessels. Normally, LSFO is traded at a higher price than HFO, as LSFO requires further oil refinement, which involves additional costs. But in some special cases, it is as well possible for an inverted situation. There is no proof in the effective con-tracts of the Company that the supplier guarantees a sufficient supply of LSFO or HFO to the Company, within a predetermined range of selling prices.

Although shown as available on CME (Chicago Merchandise Exchange), neither HSF futures nor LSFO futures have an actual market, due to the lack of market participants. Therefore, one choice for the company is to hedge on crude oil and set properly its hedge ratio, given the fact that fluctuation in crude oil prices will somehow correlate with that of other oil prices.

Specific hedging data is not reported by the company. In this case, the price quote for crude oil futures on CME, with expiration on July 15 of 2022 is taken as an example. The contract size is 1000 barrels, and the price quotation is in US dollars. On that day price is rounded at 96 for convenience. When the company enters into a long position of such contract, for every contract signed, the company will be guaranteed to receive delivery of 1000 barrels of crude oil at 96 on maturity day. Receiving physical delivery or not, the company can trade this possession of crude oil to purchase shipping fuels. As long as the fluctuation of shipping oil and crude oil move in a similar direction, the risk can be controlled.

Mix of Fixed and Floating Rate Debts. In March of 2021, the Company signed the Second Credit Agreement, which stated the pricing choices for the Company, either LIBOR plus a margin of 1.0–1.75%, or a base plus a margin from 0 to 0.75%. Specific margin is determined by the Company's condition.

As indicated by the Company's annual report, at the year-end of 2021, the Company held an outstanding fixed rate debt of $629.0 million. And the Company did not hold any outstanding revolving credit facility. Therefore, in December 2021, the Company had a capacity of $642.0 million to borrow a revolving credit facility.

In order to manage its interest risks, the company adjusts its exposure to interest rates by keeping a well-balanced mix of fixed rate debt and variable rate debt, as well as a mix of debts with various maturity dates. Regardless of the fact that normally floating interest rate is lower than the fixed one, it is more sensitive to changes in market conditions, which is to say floating rate debts face higher requirements for debt service when interest rates increases. In addition, the Company's borrowing for revolving credit facility charges a floating rate based on LIBOR, which a number of countries including the United States have begun to replace with other more representative benchmarks such as SOFR. Uncertainty will arise and the Company's financial condition may be affected by its floating rate borrowing. A mix of fixed and floating rates of debts can provide the company with a less volatile yet relatively low added-up interest rate.

Other Hedging Strategies for the Industry. Other than risks mentioned by Matson, potential risks faced by a shipping company also include vessel value risk, freight risk, and currency risk.

Asset diversification:

To mitigate vessel value risk, some tailormade tools of hedging are applied in the shipping industry. Asset diversification is one of the primary tools to stabilize firm value against fluctuations in vessel prices. By asset diversification, this hedging policy involves building a portfolio of various kinds of ships, in different types, sizes, or lives remaining, based on the fact that price changes of different ships are not in high correlation. However, this method may not be as feasible as expected, due to high transaction expenses and fees for brokers, and low liquidity in the second-hand market. Some other derivatives with ship values as underlying assets were then created, such as the Forward Ship Value Agreement provided by Clarkson in 2003 (Adland et al. 2004), although this contract was never actually put into practice for some consideration.

Forward Freight Agreement (FFA).

Of all the risks a shipping company faces, freight is one significant risk. It has been nearly 40 years since the year 1985 (Stopford 2008) when some dry bulk shipping companies began to consider derivatives for freight rates. Nowadays, freight derivatives are routinely used in dry bulk and tanker markets. In the late 1990s, a customized tool was designed to hedge freight risk, since it is always unachievable to find correlations between freight rates and commodity prices. Forward Freight Agreements (FFAs) are cash-settled principle-to-principle contracts published by Baltic Exchange or Platts (Clarksons 2022). Settlements of FFAs is the average spot rate during the corresponding month for specific routes and asset groups, i.e. Capesize, Panamax, etc., by Baltic Exchange (Alizadeh et al. 2015; Alizadeh and

Table 3 Hedging strategy based on currency forwards

Spot rate: $a/£	
Forwards rates in 1 year: $b/£	
Interest rates	In $: d1–d2%
	In £: p1–p2%

Nomikos 2009). FFAs can be traded in the form of futures or options (Pelagidis and Panagiotopoulos 2019). Maturities of FFAs are from one month up to six years (Baltic Exchange Consumer 2022). Both Freight Futures and Freight Options are standardized. Normally, regulated expiry dates are a minimum of one day, and lot sizes are 1000 metric tons.

An FFA can assist shipping companies to maintain stable freight rates, therefore mitigating risks. Take dry bulk as an example, if the company signs contracts of FFA, the shipping income will then not be affected much because freight rate risk is hedged.

Currency risk:

In this case, Matson chooses to receive every payment from foreign clients in its domestic currency, the US dollar. Through this policy, Matson avoids the risk that the exchange rate of the US dollar against other currencies may move in its favor. In another word, it avoids currency risks. But as shipping companies al-ways get involved in international services, if a company, unlike Matson, chooses to accept foreign currencies, and it provides services on credit, which means it will receive payments in the future, then it will need to prepare itself against currency risk, because exchange rates in a few months are impossible to predict. There are several hedging tools for this situation, namely currency swaps, currency futures, and currency forwards.

A simple example of hedging currency risk will be exhibited below using currency forwards (Table 3).

If today, a British shipping company enters into a contract with its customer to offer shipping service and will be paid in US dollars for $X(1 + d2%) in 1 year. Although the current exchange rate is known for certain as the spot rate, the rate in one year cannot be predicted.

The suggestion for the company is to hedge in the following method:

Today:

Step 1: borrow now $X from the bank at d2%
Step 2: exchange $X for £X/a GBP
Step 3: invest £X/a at p1%.

1 year Later:

Step 4: receive $X(1 + d2%) from customer
Step 5: return $X with interest, total $X(1 + c%) to bank
Step 6: receive £X/a(1 + p1%) from investment.

In this way, what the company has in hand at the end is always its domestic currency, GBP. Foreign exchange risk is solved.

4 Conclusion

The shipping industry has long been dependent on the supply chain. The demand–supply relationship of oil will affect oil prices and therefore influence obtaining of shipping fuels. Whilst orders and supplies of various commodities will decide the business of shipping industries.

In the specific condition of the year 2021, international trade was still crushed severely by the COVID-19 pandemic. Matson made its way through by utilizing several hedging methods, to guarantee adequate (e.g. enough shipping fuels) to satisfy required services, and to maintain a stable income from freight.

Learning from the experience, shipping companies might be able to get over cur-rent situations caused by the Russian-Ukraine relation. Focuses on attention are basically the same except that they are more significant now. A number of sup-plies from Russia are blocked, causing a cut down of routes, a shrink of total supplies, and consequently an increase in commodity prices, including oil price, and steep changes in freight rate. By entering into hedging contracts in advance, the company can reduce its loss from these uncertainties. But one thing to notice is that currency futures regarding Russian rubles need to be considered separately because for now there is low liquidity in ruble futures. In addition, diversification in derivatives can also be considered, for instance, longing futures with different maturities and strike prices. For companies running a national business at the same time, like Matson, they may as well rebalance their operations overseas and at home, to put more stress on domestic operations, for the time being, to avoid impacts from international trade.

References

Adland R, Jia H, Koekebakker S (2004) The pricing of forward ship value agreements and the unbiasedness of implied forward prices in the second-hand market for ships. Marit Econ Logist 6(2):109–121

Adland R, Ameln H, Børnes E (2019) Hedging ship price risk using freight derivatives in the drybulk market. J Shipping Trade 5(1)

Alizadeh AH, Kappou K, Tsouknidis D, Visvikis I (2015) Liquidity effects and FFA re-turns in the international shipping derivatives market. Transp Res E 76:58–75

Alizadeh A, Nomikos N (2009) Shipping derivatives and risk management. Palgrave Macmillan, Basingstoke

Baltic Exchange Consumer (2022) Freight derivatives. Available at: https://www.balticexchange.com/en/data-services/freight-derivatives-.html

Clarksons (2022) Clarksons Platou futures | Clarksons. Available at: https://www.clarksons.com/services/broking/clarksons-platou-futures/

MATSON (2021) Matson annual report 2021. Available at: https://www.matson.com/corporate/about_us/index.html
Pelagidis T, Panagiotopoulos G (2019) Forward Freight Agreements and Market Transparency in the Capesize Sector. Asian J Shipping Logistics 35(3):154–162
Stopford M (2008) Maritime economics 3e, 3rd edn. Routledge. https://doi.org/10.4324/9780203891742
Talley W (2012) The Blackwell companion to maritime economics. Wiley-Blackwell, Chichester, England

A Survey of Research on the Effect of Corporate Investment Opportunities on Capital Structure

Shengbo Zhang, Zitong Zhao, and Yujuan Zhang

Abstract Capital structure is an important basis for a company to increase its value and improve its business conditions. Investment also plays an extremely important role in the development of a firm, so it is important to understand the impact of investment opportunities on capital structure. This paper summarizes a large body of literature using the literature review method to explain how firms determine their own capital structure based on investment opportunities, what influences the choice of a firm's capital structure, and summarizes the impact of a firm's investment opportunities on its capital structure. In the extensive literature studied, it is found that corporate investment opportunities are negatively related to capital structure; investment behavior is influenced by both debt and financing, and capital structure is an important component of corporate finance, which is related to both the way a firm is financed and its cash flow.

Keywords Capital structure · Investment opportunities · Corporate leverage ratio

1 Introduction

This paper focuses on how investment opportunities affect a firm's capital structure. The article is relevant because investment is an important way for companies to make profits, and a higher number of investment behaviours means that companies have a greater chance of making profits, and some studies have shown that capital investment has become one of the main drivers of company growth. At the same time, it is

S. Zhang (✉)
School of Management, South-Central Minzu University, Wuhan 430074, China
e-mail: b285924820@163.com

Z. Zhao
Lee Shau Kee School of Business and Management, Hong Kong Metropolitan University, Hong Kong 999077, China

Y. Zhang
Chengdu Foreign Language School, Chengdu 610031, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_99

essential for corporate macroeconomic policy makers to understand the investment behaviour of companies, and studying the impact of the investment behaviour of listed companies on their capital structure can provide valuable information for corporate economic policy makers. In addition, the business activities of enterprises must be based on a certain amount of capital; and an important way for enterprises to obtain capital is that they need to seize good investment opportunities and make good investments in order to obtain capital. Therefore, after analyzing a large number of articles discussing capital structure, found that the influence between investment opportunities and capital structure is mutual; good or bad investment opportunities may directly affect the development of capital structure, and if one can find the right capital structure of a company, one can only find the right investment opportunities.

Additionally, several important issues were raised by us as follows. Firstly, want to explore how a company decides its capital structure based on the company's investment opportunities. Secondly, want to know what influences the choice of capital structure of a firm. For example, whether some peer-to-peer competition affects the firm's choice; then some of the effects on financial variables, which included market share, and profitability are selected. Finally, a firm should determine its leverage in its operations, depending on the type of industry it operates in and its own size, as different industries have different credit risks and financial flexibility, and so how a firm would choose when faced with these issues.

At the time of writing, the following three key standard definitions have been cited to inform the literature. The first select papers that are relevant to the content of our dissertation and that do not detract from the topic. Any papers that strongly highlight, illustrate, and enhance the topic will be included in the list of papers we cite, otherwise, they will be discarded, which is a basic principle in the choice of references. Secondly, the collected literature may be similar or consistent, and there are differences in the scientific and credibility of some of the literature, as a result, more attention will be paid to literature that is authoritative, scientific and credible. Furthermore, the level of references cited when writing a thesis reflects to a certain extent the author's grasp of the subject and the academic level of the thesis; therefore, when reading the thesis, more consideration will be given to prioritizing literature from refereed journals. Finally, when choosing literature, consider the timeliness and choose newer references that reflect the dynamics of the industry that have been updated and progressed in recent years, which to a certain extent reflects the advanced nature of the thesis and reflects the best state of the research as well as the academic level.

2 Theory Summary

Capital structure and investment theory have developed a mature theoretical system in today's society, and different companies have their own corporate capital structure. In recent years, scholars have done a lot of research on capital structure and investment

opportunities, both in terms of theory and capital structure. For examples, MM theory, trade-off theory, pecking order theory and so on.

In today's society, there has been a relatively mature theoretical system of capital structure and investment theory. Modigliani and Miller put forward the proposition that capital structure has nothing to do with enterprise investment on the premise of complete capital market (Modigliani and Miller 1958). However, there are many reasons to believe that there is no separation of enterprise investment and financing elements in the real economy, which can be understood according to relevant knowledge of tax shield. MM theory is such a perfect hypothesis that many of the assumptions about it don't exist in real life, so it evolved into today's tradeoff theory (Myers and Majluf 1984). The tradeoff theory also mentioned the knowledge related to tax shield. David Flath and Charles R. Knoeber proposed that tax and failure cost mean the existence of optimal capital structure (Flath and Knoeber 1980). Capital structure includes stock issuance, bond issuance, bank loans, shareholder financing, etc. Different enterprises have their own different corporate capital structure, capital structure refers to the composition and proportion of enterprise capital, specifically refers to the proportion of enterprise equity capital and borrowed capital, also known as financing structure or financial leverage.

Good capital structure refers to the specific conditions of the company to achieve maximum value of capital structure, it can make the company's financial leverage interests, financial risk, the cost of capital, such as the value of the company to achieve the optimal equilibrium among various factors, therefore, the capital structure decision directly affects the development of enterprise, and influencing factors of capital structure has long been a research hot spot, Therefore, many capital structure theories have been formed, such as MM theory, trade-off theory, pecking order theory and so on.

The development of an enterprise needs a lot of funds, which cannot all come from the enterprise itself. Enterprises need to raise funds for development through financing. Enterprise financing, also known as financing, refers to the need of enterprises according to their own production and operation, foreign investment, capital structure adjustment, through a variety of ways to raise funds needed for their own development. Usually according to the different sources of capital financing will be divided into internal financing and external financing. Praveen Kumar and Vijay Yerramilli analyse the joint optimisation of financial leverage and irreversible capacity investments, including a range of possible costs such as recapitalisation and fixed operating costs, debt tax barriers, and heavy bankruptcy costs (Kumar and Yerramilli 2018). In the real market, information asymmetry is inevitable. Enterprises may prefer internal financing, while relying on external financing may inhibit their investment intentions, which is also the main idea of pecking order theory. According to pecking order theory, the financing procedure of enterprises is usually: internal financing → debt financing → equity financing. Enterprises choose different financing channels and financing methods, will form different capital structure. Therefore, the capital structure is the result of the choice of financing methods of enterprises, and the capital structure can reflect the financing methods of enterprises.

Various theories have studied the influencing factors of the capital structure from different angles. In a comprehensive view, the main factors affecting the capital structure of enterprises include macroeconomic factors, industry nature, enterprise asset structure, enterprise profitability, tax burden rate, investment opportunities and so on. There are many factors affecting the capital structure of enterprises, and different financing methods will form different capital structures. Whether the capital structure is optimal is not a unified standard, mainly depends on the enterprise's own risk and return comparison. Enterprises with good economic benefits, fast capital turnover, debt paying ability and strong profitability can have a wide range of debt levels and ratios. To optimize their own capital structure, enterprises should start from updating their market concepts and behaviors. Specifically, it is necessary to enhance the enterprise's risk awareness, management awareness, and learn from successful experience. On this basis, according to the actual situation of the enterprise, the enterprise should make a comprehensive analysis of its own macroeconomic environment and its own actual situation, choose suitable financing methods, and then form its own capital structure. At the same time, the external environment and the enterprise's own situation are constantly changing, enterprises should timely change the financing mode according to this change and optimize their capital structure.

The investment opportunities owned by a company refer to the investment opportunities that can generate more cash flow in the future, which is where the value of a company lies and an important factor affecting the capital structure of a company. Myers divides assets into existing assets and investment opportunities. For enterprises, existing assets are physical assets, while future opportunities have no physical form (Myers 1977). The realization of opportunities is uncertain, so the collateral value is lower than existing assets. According to agency cost theory, the low guarantee value of investment opportunity will lead to the contradiction between enterprises and creditors. First of all, enterprises with high growth may overinvest in high-risk projects, which will damage the interests of creditors. In order to protect their own interests, creditors often strictly restrict enterprises to invest in high-risk projects in debt contracts. This kind of restriction conflicts with the goal of enterprises with high growth opportunities, and makes some reasonable venture capital not satisfied, thus resulting in under-investment agency cost. Therefore, from their own interests, the management of enterprises with high growth opportunities hope to reduce the current debt level and the agency cost of underinvestment. Sudipto Dasgupta and Kunal Sengupta argue that firms should not increase their debt borrowing too much and should finance themselves more by increasing the number of shareholders and reducing the risk they take (Sengupta and Dasgupta 2002). From the perspective of refinancing flexibility, the current financing behavior of enterprises will affect their future financing choices, and the future investment opportunities of enterprises will affect the current financing decisions of enterprises. If you choose equity financing now, you will have the flexibility of refinancing. In the future, you can choose either equity financing or debt financing. If you choose debt financing now, it will virtually increase the financial risk of the enterprise, and it will be difficult to choose debt financing when you need to refinance in the future. Therefore, if the enterprise has

more growth opportunities in the future, the current financing is more inclined to equity financing.

3 Empirical Literature Summary

Due to the theoretical controversy, some scholars have turned to an empirical approach to explore the relationship between capital structure and corporate investment. A number of important papers were included in the survey, explaining issues such as "how to determine the basic structure of a company based on its investment opportunities", "the relationship between investment and the capital structure of a company", and "how a company should determine its leverage in its operations, depending on the type of industry and its size".

3.1 Hypotheses Tested

The results of the survey suggest that "investment opportunities are negatively related to capital structure" is the most frequently tested hypothesis, meaning that companies with more investment opportunities are generally less leveraged.

Mills, Morling and Tease examine the relationship between investment decisions and capital structure and financial factors in Australian firms (Mills et al. 1995). The results found that capital structure, internally generated cash flows and asset liquidity all play a very important role in firms' investment behaviour, particularly for small firms, highly leveraged firms and firms with high retained earnings. Overall, debt has a negative effect on a firm's investment. Liabilities of highly leveraged companies have a negative effect on investment, liabilities of low leveraged companies have no effect on investment liabilities of large companies have a negative effect on business investment, liabilities of small companies have no effect on business investment liabilities of high retained earnings companies have a negative effect on business investment, liabilities of low retained earnings companies have no effect on business investment. Lang, Ofek and Stulz find that a firm's capital structure is significantly and negatively related to a firm's investment, and that the coefficient b on the variable obtained by regressing the data is negative and has a large value, meaning that leverage reduces future investment (Lang et al. 1996). Maksimovic and Demirgüç-Kunt's empirical evidence find that investment in fixed assets is negatively related to financing and investment in short-term assets is positively related to external financing (Maksimovic and Demirgüç-Kunt 1996). Kovenock and Phillips examine the impact of changes in firm indebtedness in ten industries on firms' going concern and investment opportunities (Kovenock and Phillips 1997). It was found that high indebtedness and firm closure were significantly and positively correlated when the variables of indebtedness and market concentration were included. The significance of this interaction emphasises the importance of considering market structure when

explaining the role of changes in capital structure. Few competitors close when leveraged firms have a high market share. In highly concentrated industries, high leverage and investment opportunities are negatively correlated. Denis, D. J. and Denis, D. K. find that as leverage rises, investment costs decrease significantly (Denis and Denis 1993). Peyer and Shivdasani argue that with the use of leverage to recapitalise, firms allocate more capital to business units that generate more cash flow, increasing their investment opportunities (Peyer and Shivdasani 2001). Lupi, Myint and Tsomocos find that leverage inhibits the ability of firms to identify investment opportunities. The above results suggest that the hypothesis is generally accepted (Lupi et al. 2017).

In addition, the results show that many scholars have studied cash flow as a factor in investment and capital structure, as they have found that cash flow affects the target rate of capital structure adjustment and is an important factor in investment. This survey shows that "the ability of firms to invest is positively related to the stability of cash flow" is also one of the frequently tested hypotheses.

Fazzari, Hubbard and Petersen empirically examine the relationship between corporate investment and internal cash flow by estimating the degree of "financing constraints" of firms based on the level of dividend payments (Fazzari et al. 1987). It is found that investment is more positively correlated with internal cash flow for firms with low dividend payments. However, the use of dividend payments as an estimate of the degree of financing constraint has been questioned by some academics. Kaplan and Zingales classify the degree of financing constraints of firms in other ways (Kaplan and Zingales 1997). The results find that firms with less financing constraints have greater investment and cash flow sensitivity than firms with a high degree of financing constraints. In a study of 693 UK firms, Carpenter and Guariglia found that a great deal of valid information about investment opportunities resides in cash flow, which is a determinant of investment (Carpenter and Guariglia 2008). The results of Lewellen, J. and Lewellen, K. suggest that investment and cash flow are closely linked after controlling for the investment opportunities of the firm, especially for those firms that are most likely to need external funding (Lewellen and Lewellen 2016). The above results suggest that the hypothesis is also generally accepted.

3.2 Empirical Tests

In studying the impact of corporate investment opportunities on capital structure, different scholars have utilised different methods for empirical testing, either building new models of their own, or innovating and altering models built by their predecessors to a certain extent, or directly using some classical models for their own data.

In examining the hypothesis that "corporate investment opportunities are negatively related to capital structure", Mills, Morling and Tease conducted a cross-sectional regression analysis of financial factors and corporate investment under high and low leverage to examine the effects of debt, internally generated cash flows and asset liquidity on corporate investment under different capital structures (Mills et al. 1995). Lang, Ofek and Stulz developed an investment equation to investigate the

relationship between investment and capital structure using a general least squares regression (Lang et al. 1996). Kovenock and Phillips decompose the 7-digit SIC code product level usage data and use time series data for each product to conduct regression analysis to examine the relationship between investment, debt and business closure. Peyer and Shivdasani investigate the sensitivity of investment by modelling firm sales revenue, firm capital structure, and firm capital expenditure (Peyer and Shivdasani 2001). Lupi, Myint and Tsomocos optimise the WACC to include variables such as investment size and expected economic profit to propose a framework for determining the optimal leverage ratio, which uses financial variables for firms in a given industry to show how a firm's leverage ratio affects a firm's investment and to investigate how to maximise the value of the firm (Lupi et al. 2017). Chabachib and Hersugondo conducted a multiple linear regression analysis with debt-to-equity ratio as the dependent variable and investment opportunities and firm size as independent variables, and a Sobel Test to test the effect of capital structure as a mediator between investment opportunities and firm value (Chabachib et al. 2020).

In examining the hypothesis that "a firm's ability to invest is positively related to the stability of its cash flows", Fazzari, Hubbard and Petersen develop a model based on Tobin's q theory to measure the financing mechanisms of different firms and compare the effect of investment on cash flows. Carpenter and Guariglia build a regression model using investment, equity replacement value, Tobin's q, and cash flow. Lewellen, J. and Lewellen, K. runs cross-sectional regressions on data from 1971 to 2009 for selected Compustat companies and analyses and tests the standard errors of slope-based time series rates of change.

3.3 Variables

In the literature we surveyed, the definitions of the various variables are essentially the same in most of the articles, since they all study investment opportunities and capital structure. However, there are also some scholars who conduct their studies using different definitions of the variables: in the article by Lupi, Myint and Tsomocos, the definition of the investment variables is different: they assume that the investments are financed with existing funds, free funds generated by the firm or debt, and are not issued by shares.

Also, they introduce some new variables: competition for investment, and return on invested capital (ROIC). Also, Lewellen, J. and Lewellen, K. define cash flow differently from other scholars, using Lehn and Poulsen's measure of undistributed cash flow. This variable is defined as operating income less taxes, interest payments, dividends on preferred shares and dividends on common shares. It therefore measures the after-tax cash flow undistributed to security holders. They measure each company's undistributed cash flow based on its total assets. This measure provides a direct estimate of the extent to which discretionary cash flows are reduced in the period following the recapitalisation.

4 Discussion

A large number of papers related to investment and capital structure are within the scope of our survey, and the results show that many scholars have produced a number of research results in this area using various theoretical studies and empirical tests to either prove or question the relationship between investment opportunities and capital structure. This section provides a further discussion and summary of some of the classic and important papers that fit the theme of this paper. This section also provides an overview of some other papers in the scope of the study.

Lang, Ofek and Stulz use a sample of large industrial firms (with annual sales revenues of $1 billion or more) in the United States and the study period is 1970 to 1989. Regressions were run by creating investment equations with ordinary least squares. They found that firms' investment opportunities were significantly and negatively correlated with their capital structure. Further research found that this negative correlation was only present in firms with low growth opportunities, while it was not present in firms with high growth opportunities. This implies that for firms with perceived good investment opportunities, it is easier for firms to obtain the necessary capital for investment and leverage does not reduce future investment, while firms that lack good growth opportunities or are not perceived to have good growth opportunities and are highly indebted will not be able to obtain external capital for investment.

Maksimovic and Demirgüç-Kunt compare the relationship between financing and investment of firms in different countries. Firms in 30 countries (both developed and developing, but excluding China) are used as a sample. Maksimovic and Demirgüç-Kunt empirically find that: investment in fixed assets is positively related to retained earnings; investment in fixed assets is negatively related to external financing; investment in short-term assets is negatively related to retained earnings; and investment in short-term assets is positively related to external financing. Maksimovic and Demirgüç-Kunt argue that external financing is not a firm's long-term investment, but rather a source of funding for liquid assets, short-term assets. This pattern of financing is present in firms in almost all countries in the sample, both developed and developing. This suggests that conflicts of interest between lenders and borrowers increase when external finance is used to invest in long-term assets. Across the sample countries with different financial systems, financial markets and financial intermediaries have an advantage in financing short-term investments by firms. Its policy implication is that measures to provide direct funding for long-term investment may not be fully successful if governments rely on standard financial covenants and standard methods of implementation. Second, to the extent that conflicts of interest between lenders and borrowers prevent effective contracting between the two parties, government lending this necessitates a reconsideration of the implications of government policies that affect the return on long-term investment by enterprises. For example, subsidising an ineffective business with subsidies may reduce the earnings of effective competitors, causing them difficulties in raising finance.

Bond, Elston, Mairesse and Mulkay provide a comparative analysis of the relationship between financial factors and investment in manufacturing firms in Belgium, France, Germany and the UK (Bond et al. 2003). It is found that the sensitivity of firms' investment to financial variables appears to be statistically and quantitatively more effective and stronger in the UK than in France, Germany and Belgium. This difference cannot be attributed to the different distribution of firm sizes or to the characteristics of the financial data available for UK firms. Investment by UK firms is more constrained by the availability of internal funds than by firms in continental Europe. This finding is consistent with the observation that the UK market-oriented financial system performs worse than the continental European system in providing access to finance for good corporate investment opportunities.

Ogawa studied the impact of indebtedness on corporate R&D activities in a sample of R&D-intensive manufacturing firms in Japan (Ogawa 2007). It was found that, while debt had a weak effect on firms' investment in R&D in the late 1980s, the accumulation of large amounts of debt in the late 1990s had a significant impact on firms' internal cash flows, thus causing a significant disruption or even loss of most of their investment opportunities, and thus having a negative effect on firms' investment in R&D. At the same time, in the late 1990s, firms' R&D investment was closely related to their total productivity growth: in the late 1980s, the relationship was even weaker. This implies that a large amount of debt was partly responsible for the decline in productivity of Japanese firms in the late 1990s.

Suto uses an agency theory approach to examine the relationship between capital structure and investment in Malaysian listed companies before and after the 1997 financial crisis (Suto 2003). Based on 375 non-financial firms from 1995 to 1999, Suto used panel data to develop an investment equation. It was found that there was a significant positive relationship between capital structure and the growth of fixed assets from 1995 to 1996. She argues that bank-dependent firms, encouraged by the government, increased their indebtedness prior to the crisis, and that the increased indebtedness accelerated overinvestment by firms. This may be due to the overestimation of the capacity of Malaysian banks to supervise firms, or to the fact that the supervisory capacity of banks is poorly assessed given the state's protection of the banking sector. These weakened the role of lenders in corporate governance and worsened the plight of Malaysian firms during the financial crisis.

Ahn, Denis, D. J. and Denis, D. K. examine the role of capital structure on investment opportunities for diversified firms in the US (Ahn et al. 2006). The sample is selected from firms with at least two different business operating divisions on a 3-digit SIC code and the period is 1982–1997. Diversified firms are more highly leveraged than the reference group. Within diversified firms, firms with fewer investment opportunities are more highly leveraged. However, the impact of capital structure on investment opportunities is more significantly larger in sectors with high growth opportunities than in sectors with low growth opportunities. The impact of capital structure on investment opportunities is more significantly stronger in non-core sectors compared to core sectors. This implies that diversified firms assign a disproportionate debt burden to the high-growth opportunity sectors and the non-core

sectors. The conclusion is that the punitive effect of debt is partially offset by the additional managerial dominance of diversified firms.

Some scholars have also considered the impact of firm size on the relationship between investment and financing. Research on this issue has mainly emerged since the 1990s, with some scholars dividing their samples according to different computational expressions of firm size. For example, Devereux and Schiantarelli measure firm size based on the true value of the capital stock and divide a sample of UK firms (Devereux et al. 1990), and Athey and Laumas measure firm size based on the book value of equity capital and divide a sample of Indian firms (Athey and Laumas 1994). Their study shows that the sensitivity of investment to internal cash flows is lower for large scale firms relative to small scale firms. Kadapakkam, Kumar and Riddick empirically tested the relationship between firm size, investment and internal cash flow by measuring firm size in terms of firm market capitalisation, total assets and sales for listed firms in six OECD countries (Canada, France, Germany, UK, Japan and US) and dividing the sample into large, medium and small (Kadapakkam et al. 1998). The results found significant differences in the relationship between investment and internal cash flow among companies of different sizes, with larger companies being more sensitive to internal cash flow than smaller companies. Lupi, Myint and Tsomocos find through an empirical test that either too much or too little leverage of a firm directly affects the amount of investment opportunities of the firm. Chabachib and Hersugondo find through a cross-sectional multiple regression that investment opportunities of a firm are positively related to the determinants of capital structure.

In conclusion, most of the findings of scholars in the scope of our investigation are biased towards investment opportunities being negatively related to capital structure, but Suto in his study of listed companies in Malaysia found that an increase in leverage accelerates firms' investment as the government gives them more investment opportunities, thus leading Malaysian firms to over-invest and worsen their distress.

5 Conclusion

The main conclusions drawn from the survey of the extensive empirical research literature are: after a firm lacks certain investment opportunities, it becomes more difficult to obtain funds for investment, making the firm's investment activities less flexible and raising the firm's leverage; at the same time, by stabilizing the firm's cash flow, it enhances the firm's ability to access investment opportunities in the industry; finally, it's found that the less invested a firm is, the higher the firm's leverage generally is.

In addition, find that the relationship between corporate investment opportunities and capital structure has been controversial among scholars. In the early models of investment theory, corporate investment and capital structure were unrelated. With the gradual advancement of theoretical research, it has been recognised that investment opportunities and financing factors are inseparable. Firms with high levels

of debt are prone to underinvestment due to the suspending effect of debt and the fact that debt reduces a firm's 'free cash flow'. As capital markets are imperfect, there is a transaction cost associated with exogenous financing compared to endogenous financing. The more severe the financing constraint, the greater the transaction costs. Firms with financing constraints are therefore more prone to underinvestment. Recent theoretical research has looked at the relationship between capital structure and corporate investment from the perspective of product market competition. This is because capital structure affects not only the investment behaviour of firms themselves but also the investment decisions of their competitors. Moreover, given that the impact of capital structure on firm investment is related to firm characteristics, the relationship between the two may not be perfectly consistent across firms. For example, for firms with good investment opportunities, the effect of capital structure on investment will probably be very small. Conversely, for firms that lack good investment opportunities, capital structure may have a negative effect on firm investment. The cost of capital for these firms rises as the capital structure increases, as it is not clear to external funders whether the funds can be used effectively compared to firms with good investment opportunities. Another possibility is that indebtedness may have an impact on investment in all firms due to liquidity constraints.

Different economists have analyzed and studied capital structure differently from ancient times to the present, and based on the complexity of capital structure, no scholar has actually proposed what the optimal capital structure of a company is. So, why should companies pay attention to the capital structure? Capital structure is always related to investment opportunities. The capital structure originally refers to the composition of long-term capital of a company, which directly affects investment behaviour, and investment opportunities also change according to the good or bad capital structure. Capital structure is the result of a long-term decision, and dynamic research makes the study more representative and feasible. Since the factors to be considered for investment are constantly changing due to continuous development, we should do long-term empirical research by combining the influencing factors of future investment and analyzing the data of consecutive years in order to come up with a further relationship between investment opportunities and capital structure.

References

Ahn S, Denis DJ, Denis DK (2006) Leverage and investment in diversified firms. J Financ Econ 79(2):317–337

Athey MJ, Laumas PS (1994) Internal funds and corporate investment in India. J Dev Econ 45(2):287–303

Bond S, Elston JA, Mairesse J, Mulkay B (2003) Financial factors and investment in Belgium, France, Germany, and the United Kingdom: a comparison using company panel data. Rev Econ Stat 85(1):153–165

Carpenter RE, Guariglia A (2008) Cash flow, investment, and investment opportunities: new tests using UK panel data. J Bank Finance 32(9):1894–1906

Chabachib M, Hersugondo H, Septiviardi D, Pamungkas ID (2020) The effect of investment opportunity set and company growth on firm value: capital structure as an intervening variable. Int J Innov Creativity Change 12(11):139–156
Denis DJ, Denis DK (1993) Managerial discretion, organizational structure, and corporate performance: a study of leveraged recapitalizations. J Account Econ 16(1–3):209–236
Devereux M, Schiantarelli F (1990) Investment, financial factors, and cash flow: evidence from UK panel data. In: Glenn HB (ed) Asymmetric information, corporate finance, and investment. University of Chicago Press, Chicago, pp 279–306
Fazzari S, Hubbard RG, Petersen BC (1987) Financing constraints and corporate investment
Flath D, Knoeber CR (1980) Taxes, failure costs, and optimal industry capital structure: an empirical test. J Financ 35(1):99–117
Kadapakkam PR, Kumar PC, Riddick LA (1998) The impact of cash flows and firm size on investment: the international evidence. J Bank Finance 22(3):293–320
Kaplan SN, Zingales L (1997) Do investment-cash flow sensitivities provide useful measures of financing constraints? Q J Econ 112(1):169–215
Kovenock D, Phillips GM (1997) Capital structure and product market behavior: an examination of plant exit and investment decisions. Rev Financ Stud 10(3):767–803
Kumar P, Yerramilli V (2018) Optimal capital structure and investment with real options and endogenous debt costs. Rev Financ Stud 31(9):3452–3490
Lang L, Ofek E, Stulz R (1996) Leverage, investment, and firm growth. J Financ Econ 40(1):3–29
Lewellen J, Lewellen K (2016) Investment and cash flow: new evidence. J Financ Quant Anal 51(4):1135–1164
Lupi A, Myint S, Tsomocos DP (2017) How investment opportunities impact optimal capital structure. Saïd Business School WP 6
Maksimovic V, Demirgüç-Kunt A (1996) Financial constraints, uses of funds and firm growth: an international comparison
Mills K, Morling S, Tease W (1995) The influence of financial factors on corporate investment. Aust Econ Rev 28(2):50–64
Modigliani F, Miller MH (1958) The cost of capital, corporation finance and the theory of investment. Am Econ Rev 48(3):261–297
Myers SC (1977) Determinants of corporate borrowing. J Financ Econ 5(2):147–175
Myers SC, Majluf NS (1984) Corporate financing and investment decisions when firms have information that investors do not have. J Financ Econ 13(2):187–221
Ogawa K (2007) Debt, R&D investment and technological progress: a panel study of Japanese manufacturing firms' behavior during the 1990s. J Jpn Int Econ 21(4):403–423
Peyer UC, Shivdasani A (2001) Leverage and internal capital markets: evidence from leveraged recapitalizations. J Financ Econ 59(3):477–515
Sengupta K, Dasgupta S (2002) Financial constraints, investment and capital structure: implications from a multi-period model
Suto M (2003) Capital structure and investment behaviour of Malaysian firms in the 1990s: a study of corporate governance before the crisis. Corp Gov Int Rev 11(1):25–39

Spatial Distribution of COVID-19 and Its Influential Factors in the City of Philadelphia

Yilin Lyu and Zicheng Zhao

Abstract COVID-19 has been a significant public health event threatening human life across the world for the past two years. Despite the invention and widespread use of vaccines, new variants such as Delta and Omicron continue to emerge, and the epidemic is still going on. This study was to explore the spatial distribution of COVID-19 positive cases and their potential influential factors in the City of Philadelphia. We visualized the change of COVID spatial patterns from June 4, 2020, to November 30, 2021, and constructed Geographically Weighted Regression (GWR) models to identify factors that were associated with the distribution. Our results indicated that there was significant spatial clustering of COVID cases in Philadelphia, with the north-central region consistently being the most severe area. The GWR model identified that health insurance and work travel time were two significant influential factors of COVID cases distribution in the city. The area with a higher population of people who have no health insurance or whose travel time to work is more than an hour has a higher number of positive cases. Targeted prevention strategies should pay attention to the vulnerable people and vary in different regions.

Keywords COVID-19 · Economics · GIS · Spatial analysis

1 Introduction

Since December 2019, COVID-19 has spread to every country throughout the world and has become an influential global health event in the twenty-first century. In the past two years, due to differences in the speed, scale, and intensity of disease intervention measures in different regions and countries, asynchronous epidemic waves have superimposed on each other, forming a steadily escalating epidemic trend

Y. Lyu (✉)
Temple University, 1801 N Broad St, Philadelphia, PA 19122, USA
e-mail: yilinlyu9902@gmail.com

Z. Zhao
University of Pennsylvania, 3451 Walnut Street, Philadelphia, PA 19104, USA

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_100

on a global scale (Wei et al. 2021). As of the beginning of October 2021, according to the New York Times, the total cases of COVID-19 worldwide have reached 244 million, of which about 4.95 million people have died. The United States is one of the countries most affected by COVID-19. Based on the estimation by the Centers for Disease Control and Prevention (CDC), the actual number of people infected in the United States may be as much as one-third of the country.

Although COVID-19 is generally known as highly contagious and has a very fast spreading speed, its temporal and spatial distribution in different regions differ. CDC indicated that where we live, and our lifestyle have a huge impact on our health quality and life expectancy (Centers for Disease Control and Prevention 2018). The pattern of disease transmission in each city or area depends on a variety of social and environmental factors (Grekousis et al. 2021). Some studies have summarized the patterns of COVID-19 and investigated possible factors that may accelerate its transmission (Kumar et al. 2015; Sarmadi et al. 2020). Also, previous studies have identified an increased risk of COVID-19 infection associated with many pre-existing diseases, including hypertension, chronic kidney disease, cardiovascular disease, etc. (Venkatakrishnan et al. 2021). However, most studies have tended to focus on health-related factors and the overall distribution trends. There are still relatively few research articles that focus on the spatial patterns within a particular city and the most significant influential factors. Hence, this research focuses on the City of Philadelphia and aims to explore the change of COVID-19 spatial distribution over time and concretize its potential influential factors besides pre-existing disease.

2 Data Source and Methods

Philadelphia (Fig. 1) has been selected as the study area, mainly because of its complicated demographic structure and the diversity of immigration and culture. It is one of the oldest cities in the United States, with a total population of more than 1.6 million, of which the African American population accounts for the highest proportion, reaching about 42% (United States Census Bureau 2007). Besides, the city's foreign-born population expanded by 69% between 2000 and 2016, according to Pew Charitable Trusts data (The Pew Charitable Trusts 2018). As the fifth-largest city in the United States, Philadelphia has 190,914 COVID cases as of November 30, 2021 (OpenDataPhilly 2021).

We collected the COVID-19 daily cases published by OpenDataPhilly, from June 4, 2020, to the end of November 2021. Also, 13 potential influential factors from five data categories are collected from the government's open datasets: demographic structure, social indicators, environmental conditions, health and safety, and transportation (Table 1). First, we compiled the cumulative number of COVID cases up to the end of each month based on the daily data divided by zip code unit. We selected five months at an interval of every 12–16 weeks to visualize the change of spatial distribution of COVID-19 positive cases in the past two years by using ArcGIS Pro. Then, Statistical Product and Service Solutions (SPSS) has been used to calculate the

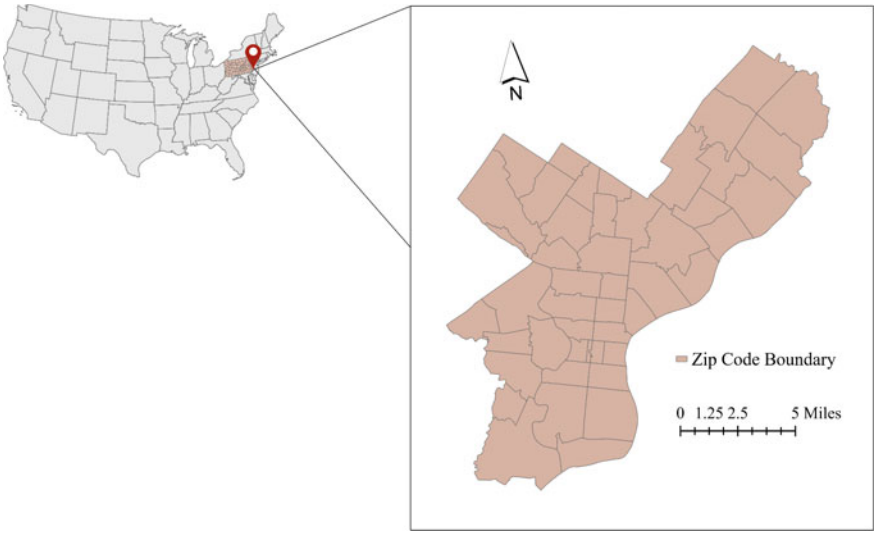


Fig. 1 Philadelphia location map

Pearson correlation coefficient between the cumulative COVID cases of November 30, 2021, with every selected factor. The value of the correlation coefficient varies from -1 to 1. A value of 0 means that the two variables are not correlated. The closer the absolute value is to 1, the stronger the positive or negative correlation between the two variables, and the closer it is to 0, the lower the correlation.

Furthermore, we analyze the spatial autocorrelation of COVID cases in Philadelphia. Spatial autocorrelation is defined as the spatial dependency between a particular attribute of one geographic unit and its surrounding units (Getis 2009). Moran's I, developed by Patrick Alfred Pierce Moran, helps to measure this autocorrelation. The formula is defined as:

$$\text{Moran's } I = \frac{n \sum_{i=1}^{n} \sum_{j=1_{ij}}^{n} (x_i - \bar{x})\left(x_j - \bar{x}\right)}{\left(\sum_{i=1}^{n} \sum_{i=1}^{n} (x_i - \bar{x})^2\right)} \tag{1}$$

On the one hand, global spatial autocorrelation is used to quantify the general clustering tendency in the entire city (Wu 2017). The value of global Moran's I statistic varies between -1 to 1. Moran's I greater than 0 indicates positive autocorrelation of the data distribution, and the distribution will be more concentrated when the value is closer to 1. Conversely, Moran's I smaller than 0 means that the spatial distribution has negative autocorrelation, the distribution will be dispersed when the value is closer to -1. On the other hand, the Local Moran's I index was used as a Local Indicator of Spatial Association (LISA) (Yuan et al. 2018). A positive local Moran's I value indicates spatial clusters, which include both high-high and low-low patterns (Zhang et al. 2008). In this study, a high-high pattern means the zip code area and its neighboring areas have similar high numbers of COVID

Table 1 Data categories and sources

Category	Data	Source
Demographic structure	Old population over 65 years old	United States Census Bureau
	Non-veteran population	National Historical Geographic Information System
	Population of single or never married	National Historical Geographic Information System
Social indicators	Population below federal poverty level	United States Census Bureau
	Population lower than bachelor's degree	United States Census Bureau
Environmental indicators	Tree canopy	OpenDataPhilly
	Litter index	OpenDataPhilly
Health and safety	Population with disability	OpenDataPhilly
	Numbers of weapon violate	OpenDataPhilly
	Population with no health insurance	United States Census Bureau
Transportation	Numbers of crash injury	OpenDataPhilly
	Travel time to work more than an hour	National Historical Geographic Information System
	Population use public transportation	National Historical Geographic Information System

positive cases. A low-low pattern indicates similar low numbers of cases in the area and its surroundings. However, negative local Moran's I value indicates that the area is a potential spatial outlier, including high-low and low–high patterns (Zhang et al. 2008). Both patterns mean the number of COVID cases within the area differs from that of the neighboring areas.

In this study, the dependent variable refers to the cumulative COVID cases by the end of November 2021. As listed in Table 1, we selected 13 potential factors as the exploratory variables. All the variables are divided by the zip code boundaries of Philadelphia, as same as the COVID cases data. Then, we use the Exploratory Regression (ER) tool to evaluate all possible combinations of the 13 explanatory variables (Kauhl et al. 2021). It helps to determine models that have passed the Ordinary Least Squares (OLS) checks with a specified threshold, which refers to an adjusted R-squared > 0.5, Jarque Bera p-value > 0.1, coefficient p-value < 0.05, variance inflation factor (VIF) < 7.5, and spatial autocorrelation p-value < 0.1 (Feng and Tong 2017). Then, we established the passed model from ER to further conduct a global regression model based on OLS, which estimates the strength of the relationship between the dependent variable (cumulative COVID cases) and the explanatory variables (potential factors) averaged over Philadelphia. However, the result of the OLS model with all observations sometimes distorts the local distinctness because the parameter values are not identical at different locations (Leong and Yue 2017). So,

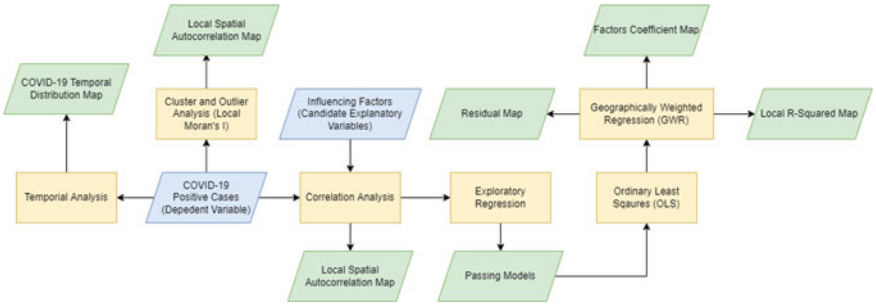


Fig. 2 Methodology flowchart

the final step is to generate a Geographically Weighted Regression (GWR) model. It is an outgrowth of OLS, but it allows the regression coefficients to vary across space (Columbia Public Health 2022) (Fig. 2).

3 Results

Figure 3 shows the change of spatial distribution of COVID-19 positive cases in Philadelphia at specific time intervals over the past two years. We found that the north-central part of Philadelphia has been the most severe area, both at the beginning and at the later stages of the outbreak, followed by the northeast and some of the southern areas. The result of spatial autocorrelation indicated that COVID cases distribution in Philadelphia has a positive spatial autocorrelation (Moran's $I = 0.339$). Additionally, the map of LISA (Fig. 4) shows a significant spatial cluster in the northeast, northwest, and Mideast regions. Combined with the COVID-19 spatial distribution map (Fig. 3), we noted that the north-central and upper northeast areas in Philadelphia have consistently had the highest number of people infected with COVID. And their surrounding areas also show a high number of COVID cases, which further indicates a high-high pattern of spatial clusters. Besides, the northwest (Roxborough and Wyndmoor) and Mideast area (Northern Liberties) show a spatial cluster with low-low patterns, and the lower northeastern area (Bridgesburg) with a low–high pattern is the only spatial outlier in the city.

Next, we calculated the Pearson correlation coefficient (Table 2) based on SPSS, and noticed that educational attainment, travel time to work, disability, health insurance, and marital status are the five factors that most correlated with the COVID-19 cases among the 13 selected factors.

The Exploratory Regression (ER) and Ordinary Least Squares (OLS) helped us to exclude multicollinearity from the 13 potential influential factors and finally identified health insurance status and work travel time as the two significant factors for the COVID-19 positive cases in Philadelphia, with a reasonable adjusted R-squared (0.874), VIF (3.675), and AICc (789.14). Our Geographically Weighted Regression

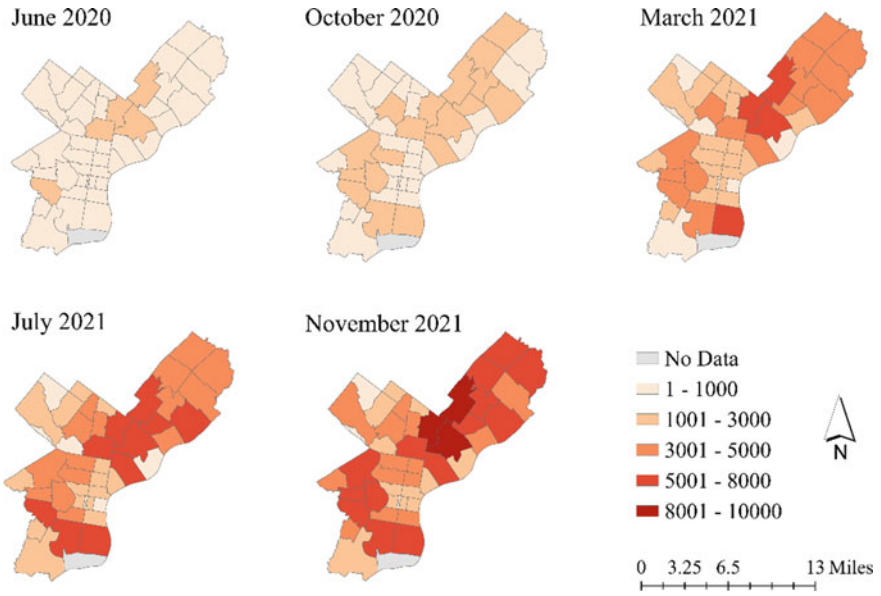


Fig. 3 Change of COVID-19 spatial distribution in Philadelphia

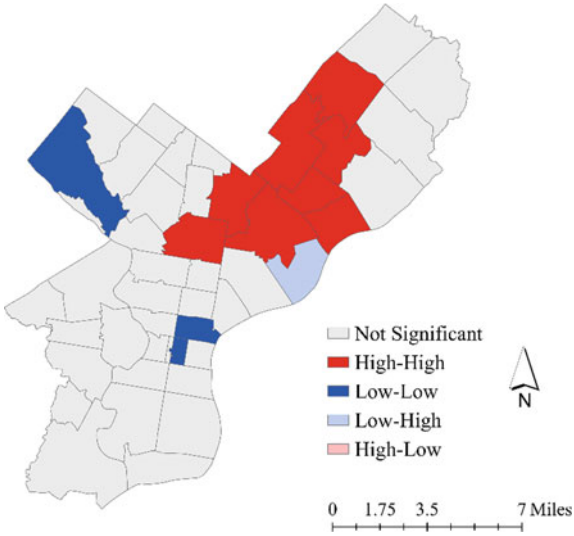


Fig. 4 COVID-19 local spatial autocorrelation

(GWR) model returns a higher adjusted R-squared (0.942) and lower AICc (768.99) compared to the OLS results, which further confirms the influence of these two factors. We have visualized some output of the GWR model, including the distribution of R-squared and residuals (Fig. 5). Our results show that the regression model

Table 2 Correlation coefficient of influencing factors

Influencing factors	Correlation coefficient	Correlation
Age (65 years and over)	0.805**	Very strong correlation
Veteran status	0.834**	Very strong correlation
Marital status	0.851**	Very strong correlation
Poverty status	0.801**	Very strong correlation
Educational attainment	0.963**	Very strong correlation
Tree canopy	−0.137	Very weak correlation
Litter index	0.363*	Weak correlation
Disability	0.899**	Very strong correlation
Weapon violate	0.527**	Moderate correlation
Health insurance	0.895**	Very strong correlation
Crash injury	0.479**	Moderate correlation
Travel time to work	0.910**	Very strong correlation
Transportation to work	0.703**	Strong correlation

* $p < 0.05$; ** $p < 0.01$

fits the observed data very well. 90% of the data fit the model in every zip code area throughout Philadelphia. More specifically, it is better in the Mideast and southern areas. Furthermore, the value of residuals shows a random pattern. This is further evidence that the model we constructed is a valid and decent fit for the data. Then, we also included the coefficient distribution map of two influential factors. In the south region, the increase of COVID cases increased more as the population with no health insurance grew. In the north region, the increase of COVID cases increased more when the number of people who traveled more than one hour to work grew.

4 Discussion

Based on the correlation analysis performed by SPSS, we noticed that most of the 13 factors are correlated with COVID positive cases distribution in Philadelphia.

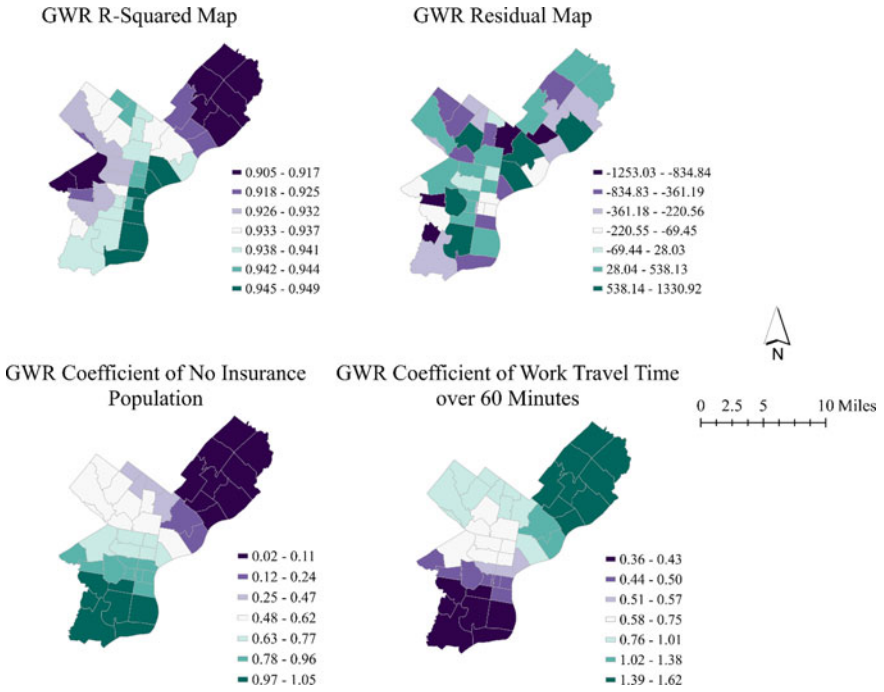


Fig. 5 Geographically weighted regression (GWR) model

Educational attainment, travel time to work, disability, health insurance, and marital status, are the factors that had the highest correlation coefficients. Above all, some early studies have shown that single and unmarried people have higher mortality rates due to various diseases (Drefahl et al. 2020). Marriage can lead to a healthier lifestyle and a lower risk of disease than unmarried people (NewsRX 2020). However, people who are in poor health are less attractive in the partner market and therefore less likely to marry (NewsRX 2020). Results of these studies may be applied to interpret the case of Philadelphia because the coefficient of marital status shows a very strong association with the COVID cases (0.851, $p < 0.01$). Secondly, CDC has noted that some people with disabilities may be more susceptible to COVID-19 infection (Centers for Disease Control and Prevention 2021). The findings of Tisminetzky et al. highlight the high proportion of chronic diseases present in COVID-19 cases, including chronic lung disease, serious heart condition, etc. (Tisminetzky 2021). Venkatakrishnan et al. also demonstrated an association between pre-existing disease and the risk of COVID infection (Venkatakrishnan et al. 2021). More importantly, CDC states that adults with disabilities are three times more likely to develop heart disease, diabetes, cancer, or a stroke than non-disabled adults, which means they face a higher risk of being infected by COVID (Centers for Disease Control and Prevention 2021). This could help to explain the strong correlation between disability and COVID cases (0.899, $p < 0.01$) found in this study.

As a serious respiratory infectious disease, COVID transmits rapidly through a variety of routes such as coughing, sneezing, and the spread of respiratory droplets or aerosols (Lotfi et al. 2020). Therefore, the enclosed spaces in many public transportations increase the risk of infection, especially those groups that spend more time on public transportation every day (Shen et al. 1987). Many pieces of research have indicated a strong correlation between COVID cases and travel by train and airplane (Shen, et al. 1987). In this case, the correlation coefficient of transportation (0.703, $p < 0.01$) and work travel time (0.91, $p < 0.01$) is also significant.

In general, educational attainment, poverty status, and health insurance status are closely related to each other. Educational attainment usually determines income level. Drefahl et al. have noted that the higher mortality rate among people with low education or low income may be largely due to lifestyle issues (Drefahl et al. 2020). Many people with lower education levels or income levels have very limited access to health care resources and even do not have any types of health insurance (Shi 1982). Therefore, they are unable to prioritize their health during the epidemic and will face a higher risk of both infection and death.

Research conducted by the Pew Charitable Trusts mentioned a few neighborhoods in Philadelphia that have undergone some major transformations in recent years, including the gentrification due to the movement of higher-income residents, rising real estate prices, and replacement of old businesses by new ones (The Pew Charitable Trusts 2016). Most of the gentrified areas are in the Mideast area (Northern Liberties) and a few in the northwest Corner (Roxborough and Wyndmoor), which correspond to the spatial clusters with low-low patterns in the LISA Map (Fig. 4) (The Pew Charitable Trusts 2016). However, the median income for the entire city declined by about 10% from 2000 to 2014 (The Pew Charitable Trusts 2016). This is because gentrification occurred in only a few areas, with most areas experiencing significant declines in median household income, including the southwest (Carroll Park), north (Ogontz), and northeast area (Lawncrest, Tacony, Somerton) (The Pew Charitable Trusts 2016). In these areas, more people are exposed to poverty and high health risks. Hence, the areas with declining household incomes correspond to higher numbers of COVID cases, as the high-high spatial clusters show in the LISA map.

5 Conclusion

Generally speaking, under the background that COVID-19 is still prevalent, analyzing the influence of various demographic, health, social, and environmental factors on its spatial distribution can effectively determine the gathering location of vulnerable groups in the city and understand the challenges they are currently facing. Our findings point to a spatial autocorrelation in the distribution of COVID-19 positive cases in Philadelphia, with the most severe areas consistently concentrated in the north-central part of the city.

All the 13 factors selected were correlated with COVID to varying degrees. After reducing multicollinearity by ER and OLS, we finally found that health insurance and

work travel time were two important factors affecting the distribution of COVID cases in Philadelphia. In conclusion, the results of this study not only aim to provide vital information for government and relevant public organizations in terms of resource planning but also hope to provide a chance to effectively prevent the increase in infection and mortality in the future.

References

Centers for Disease Control and Prevention (2021) People with disabilities [Online]. Available: https://www.cdc.gov/ncbddd/humandevelopment/covid-19/people-with-disabilities.html. Accessed 15 Jan 2022

Centers for Disease Control and Prevention (2018) Well-being concepts [Online]. Available: https://www.cdc.gov/hrqol/wellbeing.htm. Accessed 15 Jan 2022

Columbia Public Health. Geographically weighted regression. Population health methods [Online]. Available: https://www.publichealth.columbia.edu/research/population-health-methods/geographically-weighted-regression. Accessed 31 Jan 2022

Drefahl S et al (2020) A population-based Cohort study of socio-demographic risk factors for COVID-19 deaths in Sweden. Nat Commun 11(1):5097–5097

Feng Y, Tong X (2017) Using exploratory regression to identify optimal driving factors for cellular automaton modeling of land use change. Environ Monit Assess 189(10):1–17

Getis A (2021) Spatial autocorrelation. In: Fischer M, Getis A (eds) Handbook of applied spatial analysis. Springer, Berlin [Online]. Available: http://doi.org/10.1007/978-3-642-03647-7_14. Accessed 11 Dec 2021

Grekousis G, Wang R, Liu Y (2021) Mapping the geodemographics of racial, economic, health, and COVID-19 deaths inequalities in the conterminous US. Appl Geogr 135:1–10

Kauhl B et al (2021) The Spatial distribution of Hepatitis C virus infections and associated determinants—an application of a geographically weighted Poisson regression for evidence-based screening interventions in hotspots. PLoS ONE 22(5):966-970.e3

Kumar A et al (2015) Shifting US patterns of COVID-19 mortality by race and ethnicity from June–December 2020. J Am Med Directors Assoc 10(9):e0135656–e0135656

Leong Y-Y, Yue JC (2017) A modification to geographically weighted regression. Int J Health Geogr 16(1):11

Lotfi M, Hamblin MR, Rezaei N (2020) COVID-19: transmission, prevention, and potential therapeutic opportunities. Clin Chim Acta 508:254–266

NewsRX LLC (2020) Risk of dying from COVID-19 greater for men, unmarried and born in low and middle income countries. NewsRx Health, p 93

OpenDataPhilly (2021) COVID tests and cases [Online]. Available: https://www.opendataphilly.org/dataset/covid-cases. Accessed 10 Dec 2021

Sarmadi M, Moghanddam VK, Dickerson AS, Martelletti L (2020) Association of COVID-19 distribution with air quality, sociodemographic factors, and comorbidities: an ecological study of US states. Air Qual Atmos Health 14(4):455–465

Shen J et al (2020) Prevention and control of COVID-19 in Public transportation: experience from China. Environ Pollut 266(Pt 2):115291–115291

Shi L (2001) The convergence of vulnerable characteristics and health insurance in the US. Soc Sci Med 53(4):519–552

Tisminetzky M et al (2021) Multiple chronic conditions, and COVID-19: a literature review. J Gerontol Ser A Biol Sci Med Sci 77(4):872–878

The Pew Charitable Trusts (2018) Philadelphia's immigrants [Online]. Available: https://www.pewtrusts.org/en/research-and-analysis/reports/2018/06/07/philadelphias-immigrants. Accessed 15 Dec 2021

The Pew Charitable Trusts (2016) Philadelphia's changing neighborhoods
United States Census Bureau (2007) QuickFacts: Philadelphia city, Pennsylvania; Houston city, Texas; Los Angeles city, California; New York city, New York [Online]. Available: https://www.census.gov/quickfacts/fact/table/philadelphiacitypennsylvania,houstoncitytexas,losangelescitycalifornia,newyorkcitynewyork/HSD410219. Accessed 29 Sept 2021
Venkatakrishnan AJ et al (2021) Mapping each pre-existing condition's association to short-term and long-term COVID-19 complications. NPJ Digit Med 4(1):117–117
Wei Y et al (2021) Global COVID-19 pandemic waves: limited lessons learned worldwide over the past year. Engineering 1–10
Wu X et al (2017) Spatio-temporal clustering analysis and its determinants of hand, foot and mouth disease in Hunan, China, 2009–2015. BMC Infect Dis 17(1)
Yuan Y, Cave M, Zhang C (2018) Using local Moran's I to identify contamination hotspots of rare earth elements in urban soils of London. Appl Geochem 88(part B):167–178
Zhang C, Luo L, Xu W, Ledwith V (2008) Use of local Moran's I and GIS to identify pollution hotspots of PB in urban soils of Galway, Ireland. Sci Total Environ 398(1–3):212–221

Study on the Characteristics and Strategies of Chinese College Students' Group Tennis Consumption Structure

Haotong Xu

Abstract In the twenty-first century, with the continuously improved living standards and rapid economic development, people are no longer satisfied with their cur-rent material lifestyle. Still, they want to get more mental relaxation and physical pleasure. As a new concept of consumption, sports consumption becomes a brand new concept of consumption that matches the psychological consumption needs of the whole society. With China's continuous and steady economic growth, people's health awareness is also constantly enhanced, and the number of people involved in tennis and tennis consumption is also increasing. As the main group of sports consumers, contemporary college students are the new generation group who like unique and fashionable activities and have an important understanding of physical health. Due to the unique charm of tennis itself and the "tennis fever" in China's universities continuing to heat up, tennis is attracting more and more students to participate in it, promoting the rapid development of tennis consumption and sports-related industries. In this paper, research papers, re-search news, investigation method, and the relevant knowledge of consumer psychology, the theoretical basis of sports marketing, the current situation and structure of tennis consumption among college students in ordinary universities are deeply analyzed, and explore the corresponding conclusions.

Keywords Chinese college students · Tennis consumption structure · Characteristics · Strategies

H. Xu (✉)
Shanghai Hongrun Boyuan School, Shanghai 200000, China
e-mail: xuhaotong@shbs.org.can

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_101

1 Introduction

1.1 Research Background

The public has enjoyed tennis for many points, such as elegance, competition, and entertainment. At the same time, tennis is often called an aristocratic sport because of the scarcity of tennis in China and its high cost. The high cost of learning and the lack of outstanding tennis players have made tennis unpopular in China (Chen 2012). Tennis consumers have always been a minority, and they usually are not very enthusiastic. In 2004, Sun Tiantian and Li Ting won the women's doubles final in the Athens Olympics, a huge breakthrough for Chinese tennis. This gold medal let many Chinese starts to know about this sport. Zheng and Li made Asian history in 2010 when they both reached the semifinals of the Australian Open. And in 2011, Li Na won the French Open, which wrote a new chapter of Chinese tennis. In that year, thousands of newspapers and media began to report this history-making female athlete, and various sponsors came for Li Na. At the same time, students immediately wrote Li Na into their Chinese compositions during the national college entrance examination. Tennis has become more and more popular. Students and many adults have picked up rackets and tried this sport. China has updated and expanded many tennis tournaments such as China open, ATP 1000 Shanghai, and WTA final. These actions gradually expanded the influence of tennis in China. As more and more people began to pay attention to sports and their healthy development, tennis has become a public sport that many people will choose to try and keep practicing.

Since China's reforming and opening up, China's economy has been steadily rising. People begin to consider more about their health problems to enhance their immunity (Chen 2006). At the same time, sport is also a golden opportunity to meet more people who have the same interests. Since the college entrance examination resumption, our country's number of college students has gradually increased. With the rapid promotion and development of tennis and the popularity of various Internet, most universities and schools have tennis courts for everyone to try and learn. College students have the opportunity to walk on the court and swing a racket to experience the charm of tennis, which greatly influences more people to participate in tennis sports. College students have also become the main consumption force of the sports industry in the new era.

1.2 Literature Review

Zhou uses the method of social investigation to investigate part of the college students about sports consumption structure. And the study shows that sports consumption is divided into physical and participatory consumption and the spectator consumption ratio is still lower. Boys' sports consumption usually buy sports clothes and sports equipment of physical consumption as the main part. Participation in sports

consumption and information sports consumption are supplemented, while girls' sports consumption mainly includes learning sports skills and participating in various fitness activities. Both have improved sports consumption, and college students' demand for sports is still rising (Zhou 2003).

Shao's article concluded that the Shanghai sports consumption of college students is very diversified through the awareness of college students to participate in sports activities in Shanghai and the questionnaire survey of consumption structure. Sports consumption awareness and sports consumption levels of boys are higher than girls. Boys' main sports consumption is buying clothing and sports equipment, while girls' physical sports consumption is the tutorial fitness classes. But in the sports consumption of enjoyment, girls are higher than boys (Shao 2012).

Wang pointed out that although college students' cognition of health and sports consumption function is higher than that of secondary school students, there is no significant difference in sports consumption structure between them. They all have the same characteristics: most buy sports clothes and equipment. They choose to enter the fitness center to receive learning guidance and finally participate in the expenditure of ornamental sports consumption (Wang 2009).

1.3 Research Framework

To sum up, through the research on the sports consumption structure of college students, it is found that college students have no stable economic foundation, and living expenses are provided by their parents. At present, the sports consumption structure of college students is dominated by material consumption, followed by participation consumption and ornamental consumption. However, with the rapid development of China's economy and the continuous improvement of people's living standards, college students' three types of sports consumption structure will be more and more balanced (Cao 2006).

2 Methods

According to the research content, this paper has consulted and learned books related to tennis products, economics, and consumer psychology. From the documents about tennis products, this paper will explore specific tennis categories such as rackets of different brands, tennis sneakers, and racket lines to study further the love degree of college students' view of various tennis products. From documents about economics and consumer psychology, this paper learned about the trend of the tennis consumption market. Moreover, this paper will examine the possibilities of all kinds of tennis products being purchased by college students from the perspective of their consumption psychology. By consulting the documents about relevant consumption, consumption motivation literature, related college students' sports consumption,

sports consumption behavior, tennis consumption, tennis crowd, and other related documents. Then this paper summarized those documents and got certain inspiration from those documents that built a theoretical the subsequent research and writing of this paper.

What's more, this paper aims to understand further the connotation of tennis consumption and the scientificity and rationality of the questionnaire design. This method is finally confirmed by face-to-face, telephone, and email to interviewed experts and scholars. Those three ways provide theoretical support for this paper's smooth writing and the rationality of the questionnaire design.

3 Results

Tennis consumption refers to social and economic behavior in that people consume materials and good services to satisfy their own tennis needs. Some people also think that tennis consumption refers to the consumption of tennis services, information, and materials to meet the needs of residents' personal life and fitness (Dong 2012).

According to the above research, the author concludes, analyzes, and sorts all the information together. The concept of tennis consumption refers to the public group that meets the individual's multiple needs in tennis sports fitness, which would take direct or indirect materials, tennis information, paid services, and several aspects of labor consumption. It belongs to a kind of emerging economic activity behavior with social quality (Du 2009).

Tennis has gradually changed from an aristocratic sport to a popular sport. It is not only a public participation sport but also has a strong appreciation to watch. Its living space and development mainly depend on participants. With the rapid and steady growth of China's economy, sports consumption in our country is oriented toward participation and appreciation. This positioning undoubtedly adds impetus to tennis's physical consumption and appreciation consumption. As the boss in charge of HongShuangXi said: "China's sports consumption, not only more people pay attention to the events, notice the news, but also more people participate in them." With the increasing tennis population, tennis consumption, to a certain extent, has further strengthened the dominant position.

The curriculum is the basic engineering of school education and is the prerequisite guarantee of achieving teaching goals. Setting up tennis courses in colleges and universities is the primary and necessary condition for developing tennis in colleges and universities, affecting the popularity and development of tennis in the whole province and even the whole country. With the increasing heat of tennis in the whole country, contemporary college students are very interested in tennis, and the number of participants is also gradually increasing. According to the survey of 10 college students in Yunnan, due to the constraints of a large amount of capital investment in the construction of tennis stadiums and the relatively high cost of practicing tennis, the opening of tennis courses is not as large as other traditional sports with more class hours, courts and teachers.

The course is divided into two forms: elective course and compulsory course. As a branch of the college physical education curriculum, tennis courses appear in the form of compulsory and optional tennis courses. Through the data analysis of 10 undergraduate colleges in Yunnan Province, the author found that there was only one school that did not offer tennis courses, accounting for 10% of the total number of the investigation. There are nine schools offering tennis courses in Yunnan, all of which set tennis as an elective course, accounting for 90% of the total number of the survey. No school takes tennis as a compulsory course for college students instead of physical education institutes.

Tennis is a small ball sport. Due to the limitation of the number of tennis courts, the small number of tennis teachers, and the large number of students choosing tennis courses, so the school can only use the form of elective courses for students to learn. A tennis court can only accommodate 8–10 people for multi-ball practice in tennis teaching. The number of students in the class will not only affect the teaching goals and tasks of each class. But also, there will be a certain risk of not meeting the objective requirements of tennis course teaching and training. From the survey of 10 schools to open the tennis course grade statistics, most students who choose tennis courses are in the first and second grades. The reasons are as follows: the public physical education in colleges and universities in Yunnan province ends in the second half-semester of the second grade, and the tennis-teaching course will also end. In order to improve the level of tennis skills, students can only learn the basic technical movements in daily teaching courses due to the limited class hours. If they want to strengthen their technical movements, they can only progress through extracurricular professional training. Before 1–2 years graduate into society, there is enough time and vigorous energy for students to improve their tennis level further. And it will not only enrich the cultural life after school and lay a good practice foundation for students in their future lifelong sports. Non-physical education major students of the university said they like tennis very much, accounting for 27.13% and 48.25% of the total number of respondents who showed interest in tennis. Those who like tennis generally account for 12.96%, and those who don't like tennis very much account for 11.66%.

Through the investigation and analysis, the tennis consumption of college students in Yunnan Province shows that boys' tennis consumption is significantly higher than girls. Among them, male students accounted for 100% of the total number of respondents, while female students only accounted for 60%.

According to the grade survey of tennis consumption of college students of different grades in Yunnan Province, with the increase in college students' enrollment time and grade, their consumption of tennis is also increasing. There are 123 students in the first grade, 81 boys, accounting for 65.85%, and 42 girls, accounting for 34.15% of the total. There were 119 students in the second grade, including 75 boys (63.02%) and 44 girls (11.76%). There were 89 students in the third grade, 59 boys and 30 girls, accounting for 66.29% and 33.71% of the total. In the fourth grade, there were 43 students, 28 boys (65.12%) and 15 girls (34.88%).

The ten high schools surveyed students who come from urban and rural areas. By studying college students in different regions and areas, we can analyze the concept

of tennis consumption of college students and the influencing factors that restrict tennis consumption. It reflects cities or towns' economic development levels where students live from different areas to a certain extent. Based on the students' data analysis in 10 colleges in Yunnan province, 223 urban students and 151 rural students accounted for 59.23% and 40.62% of the total students surveyed, respectively. From the composition of the different student areas, the number of urban students is more than rural students. This result is linked to China's employment environment. Because of many students' weak family economic conditions, their learning cost is too high to afford. Although China has student loans, green training, and a series of financial education help policies, it is also hard for rural families to afford to consume tennis with a weak economic foundation (Han 2004).

4 Discussion

Although the development of tennis has no special requirements for gender, the number of girls playing tennis and spending money on tennis is slightly lower than that of girls. There are several possible reasons for this result: Firstly, boys like tennis more than girls. Secondly, men and women have huge differences in daily consumption. Thirdly, although both men and women seem to have the same love and interests in tennis sport, for tennis consumption, there are differences in the concept of it between men and women. Last but not least, tennis is a sport which people are easily tired of because of its high energy consumption. So physical quality is very important (Jin 2011). And because of those reasons, female students' learning improvement in the later stage of tennis is lower than that of male students, which is also the inducement for the female students to participate in tennis consumption.

And back to discuss the grades of the tennis consumption. Interviewing ten college students in Yunnan province shows that most undergraduate students like tennis lessons very much and are interested in learning tennis. And only a small part of students dislike tennis lessons, which is also a very small number of students. As a new popular sport in China, tennis has been highly introduced into colleges and universities with its unique fashion, charm, and dynamic. Once it appeared in people's sights, students quickly loved it.

While participating in tennis, college students can feel the unique fitness value and experience its interest. Participating in tennis sports can enhance the friendship between students and show the positive attitude of college students who want to make themselves better and better. The first grade is the initial stage of college students' admission. They feel curious about all new things and are keen to participate in various sports activities, so they are used for tennis consumption at a medium level. The students of grades two and three have a clear goal orientation in sports activities through the learning accumulation of the previous year, so the number of people participating in tennis consumption is large. And grade four is used for tennis consumption of the least number of a grade because students in grade four face the internship stage and will not put their energy and attention on sport. In addition, the

number of participants in grade four is small due to the intense competition and the pressure of employment, but the overall study of this paper is not affected by it.

5 Conclusion

5.1 Findings

First, College students in ordinary universities in Yunnan province show a strong interest in learning tennis, and the opening situation of tennis courses is relatively good. The number and opening time of tennis courts cannot meet the normal teaching needs, so some students cannot participate in it, and to some extent, hinder the consumption of tennis.

Second, the consumption of tennis sports meets the consumption demand of contemporary college students. Male students are significantly higher than female students in ordinary undergraduate colleges in Yunnan Province to consume in tennis. And urban students occupy the majority of the consumption group, mainly concentrated in first-year students, sophomores and juniors.

Third, the consumption motivation of tennis among college students in ordinary universities of Yunnan Province shows a diversified development trend. The consumption motivation of college students of different genders and grades is also very different. Regarding physical fitness and improving skills, grades one and two are significantly higher than grades three and four. In terms of making friends and social performance, grades three and four are higher than grades one and two. Male students have higher consumption motivation than female students in physical fitness, social performance, and skill improvement. In comparison, female students have higher consumption motivation than male students in recreation, social comparison, and fashion pursuit of tennis.

5.2 Suggestions

First, make full use of the existing resources of colleges and universities and attract social funds. Introduce market mechanisms scientifically and reasonably, speed up the construction of tennis courts, increase the number of the tennis court, attract more students to participate in tennis, and increase the number of college students in the tennis population.

Second, using media, networks, and campus radios and transmitting effective and new information about tennis timely to the students to increase publicity for tennis, bring up the tennis cultural atmosphere on campus, and improve students' knowledge, understanding, and touch this sport. The school needs to constantly improve the penetration of tennis sports on campus to promote tennis consumption.

Third, leaders and relevant functional departments of colleges and universities should correct students' unplanned comparison consumption in time. College students should moderate consumption according to their economic ability. And the school should train students to set up a correct view of life, consumption, and values.

Fourth, through the interaction of the university tennis clubs, universities and colleges should regularly hold big tennis games between those clubs to let more students understand tennis, like tennis. What's more, it will give students a good learning opportunity to raise their tennis skills. As a result, the tennis market's potential consumer motivation will be stimulated.

Fifth, introducing the history and culture of tennis, inviting some tennis celebrities to meet and teach their experiences to students by holding tennis book week and knowledge lectures. As a result, it will promote tennis sports to be more and more popular, improve the interest of beginners in learning tennis, and provide scientific guidance for tennis enthusiasts.

Finally, the school should advocate for college students to form correct sports consumption concepts and establish the basic concept of "health first". And students also form a good habit of lifelong physical exercise to improve the level of tennis consumption and form a good tennis consumption consciousness.

References

Cao X (2006) Investigation and analysis of college students' sports consumption psychology and behavior characteristics. J Guangzhou Sports Univ 27(3):16–18

Chen H (2006) Research on sports consumption consciousness of college students in east China. J Phys Educ Peking Univ 29(4):464–465

Chen Y (2012) Investigation and analysis of tennis consumption in Maoming city, West Guangdong. J Changchun Univ Sci Technol 7(2):25–28

Dong G (2012) Research on current situation of college students' tennis consumption in Huai Nan city. J Chuzhou Normal Univ 14(2):81–82

Du G (2009) Economic activity and strategy of sports consumption in universities. J Chuzhou Normal Univ 177(3):78–79

Han D (2004) Questioning sports population. Sports Sci 5(5):64–65

Jin S (2011) Study on consumption level and countermeasures of tennis in Wuhan. J Wuhan Sports Univ 1(4):71–73

Shao J (2012) Awareness of Shanghai undergraduates' sports and research of sports consumption structure. J Guangzhou Sports Coll 11(2):126-12

Wang B (2009) Research on sports value and consumption of secondary school students. J Hangzhou Sports 4(1):64–66

Zhou Q (2003) Analysis of contemporary sports consumption structure. J Nanjing Sports Coll 17(6):177–178

Studying the Causes of Overconsumption Among Post-90s Consumers in Mainland China

Linlin Huang

Abstract This article aims to try to explain the "irrational" overconsumption behavior of post-1990s in mainland China. This article investigated the changes in the number of credit cards used in mainland China from 2014 to 2021, the age composition of consumer loans, the primary use of loans in 2021, and the statistics on the total amount of credit cards six months overdue in China from 2014 to 2021, as well as a survey on the percentage of post-90s in debt. The conclusion drawn is that such consumption of the post-1990s is far beyond their pay level, making it difficult to secure their future basic living but also causes a waste of resources. These findings contradict one of the most critical premises in economics: constrained optimization. Most traditional economists believe that people in real-life situations will make optimal decisions by carefully weighing the opportunity cost. However, the actions of the post-1990s in mainland China seem very different from this premise. This article cites experiments and studies in psychology to reveal the possible reason for this "irrational" behavior: the neglect of opportunity cost. It also tries to propose some solutions to help people consume more sensibly.

Keywords Overconsumption · Post-90s consumers · Review

1 Introduction

Money is not an infinite resource that can be squandered like air. People have a finite amount of money, which means that when spending a certain amount on one item, we can't buy another item. In economics, there is a specific term to describe things we give up to get other things, called opportunity cost. Opportunity cost is defined as what is given up to achieve something. For example, if you make $3000 a month and this month you decide to spend $2500 on a pair of shoes from Balenciaga, you will have to scrimp and save for the rest of the month. The delicious food, the exciting books

L. Huang (✉)
Suon Academy, Toronto M9N 3X9, Canada
e-mail: joehuang880@yahoo.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_102

you could have bought, and the chance you could have gone to an amusement park are opportunity costs. Because our money is limited, people should carefully weigh the opportunity cost of each purchase to make the best decision. Most traditional economists believe that people in real-life situations will make optimal decisions by carefully considering the opportunity cost. This is one of the essential premises in economics: constrained optimization. Constrained optimization means that people make the best decision with a limited budget. However, people's actions in real life seem very different from this premise. Richard Thaler thinks the optimization problems that ordinary people confront are too hard for them to solve. This contradiction shows that this vital presupposition of economics does not predict human behavior well; it needs to be combined with psychological theories to provide a more accurate model for predicting human behavior.

2 Literature Review

The rise of behavioral economics in recent years has caused a considerable impact on economics. Behavioral economics has had a significant impact on mainstream economics because it questions the foundation of all economic models relied on: "the economic man hypothesis." Many behavioral economists like Thaler (2016) express that there is a big gap between the economic model established based on "the economic man hypothesis" and the actual situation in real life. Behavioral economics is seen as the product of combining psychology and other social sciences with mainstream economics. John Maurice Clark proposed the original idea of behavioral economics in January 1918. In the paper, he wrote, "The economist may attempt to ignore psychology, but it is a sheer impossibility for him to ignore human nature, for his science is a science of human behavior" (Clark 1918). He put forward that economist may try to ignore psychology when they study the economy. However, economics is a subject that explores human nature, and it will inevitably be influenced by psychology in the research process. The rising of behavioral economics in recent years is sometimes seen as a kind of radical revolution within economics. However, Ashraf, Camerer, and Loewenstein think that Adam Smith developed three of the most critical behavioral economics concepts in his book The Theory of Moral Sentiments (Ashraf et al. 2005). The causes of overconsumption have also been explored in recent years in Chinese economics. A Chinese researcher Chen Heqiu believes that the popularity of the "996" work style puts people under tremendous psychological pressure, which can lead to retaliatory overconsumption to achieve self-treatment during the compressed rest time (Chen 2020). Another Chinese professor Song Xianghua thinks many reasons cause the irrational consumption behavior of post-90s college students. In addition to the parents' excessive financial support to their children, the lack of education on post-90s consumption values in colleges and universities and the spread of consumerism on campuses have directly or indirectly influenced the consumption value of post-90s college students (Song 2013).

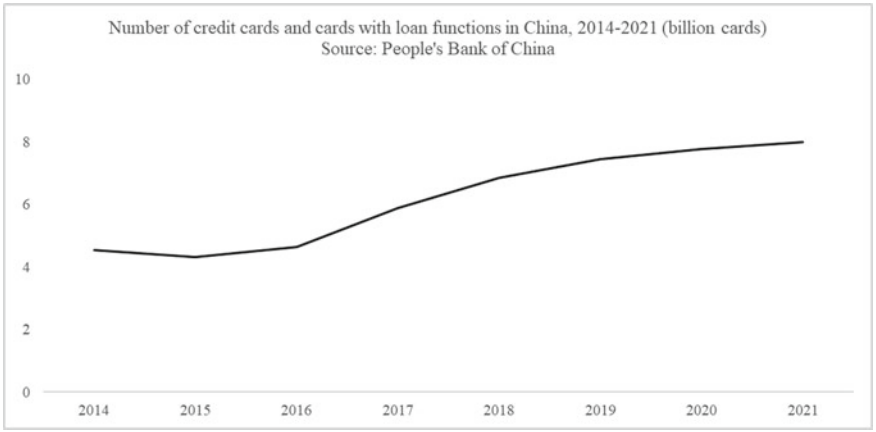


Fig. 1 Number of credit cards and cards with loan functions in China, 2014–2021 (billion cards). *Source* People's Bank of China

3 Data

A survey by Datagoo shows that post-90s account for 49.3% of consumer loan users, and in addition to paying the mortgage, more than 60% of the post-90s spend their consumer loans on basic living and leisure. The report also shows that of the 175 million post-90s in mainland China, only 13.4% of young people are debt-free, while 86.6% of the post-90s have been exposed to credit products. The two graphs below, obtained by compiling data from the People's Bank of China, reflect the changes in the number of credit cards used in mainland China from 2014 to 2021 and the total amount of credit cards six months overdue in China from 2014 to 2021 (Figs. 1 and 2).

Eight hundred million credit and debit cards will be issued in mainland China by the end of 2021. As we can see, although this curve is not very smooth, the overall trend is still up. This shows that using credit cards and other forms of borrowing to spend money is becoming more popular. The second graph shows that China's total amount of credit cards six months overdue has an upward trend. This means that more and more people, especially the post-90s, are borrowing more money than they can afford to pay in the future.

4 Analysis

One important reason for this phenomenon is that money is an abstract symbol when we look at the psychological factors behind this "irrational" consumption behavior. We use the money to exchange goods and services. As an abstract symbol, money cannot shock our emotions; however, the goods or services that money can buy

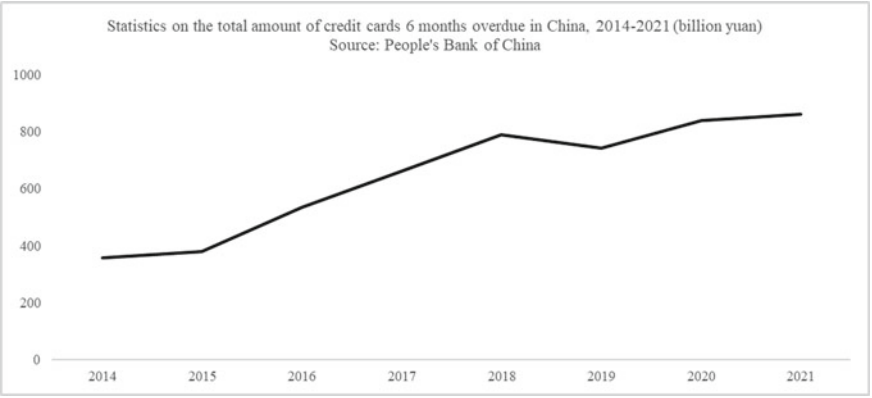


Fig. 2 Statistics on the total amount of credit cards 6 months overdue in China, 2014–2021 (billion yuan). *Source* People's Bank of China

are the things that can affect us emotionally (Ariely et al. 2017). Therefore, it is hard for people to imagine the existence of opportunity costs, so they always cannot control their impulsive consumption and overconsumption behavior. In an experiment conveyed by Shane Frederick, Nansen Novemsky, Jing Wang, Ravi Dahl, and Stephen Norris in a paper titled "The Neglect of Opportunity Costs," they recorded the willingness of experimental participants to purchase different stereo packages. They got some participants and divided them into two groups, one of which had to choose between a $1000 Pioneer stereo and a $700 Sony stereo. The second group faced a $1000 Pioneer stereo and a $700 Sony stereo plus $300 to be spent only on CDs. The experiment results showed that the Sony stereo that came with $300 CDs was more popular than the Sony stereo alone. In this experiment, $300 was presented concretely as Sony CDs, causing a much more substantial emotional impact on the experiment participants than an abstract concept like $300. This made it easy for the participants to ignore such an abstract concept as $300. It would be difficult for them to imagine that they could spend the $300 in another way. Participants could use part of the $300 to buy their favorite CDs and another part to eat a fancy meal or buy gifts for their loved ones. This might have been a better choice, but they didn't do it. People are naturally lazy, and it's hard for them to imagine the opportunity cost, so they tend to fall back on shortcuts (Ariely et al. 2017).

5 Conclusion

This article investigates the changes in the number of credit cards used in mainland China from 2014 to 2021, the age composition of consumer loans, the primary use of loans in 2021, and statistics on the total amount of credit cards six months overdue in China from 2014 to 2021, as well as a survey on the percentage of post-90s

in debt. The finding is that such consumption in the post-1990s is far above their pay level, making it difficult to secure their future basic living standards while also causing resource waste. The main reason behind this phenomenon is the neglect of opportunity cost. Based on the psychological reason for overconsumption, the government should consider changing shopping platforms in mainland China, such as the Jingdong software, to prevent impulsive consumption. For example, when a consumer places an order for something, the shopping software can indicate how much the item's price can be for other goods that the consumer frequently purchases (based on big data analysis). For example, the cost of a coat is equivalent to how many times you can watch a movie, how many cups of milk tea you can drink, and how much oil you can buy. When consumers cannot reasonably consider the opportunity cost on their own, a subtle hint can be more effective in reducing impulsive spending.

References

Ariely D, Kreisler J, Trower MR (2017) Dollars and sense: money mishaps and how to avoid them. Bluebird Books for Life, an imprint of Pan Macmillan

Ashraf N, Camerer CF, Loewenstein G (2005) Adam Smith, behavioral economist. J Econ Perspect 19(3):131–145

Chen H (2020) Observation on the phenomenon of over-consumption among young people. Rule Law Soc 04:52–53

Clark JM (1918) Economics and modern psychology: II. J Polit Econ 26(2):136–166

Song X (2013) Research on the consumption values of post-90s college students

Thaler RH (2016) Behavioral economics: past, present and future. SSRN Electron J 1–3

Study on the Cultural Participation Mechanism in Virtual Museums from the Perspective of Interaction Rituals

Wang Wanjia and Dong Meixiao

Abstract With COVID-19 sweeping the world, museums at home and abroad are both turning to online forms for survival after suffering severe setbacks. Therefore, virtual museums are thriving. However, there are still many problems in the audience's cultural participation in the virtual museum, which affect the audience's visiting experience. Based on the grounded study of four virtual museums and combined with the theory of the interaction ritual, this study constructs the audience's cultural participation mechanism in the virtual museum. This mechanism enriches the related research on cultural participation and the theory of the interactive ceremony, and in the meantime provides a direction for the further development of the virtual museum in the future.

Keywords Virtual museum · Cultural participation · Interaction ritual

1 Preface

Due to the advent of the new media era, virtual museums are being increasingly valued in the field of art and literature. With COVID-19 sweeping the world, museums at home and abroad are both turning to online forms for survival after suffering severe setbacks. According to the online survey studied by the Network of European Museum Organizations (NEMO), 80 percent of the museums investigated have increased their digital services, and 40 percent reported a 10 percent to 150 percent increase in online visits (The Network of European Museum Organization 2020). In addition, with the development of the Web 2.0 network, the media cultural style has shifted from the traditional passive mode to the participatory mode featuring creation and sharing. Cultural participation is a behavioral activity to experience the culture. The audience has a spiritual connection with a specific cultural space and actively creates and spreads media content through a certain sense of identity. With

W. Wanjia (✉) · D. Meixiao
Tongji University, Shanghai Siping Road 1239, Shanghai, China
e-mail: zhuxinxianzi@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_103

the intervention of technology, the bodies and objects in virtual museums gradually form a new relationship, which could be called experiencing and being experienced. However, the following problems still exist in the audience's cultural participation and experience during their visit to the virtual museum. For one thing, unlike physical museums, the virtuality of the cognitive activities and objects in virtual museums makes the audience lack a sense of presence and an effective cultural participation field. For another, during the transition process from physical cognitive activities to sensory experience activities, the investment produced by the interaction between the audience and the virtual museum is not enough. Therefore, how to create a spiritual connection with the cultural space and carry out interactive cultural participation becomes the key to the future development of virtual museums.

From the perspective of existing studies, the analysis of this problem can be mainly divided into two categories. The first category, from the supply side, ascribes the existing problems to the lack of technology and carries out in-depth technical exploration (Hongxia and Lili 2014; Dan and Shuyuan 2017). The second category, from the demand side, proposes building a variety of virtual museums that could cover the cultural needs of various groups (Jian 2013), and points out that attention should be paid to the shaping of the audience's sense of ritual during their visits in virtual museums (Qi 2018) to arouse their internal understanding of values (Yulie et al. 2019). However, these existing studies all ignore the fact that the audience's cultural participation in virtual museums is in essence an interactive process between individuals and machines. Based on this, this study, from the perspective of human–computer interaction at the micro-level, constructs the cultural participation mechanism in the virtual museum. This mechanism treats personal factors, situational factors, and the fitness between personal factors and situational factors as enabling conditions, and takes good advantage of various media means in the field to form powerful emotional energy. It puts emphasis on the influence of the human–computer interactive process on the cultural participation of virtual museums and extends the Collins theory of the interaction ritual and the related research on virtual museums in line with the times.

2 Literature Review

2.1 Cultural Participation

Regarding cultural participation, research results have been achieved in terms of demand, influencing factors and mechanism construction. It is mainly divided into two research directions, namely the study of cultural participation in the field of public cultural space and new media.

First, it takes a certain type of public cultural space as the research object to explore the characteristics and factors of cultural participation in this type of scene. For example, the cultural scene theory explains the theoretical framework of cultural

participation and explores the conditions under which cultural participation occurs (Shaoguang 2008). In addition, it also points out some practical problems such as the differentiation of participating subjects, the privatization of participation content, and the simplification of the content of participation, and proposes a scientific system of cultural participation mechanism (Jiabin 2014).

Second, it shows a new type of participatory cultural system constructed by new media represented by the Internet. The performance of participatory culture in the new media era mainly includes four aspects: the change of communication mode, the development of shared culture, the promotion of social change, and the reconstruction of individual interaction (Qi 2019). At the same time, it demonstrates the relationship between the rapid development of China's cultural and creative industries and culturally productive consumers (Yiting 2021). Moreover, based on the theoretical framework of participatory culture, some experts not only reflect on the development status of new formats such as short videos (Mengqian 2021) and interactive dramas (Fei and Wenliang 2021), but also put forward the three characteristics of cultural participation in the new media environment, namely, cultural, practical, and powerful (Chengliang 2021).

However, most of the current research only focus on the physical space, such as economic status, facilities, and convenience of venues, or a macro study of the interaction between the media and the audience. Thus, we find that there are few studies on the relationship between virtual space and the subjective cognitive system and cultural participation.

2.2 Virtual Museum from the Perspective of Interaction Ritual Theory

The theory of interaction ritual originated from Durkheim's sociology of religion, before Goffman proposed the term "interaction ritual", studying daily ritual issues from a micro perspective. After that, Collins put forward the interaction ritual theory on his basis. He contended that successful interaction rituals are characterized by collective effervescence and that a set of factors—the mutual focus of attention, shared emotion, bodily co-presence, and barriers to outsiders.

It can be seen that the original interaction ritual theory regards the co-presence of the body in the physical space as an essential element of the interaction ritual. However, since the technological revolution, the rapid development of the Internet and new media technologies has broken the limitations of time and space for traditional communication methods, and profoundly changed the way of communication and interaction. Consequently, people can communicate effectively and fluently without being in the same physical space.

Therefore, the application boundary of the interaction ritual has also expanded from physical space to virtual space, including online fan communities (Shuya and Yuqi 2014), Bilibili videos with bullet curtain (Xin 2015), TikTok short videos

(Qiuhua and Qiaoli 2018), online reading (Xiaopeng and Yiping 2020), and Esports (Minglei 2021), where people will generate a certain amount of emotional energy and group unity when they communicate. Correspondingly, as a virtual space, the virtual museum also forms an "interactive ceremony" with the audience. The interaction between humans and machines creates emotional energy, enabling individuals to be highly focused, resulting in a good user experience and knowledge gains.

3 Research Data Sources and Methods

Our research adopts the grounded theory for cross-case studies. Based on the typical requirements of the case study, we selected four virtual museums as theoretical samples, including "the Forbidden City Exhibition", "the National Museum", "Shanghai Museum", and "Hunan Museum", because they are produced by national or local museums, and generally represent China's virtual museums. In addition, they are the most downloaded apps in APP Store, but the ratings are either the highest or the lowest. Therefore, we selected 1,832 user comments as the data source, and systematically screened, cleaned, coded, summarized, refined, and abstracted the original data (Table 1).

Based on the grounded theory, this paper studies the 1832 user comments, and constructs the model of audience cultural participation enabling mechanism. We have summarized the influencing factors of the audience's cultural participation, which are personal, situational factors, and the fitness between personal factors and situational factors. Each of these aspects covers two categories, namely, differences in motivation and ability, scene verisimilitude and interface organization, and instrumental matching and affective matching. As a result, we have formed the enabling conditions for audience cultural participation.

4 The Visitor-Visual Museum Interaction Process from the Micro-view

Combining the interaction ritual model and the content based on grounded research, this paper constructs a cultural participation input mechanism in virtual museums. The mechanism is divided into three parts: enabling conditions, interaction process, and interaction results as shown below (Fig. 1).

Table 1 The encoding process

Main category	Subcategory	Original information (partial comments)
Personal factors	Motivation differences	I am a student majoring in cultural relics…
		I usually like to download some interesting apps… When I saw the icon of this app, it attracted me a lot
		When I traveled to the Forbidden City, there were so many tourists, and it was super boring…
	Ability differences	I'm a mother of 5-year-old…It's really cool that children can understand traditional culture in a simple way
		Wow! I am studying the history of Chinese art…it is a gospel for students majoring in Chinese painting
		As an art lover for more than 20 years, I feel enjoyable to look at these traditional artworks after work…
Situational factors	Interface organization	I feel that the experience of the search function is very bad…If it can be improved in the future, I hope to add a picture zoom view function…
		Thank you so much for the hard work of the designers! …Every exhibition hall has a map, which is very friendly to me, hahaha…this software is very convenient to use
		…It would be great if I could take notes. I mean I want to draw a little surprise in the circle above, and some notes. I think it will be another surprise when I come back
	Scene verisimilitude	I heard classical music as soon as I entered the exhibition hall, it was a real pleasure…
		This exhibition is amazing! The texture and texture of the cultural relics seem to be right in front of you…

(continued)

Table 1 (continued)

Main category	Subcategory	Original information (partial comments)
		Its pictures are super fuzzy, and the loading process is very long, which confuses me… and only the front of the artifacts can be seen. I look forward to a 360-degree panoramic view…
The fitness between personal factors and situational factors	Instrumental matching	As a fan of traditional culture, this software allows me to get in touch with a lot of traditional culture and increase my knowledge!
		…It is too important for students majoring in Chinese painting! It is much clearer than the original version, and the content is larger. Ever since I used this, I never buy a copybook again…
		its knowledge is not deep at all where I feel that I can't learn anything. In my opinion, it is totally incomparable to physical museums
	Affective matching	Amazing! It even has mini games, which can promote traditional culture… and it is also a great help for the improvement of children's logical thinking ability, support you!
		…There are other users who share the beauty of art with me on the bullet screen, which can bring some happiness and comfort to me
		…Every time I want to share my thoughts about the exhibition with my friends, I can only send them screenshots. It feels very stiff. After a long time, I am not very enthusiastic about this

4.1 Enabling Conditions

Personal Factors. Fans may respond to the interactions in virtual museums differently as shown from the table, due to motivation differences and ability differences. For instance, "I am a student majoring in cultural relics…(Major-art learning needs)", "When I traveled to the Forbidden City, there were so many tourists and it was super boring…(Conditional Limitation-Art Appreciation Needs)" which all belong to the scope of motivation differences. Moreover, when audiences enter the virtual museum,

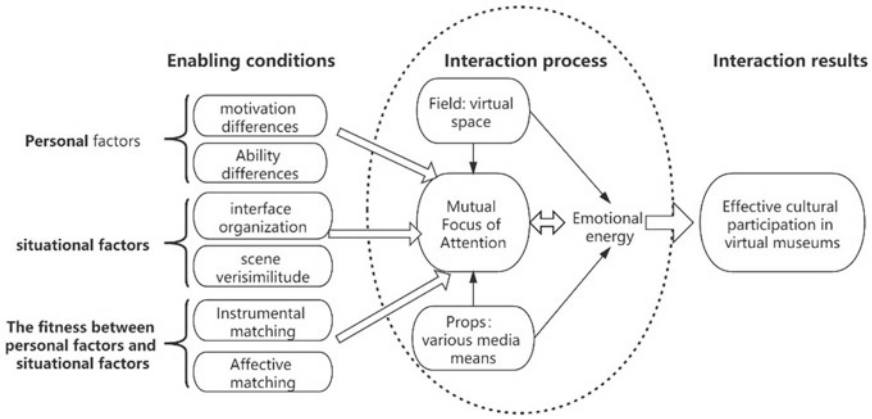


Fig. 1 The audience's cultural participation mechanism in virtual museums

their behaviors and learning effects could be influenced by their knowledge of the heritage and the traditional culture behind the museum—"I'm a mother of 5-year-old…it's really cool that children can understand traditional culture in a simple way.", "Wow! I am studying the history of Chinese art…it is a gospel for students majoring in Chinese painting". The theory of interaction ritual suggests that at the beginning of any interaction, the subject enters the interactive situation with the emotional energy formed in the original social interaction. Therefore, before the official interaction with the virtual museum begins, audiences will deliberately or unintentionally make preliminary preparations and psychological presuppositions, which constitutes an important part of the audience's experience in the virtual museum.

Situational Factors. Collins emphasized that the occurrence of interaction must rely on specific contexts, and the generation of emotions can only be accurate and convincing when placed in specific contexts. Unlike traditional brick-and-mortar museums, virtual galleries present visitors on the mobile terminals. "…It would be great if I could take notes. I mean I want to draw a little surprise in the circle above, and some notes. I think it will be another surprise when I come back." "I feel that the experience of the search function is very bad…If it can be improved in the future, I hope to add a picture zoom view function…" The above evaluations all reflect from audiences' assumptions about the organization of the functional interface. "I heard classical music as soon as I entered the exhibition hall, it was a real pleasure…" and other comments illustrate audiences' requirements for audiovisual elements of the virtual museums, which also demonstrate the importance of the scene verisimilitude for the occurrence of interaction.

The Fitness between Personal Factors and Situational Factors. The interaction ritual theory indicates that human emotional energy is the result of continuous accumulation. The relevant subject will have a strong emotional desire before the interaction when an interaction occurs every time. "…It is too important for students

majoring in Chinese painting! It is much clearer than the original version, and the content is larger. Ever since I used this, I never buy a copybook again…" "Its knowledge is not deep at all where I feel that I can't learn anything. In my opinion, it is totally incomparable to physical museums." The above shows that whether the virtual museum can provide audiences with sufficient knowledge and art appreciation value through technical means is very important, which constitutes an instrumental match between audiences and virtual museums. While pursuing knowledge, audiences will also pay attention to the expression and response of emotions, like "…There are other users who share the beauty of art with me on the bullet screen, which can bring some happiness and comfort to me" Through the creation of functional value and hedonic value to obtain individual self-identification, audiences form a common focus and develop into collective excitement and community unity, which constitutes the affective match between audiences and virtual museums.

4.2 Ritual Process

The theory of interaction ritual theory focuses on the ritual scenes of two or more people and points out from the interactive point of view that rituals have four basic elements: field, common attention, interactive props, and shared emotions (Collins 2011).

First of all, motivation or ability differences and scene verisimilitude are converters that transform short-term emotions into long-term emotions, providing a prerequisite for the launch of the interaction ritual. It can be seen that the audience's motivation, interest, and understanding ability are different through grounded research, roughly divided into three categories: professional research type, interest-driven type, and leisure type. Therefore, based on different motivations and abilities, the audience communicates with the information in the mobile terminal space through their own interactive behaviors. At the same time, since the audience conducts cognitive learning in a specific time and space, the field is no longer a purely physical concept, but a joint presence of the audience and the virtual museum through the mobile platform. In this one, the perfect and personalized interface organization and the scene verisimilitude can weaken the dependence on physical space by stimulating the audience's senses such as vision and hearing, which makes the audience accustomed to the form of cultural activities on the mobile terminal, and then participates in this field more immersively, setting boundaries for outsiders.

Secondly, the fitness between the audience and the virtual museum, as the common focus and emotional input of the participants, will further promote the operation of the interaction ritual. Collins believes that the most important thing is not the "procedure" in the interaction rituals, but a transition from transient emotions to a sense of group belonging or unity. On the one hand, the display of the virtual museum is not restricted by time and space and can increase reasonable imagination based on reality. Through the creation of information and new carriers to reproduce the past and future of historical relics, it can further enrich users' information sources and improve their

artistic appreciation capabilities, showing the instrumental matching capabilities. On the other hand, although the audience cannot interact with small-scale acquaintances, the setting of bullet screens, forums, and other functions allow participants to have a common focus of attention and a shared emotional state. Therefore, when the various elements are effectively integrated and accumulated to a certain extent, the audience's cultural participation in the virtual museum will produce individual emotional capabilities and a sense of identity of the group, prompting the start of the interaction ritual.

Under the effect of the above enabling conditions, the interaction ritual begins.

Common Focus. During the visit, the audience's attention is highly concentrated on the virtual museum itself, such as the cultural relics, documents, and historical stories displayed. In consequence, the personal factors and the situational factors of the virtual museum can be matched with each other, so that the audience can receive positive emotional feedback and be more continuously invested in this virtual space.

Field: Virtual Space. In such a state of continuous investment, the audience enters an independent field built by the virtual museum without external interference. Here, the audience's attention is isolated from the outside world and highly concentrated on the interaction with the museum itself.

Props: Various Media Means. The interactive ceremony is also boosted by props in the field. Through the classification and induction of user reviews in grounded research, it can be concluded that some virtual museums use multimedia methods to increase the audience's attention and make them actively participate in cultural activities, while others use a single picture, text, and video to weaken the focus of the audience's attention, making it impossible to fully engage in the interactive process. As a result, a variety of media methods, such as VR and AR technology or game and bullet screen functions, can make audiences more involved in the process of cultural participation and produce better interactive effects.

Emotional Energy. Collins pointed out that interactive props and a high degree of shared emotion make the participants unite so that the ceremony can work and deepen the relationship between the participants of the ceremony. Specifically, under the influence of the field and props, the audience's attention is more highly concentrated on information and services, making the personal factors highly match the situational factors of the virtual museum. Under such circumstances, the audience has a wealth of tools or emotions in the process of cultural participation, which generates huge emotional energy and deepens the emotional connection with the virtual museum.

In the end, the audience can form a good interaction with the virtual museum, in which they are able to carry out effective cultural participation, and obtain rich cultural knowledge and cultural experience.

5 Conclusion

Based on the theory of interaction ritual, the article has conducted a cross-case study about visual museums through grounded theory and has constructed audiences' cultural participation mechanism in the virtual museum. From the theoretical perspective of interaction ritual, when audiences visit virtual museums, it is a process of the interaction between humans and machines. Under the effect of the enabling conditions, the visitors focus on the mutual focus of attention in the virtual space and generate huge emotional energies with the help of various media means. Therefore, it enables the audience to have effective cultural participation in the virtual museum.

First, this research expands the extension of cultural participation research and explores the audiences' cultural participation in the c Guo Dan ontext of virtual space. Existing empirical research on cultural participation mainly focuses on cultural participation in public cultural space or in new media (Hongxia and Lili 2014; Dan and Shuyuan 2017). However, most of the current research on cultural participation only limits to the various physical space, or the macro-study of media communication and the audience's cultural participation in the era of new media. Instead, the article looks at the virtual space constructed by the new media discussing the input effect of audiences' cultural participation under this situation, and enriches the relevant research in the field of cultural participation.

Second, the article puts forward the audience's cultural participation mechanism in the virtual museums from the perspective of micro-interaction. The existing problems of the audience's cultural participation in virtual museums are mainly attributable to insufficient technology and audiences' personal differences, and thus propose technologies based on Unity3D, Web3D, VR, AR to improve the users' cultural participation experience in virtual museums or build various types of virtual museums that cover the cultural needs of various people. However, the focus of these existing studies ignores that the audiences' cultural participation in the virtual museums is essentially the process of interaction between individuals and machines. Therefore, this research, from the micro level, focuses on the impact of the process of human–machine interaction on the cultural participation in virtual museums, and finally a mechanism for the degree of cultural participation in virtual museums constructed under the Collins interactive ritual model.

Third, this mechanism also provides useful and feasible ideas for how to organize effective cultural participation practical activities for online museums in the era of digitization, which will help virtual museums to propose effective future development direction planning. In this case, the study has topical significance.

However, this article still has some shortcomings when considering epistemology and methodology. First, the article mainly uses interaction ritual theory to construct an interactive mode of audience's cultural participation, which is relatively simple and partial that cannot explain all problems caused by the complexity and variability of the virtual museum. In this way, subsequent studies can analyze them from the perspectives of social presence theory, cognitive information process theory, and affective events theory, etc. Second, due to the limitation of using grounded theory to

conduct cross-case research, those cases are not comprehensive enough, and slightly subjective and single-minded approach to measurement. Subsequent studies can try to use research methods such as experiments to further explore the influencing factors and effects of the audience's cultural participation in virtual museums, expand the application of the theory to new fields and scenarios, and provide new ideas for the construction of experience scenarios.

References

Chengliang L (2021) Research on the cultural interpretation of news discourse and user participation in the new media environment. China Nationalities Expo 09:137–139

Collins (2011) Interactive ceremony chain. The Commercial Press, China

Dan G, Shuyuan S (2017) Research on the virtual museum exhibition model based on Unity3D. J Beijing Inst Fashion Technol (Nat Sci Ed) 37(02):63–68

Fei G, Wenliang Ji (2021) Weak interaction and strong experience: reflection and innovation of interactive drama from the perspective of participatory culture. Editing J 03:52–57

Hongxia Li, Lili J (2014) The current exploration of the construction of public museums based on Web3D virtual reality technology. Art Hundreds of Arts 30(S1):318–320

Jiabin D (2014) The status quo and thinking of public cultural participation preferences in the four types of urban and rural communities—based on a questionnaire analysis of 20 provinces and 80 cities (states) across the country. China Rural Discov 01:184–192

Jian W (2013) Research on the digital virtual museum of traditional crafts. J Nanjing Univ Arts (Fine Arts Des Ed) 02:88–91

Mengqian Y (2021) Intangible cultural heritage communication based on the Douyin short video platform: content curation, participation culture and empowerment. China Lit Art Rev 07:87–98

Minglei W (2021) Research on E-sports user culture from the perspective of interactive ceremony chain—taking league of legends fans as an example. Contemp Youth Res 04:18–24

Qi Y (2018) Research on the interactive application of ritual shaping in digital virtual museums. Beauty and Times (Part 1) (07):22–25

Qi C (2019) Stylized performance and ritualized interaction: a re-examination of webcasting. Media Obs (03):5–11+2

Qiuhua G, Qiaoli M (2018) The interactive ritual chain and value creation of Douyin. China Editor 09:70–75

Shaoguang W (2008) The influence of political culture and social structure on political participation. J Tsinghua Univ (philos Soc Sci Ed) 04:95–112

Shuya P, Yuqi Z (2014) Virtual presence: the interactive ritual chain of the online fan community. Int Journalism 36(09):35–46

The Network of European Museum Organization (2020) Survey on the impact of the COVID-19 situation on museums in Europe final report 2

Xiaopeng G, Yiping G (2020) Analysis of the interactive ritual chain of WeChat reading APP. Media 12:91–93

Xin D (2015) Analysis of barrage video from the perspective of interactive ceremony chain—taking Bilibili network as an example. News 13:14–19

Yiting Xu (2021) Productive participation and resistance: Chinese IP culture in the creative era. Editor's Friends 07:52–57

Yulie W, Xin S, Hao T (2019) Research on the narrative display and experience of virtual reality in the ruins museum. J Nanjing Univ Arts (Fine Arts Des) (03):199–201

SWOT Analysis of Digital Transformation of Inclusive Finance of Chinese Commercial Banks

Xiaoke Pu

Abstract With the continuous development of digital technology, Chinese commercial banks are actively carrying out the digital transformation of inclusive finance, striving to develop new digital inclusive finance services and products to better serve the public. Judging from the current achievements of commercial banks, the future development of inclusive finance digital transformation has broad prospects. Based on the SWOT model, this paper can analyze the internal and external environment of China's commercial banks' financial inclusion from four aspects: strengths, weaknesses, opportunities and threats. At the end of the article, the article proposes specific development strategies under four different conditions, namely, providing personalized financial services, innovating marketing and business models, and improving risk prevention mechanisms. Financial knowledge, strengthen the construction of information sharing platform, thereby reducing transaction costs. Therefore, exploring a new digital inclusive financial model is one of the important issues in the current big data era, and has certain practical significance.

Keywords Commercial bank · Inclusive finance · Digital transformation · SWOT

1 Introduction

1.1 Research Background and Motivation

With the integration of big data, cloud computing, artificial intelligence, blockchain and other technologies into various fields of economic and social development, fintech is reconstructing the traditional financial service industry. The development of financial digitalization provides strong support for the development of the digital

X. Pu (✉)
School of Information and Communication Engineering, Communication University of China, Beijing 100000, China
e-mail: 15040140337@xs.hnit.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_104

economy. From the perspective of financial digitalization, digital financial services have effectively improved user experience and comfort, improved the efficiency of financial services, and expanded the breadth and depth of financial services. In the process of digitalization, commercial banks and financial institutions are increasing their emphasis and investment on fintech. From the perspective of the digitalization of financial services, financial technology has fully proved its unique value. Since 2019, the People's Bank of China has successively issued the "Fintech Development Plan (2019–2021)", and the People's Bank of China has re-issued the "Fintech Development Plan (2022–2025)", which will help promote the development of digital finance in my country. Taking it to a new level is also a new impetus given to the digital transformation of domestic commercial banks by fintech, pointing out the direction for domestic commercial banks to promote digital transformation.

"Inclusive finance" is a concept formally proposed by the United Nations in 2005. Since it was proposed, countries around the world have been promoting the development of inclusive finance, such as Grameen Bank in Bangladesh, correspondent bank in Brazil, and the self-help group model in India. The first conference in China where the concept of "inclusive finance" emerged was the Third Plenary Session of the 18th CPC Central Committee held in 2013, which pioneered the idea of "developing inclusive finance". Encourage financial innovation to enrich financial market levels and products. After that, the 2016 China Inclusive Finance International Forum was held in Beijing to discuss a new development route for my country's inclusive finance. In September of the same year, at the G20 summit, according to the general trend of the times, Xi Jinping put forward the desire to promote the growth of inclusive finance, and supported the integration of Internet finance and inclusive finance, that is, digital inclusive finance. In the context of globalization, as informatization continues to penetrate into all levels of society, the integration of Internet finance and traditional inclusive finance has become inevitable. The combination of informatization and inclusive finance, on the one hand, is conducive to improving the availability of financial services; on the other hand, it can reduce the cost of capital agglomeration, improve the enthusiasm of small, medium and micro enterprises for financing and development, and ultimately improve regional innovation capabilities and regional economic development.

With the rapid development of digital technology, commercial banks have begun to explore financial technology. However, due to the insufficient infrastructure in China's rural areas, the weak awareness of digital security among target customers, the imperfection of the existing credit reporting system, the need to strengthen the legal, regulatory and supervisory systems, and commercial banks facing system stability, security and digital security Practical problems such as risk communication have created certain obstacles to the digital transformation process of inclusive finance, making it difficult to play the true role of inclusive finance. Under such circumstances, it is of great practical significance for commercial banks to further promote the digital transformation of inclusive finance by analyzing their own advantages and disadvantages and the external environment of the digital transformation of inclusive finance of commercial banks, and actively exploring the future development strategies of commercial banks.

1.2 Literature Review

The current research on the digital transformation and development of inclusive finance in commercial banks in China is mainly carried out by most scholars from the following aspects. Wu Jinwang and Gu Zhouyi believe that digital inclusive finance is the deepening expansion of inclusive finance in the "Internet+" field, and it has the characteristics of commercial and public service (Wu and Gu 2018). Song Xiaoling believes that digital inclusive finance refers to the use of information technology to drive inclusive finance to achieve overtaking on the curve of growth, narrowing the urban–rural income gap, and improving social equity (Song 2017). Votintseva and Andreeva (2019) believed that commercial banks must improve their core competitiveness through digital transformation, and digital transformation has become the core strategy, and discussed the path and related issues of rural commercial banks' strategic transformation (Ludmila et al. 2019). Liang Weimin believes that commercial banks should focus on establishing a long-term mechanism for the promotion and guidance of digital inclusive finance, adopt a combination of online and offline methods, make extensive use of digital media and other channels, widely popularize relevant data and financial inclusion knowledge, and effectively strengthen Risk awareness and recognition ability of consumers (Liang 2021a). Huang Yiping believes that digital financial inclusion involves two parts, namely emerging Internet financial companies that conform to the trend of the times and traditional service-oriented financial institutions (Zeng 2020). Yang Ximing and Guo Wei believe that commercial banks should focus on the deep integration of digital technology and the real economy, inject digital elements into the whole process of financial services, run digital thinking into the entire chain of business operations, and focus on the technological drive of financial innovation and data empowerment, innovate inclusive financial products and services, and provide SMEs with more convenient and higher-quality financial services. At the same time, it is also necessary to accelerate the pace of digital transformation of small, medium and micro enterprises, promote the digital transformation of the whole process from production and processing, operation management, to sales and services, and open up the production process with digital channels such as finance, logistics, and trading markets to promote digital transformation. The application ecology of inclusive finance (Yang and Guo 2008). Two scholars, Kong Zugen and Ye Yinlong, took Lishui City, Zhejiang Province as the research object, and proposed that digital inclusive finance can realize digital payment, micro-credit and tax collection with the help of various tools, information development and farmers' credit information management system. In order to solve the problem of "three rural" development needs and financing difficulties, it can also effectively narrow the income gap between urban and rural areas (Kong and Ye 2012).

Overall, digital financial inclusion is a homeopathic product of today's "Internet+", and a new product that is different from traditional financial inclusion in terms of work service methods. At present, commercial banks have taken digital inclusive finance as a key development direction in the future. At the same time,

due to the impact of the new crown pneumonia epidemic, on the one hand, small and micro enterprises are facing increasingly severe business environment, and the financial pressure to maintain operations is also increasing; on the other hand, people are considering their own safety. The demand for financial services has risen sharply, which has accelerated the digital transformation of commercial banks. Commercial banks need to continuously innovate their businesses, improve their overall risk control, and support the real economy with greater strength and determination. It can be said that commercial banks have shouldered the responsibility of cooperating with the state to do the work of "six guarantees" and "six stability", among which, intensifying efforts to develop the digital transformation of inclusive finance is a key part.

Based on the SWOT model, it can conduct a detailed analysis of the internal and external environment for Chinese commercial banks to promote the digital transformation of inclusive finance, and propose specific development strategies under four different conditions, including providing personalized financial services, innovating marketing and business models, improving Risk prevention mechanism, strengthen talent team building, popularize digital financial inclusion knowledge, strengthen information sharing platform construction, reduce transaction costs, provide decision support, etc.

1.3 Research Contents and Framework

In view of this, this paper takes the development of financial technology and the digital transformation of commercial banks as the research theme, analyzes in detail the development impact of the digital transformation of commercial banks in the context of financial technology, and summarizes the general stages of digital transformation of commercial banks and the main current measures. On this basis, it analyzes the deficiencies in the process of digital transformation of commercial banks at this stage, and puts forward specific suggestions to promote domestic commercial banks to better implement digital transformation. The framework of this paper is arranged as follows, the first part is the introduction, the second part is the theoretical and empirical analysis, the third part is the results and discussions based on the theoretical and empirical analysis, and the fourth part is the conclusion.

2 Methodology

Based on the SWOT model, this paper analyzes the advantages, disadvantages, opportunities and threats of commercial banks in the process of transformation, so as to explore the development of digital financial inclusion in commercial banks. The so-called SWOT analysis is a situational analysis based on the internal and external competitive environment and competitive conditions, is to enumerate various major

Table 1 SWOT analysis of commercial banks promoting the digital transformation of inclusive finance

Internal analysis	*Strengths*	*Weaknesses*
	1. Wide channels 2. Sufficient funds 3. System Improvement	1. Insufficient endogenous power 2. Prominent risk issues 3. Lack of professional talents
External analysis	*Opportunities*	*Treats*
	1. National policy support 2. Urgent market demand 3. Digital technology upgrade	1. Incomplete laws and regulations 2. Inadequate infrastructure 3. The digital divide needs to be broken 4. The credit reporting system needs to be strengthened

internal advantages, disadvantages and external opportunities and threats closely related to the research object through investigation. The data comes from the "2020 China Electronic Banking Survey Report" and the 47th "Statistical Report on the Development of China's Internet" (Table 1).

2.1 Analysis of the Strengths of Commercial Banks in Developing Digital Inclusive Finance

Wide Channels. Commercial banks have a large number of physical business outlets, which are widely distributed in various regions, especially in rural and remote areas, which is beyond the reach of other financial platforms. Digital inclusive financial services should not only be oriented to cities, but also need to further expand the business scope to rural areas. By the end of 2020, the total number of branches of banking financial institutions nationwide reached 226,700. A total of 156,200 self-service banks were deployed, and a total of 973,700 self-service devices were deployed. The transaction volume of self-service devices reached 21.254 billion. It further shows that the financial scale continues to grow. The coverage of bank branches in townships is also increasing. According to survey results, the lower net worth customers are, the more likely they are accustomed to going to outlets to handle financial business. Therefore, commercial banks can take advantage of the channel advantages of offline business outlets to continuously improve the penetration rate of inclusive finance.

Sufficient Funds. The development of digital inclusive finance requires sufficient financial support, and commercial banks have a special social status and can use the credit intermediary function to absorb deposits, issue loans, and realize capital financing. As of the end of 2020, the total assets of commercial banks totaled 25.9 trillion yuan, an increase of 11.5% over the same period of the previous year, and from the perspective of the financing supply of commercial banks' total assets to small

and micro enterprises, the composition of commercial banks' total assets is much larger than that of small and micro enterprises. It can be seen that commercial banks have the financial strength and advantages to promote the digital transformation of inclusive finance, and can meet the financing needs of customers to the greatest extent, which is beyond the reach of Internet financial platforms.

System Improvement. After long-term development, commercial banks have formed a relatively mature management system. Compared with new financial service platforms, commercial banks have standardized procedures, orderly operations, and perfect business models. At the same time, commercial banks have complete licenses and qualifications, and can operate a wide range of financial products to meet customer needs in one-stop. In addition, commercial banks have more experience in providing financial services and attracting customers. The sound management and operation system provide favorable conditions for the digital transformation of commercial banks' inclusive finance, which is conducive to the orderly development of digital inclusive finance business.

2.2 Analysis of the Weaknesses of Commercial Banks in Developing Digital Inclusive Finance

Insufficient Endogenous Power. When commercial banks carry out the digital transformation of inclusive finance, they need to invest a lot of money to innovate existing products and technology, and invest manpower and material resources to build financial infrastructure in remote areas such as rural areas to meet customers' diversified financial service needs. Under normal circumstances, the return time of such investment funds is relatively long. At the same time, in terms of cost and benefit, commercial banks lack motivation for development due to the relatively small loan amount and poor profitability of small and micro enterprises and farmers. As a special industry, commercial banks also follow the principles of market economy and pursue profit maximization, which will lead to insufficient enthusiasm for commercial banks in the process of investment, and lack of sufficient motivation to develop digital inclusive finance.

Prominent Risk Issues. Fundamentally speaking, digital financial inclusion still belongs to the financial field, so it cannot escape the risky nature of finance. Due to the relatively high operational risks of small and micro enterprises, it is relatively difficult for farmers to collect credit information, and commercial banks are also faced with greater risks. At the same time, problems such as data and information security in the digital age will only become more prominent. The digital technology applied by commercial banks to expand digital inclusive finance business may lead to certain problems in systems, information and funds. Risk, which makes commercial banks need to pay more attention to the prevention and control of risks in the process of

transformation, and increases the difficulty of innovation in methods and technologies (Zhao 2020).

Lack of Professional Talents. For commercial banks to develop digital inclusive finance, fintech talents are the key. At present, due to the rapid upgrading of digital technology, digital risks are intensified, and commercial banks need a large number of high-quality financial technology talents to meet new challenges. However, according to the current situation, the number of fintech talents is very limited, and they are mainly concentrated in strong commercial banks. Small banks generally have the problem of lack of talents to carry out digital transformation. In addition, domestic fintech talents mainly come from colleges and universities, but now there are relatively few colleges and universities that set up fintech-related majors, and some master's education is carried out in the form of on-the-job education, so the supply of professional talents is very short. These factors restrict the digital transformation of commercial banks' inclusive finance (Song 2021).

2.3 Analysis of the Opportunities for Commercial Banks in Develop Digital Inclusion

National Policy Support. Inclusive finance has always been one of the shortcomings of my country's financial services to the real economy. This is a major issue related to the national economy and people's livelihood, and it is also an important direction for my country to deepen the reform of the financial system. Therefore, the government has issued many preferential policies in building an inclusive financial system, such as implementing a differentiated deposit reserve ratio policy for banks and increasing the tolerance of non-performing loans for small and micro enterprises. In addition, in order to cope with the impact of the new crown pneumonia epidemic, the state has introduced a series of measures to support the resumption of production and work of small and micro enterprises, and to support enterprises that have encountered temporary difficulties to tide over the difficulties. The proportion of loans, reducing its comprehensive financing costs, and increase the resource preference in the field of inclusive finance. Therefore, in the context of this era, commercial banks should seize the relevant policy dividends of the country and vigorously develop digital inclusive finance to promote their own sustainable development (Bai 2021).

Urgent Market Demand. Before the introduction of digital financial services, the resources of traditional commercial banks tended to be concentrated in developed regions and cities, and they were more inclined to provide credit services to large companies and large customers with secured mortgages. And farmers' investment in financial services is not enough, and their financing needs have been difficult to meet, which hinders the development of the latter to a certain extent. As shown in Fig. 1, in 2019, small and micro enterprise loans accounted for 37.5% of corporate loans, while inclusive small and micro enterprise loans only accounted for 31.6% of

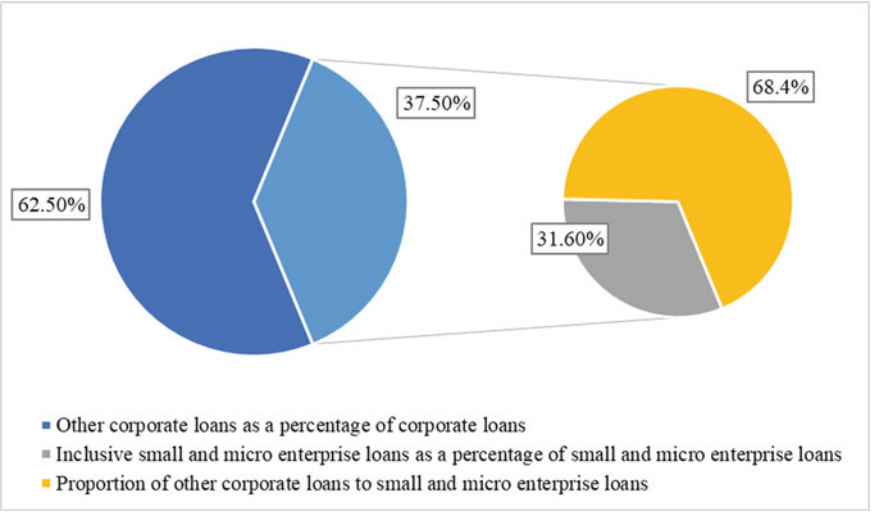


Fig. 1 Financing support obtained by small and micro enterprises

small and micro enterprise loans. The financing needs of small and micro enterprises are still in an unsatisfactory state. Especially during the COVID-19 outbreak, there is a bigger gap in the borrowing needs of small and micro enterprises and farmers. Therefore, the urgent market demand provides a broad space for commercial banks to carry out digital inclusive finance, and at the same time helps them to spread risks to a wider customer base, providing them with new impetus to maintain business sustainability.

Digital Technology Upgrade. With the rapid development of digital technology, the banking industry is moving forward in the direction of intelligence, mobility and dataization. The development of inclusive finance with the help of digital technology has lowered the threshold for ordinary users to enjoy financial services, reflecting the availability of inclusive finance, affordability, diverse forms, and commercial sustainability, providing more possibilities for its digital transformation. The digital transformation of commercial banks is a necessary condition for them to participate in the digital banking competition in the future. In the future of digital inclusive finance, big data and government risk compensation can be used, combined with taxation, industry and commerce and other departments to conduct multi-dimensional data cross-validation, so as to provide more comprehensive and personalized financial services for the target customers of inclusive finance (Liang 2021b).

2.4 Analysis of the Treats of Commercial Banks in Developing Digital Inclusive Finance

Incomplete Laws and Regulations. At present, my country's relevant policy documents on the digital transformation of inclusive finance are continuously being rolled out, but in general, the degree of perfection of laws and regulations in this area is still relatively low, and the requirements of relevant departments in the field of digital inclusive finance are not yet specific and complete. For example, during the two sessions in 2020, the deputies of the National People's Congress submitted a proposal to promulgate the "Inclusive Finance Promotion Law of the People's Republic of China" as soon as possible, but there has been no major progress; Relevant regulatory policies such as the "risk compensation mechanism" have not been fully implemented. The application of digital technology may lead to uncontrolled commercial banks, lack of motivation for transformation, or excessive use of new technologies in some aspects, which will eventually lead to financial risks. In addition, there are currently no standardized industry standards and industry self-discipline rules among financial institutions, all of which restrict the digital transformation of inclusive finance.

Inadequate Infrastructure. For some rural areas that need inclusive financial services, there is still a lack of hardware infrastructure, and they usually lack developed communication networks and abundant mobile terminals. According to relevant data, as of the end of 2020, the number of rural netizens in my country was 309 million, and the scale of urban netizens was 680 million. The specific trend of Internet penetration in urban and rural areas in recent years is shown in Fig. 2.

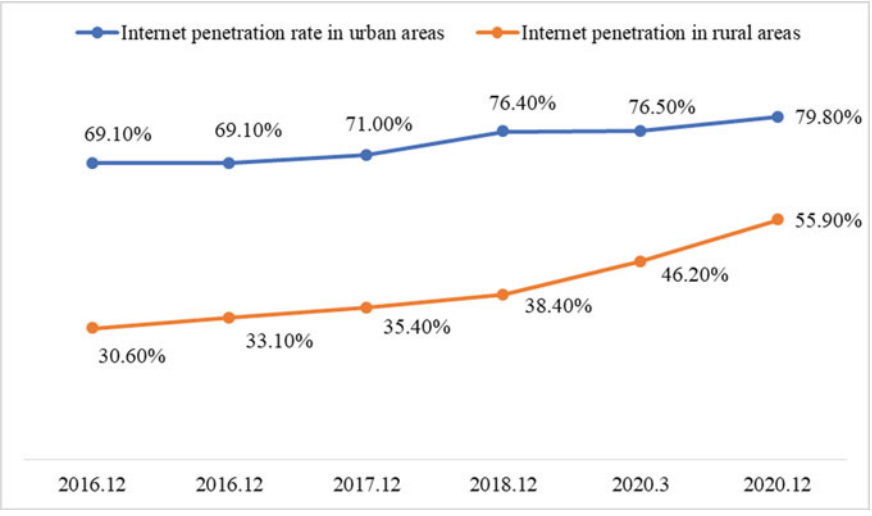


Fig. 2 Internet penetration rate in urban and rural areas

Although the Internet penetration rate in urban and rural areas in my country is increasing, there are still obvious differences between urban and rural areas in specific applications. Urban netizens are more inclined to use the Internet to check news information, make daily payments, and conduct business transactions; while in rural areas, the proportion of netizens who access the Internet through computers, smart TVs, and tablets is relatively low, and the efficiency of Internet use is not high. In addition, when obtaining relevant data in rural areas, commercial banks consume more manpower, material resources and time, which make the digital transformation of inclusive finance difficult to reach.

The Digital Divide Needs to be Broken. Digital financial inclusion relies on digital technology, and the target customers of financial inclusion generally cover people in remote areas. For a long time, they have been difficult to access the Internet, seldom use smart terminals, and are not familiar with related businesses of financial services. Personal information is more difficult to query, which just confirms the core content of the financial exclusion theory, that is, they lack the ability to obtain necessary financial services in an appropriate way, and it is more difficult to quickly integrate into the financial service system, and it is difficult to enjoy the benefits brought by financial services. In addition, weak awareness of risk prevention and lack of financial knowledge also led to credit and operational risks when they use digital finance, leaving room for digital criminals to commit crimes.

The Credit Reporting System Needs to be Strengthen. At present, my country's credit reporting system has problems such as resource closure, data segmentation, lack of effective credit information, and lack of a comprehensive credit guarantee system. According to data released by the official website of the People's Bank of China, as of the end of 2020, my country's credit information system had recorded a total of 1.1 billion natural persons, 60.923 million enterprises and other organizations; 1.67 million households.

Among them, the proportion of small and micro enterprises that have received credit support is very low, the customer information that commercial banks can obtain from the existing credit reporting system is still very small, and the available credit archives are also very limited, which has led to widespread the credit dilemma of Hui Finance has not been fundamentally resolved. It is urgent for the state to speed up the construction of the credit system, improve the information collection and integration of the credit reporting system, and provide multi-level effective guarantees for the digital transformation of inclusive finance.

2.5 Analysis of SWOT Matrix

According to the above analysis, the SWOT analysis of commercial banks' promotion of the digital transformation of inclusive finance can be formed into a rectangular array of "field characters", as shown in Table 2.

Table 2 SWOT analysis matrix for commercial banks to promote the digital transformation of inclusive finance

	Strengths	*Weaknesses*
	1. Wide channels 2. Sufficient funds 3. System improvement	1. Insufficient endogenous power 2. Prominent risk issues 3. Lack of professional talents
Opportunities 1. National policy support 2. Urgent market demand 3. Digital technology upgrade	*Opportunity—Strength strategies*	*Opportunity—Weakness strategies*
	Seize the policy dividends, provide personalized digital inclusive financial services based on customer needs, and achieve product segmentation and precise marketing	Use digital technology to carry out risk management and control before lending and after lending, expand the scope of beneficiary companies, and improve the talent training mechanism
Threats 1. Incomplete laws and regulations 2. Inadequate infrastructure 3. The digital divide needs to be broken 4. The credit reporting system needs to be strengthened	*Threat—Strength strategies*	*Threat—Weakness strategies*
	Take advantage of channels to popularize digital inclusive finance knowledge online and offline, improve customer acceptance, strengthen cooperation between "bank tax" and "bank enterprise", and jointly build an information sharing platform	Maximize the use of its own assets, reduce transaction costs, cooperate with relevant departments, and provide decision support for the country to introduce new systems

Through the SWOT analysis of commercial banks promoting the digital transformation of inclusive finance, it can be seen that under different strategic combinations, the focus is different, and the coping strategies that need to be adopted are also determined by the situation. Giving full play to strengths, taking advantage of opportunities, making up for weaknesses and avoiding threats will be the overall direction for commercial banks to develop digital transformation of inclusive finance in the future.

3 Results

Judging from the current achievements of commercial banks, the digital transformation of inclusive finance in the future has huge development prospects. Based on the above SWOT analysis, the following development strategies can be proposed. In the process of promoting the digital transformation of inclusive finance, commercial banks should give full play to their advantages such as sufficient funds and wide channels, constantly make up for their disadvantages, and strive to seize the external development wave of digital technology, the country's policy dividends, and the

urgent needs of the market. Seize opportunities, avoid external threats, focused on providing customers with more personalized financial services, innovating marketing and business models, improving risk prevention mechanisms, strengthening the construction of information sharing platforms and other aspects to promote the digital transformation of inclusive finance.

4 Conclusion

With the rapid development of digital technology, commercial banks have begun to explore financial technology. Judging from the current achievements of commercial banks, the future digital transformation of inclusive finance has great development prospects. This paper has conducted a SWOT analysis of commercial banks to promote the digital transformation of inclusive finance, and found that under different strategic combinations, the focus is different, and the coping strategies that need to be adopted are also determined by the situation. In the future, the overall direction for commercial banks to develop inclusive finance digital transformation will be to give full play to their advantages, take advantage of opportunities, make up for disadvantages and avoid threats.

References

Bai Z (2021) Research on the dynamic mechanism of digital inclusive finance to support rural domestic demand expansion under the background of dual cycle. Bus Econ Res 8:128–132

Kong Z, Ye Y (2012) Lishui practice of digital inclusive finance. China Financ (06)

Liang W (2021a) Thoughts on promoting the high-quality development of digital inclusive finance by commercial banks. The Banker 7:63–66

Liang W (2021b) Thoughts on promoting the high-quality development of digital inclusive finance in commercial banks. The Banker 7:63–66

Ludmila V, Marina A, Ivan K, Roman V (2019) Digital transformation of Russian banking institutions: assessments and prospects. Mater Sci Eng 497(1)

Song X (2017) An empirical test of digital inclusive finance narrowing the urban-rural income gap. Financ Econ 06

Song J (2021) The influence of the development of digital inclusive finance on the competition of my country's banking industry. Econ Res Guid 28:70–72

Wu J, Gu Z (2018) Literature review of digital inclusive finance. Finance Acc Mon 19

Yang X, Guo W (2008) High-quality promotion of financial digital transformation and sustainable development of inclusive finance. China Rural Credit Cooperation News, 004

Zeng G (2020) Difficulties and paths of digital transformation of commercial banks. Enterp Observer 07:71–73

Zhao D (2020) Research on the digital transformation of my country's commercial banks' inclusive finance. Southwest Finance 12:35–43

Tesla's Global Talent Strategy Research and Prospects

Ziyi Jie, Tsz Hong Ma, Xing Wu, and Meng Xia

Abstract Tesla, a Silicon Valley startup founded in 2003, has become the world's most valuable car brand in less than 20 years, with a total market value of $1.03 trillion. For many years, talent strategy has always been a vital force supporting Tesla's corporate strategy in development. Thanks to the personal management style and unique corporate culture of founder Musk, Tesla has gathered many talents since its establishment. With the company's rapid development, the loss of talents has become a potential risk for the company. Through the analysis of talent turnover data from 2019 to now, the study finds that abusive management is one of the crucial reasons for the high turnover rate of Tesla employees. This paper innovatively puts forward suggestions to deal with abusive management from three dimensions of "supervisor, employee and organization."

Keywords Tesla · Talent strategy · Organizational behavior · Abusive management

Tsz Hong Ma, Xing Wu, Meng Xia—contributed equally

Z. Jie (✉)
Shenzhen College of International Education, Shenzhen 518017, Guangdong, China
e-mail: 2823453823@qq.com

T. H. Ma
Kings College, Hongkong 999077, China

X. Wu
Arizona State University, Arizona 85287, USA

M. Xia
Huazhong University of Science and Technology, Wuhan 430074, Hubei, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_105

1 Introduction

Talking about the future development trend of the electric vehicle industry, in 2020 January, General Motors announced plans to end production of diesel- and gasoline-powered vehicles by 2035. The move comes after Volkswagen, Europe's largest automaker, announced it would invest $86 billion over the next five years to develop electric vehicles, digital automakers, and self-driving cars. In addition, in 2020, Tesla's market value has soared from $100 billion to $800 billion, more than the combined market value of the nine traditional car companies, as investors are very interested in electric vehicles. Although Tesla sold less than 500,000 vehicles last year, sales are expected to increase by 50% year on year.

Tesla was launched in 2003 with the mission of "to accelerate the advent of sustainable transport by bringing compelling mass-market electric cars to market as soon as possible (Musk 2018)." It has now become the market leader of the electric vehicle industry and has successfully boosted the development of electric vehicles. In the first two fiscal years of 2020, Tesla maintained an 81.66% market share of the EV Market in the U.S. (Lambert 2020). It continues to dominate the U.S. electric vehicle market, with an estimated 302,000 electric vehicles sold in the United States in 2021 (Carlier 2022). It is its ambitious aim, the spirit of changing the world, being innovative, and focusing on producing the product that enables the company to succeed. From day one, Tesla follows their long-term plan of making a car affordable to the general public while having zero-emission of electric power. They never follow the trend but are highly innovative and constantly develop new and revolutionary ideas. Whenever they are in a plight, they never compromise but keep thinking and coming up with solid solutions. Focusing on hiring like-minded people and prioritizing technology development is essential for Tesla's colossal success. Peter Thiel, the co-founder of PayPal with Musk, wrote in his book Zero to One, "Tesla's CEO is the consummate engineer and salesman, so it is not surprising that he has assembled a team that's very good at both." Tesla assembled elites in the technology, management, and financial industry to help them develop the most cutting-edge technology, patent, and produce the best product. It is undeniable that Tesla is one of the most powerful corporations in the twenty-first century (Person 2020).

Tesla is about to announce the highly anticipated fourth-quarter delivery report card, released around January 3, 2022. According to FactSet data, Wall Street expects to deliver 267,000 vehicles in the fourth quarter, up from 241,300 in the third quarter of 2020. Barron's contributor Al Root noted that Tesla needs to deliver 272,650 vehicles to reach 900,000 in all of 2021.

Deutsche Bank raised its forecast for Tesla's fourth-quarter deliveries to 282,000 from 268,000 due to higher deliveries of the Tesla Model 3 and Model Y in China. The fourth-quarter revenue forecast raised $16.1 billion from $15.4 billion, while earnings per share were raised to $2.46 from $2.22. Deutsche Bank is modeling 1.47 million Tesla vehicles for the entire year of 2022. It predicts that if the supply of chips improves, the number of vehicles delivered throughout the year is expected to

increase further. Tesla (TSLA-US) was down 0.065% at $1069.41 a share in early trading Friday, up more than 46% so far this year.

Nonetheless, although Tesla currently ranks fifth in the U.S. stock market after Microsoft, iPhone, Google, and Amazon in terms of total market capitalization, the company has experienced a series of executive turnover since 2019, with more than 100 executives leaving the company in the past three years. Even leaving out senior executives, the turnover rate for all Tesla employees is 27%, far higher than the 15% rate for all other Silicon Valley tech companies. Various data indicate that this constantly increasing demission rate may become a potential crisis for Tesla's development in the future. A combination of research has shown that founder Musk's management style and the highly demanding corporate culture he has established are the biggest reasons for the brain drain. As a form of toxic leadership, abusive management has become a hot topic in human resource management, organizational behavior, and leadership research since Tepper (2000) first put forward this concept in 2000. The reading of literature papers found that the research on the causes of abusive management has been relatively mature, and abundant antecedent variables have been excavated. By combing the literature and the practical problems encountered by Tesla in talent management, this study innovatively gives countermeasures and opinions from three dimensions of supervisor, employee, and organization.

2 Background and Essential Information of Tesla

2.1 Tesla 's Organization Culture, Leadership Style and the Situation of Tesla in the Industry

Tesla's Organizational Culture and Human Resource Strategy. Tesla has a unique organizational culture of innovative, propelling, and high-standard (Grove HR Solution 2022). It encourages its workers to be creative and think out of the box, challenging the current status quo of conducting the business, constantly identifying customers' needs, and producing the ideal product to accelerate the world's transition to sustainable energy (Meyer 2019). It is precisely due to their innovative thinking and ambition to do the "impossible" that leads to the production of the Model S—The most extraordinary vehicle of the twenty-first century, pushing the development of the entire electric vehicle industry. The organization always works highly productively and efficiently since effective communication is stressed in its organizational culture. Any level of management is not restricting their day-to-day talk. It is said in their anti-handbook handbook that "Anyone at Tesla can and should email or talk to anyone else according to what they think is the fastest way to solve a problem for the benefit of the whole company." (Murphy 2022). The organization works in a flat structure, where employees are all given equal rights of advising workers and the corporation. The ability for the workers to think fast, move fast,

and act factually is also stressed in the corporate culture. It valued the capability of quickly generating innovative ideas according to the change in the international market. For example, the ability of the workers to develop a cutting-edge product that could exceed that of their competitors, which gives them an absolute competitive advantage (Meyer 2019). This type of innovation, while high-demanding organizational culture, leads to Tesla's unique human resource strategy, where they prefer to "hire exceptional people who enjoy pushing themselves to perform at the highest levels every day." Murphy (2022) to work in their company. It is precisely due to their unique and special culture that makes Tesla stand out in the global automotive, renewable industry.

Tesla's Leadership Style. Tesla's Leadership style is set around meeting their company's ultimate goal. However, what is noticeable is that Elon Musk, the CEO of Tesla, often sets an impracticable and ambitious target that seems impossible to achieve rather than setting some reasonable goal to complete it. He links the company's goal to a brighter and better future, which makes the whole company believe that their work matters and that it fits into the bigger picture (Archwell and Mason 2021). This led the company to be ambitious and think big, pushing the employees to set stretched targets and motivating them to work harder (Khan 2021). The whole company is also action-orientated. They think big and outline and set up strategies to make their visions a reality. These all attribute to the implementation of the transformational leadership of Musk, and it is also why Tesla succeeds in becoming the leader of the automobile industry.

On the other hand, due to Musk's meticulously attitude towards the work and his personality of lack of loyalty and connection, Tesla develops a high-demanding management mode (Khan 2021). It is said by current Tesla workers that "Most jobs are predominantly easy, but you are over worker due to the lack of staff. Moreover, management absolutely sucks. When you want to use PTO it all depends on work demands. Most of the time they deny it." "It's a terrible place to work. We're forced into doing mandatory overtime at the end of every quarter."

Indeed's Work Happiness survey asked over 1,197 current and former employees if they felt stressed working at Tesla. Of the respondents, 51% said they strongly agreed or agreed that they felt stressed at work most of the time (Tesla 2022). Changing their demanding leadership style, Improving the working environment, and treatment towards their work is undoubtedly something that Tesla should focus on in recent years.

2.2 The Situation of Talents in the Global Electric Vehicle Industry and the Essence of Tesla's Talent Team Building in the Industry

As a manpower-intensive industry, talents are essential for the automotive industry. This is especially true for the emerging field of new energy vehicles. The most significant difficulties facing the new energy vehicle industry are technical bottlenecks and the shortage of corresponding technical talents. Excellent technical personnel can help solve technical bottlenecks, so it can be seen that the shortage of excellent R&D personnel is the core problem that new energy vehicle enterprises need to solve, in addition to capital and government relations. In terms of talent distribution, the middle and high-end talents of new energy vehicles in China mainly come from domestic enterprises that have been engaged in relevant research and development for a long time, such as BYD. In addition, overseas scholars and overseas returnees from relevant R&D units and supporting suppliers of foreign vehicle factories are also the primary sources. It is estimated that about 60–70% of candidates have changed careers from other industries, and more than 700 candidates have been contacted (Mangram 2022).

In terms of market capitalization, the total market value of American electric vehicle enterprises is 1.32 trillion US dollars, accounting for 89.82% of the total market value of TOP10, of which Tesla alone accounts for 75.96%. The total market value of the other five American car companies accounts for less than 14%. The total market value of Chinese electric vehicle enterprises is 1387 billion US dollars, accounting for 9.80% of the whole market, and British car companies have a market value of $5.6 billion, accounting for 0.38% of the whole market. Judging from the listing time, seven years after 2010, Tesla was the only pure electric vehicle company in the capital market. Arcimoto, the second electric vehicle company, was listed in 2017. In 2018, Nikola (Nicola), Electro Meccanica, NIO, and Fisker (Fisk) were listed. In 2019, Lordstown and Canoo (Kano) were listed, with the most significant listings in 2020, including Arrival, Ideal Automobile, Xiaopeng Automobile, Lucid, and Prot. Erra 5 car companies are listed, and since 2021, two car companies, REE and Rivian, have been listed. In terms of the ranking, Tesla's market value has consistently ranked first in the past 11 years, far exceeding the market value of other electric vehicle companies. Since 2020, Tesla's market value has proliferated, with an average daily market value of more than 100 billion US dollars in the first quarter of 2020, nearly 500 billion US dollars in the fourth quarter, and exceeding trillion US dollars in the fourth quarter of 2021 (Sina Auto n.d.). The reason why Musk can attract and gather a large number of excellent talents and follow him to achieve subversive innovation and breakthroughs is inseparable from Tesla's pursuit of excellent engineer culture. He persistently insists that engineer culture is "making the best product" and openly despises the usual practices in business.

Lian Pope, Tesla's former chief financial officer (CFO), believes that Tesla's achievement is entirely due to Musk's full pursuit of products and perfection, leading the team to solve all technical challenges constantly.

The thinking brought to us by the construction of Tesla's automobile talent team is that excellent corporate culture, visionary leaders, outstanding engineers, and the spirit of always challenging ourselves are the essence of Tesla's talent team construction.

First of all, use the "first principle" to establish the ideal and goal of "geek" and establish a "special force" talent team. Musk's every start-up is a subversive innovation from 0 to 1. Naturally, geek engineers volunteer to join his team to change the world. The connotation of Tesla's geek culture is that once you join Tesla, you are ready to devote your time and energy to creating a better future together—"accelerate the transformation of human beings to sustainable transportation."

Secondly, low salaries and high pressure can also recruit talents. At Tesla, many geek engineers are willing to accept lower salaries than Silicon Valley IT companies such as Google and Apple and the challenges and pressures of Tesla time. Tesla's approach is very different from Google and Ford. Both Google and Ford advocate the best compensation for the best talents. However, Tesla's salary level in Silicon Valley is significantly lower than that of IT companies like Apple and Google.

Tesla's product demand and popularity index are growing, bringing employees a sense of satisfaction and achievement. This is the secret of Tesla's gathering talents (Springasia.com 2022).

3 Identification of the Problem and Suggestion

3.1 Analysis of Employee Satisfaction and Turnover Rate in Tesla

According to incomplete statistics from《Auto Commune》, Tesla has experienced a series of executive turnover since 2019, with more than 100 executives leaving the company in the past three years. In 2020, Tesla's vice president of Business Development Ren Yuxiang, human resource manager Kevin Kassekert, production director Jatinder Dhillon, and vice president of global finance Justin McAnear all left the company on and off, and suitable talents did not fill some positions. Mr. Musk has chosen to reorganize these positions. In January 2021, Joseph Mardall, Tesla's director of engineering, handed in his resignation to join drone startup Zipline after helping Musk create his innovative "dark tech"—the heat pump system for the Model Y. In April 2021, Alan Prescott, Tesla's vice president of legal and acting general counsel, left to join Luminar as chief Legal officer, being the fourth-tesla general counsel to leave the company in the last three years. In the first half of 2021 alone, four departing executives reported directly to Musk, and if we go back over the past two to three years, Tesla's accounting, legal, and R&D department are all hot spots for "high-level unrest."

Why can't Tesla keep talents? A 2019 report by Analysts at Sanford C. Bernstein found that the annual job turnover rate of Tesla executives reporting to Mr. Musk at

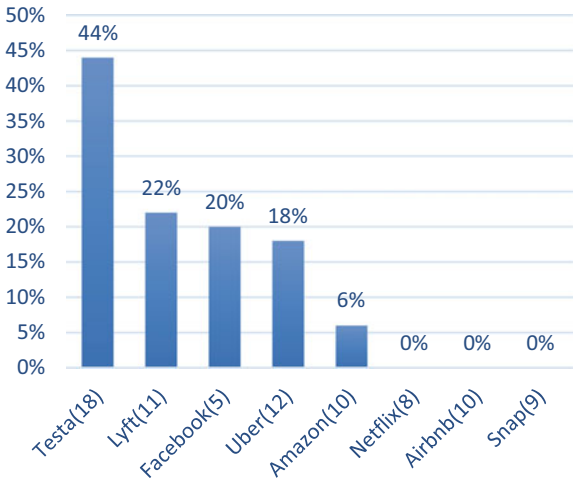


Fig. 1 Annualized turnover rates of CEO's direct reports: TSLA versus peers

the time was 44%, well above the 9% average for American tech companies. The No. 2 company, Lyft (the US version of DiDi), had a turnover rate of 22%, half that of Tesla, while the No. 3 company, Facebook, had a turnover rate of 20%.

Even leaving out senior executives, the turnover rate for Tesla's entire workforce is 27%, compared with 15% for other Silicon Valley tech companies (Fig. 1).

The turnover rate at the top of Tesla has been high in recent years, with many key figures and even top executives who have been with Musk for many years leaving the company, causing widespread public concern. Furthermore, the focus of much attention tends to shift to Mr. Musk. The Silicon Valley genius was brilliant and hard-working, but he was also paranoid, irritable, and prickly. Musk has lashed out at the analysts on earnings calls while simultaneously lashing out at journalists and fellow car makers on social networking sites, making Tesla's stock price fluctuate sharply in response to his comments.

In addition to founder Musk's leadership style, there is demanding company culture.

Musk, known as the "lonely Iron Man" in the industry, is himself a workaholic who is obsessed with his career day and night. In terms of the progress of many important projects, he was very aggressive and often required his senior managers to finish them within a few hours or a day. As a result, this high-pressure culture of "working hard" was gradually formed in the whole company, becoming increasingly severe over time.

Of course, there are also external factors. When the transformation of the automobile industry is in full swing, traditional automobile manufacturers spend a considerable amount of money on building new departments facing the future. At the same time, there is a constant emergence of new car companies, and many startups with great potential also get colossal financing. The high-level mobility of China's new car power mirrors the external environment that needs, or likes, mature executives with Tesla's working experience.

In 2019, at the height of the executive exodus, a recently departed Tesla executive attended a Silicon Valley cocktail dinner and was asked, "What do you think of Musk?" "Like the sun, the closer you are to him, the more likely you are to get burned."

This "burn" in organizational behavior can be called abusive management. Abusive management refers to hostile verbal and non-verbal behavior perceived by subordinates to be repeatedly exhibited by superiors, but no physical contact (Tepper 2000). The specific manifestations are mocking and ridiculing subordinates, criticizing them openly, being rude to them, and encroaching on their achievements. About 13.6% of U.S. employees report being abused at work, costing companies $23.8 billion (Tepper 2007) yearly in absenteeism, turnover, and lost productivity. Many studies have found that in different cultural backgrounds and different organizational situations, the shame of boss abuse management will trigger subordinates' mental tension, hostility, anger, and other negative emotions. This could lead to increased job burnout and turnover intention, motivating Organizational deviant behavior; in addition, it negatively affects the creativity and work performance of employees, harming the development of the organizations to a large extent (Tepper 2007; Mackey et al. 2017; Tepper et al. 2017).

3.2 Suggestion Given to the Identified Problem

Suggestion Given in the Supervisor Level. One of the key things is to maintain a good lifestyle. Barnes et al. (2015) found that inadequate, poor-quality sleep can lead to supervisor ego depletion, leading to abusive management. Therefore, supervisors at Tesla (Musk specifically) should form a healthy life, fully ensure the quality and quantity of their sleep, and strengthen physical exercise to relieve negative emotions, which improves their work efficiency and avoids the emotional release to employees through abusive behavior. Eissa and Lester (2017) point out that some supervisors bear much workload in order to maintain the competitiveness and performance of the enterprise, so their role overload causes a lot of destructive emotions. Appropriate work content or time can reduce the supervisor's work pressure to a certain extent, eliminate a source of negative emotions, and then inhibit the generation of abusive management or reduce abusive behavior. Managers should learn to control and vent their emotions reasonably. They should understand that their emotions will adversely affect employees and the organization and limit their development. Only managers who know how to manage their emotions are more likely to win respect and trust of others and achieve success.

Suggestions Given in the Employee Level. Employees should be clear about the organization's development vision and goals. As well as that, in face of the abusive behavior of supervisors, employees should not blindly seek peace or obey because of fear, or even insinuate to the abusive management of the superior leader for personal interests, nor should they just quit and resign. These will only aggravate the abusive

management but not ease it in any extent. Active and positive coping strategies are the most advocated. Employees in Tesla should learn to communicate with their supervisors actively, understand the in-depth information, and make clear the reasons for their supervisors' behavior, to take targeted strategies. At the same time, when employees are suffering from abusive behavior, they must first learn to self-regulate, manage their emotions well, find appropriate ways to release their nervous emotions and work pressure to reduce the negative impact of abusive behavior. They could then objectively evaluate themselves based on the actual situation. If personal improvement is needed, take the initiative to express a reflective attitude to the supervisor and actively improve work performance.

Suggestions Given in the Organization Level. As the behavior of supervisors is closely related to their characteristics, if employees in Tesla are aggressive or tend to manipulate others, then the organization's control of abusive management will become extremely difficult. As a consequence, in the selection and appointment, the organization needs to strictly control each detail and thoroughly investigate personnel's soft aspects. During this process, attention should be paid to evaluating candidates' emotional intelligence, and this should be regarded as one of the criteria for selection. In addition, Tesla needs to carry out strict checks on supervisors' personal experience, educational background, and family background, which is related to supervisors' ability and capital for work and related to the possibility of abusive management. Simultaneously, it is necessary to fully understand the individual characteristics of employees in Tesla when selecting them, and employees with personality defects should be avoided from entering the organization as far as possible. In addition, it is necessary to take emotional intelligence as an essential part of employee recruitment, selection, and training. Employees with a high level of emotional intelligence are better at self-control. Self-regulation, making reasonable judgments, and positive responses to the supervisor's behavior contribute to the suppression and weakening of abusive management.

The firm should also create an excellent organizational environment, which means that Tesla should cultivate a fantastic corporate culture and create a harmonious cultural atmosphere. As well as that, it is necessary to build a sound organizational system. The organization can establish a subordinate scoring mechanism to evaluate the abusive behavior of supervisors in combination with other auditing methods. Furthermore, in the implementation process, all systems must strictly control each link to be fair, justice, and open. Organizational justice is crucial for supervisors; it can also regulate counterproductive behaviors caused by abusive management.

Additionally, strengthening training can promote the knowledge learning and ability improvement of personnel. Tesla could further focus on strengthening their communication, education, and training of supervisors who frequently commit abusive behavior, improving their communication ability and overall management level, and improving supervisors' lousy management behavior. Training employees can enhance their business ability and interpersonal skills, improve their performance,

strengthen the communication between employees and supervisors through activities, close the relationship between them, and reduce conflicts between superiors and subordinates.

Reasonable collocation of personnel and post-matching can give full play to the maximum utility and value; good leader-subordinate matching is also essential, which is very meaningful to reduce friction and communication barriers.

To solve the problem, Tesla can provide leisure and entertainment areas in the workplace, organize regular outing activities, provide psychological counseling and other measures to reduce the tension atmosphere at work, help supervisors and employees release destructive emotions and work pressure, reduce the negative impact of abusive behavior.

4 Conclusion

In the view of most scholars, abusive management is a kind of destructive management behavior caused by various reasons. It will negatively affect employees' psychological health, behavioral performance, and organizational performance. Consequently, organizations should learn to take effective and targeted measures to avoid the emergence of abusive management and create a harmonious organizational atmosphere to boost the realization of organizational goals and personal interests. However, it can be seen from the market value increase of Tesla in the past three years that the high demission rate of senior executives or employees does not severely impact the corporate's efficiency. Thus, we should also notice that with specific situations, the measures to deal with abusive management should also be flexible so that it will not restrict the advancement and prosperity of the organization.

Acknowledgements We appreciate for the equal contribution of every author and we would also like to thank everyone who had offered suggestions and deep insight into the study.

References

Archwell D, Mason J (2021) Evaluating corporate leadership in the United States: a review of Elon Musk leadership. Afr J Emerg Issue, 3(2):1–10. Retrieved from https://www.ajoeijournals.org/sys/index.php/ajoei/article/view/170

Barnes CM, Lucianetti L, Bhave DP, Christian MS (2015) "You wouldn't like me when I'm sleepy": leaders' sleep, daily abusive supervision, and work unit engagement. Acad Manag J 58(5):1419–1437

Carlier M (2022) Topic: electric vehicles in the United States [Online]. Statista. Available at: https://www.statista.com/topics/4421/the-us-electric-vehicle-industry/. Accessed 12 Mar 2022

Eissa G, Lester SW (2017) Supervisor role overload and frustration as antecedents of abusive supervision: the moderating role of supervisor personality. J Organ Behav 38(3):307–326

Grove HR Solution (n.d.) Inside tesla company culture: innovative and propelling. Retrieved March 13, 2022, from https://blog.grovehr.com/tesla-company-culture

Khan M (2021) A critical analysis of Elon Musk's leadership in Tesla motors. J Glob Entrepreneurship Res 1–10

Lambert F (2020) Tesla holds 80% of US EV market despite losing federal tax credit. Electrek. Retrieved March 13, 2022, from https://electrek.co/2020/08/21/tesla-holds-us-ev-market-losing-federal-tax-credit/

Mackey JD, Frieder RE, Brees JR, Martinko MJ (2017) Abusive supervision: a meta-analysis and empirical review. J Manag 43(6):1940–1965

Mangram M (n.d.) (PDF) The globalization of Tesla motors: a strategic marketing plan analysis. ResearchGate. Retrieved March 13, 2022, from https://www.researchgate.net/publication/254322834_The_globalization_of_Tesla_Motors_A_strategic_marketing_plan_analysis

Meyer P (2019) Tesla Inc.'s organizational culture & its characteristics (analysis). Panmore Institute. Retrieved March 13, 2022, from http://panmore.com/tesla-motors-inc-organizational-culture-characteristics-analysis

Miller HL (2022) 4 ways to apply Elon Musk's leadership style. Leaders.com. Retrieved March 13, 2022, from https://leaders.com/articles/leadership/elon-musk-leadership-style/

Murphy B Jr (2020) Tesla's 'anti-handbook handbook' for new employees just leaked. It's pure Elon Musk, and your business should definitely copy it. Inc.com. Retrieved March 13, 2022, from https://www.inc.com/bill-murphy-jr/teslas-anti-handbook-handbook-for-new-employees-just-leaked-its-pure-elon-musk-your-business-should-definitely-copy-it.html

Musk E (2018) The mission of Tesla. Electric cars, solar & clean energy. Retrieved March 13, 2022, from https://www.tesla.com/blog/mission-tesla

Person (2020) 7 reasons why tesla has succeeded where others have failed. Manufacturing Digital. Retrieved March 13, 2022, from https://manufacturingdigital.com/smart-manufacturing/7-reasons-why-tesla-has-succeeded-where-others-have-failed

Sina Auto (n.d.) Understand the changes in the market value of global electric car companies, the United States relies on Tesla. Retrieved March 13, 2022, from https://auto.sina.com.cn/zz/hy/2021-11-24/detail-iktzqtyu9224927.shtml

Springasia.com (2022) [Online]. Available at: https://www.springasia.com/media/spring-asia/client/content/New%20Energy%20Automotive%20Industry%20Report.pdf. Accessed 12 Mar 2022

Tepper BJ (2007) Abusive supervision in work organizations: review, synthesis, and research agenda. J Manag 33(3):261–289

Tepper BJ (2000) Consequences of abusive supervision. Acad Manag J 43(2):178–190

Tepper BJ, Simon L, Park HM (2017) Abusive supervision. Annu Rev Organ Psychol Organ Behav 4:123–152

Tesla (n.d.) Working at Tesla: 4,739 reviews | Indeed.com. Retrieved March 13, 2022, from https://www.indeed.com/cmp/Tesla/reviews

The Application of Newsvendor Model with Empirical Data—A Case Study of the Specialized Wholesale Market in Wuhan, China

Qiaoyang Liu

Abstract The specialized wholesale market is the place where high volume transactions happen. Due to the high concentration of industries, this kind of market often faces inventory problems. This paper takes the fashion wholesale market on Hanzheng street as the research object. First, we conducted the qualitative analysis of the local business environment, including the field investigation of locational conditions and the supply chain process. Then, we conducted the quantitative analysis of the daily sales data of the Autumn–winter series in 2020, 151 days in total. Finally, the newsvendor model was applied with the daily sales data to give the optimized daily output quantity, and suggestions were provided at the end of the paper for better purchasing or production plans.

Keywords Newsvendor problem · Wholesale market · Supply chain optimization

1 Background Introduction

The specialized wholesale market is defined as the place where concentrate commodities with strong complementarity or inter-substitution, which is a kind of market system for large-scale centralized trading. The research object of this paper, Hanzheng Street in Wuhan, is the largest trade zone in central China, representing a typical business model of a specialized market. At the end of the last century, Hanzheng Street used to be the largest small commodity market in China, with 13,000 merchants gathering and attracting more than 100,000 visitors per day (Yang 2017).

Q. Liu (✉)
Alliance Manchester Business School, University of Manchester, Manchester, UK
e-mail: qiaoyang.liu@student.manchester.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_106

Although once ranked the top of the wholesale markets in China, Hanzheng Street is facing the dilemma of transformation. After 2000, with the development of electronic commerce, the traditional wholesale model of Hanzheng Street has lost a competitive advantage. However, based on the research of Wang and Pan (2021), 80% of merchants in Hanzheng Street still rely on money transactions on the spot, and the online business information platform put forward by the government was not successfully promoted well. This is consistent with the findings of our field investigation. What is more, part of businesses here does not use a spreadsheet like Excel but record daily transactions with pen and paper.

Due to the insufficient use of data, inventory problems follow. Located in the central urban district, Hanzheng Street occupies a limited area with mixed businesses and residences. The large density between businesses results in the serious problem of backlog of goods, which piles up in the public space. As a result, the merchants in Hanzheng Street wholesale market generally have waste-adverse preference, and do not leave inventory at the end of each season.

2 Related Literature

The newsvendor model is a basic model used in supply chain management, capturing the trade-off between overstocking costs and unsatisfied customers' needs based on the estimation of demand. In practice, the model can be applied in various industries such as fashion goods, fresh food, and printed media.

However, the distribution of demand is often unknown to decision-makers in real-world applications. In most cases, the Bayesian approach is employed to solve the unknown demand distribution, assuming the distribution pertains to a parametric family of distributions and the values of parameters are unknown (de Castro Moraes and Yuan 2021). This method is referred to as a "parametric" approach.

The "non-parametric" approach, also known as the "data-driven" method, provides another way to solve the problem, that is, relying on empirical information rather than assumptions. Based on the growing availability of large data set, solutions such as quantile regression, machine learning, and sample average approximation can be applied to improve the performance of the inventory model in real-world situations. At present, the development of non-parametric or data-driven method is still in the early stages. Both de Castro Moraes and Yuan (2021) and Huber et al. (2019) mentioned that it remains unclear whether the data-driven method performs better than the model-based approach.

As stated in the background information, data underutilization still exists among businesses in Hanzheng Street or even other low-level business clusters. Meanwhile, on account of the large density and limited spaces of businesses, the problem of inventory redundancy becomes even more prominent. Therefore, this case study aims at helping small merchants make more reasonable purchasing or production plans, rather than the dependence on experiences and speculation.

3 Modelling

Considering a classical newsvendor problem with the unknown demand distribution—the merchant chooses the number of products to order or produce prior to the selling season. D denotes the one-period random demand, with mean μ and variance σ^2. Let c be the unit cost, p be the selling price, and s be the salvage value. When q units are produced, min (q, D) units will be sold. Newsvendor problem intends to minimize the total expected cost, comprising the overage cost C_o for unsold products, and underage cost C_u for the shortage, i.e.

$$\min C(q), C(q) = E\left[C_u(D-q)^+ + C_o(q-D)^+\right] \tag{1}$$

The stochastic demand D is represented by a cumulative distribution function F, the optimal order or production quantity q* is:

$$q* = \inf\left\{q : F(q) \geq \frac{C_u}{C_u+C_o}\right\} \tag{2}$$

4 Empirical Evaluation

The empirical data comes from a garment store in Hanzheng Street fashion wholesale market. The merchant adopts the mode of "front store, back factory"—the garment store locates in Hanzheng Street fashion wholesale market, while the factory lies on the Beihe industrial park, which is 50 km from Wuhan (Figs. 1, 2, 3 and 4).

The production for the Autumn–winter season started in August. Firstly, the merchant makes seasonal demand predictions, then purchases raw materials and make samples. Finally, the products will be delivered to the garment store in Hanzheng Street fashion wholesale market, which displays and stores the clothes in the space of 10 m^2. Most of the wholesale market customers are fashion retailers from all over China, entering different stores to select preferred products, and placing the order on the spot.

The daily sales data of the Autumn–winter series in 2020, 151 days in total, was collected during the field investigation. The garment factory produced 28 different styles in the selected season and sold a total of 82,334 units. The dataset contains 7 attributes—Date, Sales volume, Average unit price, Clearance volume, Average clearance price, Total volume and Overall average unit price. The data interpretation is shown in Table 1.

A line graph of the daily sales is made to demonstrate a general impression of the sales status, which is shown in Fig. 5. It is observed that the sales data do not represent an evident pattern.

Further, we made a boxplot graph for the sales volume to demonstrate the symmetry and dispersion of the data set. As shown in Fig. 6, the dataset has an

Fig. 1 Location map of Beihe Industrial Park

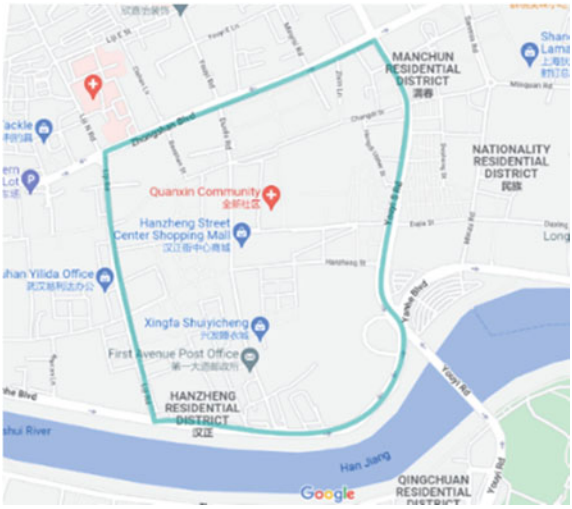


Fig. 2 Location map of Hanzheng Street

outlier value of 1324, higher adjacent of 1164 and lower adjacent of 0. The upper quartile, median and lower quartile are 722.75, 536 and 382.25, respectively, which is approximately symmetrical. After excluding the outlier value, the remaining 150 records were processed to predict the demand distribution.

The observed sales data are not accurately equal to demand, as stock-outs may occur. Therefore, we need to use the empirical data of previous years for continuous

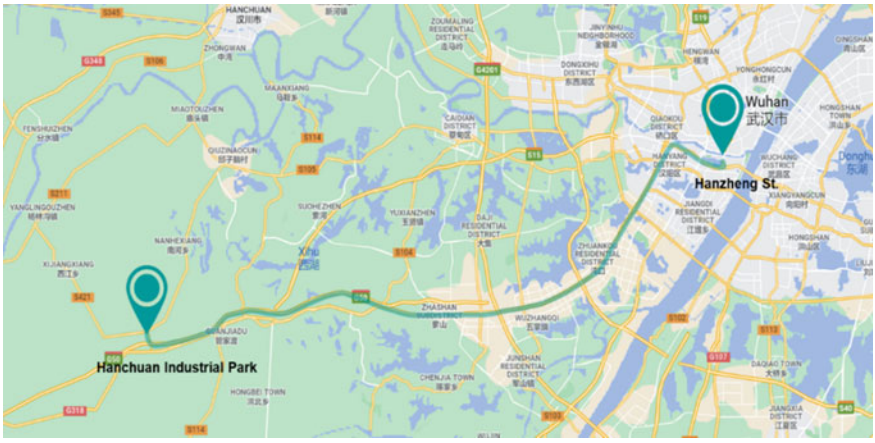


Fig. 3 Relative location of factory and store

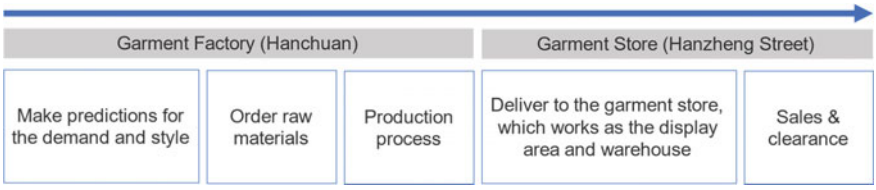


Fig. 4 The supply chain process

Table 1 Data interpretation of the empirical dataset

Attribute	Interpretation
Date	The date when the products were sold, ranging from 12th August 2020 to 9th January 2021
Sales volume	The sales volume of the products that sold at list price
Average unit price	The average price of the products that sold at list price
Clearance volume	Clothes will be out-of-season after a period, and the inventories will be sold at below-cost price. This field records the daily clearance volume of the store
Average clearance price	The average price of the clearance
Total volume	The sum of the sales volume and clearance volume
Overall average unit price	The average unit price of both sales and clearance

iterative verification. Due to the impact of COVID-19, the data of previous years are unrepresentative, so only the data of 2020 are used here for demand fitting (Fig. 7).

The fitting result shows that Demand D follows a normal distribution with a mean of 549 and a variance of 256 (reserved integers).

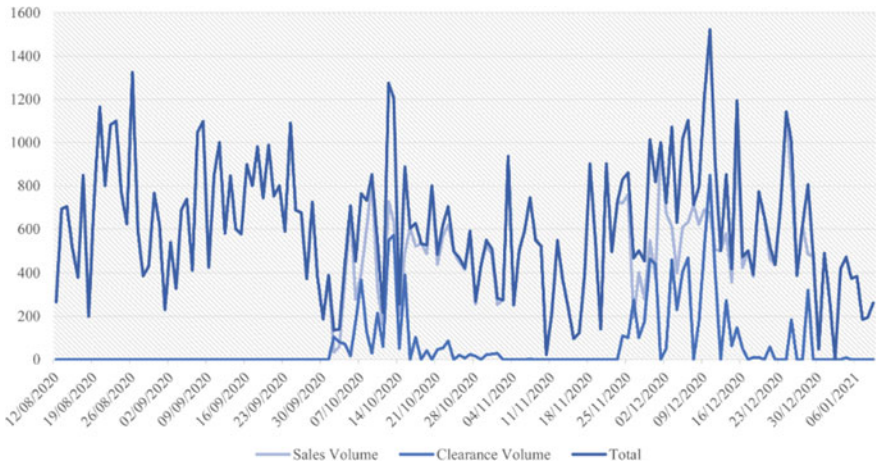


Fig. 5 Time series plot of the daily sales

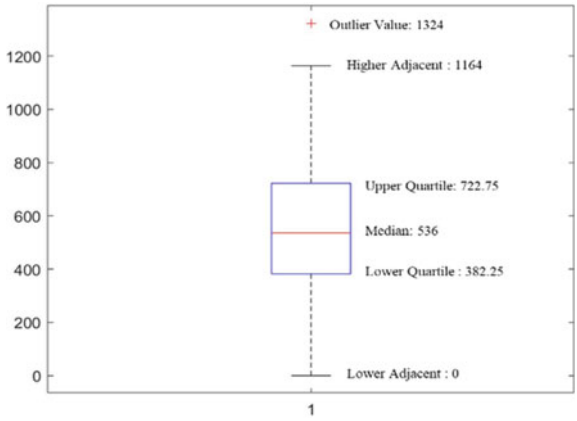


Fig. 6 Boxplot graph for the sales

The corresponding probability density function is:

$$f(x) = \frac{1}{16\sqrt{2\pi}} \exp\left(-\frac{(x-549)^2}{512}\right) \tag{3}$$

To calculate the optimal output, the economic inputs are defined and calculated as follows (Table 2):

The overage cost is defined as:

$$C_o = \text{Manufacturing cost} + \text{Landed cost} + \text{Holding cost} - \text{Salvage price} = 11$$

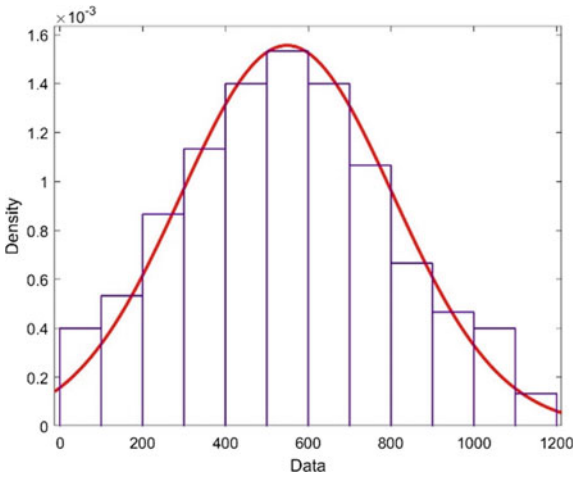


Fig. 7 Probability density graph

Table 2 Economic inputs

Economic inputs	Interpretation	Value (per unit)
Manufacturing cost	Manufacturing cost mainly includes the operation cost of the garment factory, workers' salary, and the cost of raw materials	¥40
Landed cost	Landed cost occurs when getting the products from the factory to the warehouse, including the shipping costs and handling costs	¥0.5
Holding cost	The holding cost is calculated by warehouse daily rent/warehouse capacity	¥0.5
Selling price	The selling price is given by the average price of the 28 products during the season	¥70
Salvage price	The salvage price is the sales price after the season, which occurs when the output exceeds the demand	¥30

The underage cost is defined as:

$$\begin{aligned} C_{\mathrm{u}} &= \text{Selling price} - \text{Manufacturing cost} - \text{Landed cost} \\ &= 29.5 \end{aligned}$$

Based on the model given, the critical ratio is:

$$\mathrm{CR} = \frac{C_{\mathrm{u}}}{C_{\mathrm{u}} + C_{\mathrm{o}}} = 0.7284 \tag{4}$$

The corresponding Z-score is calculated as 0.61. From that, the daily optimal output quantity (Q) to maximize profit is:

$$Q = \mu + Z * \sigma = 559 \tag{5}$$

5 Conclusion

This paper takes the wholesale market on Hanzheng street as the study object, targeting the problem of (1) Backward trading pattern (2) Insufficient use of data (3) Problem of good backlogs. Considering the locational factor, business model and field investigation, the newsvendor model was applied with the daily sales of the Autumn–winter series in 2020 and finally gave the optimized daily output quantity.

The quantitative analysis of the sales data and the qualitative analysis of the business environment are the main contributions of this paper. The transformation of Hanzheng Street is not only the top-down guidance of the government but also the bottom-up change management of vendors.

Here we propose two suggestions:

1. Optimize business models, such as using e-commerce applets and financial systems instead of paper-and-pencil bookkeeping, to lay the foundation for quantitative data collection.
2. Demand prediction analysis based on empirical data, and optimizing the purchasing or production plan, rather than the dependence on experience and speculation.

References

de Castro Moraes T, Yuan XM (2021) Data-driven solutions for the newsvendor problem: a systematic literature review. In: Dolgui A, Bernard A, Lemoine D, von Cieminski G, Romero D (eds) APMS 2021. IFIP advances in information and communication technology, vol 633. Springer, Cham, pp 149–158. http://doi.org/10.1007/978-3-030-85910-7_16

Huber J, Müller S, Fleischmann M, Stuckenschmidt H (2019) A data-driven newsvendor problem: from data to decision. Eur J Oper Res 278(3):904–915

Wang Q, Pan Y (2021) Research on the living space of small commodity market under the evolution of consumer behavior—a case study of Hanzheng Street small commodity market. Chin Market 05:11–14

Yang J (2017) Industrial and spatial renewal of Hanzheng Street wholesale market from the perspective of historical continuity. Huazhong University of Science and Technology

The Blue Ocean Strategy of Mixue Ice Cream and Tea During Market Saturation Crisis in the Milk Tea Industry

Ningqi Hu, Xin Liu, Ke Mu, Yi Shen, and Mingya Zhang

Abstract In recent years, China's milk tea market has developed at a rapid speed and well-known milk tea brands such as HEYTEA, NAYUKI and CHABAIDAO have seized market share quickly. The phenomenon of dense store distribution appears in the milk tea industry with the serious homogenization, fierce competition and so on. China's milk tea industry is facing a serious market saturation crisis, which makes it the red ocean. To survive this crisis, Mixue Ice Cream and Tea has adopted the blue ocean strategy and made a big success. This paper takes Mixue Ice Cream and Tea as a case, analyzing how the brand uses strategy canvas and ERRC model to develop blue ocean strategy, as well as the aspects that can be further improved. Accordingly, this work wants to research the suitable blue ocean strategy for the whole milk tea industry to deal with the market saturation crisis.

Keywords Blue ocean strategy · Crisis · Market saturation · Milk tea industry · Mixue ice cream and tea

N. Hu
Lee Shau Kee School of Business and Administration, HongKong Metropolitan University, HongKong 999077, China

X. Liu
UTS Business School, University of Technology Sydney, Sydney 2007, Australia

K. Mu
College of Tourism and Culture Industry, Guizhou University, Guiyang 550025, China

Y. Shen
Abbey College Cambridge, Cambridge CB2 8EB, UK

M. Zhang (✉)
Law and Public Management School, Jishou University, Jishou 416000, China
e-mail: y02193021@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_107

1 Introduction

In the 1980s, milk tea started to appear in the Taiwan district of China, originating from Tainan and Taichung. Milk tea is a tea-based drink that contains milk and the consumers can choose the flavor of their drinks depending on their personal preferences as they can pick the tea base, the sugar level, the ice level and the toppings such as pearls, coconut jelly sago, and taro balls. Nowadays milk tea has gradually gained popularity in the worldwide market. According to the research from Han (2018), in Asia, the popularity of milk tea has increased by 3500% in 2018 and in 2019 it reached a market share valuing $2.4 billion. What's more, it is estimated to hit $4.3 billion by 2027.

However, since the milk tea market becomes more and more competitive with an increasing similarity in products, the milk tea industry is now shifting into the maturity stage in the product life cycle, which is leading to a serious market saturation crisis. In China, the over-saturation of the milk tea market causes many stores to shutter. According to statistics in 2019, about 26,000 tea houses collapsed with only 18. 8% of the total surviving for more than one year (Sangwai and Deshmukh 2020). In the Changsha district, there are 87 stores have been closed since last November of 2021 (Week in China 2022). The competition becomes obviously intensive in many Chinese districts, for example, in Xinjiekou commercial district of Nanjing, there are 7 bubble tea stores every 500 m (The Sla 2022) The fierce competition and market saturation bring pretty much surviving pressure on many Chinese milk tea stores. Therefore, it is essential to figure out a strategy to help the milk tea stores survive and develop in the saturated market.

The study aims to figure out how the milk tea industry can survive market saturation and fierce competition. We choose a famous milk tea brand in China named Mixue Ice Cream and Tea as an example, which uses unconventional marketing techniques and low-cost investment to successfully survive in the intensely competitive milk tea market. The Blue Ocean strategy refers to creating new demand in an uncontested market space rather than competing head-to-head with other suppliers for the known customers in an existing industry. Mixue Ice Cream and Tea brand takes advantage of this strategy by opening large amounts of stores in third-tier and fourth-tier cities even in the villages and towns to make profits instead of competing with other brands in the first-tier and second-tier cities where the milk tea market is almost saturated. It attracts a large number of consumers with quite a low price, an impressive brand image IP and web-mediated interaction. Thus, Mixue Ice Cream and Tea brand nearly occupies the low-price milk tea market and even attracts lots of consumers from the high-price milk tea market.

2 Literature Review

Our research topic is the blue ocean strategy of Mixue Ice Cream and Tea during the market saturation crisis in the milk tea industry. To understand how this brand survived the crisis and to find out the universally applicable strategy, we will study market saturation and blue ocean strategy.

2.1 Market Saturation

The formation of market saturation is based on the change in the macroeconomic supply–demand relationship. Market saturation is the total amount of a product sold divided by the amount of market demand for a product. When this value is closer to 1, the market is more saturated. High saturation market development costs are higher and profits are lower. Low saturation market development costs are lower but customers are unstable. If a product has a high market saturation, it means that customers have a wider range of choices for that product and demand is lower than before.

Cliff Guy (1994) defines the concept as when the new store development reaches a certain level such that any further new stores will not be viable financially because they cannot gain a sufficient share of the local market or the new stores could survive only if the existing stores are forced to close down. Thus, the saturation is very a local phenomenon that is dependent on individual catchments and their conditions and, in turn, the interaction between retailers and consumers at the local level (Lord 2000). If competitors have a higher market share during the saturated market, the operating costs and subsequent costs will be much higher.

There is intense competition in milk tea markets where several chains have store locations within a few blocks of each other, making it difficult for new entrants to consider the market and a hostile environment for smaller participants already in those markets (O'Kelly 2001). However, when the product category is highly expandable, the saturation effect disappears(Liu and Yang 2009). So, in an already saturated market, competition from peers is more intense. If competing firms do not adjust their strategies accordingly, this can create a redistribution of consumers in the market (Wood and McCarthy 2013).

In such a market environment, milk tea enterprises that can survive must have their unique marketing methods and have accumulated a large group of loyal customers. In addition to basic factors like taste and price, promotion is also a key factor in winning in a saturated market.

At present, China's milk tea industry is facing a crisis of market saturation, which makes it the red ocean. Red ocean refers to all the known industries, whose market space becomes crowded and competition is extremely fierce. In the red ocean, industries are bounded, which is a widely accepted idea, and industry participants have

reached a consensus that there are default rules of competition in the competitive domains (Kim and Mauborgne 2005).

According to this definition, the milk tea market is the red ocean's specific performance that is shown as follows. Firstly, there exists fierce competition between these brands. Secondly, there are many physical stores of tea drinks and their distribution is very concentrated. Thirdly, too many milk tea products result from the product homogenization phenomenon which is becoming more and more serious. Lastly, the psychological maturity of consumers leads the innovation requirements for brand products, promotion and marketing to improving. If the milk tea brand wants to develop sustainably, it should try to find a blue ocean with sufficient market space and no competition.

2.2 Blue Ocean Strategy

Blue ocean refers to the potential, unknown and unexplored industry or market space. Compared to the red ocean, competition is irrelevant to the blue ocean. In the blue ocean, there are no competition rules and demand can be created, not through contention (Kim and Mauborgne 2005). This indicates that there are more profits and development opportunities in the blue ocean.

Blue Ocean Strategy is to develop potential market space, create new demand and reduce costs while pursuing differentiation to provide higher value to buyers (Chang 2010). It is based on the reconstructionist view that both market boundaries and industrial structures are unrestricted, undefined and can be reconstructed (Kim and Mauborgne 2005). The realization of the blue ocean strategy requires the adjustment and coordination of the entire company structure and business activities and developing such a strategy requires some analytical frameworks and tools (Chang 2010).

2.3 Value Curve and Strategy Canvas

The value curve is part of the strategic canvas, which depicts the relative position of a brand or a company in various competitive factors throughout the industry (Kim and Mauborgne 2005). The Strategy Canvas consists of multiple value curves, which is the primary tool for finding the blue ocean (Raith et al. 2008). It allows you to see the following things on a chart: the current key development factors, the competitive environment of a market and the future landscape of the entire industry. The idea behind the strategy canvas model is that the framework that allows users to block competitors in a market based on the extent to which they compete on certain factors or competition. Based on these roles, it is both an industry analysis tool and an action strategy direction (Kim and Mauborgne 2005). It can be used to develop a promotion strategy by manipulating the curves and coming up with something that

raises certain factors or competitions decreases or eliminates or creates an allied effect as a competition. By doing this, a company can use the framework to develop a blue ocean strategy.

2.4 Four Actions Framework and Eliminate-Reduce-Raise-Create Grid (ERRC Model)

An industry or company can rebuild the buyer's value element through a Four Actions Framework by figuring out which factors should be eliminated, which factors should be reduced to levels well below industry standards, which factors should be far above industry standards and what factors should be created that the industry has never provided (Chang 2010).

The Eliminate-Reduce-Raise-Create Grid (ERRC model) is used to complement the Four Actions Framework, which is the key to creating a blue ocean and defining action (Chang 2010). This grid allows a company or a brand not to stop answering all the questions of the four action frameworks, but to act on them all (Kim and Mauborgne 2005). By properly using these analytical frameworks and tools, brands or companies can draw a new value curve, then find the blue ocean of the industry and finally achieve a sustainable development.

In China's milk tea industry, the brand Mixue Ice Cream and Tea has done this very well. In the following content, this article will take Mixue Ice Cream and Tea as an example to analyze how it uses the blue ocean strategy to survive the crisis of market saturation.

3 Case Study

We choose Mixue Ice Cream and Tea brand as our case study because it stands out from the large amounts of milk tea competitors with its unique strategy. This brand takes advantage of the blue ocean strategy by occupying the milk tea market of third-tier and fourth-tier cities where the milk tea market hasn't been mature. Mixed Ice Cream and Tea was founded in Zhengzhou, Henan province in August 1997 by a graduate named Hongchao Zhang. It is a milk tea brand that mainly sells fresh tea drinks and ice cream and aims to bring high-quality and affordable products to the customers. From the beginning of his career, Hongchao Zhang insisted on the concept of "small profits but high sales, genuine goods at a fair price, treating customers honestly and operating on a continuing management". Due to relying on this simple product strategy, Mixue Ice Cream and Tea survived the fierce business war. In April 2008, Mixue Ice Cream and Tea brand was officially registered as Zhengzhou Mixue Ice Cream and Tea Trading Co. LTD and a new journey started from this point. In June 2020, Mixue Ice Cream and Tea officially announced that

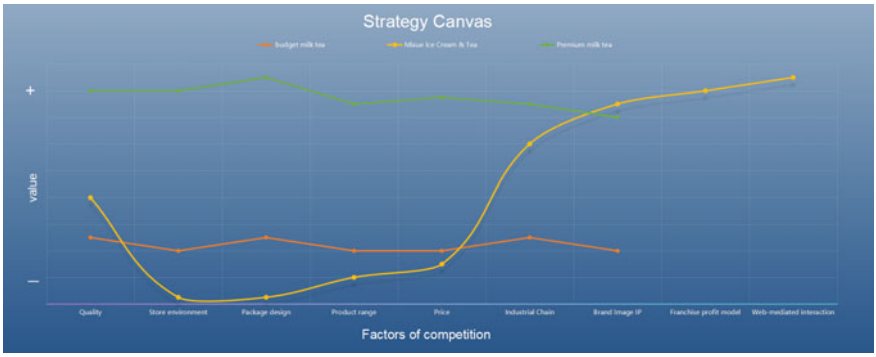


Fig. 1 Strategy canvas

the number of global stores exceeded 10,000. This represents that the first milk tea brand with more than 10,000 stores is neither HEYTEA which takes the high-end route and pays attention to creativity, nor CoCo which also takes the cheap route, but Mixue Ice Cream and Tea (Baidu 2020). It is worth mentioning that in order to control the product at a very low price, Mixue Ice Cream and Tea developed a trinity supply chain model, so as to lower the cost and achieve the purpose of "saving money".

As Fig. 1 shows, Mixue Ice Cream and Tea did not put too much effort into all the competitive elements, which is different from other brands did, but only focused on the key competitive factors. Specifically, Mixue Ice Cream and Tea focuses on the product quality and it has taken an elimination approach to the product packaging and the shop environment. It reduced product prices and the range of products while improved the construction of the industry chain and the brand image IP. What's more, it creatively proposes strategies for franchising profit model and web-media interaction.

3.1 Elimination of Package Design and Shop Environment

In terms of the shop environment and product packaging design, Mixue Ice Cream and Tea has given up investing too much on these. Most shops are small with almost only a bar to order products and the packaging is also simple.

In contrast, general budget milk tea brands such as CHABAIDAO and GOODME would offer larger breakout areas with packaging designs updated quickly. Not to mention the premium milk tea brands such as HEYTEA, which not only launches special packaging in association with brands such as Sesame Street and the British Museum, but also have large and artistic lounge areas in their shops.

However, as for the packaging materials and the shop image, Mixue Ice Cream and Tea has taken more aggressive approaches. For example, in March 2007, Mixue Ice

Cream and Tea used environmentally friendly recycled paper to replace the traditional plastic polluted paper (Tang 2021), which has contributed to the achievement of the SDGs (UN, 2015–2030). When it comes to 2018, Mixue Ice Cream and Tea partnered with Hua and Hua, using bright colors and flashy fonts on its billboards to attract consumers' attention.

3.2 Reduction in Product Range and Product Prices

Selling low-priced and featured products is also an important part of Mixue's strategies. In 2003, Mixue Ice Cream and Tea offered a wide range of products such as cold drinks, stir-fry and western food. When it comes to 2006, ice cream appeared and quickly became popular. The first franchise focusing on ice cream and tea was decided to be established. After that Mixue Ice Cream and Tea grew rapidly, with 26 franchises established in just a few months. It also showed that selling targeted products would help support the growth and development of the business.

An ice cream costs ¥3, a glass of lemonade costs ¥4 and most milk tea drinks cost less than ¥10. The average price of Mixue Ice Cream and Tea's products is around ¥6 or ¥7, while the average price of budget milk tea brands such as CHABAIDAO and GOODME, is almost ¥12, not to mention the premium milk tea brands such as HEYTEA and NAYUKI, which are priced at nearly ¥30.

The most crucial measure to reduce the cost of products is the establishment of its own R&D and logistics chain to avoid the involvement of middlemen and then can achieve high sales. What's more, Mixue Ice Cream and Tea usually rent a small storefront and the relatively cheap rent would also be a good way to keep costs down.

3.3 Raising the Industrial Chain and Brand Image IP

Mixue Ice Cream and Tea focused on enhancing the construction of a complete industry chain and the building of brand IP image, which will make the brand more competitive. The complete industry chain of Mixue Ice Cream and Tea includes R&D, Warehousing and Logistics and Operations and Management. A complete supply chain was completed by 2014, which enabled it to effectively control costs, keep product prices low and gain the trust of customers (Chen 2021). Meanwhile, the free shipping policy on logistics nationwide has strong appeal to franchisees. Mixue Ice Cream & Tea could get an opportunity to open shops nationwide at a frantic pace.

A Super IP needs to be more important to make people empathize as well as have a certain visual recognition to impress everyone (Wang 2022). The Mixue Ice Cream and Tea has created the super symbol IP called "Snow King", a small snowman wearing a crown and holding an ice cream scepter. Consumers can directly perceive, feel and accept the brand's ambition without thinking too much (Zhao and Wu 2022). In order to make an impression, this "Snow King" appears almost everywhere, not

only being printed on the signboard and packaging, but also being painted on the roller shutter door. Whenever the store closes, passers-by can see the huge IP displayed. What's more, the image of "Snow King" was also presented in a music video with the classic melody of the ballad "Oh! Susanna", tapping into people's subconscious empathy.

3.4 Creative Franchise Profit Model

Innovation in the Franchise profit model and Web-mediated promotion are the most important factors in the success of Mixue Ice Cream and Tea. Mixue Ice Cream and Tea's profit model is completely different from other milk tea brands. The majority of the profits of the Mixue Ice Cream and Tea brand come from the various fees paid by franchisees to the brand. According to the news, in 2020, Mixue Ice Cream and Tea had sales of ¥6.5 billion and profits of ¥800 billion. However, in 2020, NAYUKI's revenue was only about 43% of Mixue Ice Cream and Tea's, which was ¥2. 871 billion, but its profit was negative, with a loss of ¥202 million (Thepaper.cn 2022). On the one hand, brands such as HEYTEA and NAYUKI have stated that they will not join or act as agents in any form and all the stores are directly operated on their official websites and other occasions. On the other hand, Mixue Ice Cream and Tea has created its own franchise system. Its brand has placed advertisements on various platforms to promote its franchise. The official website had even set up a dedicated "Franchise consultation" page, clearly informing the joining process and cost. And according to the different city levels, the franchise fee is not the same: provincial capital city ¥11,000, prefecture-level city ¥9000 and county-level city ¥7000. In addition to the franchise fee, the equipment and raw materials of the franchise stores would have to be purchased from the Mixue Ice Cream and Tea brand. The decoration and materials costs of the stores would also be paid to Mixue Ice Cream and Tea or the designated third party. With the help of the franchise system, Ice Cream and Tea expanded rapidly. In many cities (especially fourth-tier and fifth-tier cities), you could see very dense stores on the streets. In other words, compared to other brands, Mixue Ice Cream and Tea quickly and comprehensively occupied the sinking market. What is worth studying is that the whole strategy system of the Mixue Ice Cream and Tea and the sinking market are complementary.

The milk tea market in the first and second-tier cities has become the red ocean while the market space is extremely limited. In order to make profits, Mixue Ice Cream and Tea chose to turn to the sinking market. In the franchise system of Mixue Ice Cream and Tea, the franchisees from third-tier, fourth-tie and fifth-tier cities accounted for the majority of the franchisees. At the same time, Mixue Ice Cream and Tea's product pricing, cost reduction, store environment, packaging reduction and even removal of such strategies is just right to the consumer standards of the sinking market.

3.5 Creative Web-Mediated Interaction

The core is innovation in the promotion. Mixue Ice Cream and Tea becomes very popular on the internet relying on a brand theme song. This special marketing method creates a profound brand image in consumer psychology. Mixue Ice Cream and Tea mainly focuses on the sinking market and its consumer groups are mainly students and young people. Although these groups have limited spending power, they are the main users of platforms such as TikTok, Bilibili, and Weibo since they like personalized entertainment. Mixue Ice Cream and Tea happened to seize this demand, releasing the theme song MV on Bilibili on June 3, 2021 and releasing another bilingual version on June 5. The theme song is not original but based on the 1847 American classic song "Oh Susanna". The lyrics of the theme song is only one sentence: "I love you, you love me, Mixue Ice Cream and Tea". After repeated many times, it only lasted for about 20 s and it takes less than two minutes for the bilingual edition. Short lyrics, a strong sense of rhythm and reproducibility etc. these characteristics let the song get a viral spread and led to a large-scale re-creation such as the Cantonese version, Huangmei Opera version, Beijing opera version and Soviet version etc. to bringing a wave of traffic for the Mixue Ice Cream and Tea. By the end of 2021 June, the brand's theme song had been viewed more than 2.5 billion times on the Internet.

This time, the popularity of Mixue Ice Cream and Tea allowed it to seize the opportunity to interact with consumers on various platforms such as TikTok and Weibo in a unique and down-to-earth manner, constantly consolidating its brand image and impress the consumers.

3.6 Outcome

Mixue Ice Cream and Tea reduces the cost of store environment and packaging design and the net income will increase. Similarly, reducing product innovation and focusing on selling tea and ice cream is a way to reduce costs and increase revenue, even though the sales price is low.

The cost saved from store environment, product packaging and new product innovation is used in more critical areas, such as strengthening the complete industrial chain and realizing self-production and self-marketing creating unique advertising and marketing methods, building brand IP image, improving brand awareness and achieve sensory marketing etc.

In addition, Mixue Ice Cream and Tea charges a very low franchise fee for low-level cities to attract more franchisees. At the same time, the parent company monopolized raw materials and equipment, which also increase the profits of a large number of franchisees from the sinking market of Mixue Ice Cream and Tea.

To sum up, Mixue Ice Cream and Tea is committed to spending a lot of costs on advertising and marketing and attracting many franchisees with low prices. In this way, not only consumers can make a deep impression on Mixue Ice Cream and Tea

through a large amount of brainwashing marketing and increase the purchase rate to improve profits, but also by increasing the number of franchise stores, franchise fees, raw materials and equipment costs can be earned, the company's income will improve. According to the survey, after the launch of the theme song, the turnover has increased significantly, coupled with the continuous increase of franchise stores and the annual turnover of Mixue Ice Cream and Tea has reached 6.5 billion.

Thus, different from other milk tea brands, Mixue Ice Cream and Tea focuses on the sinking market in China and wins by maximizing profits at the lowest cost.

3.7 Recommendation

From the previous analysis of the article, it can be seen that although Mixue Ice Cream and Tea gains favor from the majority of consumers at quite a low price, it lacks a good product quality. The product quality includes two aspects. One is the product taste and packaging and the other is the product innovation.

Although the ice cream products of Mixue Ice Cream and Tea are different from those of other milk tea shops and the prices of all products are generally low, it is important for the company to constantly innovate its own products in the rapidly developing society.

Mixue Ice Cream and Tea has its own industrial chain. If it could launch fruit drinks made from fresh fruits of the season every month and make exquisite and representative series of packaging for new products. Meanwhile, if it could increase new products and publicity at the unchanged price, it is believed that Mixue Ice Cream and Tea will become more popular.

4 Conclusion

To sum up, the blue ocean strategy for Chinese milk tea saturation is to use ERRC model to cut or explore market competition factors to help the brand become more differentiated and competitive. The validity of blue ocean strategy method and strategy canvas model is verified by example analysis. This shows that the blue ocean strategy can be applied. Also, in any industry like Mixue Ice Cream and Tea, which we've seen before, in a context like China, our case study demonstrates the usefulness and versatility of the blue Ocean and its efficacy. For Mixue Ice Cream and Tea, it decreases the capital of the product and lowers the price level but focuses on creating an entertainment effect by their brand IP and brand theme song which attract a lot of consumers on the internet. Also, concentrating on building self-industry chain helps the brand earn a lot of profits from the decoration and construction of the stores. This is how Mixue Ice Cream and Tea makes itself self-differentiate from other milk tea brands. However, even though the blue ocean strategy helps Mixue Ice Cream and Tea survive in the market, this is not a sustainable way to develop. With the

improvement of consumers' demand, more requirements appear for the production of the brand. If the brand does not concentrate on developing its products and service, it will be wiped out of the market in a matter of time.

References

Baidu (2020) The next step is to go public? Mixue Ice Cream & Tea announced that the number of stores has officially exceeded 10,000! https://baijiahao.baidu.com/s?id=1670195825930477449&wfr=spider&for=pc. Accessed 21st June 2022

Chang SC (2010) Bandit cellphones: a blue ocean strategy. Technol Soc 32(3):219–223

Chen Z (2021) Analysis on the marketing strategy of MXBC milk tea. In: 2021 3rd international conference on economic management and cultural industry (ICEMCI 2021), pp 60–64

Han Y (2018) Study on consumption behavior of milk tea based on the customer value theory—taking "A Little Tea" in Shenzhen as an example. Adv Soc Sci Educ Humanit Res 236:498–505

Kim WC, Mauborgne R (2005) Blue ocean strategy: from theory to practice. Calif Manage Rev 47(3):105–121

Liu YP, Yang R (2009) Competing loyalty programs: impact of market saturation, market share and category expandability

Lord D (2000) Retail saturation: inevitable or irrelevant? Urban Geogr 21(4):342–360

O'Kelly M (2001) Retail market share and saturation

Raith MG, Staak T, Wilker HM (2008) A decision-analytic approach to blue-ocean strategy development. In: Operations research proceedings, pp 225–229

Sangwai V, Deshmukh R (2020) Bubble tea market by base ingredient (black tea, green tea, oolong tea, and white tea), flavor (original flavor, coffee flavor, fruit flavor, chocolate flavor, and others), and component (flavor, creamer, sweetener, liquid, tapioca pearls, and others): global opportunity analysis and industry forecast, 2020–2027. Market research report, pp 1–261

The Sla (2022) Have the Number of Bubble Tea Shops reached Saturation in China? https://thesla.org/2020/05/has-the-number-of-bubble-tea-shops-reached-saturation-in-china/. Accessed 20th June 2022

Wood S, McCarthy D (2013) The UK food retail "race for space" and market saturation: a contemporary review

Tang J (2021) Analysis of management strategy of MXBC. In: 2021 3rd international conference on economic management and cultural industry (ICEMCI 2021), pp 1479–1482

Thepaper.cn (2022) Mixue Ice Cream & Tea, join out of control. https://www.thepaper.cn/newsDetail_forward_17562361. Accessed 21st June 2022

Wang R (2022) Research on development strategy of super IP—upgrading the forbidden city IP. Comp Study Cult Innov 01:124–127

Week in China (2022) Bubble tea. https://www.weekinchina.com/2022/02/bubble-tea/. Accessed 21 June 2022

Zhao F, Wu D (2022) Research on the strategy optimization of enterprise brand in new media era: a case study of tea brand Mixuebingcheng. Bus Econ 06:46–48

The Current Situation, Issue and Constructive Approaches of the A-Share Market

Xianghui Dong, Shiqi Lin, and Xiaojin Tong

Abstract The existence of the A-share market has contributed to some extent to the development of China's capitalist market and the study of its development is one of the hot topics today. This paper analyses the current situation of the A-share market based on the important Chinese policies and previous research. Besides, this paper focuses on the problems of the A-share market in the context of Chinese social phenomena. Specifically, this paper generalizes the problems to four aspects, i.e., delisting mechanism, stock speculation and bubble, corporate goodwill and insider trading, etc. Finally, constructive suggestions regarding laws, investors, global market and financial innovations, are made to solve the current problems in the light of the characteristics of the Chinese A-share market and the unique "T + 1" system.

Keywords A-share · T + 1 · China

1 Introduction

The A-share market in China is one of the most important research topics today. The A-share market was created in 1990 with a total of 10 stocks, but today there are more than 3000 A-shares, which represent the Chinese stock market and are an important part of the Chinese capital market with the number of companies listed on other stock markets. Resultingly, this paper centers on the Chinese A share.

Shiqi Lin, Xiaojin Tong—contibuted equally

X. Dong (✉)
University of Hull, Westfield Court, Cottingham Road, Hull HU6 7EL, UK
e-mail: x.dong-2021@hull.ac.uk

S. Lin
Haihua College, Liaoning Normal University, Dalian, Liaoning, China

X. Tong
Xiamen University Malaysia, Sarat Dini, Sepang, Selangor, Malaysia

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_108

2 Current Status of Chinese a Shares

Depending on where the shares are listed and for whom they are intended, the A-shares of mainland China's listed companies represent renminbi ordinary shares, also known as domestic shares. A-shares are traded in renminbi on the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE), two Chinese stock exchanges. Nowadays, the A-share market is heavily influenced by China's fiscal and monetary policy adjustments. China will adjust its fiscal policy according to the state of the stock market. At the same time, China applies monetary policy to the A-share market. In general, a contractionary monetary policy will cause share prices to fall and thus the stock market to weaken, while an expansionary monetary policy will cause share prices to rise and thus the stock market to strengthen. As a result, the A-share market shocks will replace the general rise that investors are looking for. This means that investors need to keep an eye on policy and thus change their investment strategies in a timely manner.

Unlike other stock trading systems around the world that adopt a T + 0 system, the A-share market insists on using a T + 1 system to prevent excessive speculation thereby ensuring the stability of the stock market. In other words, stocks bought on one day cannot be exited until the next trading day. Diao et al. (2018) compared the data from T + 1 and T + 0 systems respectively and showed that T + 1 trading rules may have an impact on daytime and overnight returns. The SSE Composite and SZSE Component Indices show a pattern where overnight returns will not be higher than daytime returns, while the exchange securities under the T + 0 system, such as the NYSE and NASDAQ, where overnight returns exceed daytime returns.

China launched the Qualified Foreign Institutional Investor (QFII) scheme in 2002 to allow foreign investors to enter the A-share market to trade stocks in renminbi. Before the introduction of this scheme, foreign investors who wanted to trade in the Chinese market could only invest in the B-share market or the H-share market or the N-share market or the S-share market. The implementation of the QFII scheme sends a friendly investment signal to foreign investors to attract more international capital attention. The QFII scheme will increase the convenience of access to the A-share market for foreign investors, which will in turn increase the incentive for foreign capital to participate directly in the Chinese capital market. Research by Korkeamäki et al. (2019) shows that QFIIs have shifted their investments towards volatile companies and highly state-owned companies. And they have started to look more closely at investments in Chinese mutual funds and are following closely behind. QFII has also undergone several reforms as the economy has developed, finally the State Administration of Foreign Exchange (SAFE) eventually decided to eliminate the restrictions on QFII and RQFII investment quotas in 2019. This will further promote the prosperity and globalization of China's financial markets.

When Morgan Stanley Capital International included the A-share market in its Emerging Markets Index in 2017, the Chinese market celebrated a significant moment. The steady efforts to open China's capital markets are reflected in the inclusion of A-shares in the index. The China Securities Regulatory Commission

also stated that this move reflects international investors' recognition of China's economic development and confidence that it has a stable and positive prospect. It also represents the further globalization of the Chinese stock market. Li and Li (2021) compared Morgan Stanley Capital International China A-shares with positive returns, positive Sharpe ratios and the maximum drawdowns is the smallest, while SSEC and SZI both had negative returns and Sharpe ratios with even larger maximum drawdowns. This outcome supports Morgan Stanley Capital International China A-shares' significance in the Chinese stock market and will also attract more global investors to the Chinese capital market. In addition, they recommend that international investors use the classic minimum variance portfolio (MVP) approach when making investments in Morgan Stanley Capital International's China A-shares. Back in autumn 2018, Chen et al. (2018) constructed their portfolio considering the characteristics of stock suspension in China's A-share market, the results showed that the minimum variance investments in A-shares can achieve a reduction in volatility. Also compared to other major stock markets, the volatility decline in the Chinese A-share market is lower. Therefore, they also recommend investors to use minimum variance investing into the A-share market.

China's A-share market still suffers inefficiencies and a number of non-economic factors that affect stock market returns after more than 30 years of development and several financial market reforms (Li 2021). Meanwhile, Jansen et al. (2021) pointed out that the A-share market in China is still dominated by state-owned enterprises and retail investors and is also characterized by low data consistency due to the evolution of reporting standards. The unique attributes of the A-share market are a result of the regulatory and economic landscape. Based on their findings, the abnormal excessive returns of SOEs have not completely disappeared after the market reform and liberalization but have declined.

3 Problems in the a Share Market

3.1 Delisting Mechanism

At present, delisting system refers to that before delisting, companies usually pass ST and ST two "risk warning". ST and ST are not only warnings to blue-chip stocks, but also remind investors that such companies risk delisting and need to be invested carefully in. However, those ST and ST stocks with the risk of delisting have become a hot topic in the stock market, because in the stock market, the company's listing qualification or status is a scarce resource, therefore, poor performance stocks will often try every means to avoid the fate of exit through merger and reorganization. The stock market has two most basic roles: the allocation of funds and funds. The essence of the stock market is the survival of the fittest, the big waves. It is precisely because of the existence of delisting mechanism that the withdrawal of junk stocks has become

a common phenomenon. That is why institutional and individual investors dare to crazy junk stocks.

3.2 Stock Speculation

Speculation performance of China's stock market: First, China's stock market fluctuates greatly. Second, the turnover rate of China's stock market is too high, and most of them participate in short-term investment. For a long time, the market is basically in the hype concept, high-quality stocks are neglected for a long time, poor performance stocks are inflated, and serious banker manipulation. China's stock market is too speculative, and even the trend of diffusion, its negative effects are mainly reflected in Zhang (2014), first, illegal speculation. At present, there are illegal behaviors in China's securities market, such as insider trading and the use of related party transactions to make huge profits, which damage the interests of investors and investment enthusiasm, and conflict with the principle of "three official vehicles". Second, take a profiteering attitude. In the stock market, when the stock market is generally optimistic or pessimistic, the speculative behavior will accelerate or expand, thus increasing the volatility of the stock price, and thus expanding the risk of the market. Therefore, it is alienated into a distorted price operation mechanism, resulting in a strange fluctuation in the market, so that the market and even the whole economy appear excessive or excessive contraction.

3.3 Stock Market Bubble

The "herd effect" is not only for individual investors, but also for other institutional investors, such as fund companies. The manager has no financial investment, and if the fund is positive, the remuneration arrangement is similar to the purchase option and optimal. However, this kind of contract can easily arouse managers' risk preference in the case of asymmetry. The pursuit of speculative interests has led to speculative bubbles.

3.4 Corporate Goodwill

In fact, in the merger and acquisition of China's A-share listed companies, the goodwill problem of enterprises is increasingly attracting attention. However, when the stock market is booming, many acquisitions will inevitably appear in the premium acquisition and goodwill problems, while the listed companies are generally optimistic about the sustainable development and future profits and will give a reasonable

price and a certain premium space. However, with the sharp decline of the market situation, the company's profit expectations have declined, and even appeared a turning point in performance, which has caused the problem of goodwill impairment. At the same time, for some companies, with the deteriorating market environment, the pressure of goodwill impairment will become more and greater. From the recent changes of several companies, most of these companies are due to goodwill impairment, especially those that are often acquired, which are facing huge goodwill impairment (Han 2019).

3.5 Insider Trading

The China Securities Regulatory Commission on the determination of insider trading behavior (trial), insider trading refers to the insider trading, insider or through improper means to obtain insider information, before disclosing insider information, the securities, or to provide insider information, or recommend others to buy and sell. Therefore, the insider trading in China's securities market violates the basic principles of openness, fairness and justice in the securities market, and also infringes on the ordinary investors' right to know. At the same time, due to the existence of internal transactions, the stock price is only a small number of people to speculate through internal information, rather than investors' comprehensive evaluation of their business performance, so that the securities market cannot effectively allocate resources.

Failure to effectively stop the "circle of money" behavior occurred. The main role of the stock market is to finance listed companies, thus improving their operating performance and creating space for investment returns. However, some listed companies see the stock market as "automatic" cash machines and abuse their funds, such as converting their original investment projects to new projects, without even using the funds. Although the "circle of money" of listed companies alleviates the "financing hunger" of the company, it greatly weakens the resource allocation of the stock market, resulting in the long-term performance decline after the stock reissue, and has a great impact on the sustainable development of the stock market.

4 Potential Solutions

4.1 Laws and Regulations

There are a series of differences between China's securities market and those developed economy with mature market, such as the overall government intervention degree, the economic system and investor education. So, it is necessary for China to formulate a system suitable for the new share issuing at this stage. Punishment

for behaviors that disrupt market order is inadequate chronically. As a result, that many investors in the stock market use illegal means to obtain profits has been a long-standing issue, which also encourages the atmosphere of speculation. On the premise of improving laws and regulations, it is essential to improve the strength and deterrence of supervision to make the A-share market develop healthily. Regulatory authorities should strengthen the supervision of the company's executives, underwriters, and institutional investors of new share inquiry, with the implementation of the responsibility of the inquiry body, standardize the behavior of its quotation. Improve the new share inquiry mechanism, requiring those institutions issue at a high price to bear the corresponding risk. As the development level of Chinese stock market is not mature enough, it is not suitable for complete market-oriented issuance at the present stage, especially the market-oriented issuance of Growth Enterprise Market, government guidance is still required. Government should also stick to the market-oriented pricing with appropriate government intervention. improve the current IPO inquiry mechanism, introduce more small and medium-sized investors, prevent institutional investors from monopolizing quotation in inquiry. Put most of the offline allocation of new shares on the Internet for public issuance, so that offline application rate and the proportion of online inquiry and allocation will be more equal (Wang 2017).

4.2 Investors' Investment Idea

Provide more education and guidance for investors. A group of rational investors is a very important component of the mature securities market, in terms of market scale and the quality of the laws and regulations, China's stock market is in constant progress and development, but the improvement of the degree of investors' rationality is not obvious, speculation is still very prevalent (Zhang 2016). Education for investor still has a long way to go. Enhance investors' rational investment concept. Because investors are lack of knowledge about stocks, their investment mindset is not mature enough, the ability to resist risks is poor, it is easy for them to follow the trend to make speculation. China's capital market is gradually moving toward marketization, it is important for investors to develop the concept of rational investment, for example, be prudent about those shares with high P/E ratio, improve risk resistance ability. For individual investors, rational investment idea can help them avoid the significant property losses caused by the sharp ups and downs of stock prices. For the whole stock market, investors' rational investment behavior can effectively avoid and reduce the large fluctuations of stock prices. Encourage investors' reinvestment behavior, create a long-term investment trend in the market, stabilize the securities market, restrain short-term investment behavior. The behavior of using dividends and bonuses for reinvestment should be given a certain proportion of preferential tax policies, or even exempt from income tax. The preferential tax treatment to individual investors can narrow the gap between personal dividend income tax and enterprise dividend income tax rate.

4.3 Global Trading Markets

Make improvements in foreign investment quota, trading mode, and taxation policies. China Securities Regulatory Commission should be more transparent in the formulation of foreign investment quota and may consider granting more investment quota to foreign investors. Although the foreign investment quota issue involves a series of problems such as China's capital market security and foreign exchange management, which is difficult to solve in the short term effectively and comprehensively. In terms of the trading mode, the "T + 1" trading model adopted by China's stock market for a long time has greatly reduced the liquidity of funds and is inconsistent with the "T + 0" model adopted by major exchanges around the world. Investors nowadays are used to "buy and sell at any time" as the global trading mode tends to be fast and mobile. Therefore, the trading mode should be improved to adapt with the trend in the international market, cater for the trading habits of global traders and eliminate the fear of investors (Yuan 2016). About taxation policies, China's trading market has long adopted stamp duty, that is, whether it is profitable or not, the tax is levied according to the trading scale and frequency. The larger the capital scale and the more frequent the trading, the more tax will be levied, which is hard to be accepted by global investment institutions. Capital gain tax can be adopted in China as major global trading markets, and regulation should be improved at the same time to reduce tax rate fluctuations, enhance stability and transparency, and provide international investment institutions with relatively stable investment return expectations.

4.4 Financial Innovation

Mature overseas markets have a variety of derivatives for investors to choose from, investors can provide idle funds to some other better appreciation investment channels, then the fanaticism of speculating new shares will be greatly alleviated. The interests of different parties should be coordinated to optimize the investment environment. There are a lot of interest groups in the stock market, with the continuous development and progress in the past decades, the power of interest subjects has also been growing and developing. This brings China's stock market many problems. In order to promote the healthy development of China's securities market, it is important to manage the behavior of interest subjects participating in securities market competition and coordinate the interests of all parties (Pu et al. 2010).

5 Conclusion

With the development of China's economy, China's A-share market has become an increasingly important part of the global capital market, attracting the attention of

investors around the world. Under the trend of globalization, China's economy and China's A-share market are becoming more and more open and internationalized, for example, the adoption of market-oriented pricing. However, due to the particularity of China's political and economic system and the inadequacy of China's economic development level as a developing country, there are still many problems in China's stock market. For example, China's stock market has always been known for high risk and high return, with obvious speculation, herding effect and bubble, which is related to the underdevelopment of the overall economy. Moreover, the strict quota for foreign investment, "T + 1" trading mode, and the unreasonable and non-transparent tax policies all make China's stock market relatively closed and backward, hindering China's stock market to further conform to international standards. To address these issues, Chinese policy makers can start by improving laws and regulations, changing investor perceptions, reforming relevant policies and system, and promoting financial innovation. Furthermore, the problems of China's A-share market also involve many other factors, such as the security of China's capital market, foreign exchange management, and the economic development level, which is the most essential one. All these problems are difficult to be solved in a short period of time. Therefore, the reform of China's A-share market still has a long way to go.

References

Chen A, Pong E, Wang Y (2018) Accessing the China A-shares market via minimum-variance investing. J Portfolio Mgmt 45(1):106–117. https://doi.org/10.3905/jpm.2018.45.1.106

Diao X, Qiu H, Tong B (2018) Does a unique "T+1 trading rule" in China incur return difference between daytime and overnight periods? China Finance Rev Int 8(1):2–20. https://doi.org/10.1108/cfri-12-2016-0130

Han X (2019) Analysis of the accounting treatment motivation and consequences of enterprise goodwill impairment. Account Newsl 2019(10):68–70

Jansen M, Swinkels L, Zhou W (2021) Anomalies in the China A-share market. Pac Basin Financ J 68:101607. https://doi.org/10.1016/j.pacfin.2021.101607

Korkeamäki T, Virk N, Wang H, Wang P (2019) Learning Chinese? The changing investment behavior of foreign institutions in the Chinese stock market. Int Rev Financ Anal 64:190–203. https://doi.org/10.1016/j.irfa.2019.05.011

Li Y (2021) Research on the effectiveness of China's A-share main board market. E3S Web Conf 235:01031. http://doi.org/10.1051/e3sconf/202123501031

Li Y, Li W (2021) Empirical analysis of MSCI China A-shares. J Risk Fin Manag 14(11):514. http://doi.org/10.3390/jrfm14110514

Pu J, Fan L, Liu J (2010) IPO underpricing problem under transition economy—an empirical study based on China A-share market. Manage World 7:180–181

Wang S (2017) IPO underpricing in China's A-share market and reforming policies. Econ Forum 2017(05):88–91

Yuan L (2016) Problems and reflections on the inclusion of China A-share into the Morgan Stanley capital international emerging markets index. Times Finance 6:156–157

Zhang B (2014) The effectiveness analysis and empirical study of China's stock market. Nanjing Agricultural University

Zhang Y (2016) The Chinese stock market supervision issues from the perspective of stock market disaster. Contemp Econ 29:33–35

The Effectiveness of Allocation Model Regarding to Kidney Transplantation

Tianxiang Huang, Shuxin Zhu, and Leyan Huang

Abstract A growing number of countries are implementing various kidney transplantation systems to address the urgent shortage of organ transplants. The most common approach, and the one that best fits the current situation, is the opt-in and opt-out system. According to the study, 90% of countries have adopted the opt-out approach, while just 15% have adopted the opt-in system. Israel has one of the lowest rates of organ donation among the developed countries because it does not participate in any such system. Many mechanisms, such as TTC or matching algorithms, can assist society in addressing some of the fundamental concerns of organ transplantation shortages and increasing efficiency, but they are unable to address the underlying issues. Opt-in and opt-out systems are basically trade off. There will be compromises regardless of which system we pick. As a result, countries can design systems that are specific to their laws, education, and religious. Similarly, we anticipate that such methods will confront some difficulties. As a result, algorithms like the matching algorithm in these systems can only be utilized as a tool, not as a solution, to alleviate the basic kidney transplantation shortage. Only by strengthening themselves can countries overcome basic impediments to long-term prosperity.

Keywords Allocation model · Kidney transplantation · Opt-in system · Opt-out system

T. Huang (✉)
University of Washington, Seattle, WA 98195, USA
e-mail: freya725188@gmail.com

S. Zhu
Canadian International School of Kunshan, Suzhou 215300, China

L. Huang
Wuhan Britain-China School, Wuhan 430000, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_109

1 Introduction

According to the current situation of global kidney transplantation shortage, this article will first introduce how to use TTC and matching algorithm to solve this series of problems through the allocation model, so as to lead to better solutions. In the work, this paper finds that the most important problem faced by all countries is the imbalance between supply and demand of kidney transplantation. Each country needs different solutions: developed countries need the most technological research and development, while countries that have not yet fully developed need to seek upgrading and innovation in infrastructure. How each country should operate to bring the most effective benefits is still unknown, and this is also the part of this question that has not been studied. The purpose and significance of this article is to further improve the effectiveness of kidney transplantation, save more patients and increase the matching rate according to the policies and laws of different countries. Research question is can allocation models fully solve the dilemma of kidney exchange? If not, what are some other solutions?

2 Kidney Exchange

The transplanting of healthy people's kidneys to individuals with renal disorders and loss of renal function is known as kidney transplantation. A healthy kidney is implanted into the iliac fossa of the patient's right lower abdomen during a kidney transplant. Because the blood arteries in the right iliac fossa are shallow, connecting to the new renal vessels is simple during surgery. In most cases, anastomosis is performed on the internal iliac artery. If the right internal iliac artery has arteriosclerosis, the lumen is narrowed, and there is a risk of insufficient blood flow following surgery, it can be anastomosed with the patient's external iliac artery. After Release the vascular forceps that are blocking all blood vessels after the blood vessel has been anastomosed. Suture the abdominal wall layer by layer to conclude the operation after the new kidney's blood supply is good. Kidney transplantation is not the same as exchanging one kidney for another (Chan-on and Sarwal 2017).

Figure 1 demonstrate the global kidney health map released by the international society of Nephrology (ISN) covering 160 countries shows that it is estimated that there will be 14.5 million patients with end-stage renal disease (ESKD) in the world in 2030, but 5.4 million of them will not receive treatment due to social, economic, political and other factors. Every year, more than 2 million patients worldwide die because they fail to receive dialysis treatment or kidney transplantation. This is the most basic kidney exchange paradigm, as seen in the diagram below (Atlas 2019). A successful kidney exchange system was developed, saving countless lives, although kidney exchange is a difficult procedure. It must first and foremost be matched. Second, we can't define it with money (at least in theory). Our main goal is to save as many people as possible. We commonly bind our model in this way because

kidney exchange must be the exchange of support between one family (or similar small groupings) and another (some) family. Each point is formed by a patient Pi and a donor Di. The directed edges of the graph can be matched (not necessarily bidirectional) (Fig. 2).

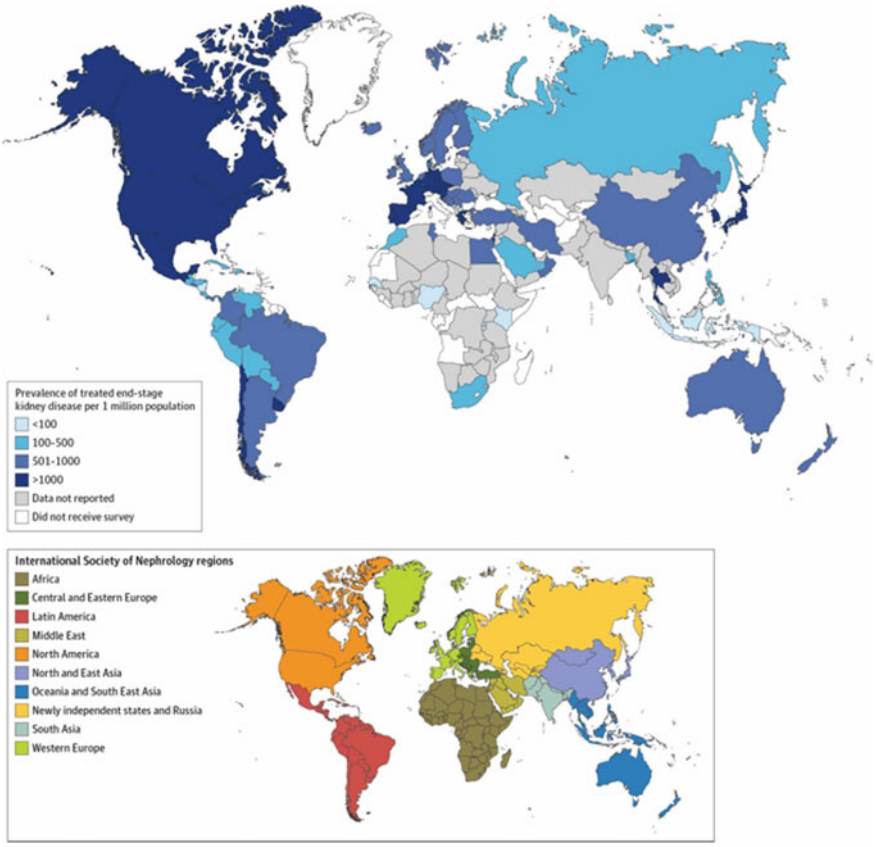


Fig. 1 Global population of kidney disease dispersion map (Bello 2017)

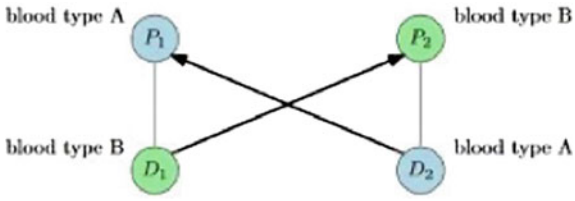


Fig. 2 A Kidney exchange examples (Roth 2004)

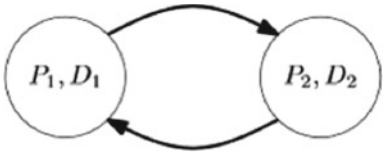


Fig. 3 A good case for the top trading cycle algorithm (Roth 2004)

2.1 Top Trading Cycle (TTC) Algorithm

The top trading cycle algorithm was proposed in 1974, hereinafter referred to as TTC algorithm. It is applicable to "allocation" or "transaction" scenarios, that is, unilateral matching problem. TTC algorithm is more applied to one-sided pairing problem, the allocation and exchange of indivisible goods, for example house allocation problem Domitory allocation, organ transplantation, class scheduling, etc. (Bello 2017). Figure 3 is a example of a good case for the Top trading cycle Algorithm. There is no priority in the problem of kidney matching, and patients who do not get a match are also likely to face death, but this is still the responsibility of DSIC. In addition, there will still be a series of situations. For example, this circle will be very large. If one of them reneges, the whole circle will collapse and can only be recycled. In order to reduce this situation, we require kidney transplantation to be carried out simultaneously, so as to prevent some people from running away after getting the kidney. If the circle is large, we may not be able to gather enough hospitals/operating rooms. So this circle needs to be very small, the smaller the better (for example, two groups). In addition, since there is no priority, as long as it is matched, some functions of TTC are redundant, and it is best to replace them with binary preference (match/mismatch).

2.2 Matching Algorithm

The matching principle is binary preference and small cycle. The undirected graph is the most ideal model. Select all disconnected edges, increase the number of edges as much as feasible, and maximize the matching (Monteiro et al. 2020). Figure 4 is the model: i have a matching edge set Ei, and he will select to report Fi $\subseteq$ Ei instead of Ei \Fi, which is also an option. We need to come up with a way to optimize matching and DSIC, i.e. Fi = Ei (Fig. 5).

The solution is to prioritize the vertices, which should be completed before the mechanism design. Assuming that the arrangement is degraded from 1 to n, the step of maximum matching is refined as follows: first, M0 represents all the maximum matching sets of graph G, and then cycle, for example, I = 1 …. n, Zi means that the matching of I is included in Mi − 1. If it is not empty, Mi = Zi, otherwise Mi = Mi − 1 Finally, any match in Mn is returned. At this time, only the edges (may) are different, but the point set is the same. The idea of this scheme is to start from the order of priority and find the points with high priority in the various possibilities

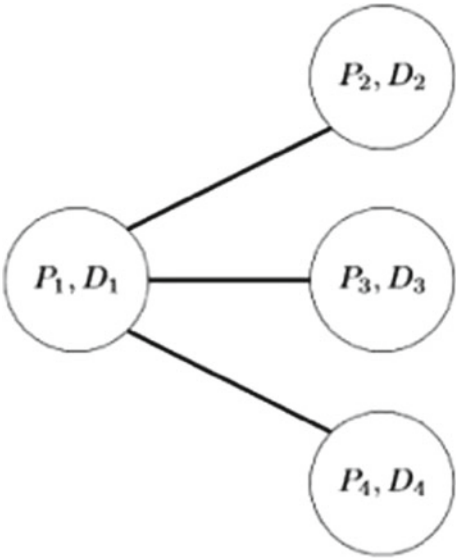


Fig. 4 Different maximum matching can match different subsets of vertices (Roth 2004)

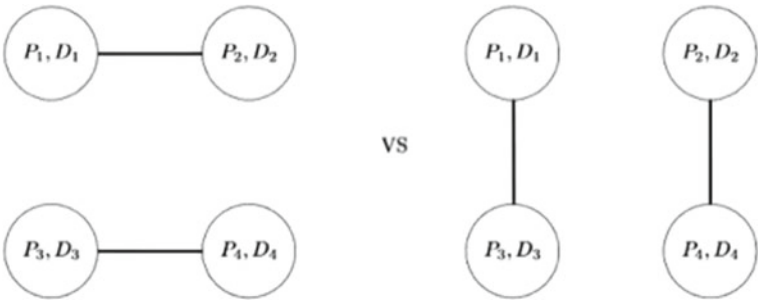


Fig. 5 The same collection of vertices can be matched in many ways (Roth 2004)

of maximum matching. This scheme is DISC, and no one can increase revenue by underreporting (no misstatement).

Based on Figs. 6 and 7 we can find out that the problems encountered in the current research come from the hospital level, not from the individual. Individuals have no incentive to hide. Our goal is to give priority to ensuring that people in our own hospital have as many matches as possible, so as to increase the proportion of organ transplantation.

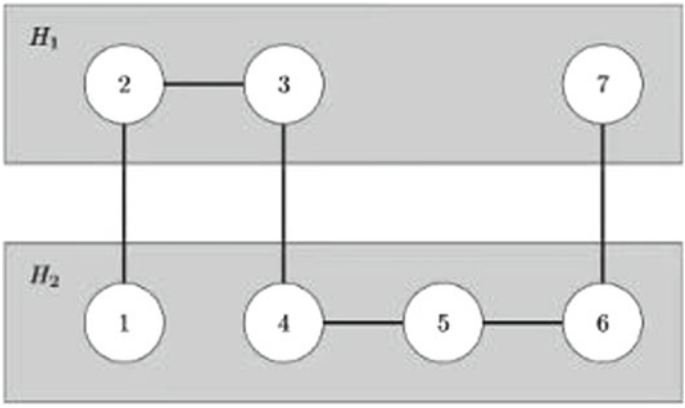


Fig. 6 More matches are generated by hospitals that report everything rather than just internally (Roth 2004)

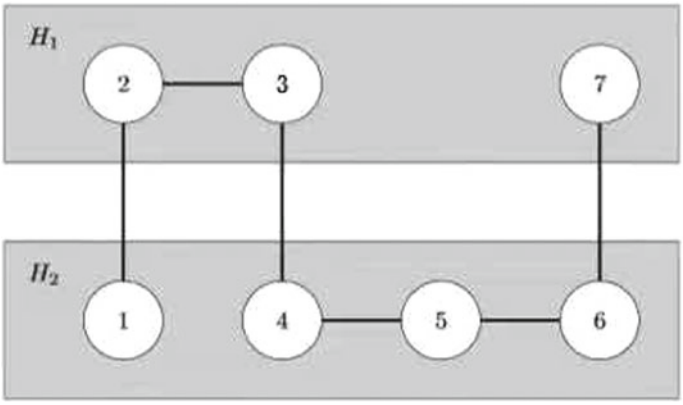


Fig. 7 Hospitals may be enticed to conceal patient-donor pairs (Roth 2004)

2.3 Another Possible Solution

Because the probability of kidney matching is small, even relatives related to the patient may not be able to match it completely. In the face of the above serious mismatch between supply and demand, many experts have proposed a kidney transplantation operation based on kidney exchange (Compatibility and Registry 2019). Specifically, every patient who needs to wait for a kidney transplant (the patient does not find a suitable donor among close relatives and friends) also has the opportunity to find a suitable living organ through kidney exchange. But the premise is that the patient needs to find a healthy donor who is willing to donate kidney (the donor is usually a relative or friend of the patient), form a "patient donor combination" and complete kidney exchange with other "patient donor combinations".

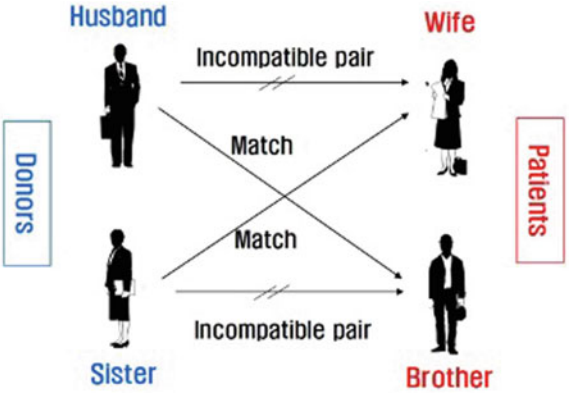


Fig. 8 Paired matching of kidney exchange (Lee 2019)

The "patient donor combination" of husband A and wife B (A is a healthy donor, B is a patient, and their kidneys cannot be transplanted to one other).

Sister C and brother D (C is a healthy donor, D is a patient, and their kidneys cannot be transplanted to each other).

According to Fig. 8, patient D can receive a kidney from patient A, and patient B can receive a kidney from patient C. The two "patient donor combinations" are believed to have been successfully paired in this fashion.

Sometimes it is impossible to find a perfect match between two "patient donor combinations". At this time, if three "patient donor combinations" can be found, under the limitation of various resources of the hospital, the allowable length of the chain structure is small, usually binary chain or ternary chain.

From Fig. 9 we can see that the healthy people join the kidney exchange process voluntarily in order to help sufferers. When a selfless donor is involved, the chain begins with the selfless donor, then passes down in turn to the patient on the waiting list (who is unable to contact family or friends to assist him in forming a "patient donor combination"). Figure 10 depicts the exchange mechanism. This chain exchange cannot be completed simultaneously, but it can be completed over time as long as the source of transplantation procedure is healthy people who freely donate their kidneys. If a matched patient has already gotten a kidney transplant from someone else, the donor can opt out of the kidney exchange by not donating his own kidney. Although this is ridiculous, it is legal because there is no law requiring donors to donate their kidneys in the United States.

3 Opt-in and Opt-out System

Opt in means that only those who explicitly agree will become a donor. On the contrary, opt out means that anyone who does not explicitly refuse will be regarded as a donor. Opt out system is more effective than opt in system (most users are willing

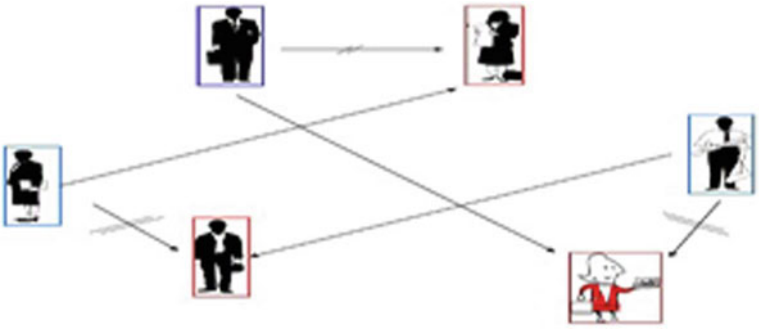


Fig. 9 Three membered ring structure of renal exchange (Lee 2019)

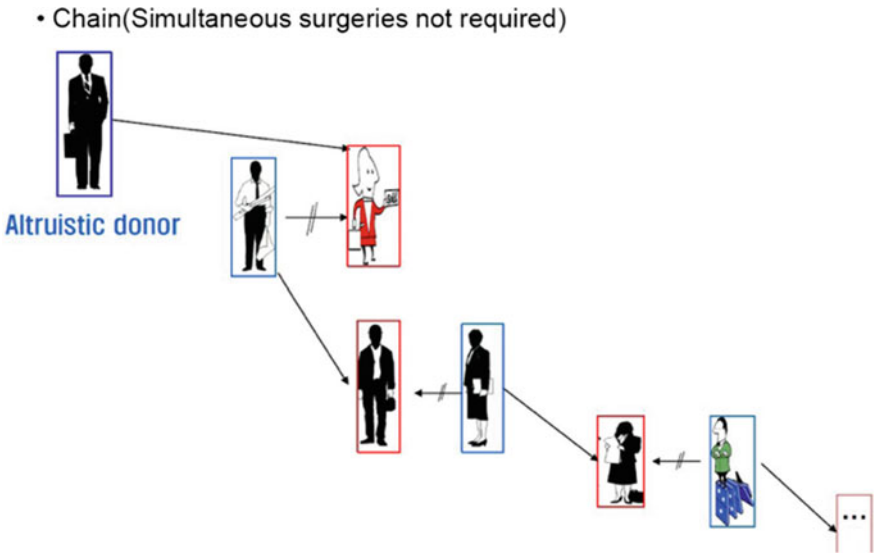


Fig. 10 Chain structure of renal exchange (Lee 2019)

to share their information in exchange for some value). Opt in will be less effective and more expensive (Ezaz and Lai 2019).

Opt out system: A donation policy that assumes that all individuals living in a country / state are voluntary deceased organ donors unless they explicitly "opt out" to do so. Also known as "constructive consent". Opt out will require individuals to show their preference against late organ donation while alive.

Opt-in system: Organ donation will be automatic unless a specific request not to obtain an organ is made before death (Etheredge 2021).

3.1 Country Without Option and Opt-out System

Since its inception in 1968, Israel's organ donation system has been predicated on the principle that organs can only be extracted from brain dead donors with the approval of the relevant first-degree relatives for transplantation. Even if potential donors sign a donation card expressing their wish to donate organs after death, this consent is essential. A donor card is a government form that permits people to give certain organs when they die voluntarily. Israeli officials are accelerating the development of legislation to encourage families to donate deceased relatives' organs and live persons to donate one of their kidneys. However, Israel does not have an opt-in or opt-out system for organ transplantation, resulting in the lowest organ donation rate among developed countries. Israel's population is estimated to be around 7.4 million people. Its citizens are well-educated, and it has a sophisticated medical system, but human organs are in short supply. Only 12% of Israelis signed an organ donation agreement and committed to donate organs after death, according to the Israeli organ transplant center. In the United States, 40% of people are willing to give organs, compared to 72% in Turkey and Spain. But In Israel, only 14% of people have an organ donor card; in Western countries, the number is 30–40% and Opt-in and opt-out processes are used in these nations.

3.2 Advantages of Opt-out System

From Fig. 11, we can see that in most situations, countries using opt-out systems of organ donation had higher total numbers of kidney donated. This shows that generally, opt-out system is more effective than opt-in system and it can raise organ donation rate. In order to explore the reasons behind the phenomenon, we need to start with the mechanism of opt-out.

Opt-out means that unless people voluntarily refuse to donate their kidneys, it's default that they are willing to donate their deceased organ donors. So from the psychological side of people, when they are under the opt-out system, the system normalizes the donation after death. This makes people get used to the donation after death and regard this action as a normal thing. As a result, people are more easily to accept to donate their deceased organs. Crowd mentality in group psychology makes most people are willing to donate their deceased donors. Secondly, from the practical matter, opt-out maximizes the use of the kidneys of the deceased for transplantation. Comparing with opt-in system, when people are under opt-in system, they have to express their preferences and apply for being an organ donor. So it's possible that the person is willing to donate his donor but because of lack of time or channels to attach the application form, he fails to donate his donor. However, opt-out system is able to solve this problem. It enables the fully use and reduce the waste of deceased donors.

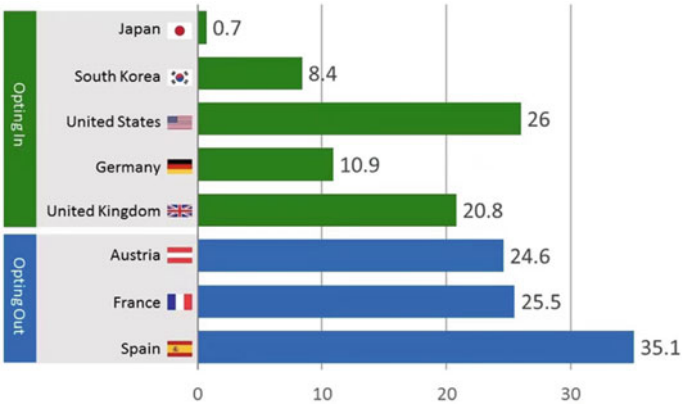


Fig. 11 The rate of organ donation in different countries (Donantion and Transplantation Institute (IRODaT) 2017)

The life situation example of successful opt-out system is Spain. Thanks to opt-out system, Spain has the highest organ donation rate per million people in the world and it keeps this leading position for 29 years. Spain has 43.4 organ donors per million people and performs about 5000 transplants a year. Also, from 1989 which is the beginning year of operating opt-out system in Spain, the organ donation rate raises from14.3% in 1989 to 46.9% in 2017. It seems that opt-out system can completely pareto dominated opt-in system. But why some countries still use opt-in system in their kidney exchanges?

3.3 Opt-out System's Hidden Disadvantage and Opt-in System's Benefits

In order to answer the question above, we need to consider the hidden disadvantages of opt-out system. Also starting with people's psychology side, the rule of opt-out system is a kind of compelling. People may think their human rights are violated and the unwillingness in people's hearts lead to increased public distrust of health care system. This is to say, when the opt-out system isn't used properly and credibly, the system will not increase the organ donation rate as expected, but inversely, it may enlarge people's dissatisfaction and distrust, thus decreasing the organ donation rate.

The life situation example of opt-out system's inverse effect is Brazil. Brazil introduced a "hard" opt-out system in 1997(Harriet Rosanne Etheredge 2021). The word "hard" here means that families are expelled out of the donation authorization. This legal infuriated the public a lot and people became extremely indignant about the legal. It was impossible for people to accept the legal so they continued the practice of seeking consent from families spontaneously. Using of the "hard" opt-out system

in Brazil not only fails to increase the organ donation rate but also destroys the trust between the government and the public.

This is the risk of using opt-out system. Without suitable design and the time for people to adapt and get used to the change, the effect is limited and to be even worse, the effect is inverse. This is the reason why some countries don't use opt-out system. Also, opt-out system requires many improvements. We take Chile as an example.

In 2010, opt-out was required and used mandatorily in Chile. Soon after the legal change, 29% decrease in deceased donor rates happened (Senne 2014). The donor rate not only failed to increase but also caused an inverse effect. The remedial measure of Chile's government was to provide a reciprocity principle for those who stayed in the opt-out system rather than jumping out of it. The principle is when those people need a transplant, they have the priority to get the donor. After this reciprocity principle, the situation began to improve and became better.

Considering individual right and human right, opt-in system's benefits appear. Because it fully respects people's willingness. For some countries, opt-in system can have better effect. The real-life example is Germany. Germany uses the double opt-in policy. This means that after people register for the opt-in system, a confirmation email is sent to these people and require them to make double check. After that, the details of the confirmation letter are recorded by government. The double opt-in policy provides people with enough time to consider the decision and takes care of people's feelings. Trusts and appreciation are built between the public and government. This is an important reason for opt-in to be successful. Now we can realize that the trade-off exists.

4 What to Consider When Choosing an Allocation Model

It can be seen from the above argument that in the process of distribution, one party's gain is always accompanied by the another party's loss, and no matching model can be completely more effective than the other. Blindly using a seemingly better matching model without considering the actual situation, although there is a clear advantage in data at the moment, the problems lurking behind the prosperity of the appearance will also backfire in the future, causing immeasurable consequences. Allocation models are more of a problem-solving tool than a solution. The needs and the strengths should be measured first to choose a suitable allocation model. In the case of kidney transplantation, there are a few key needs that counties should consider when choosing whether to use opt-in or opt-out, including national economic situation, national credibility, social welfare, national religious culture, education level, etc. Only sticking to the data of number of transplantation is not sufficient for making such a decision. Brazil's early legislative failures on kidney transplants explains this statement. In 1998, two major medical organizations in Brazil have indicated that family inputs are very important in kidney donation of the deceased, and family members need to be consulted at the time of transplantation [14]. More importantly, Brazil at that time lacked the infrastructure for transplantation coordination, such us

the national waiting list, and a effective system for individuals to opt out of being a donor [15, 16]. Nevertheless, in order to address the imbalance between kidney supply and demand, the Brazilian government legislated and established a binding presumptive consent system, which is the opt-out system [14]. The forced introduction and legalization of an inappropriate system has intensified panic among Brazilians, especially the majority of groups who do not have access to high-security medical care. Brazil finally repealed the presumptive consent legislation within a year and reinstated the "opt-in" system [14].

4.1 Hidden Solutions Other Than Choosing a Suitable Matching Model

However, even when the allocators have made flexible adjustments to the application model according to their own circumstances, problems still exist. Singapore is a typical instance. As a country with a strong religious culture, Singapore is very cautious in the kidney donation and transplantation. In Singapore, a large portion of the population are Islam. Due to concerns about the sanctity of the body, Islamic religion has a certain rejection of organ donation from the deceased. Because of this, Singapore has been using the opt-in system since 1973 [17]. However, in the face of growing demand for donated organs, Singapore enacted opt-out legislation under the Human Organ Transplantation Act (HOTA) in 1987: able-minded non-Islamic individuals between the ages of 21 and 60 identified as "accidental deaths" are presumed to be kidney donors unless they expressly opt out [17]. It can be seen that all Islamic individuals are automatically excluded from this law in order for Singapore to show respect for religious groups. Unfortunately, there is still a severe shortage of donors in Singapore, so Singapore has again revised HOTA to extend donations to potential donors who are not dead for accidental causes [18]. In 2008, HOTA was revised again, under pressure from the growing gap in demand and supply of kidney transplants, Singapore was reluctant to include the Islamic community in donations. The upper age limit for presumptive consent was subsequently expanded and additional safeguards added in 2009 [18]. With such a flexible policy adjustment, will Singapore make a qualitative leap in the number of kidney transplants as expected? The data shows that the total number of donor kidney transplants in Singapore in 2007 was an average of 22.2 cases per million people per year. After a series of rectifications, the total number of donor kidney transplants in Singapore in 2013 was an average of 19.07 cases per million people per year [19]. It can be seen that even though Singapore has weighed various domestic situations and selected the opt-out system with the best donation data, the overall donations has not achieved very huge changes (Table 1).

In contrast, the United States, like Singapore, chooses to respect its citizens: after only 34% of people support the opt-out system, the United States chose to use the OPT-IN, FIRST-PERSON CONSENT SYSTEM [20]. This means individuals must

Table 1 2007–2014 living and deceased donation rates in Singapore, patients per million population [20]

2	2014			2013			2012			2011			2010			2009			2008			2007		
	LD	DD	TT	LD	DD	TT	LD	DD	TT	LD	DD	TT	LD	DD	TT	LD	DD	TT	LD	DD	TT	LD	DD	TT
Singapore	9.82	2.91	15.45	8.52	4.44	19.07	6.61	2.83	13.77	6.54	3.85	16.92	7.50	5.32	18.75	7.66	5.32	21.06	25.77	6.00	40.44	7.96	5.91	22.27

The data based on the WHO-ONT global observatory on donation and transplantation
LD living donation; *DD* deceased donation (actual deceased donor); *TT* total organ transplantation

actively sign up on the donor registry and, upon doing so, no further authorization is required when the decision of the donor is legally documented. Even with the opt-in system, which is not prominent in the data, the number of kidney transplants in the United States far exceeds that of other countries such as Singapore, and it ranks fourth in the list of countries with the highest number of kidney transplants. What is it that makes the value of the distribution system fully utilized in the United States?

First, the United States is more advanced in kidney transplant technology. Let's be clear first, the number of kidney donations does not equal to the number of kidney transplants. The basis of deceased organ donation is that the deceased's kidney can be implanted in another person in a healthy manner. Sometimes even though the deceased agreed to donate, the organ was not successfully transplanted, so it was not counted in the number of transplants. The first problem to be solved in the United States is to improve the success rate of transplantation. In order to reduce the discard rate of deceased donated organs, the United States decided to use nonstandard kidneys after demonstrating that nonstandard kidneys (Organs from donors after circulatory determination of death (DCDD), or hypothetical or actual donor (KDPI) with a age of 85 and higher) were as suitable for transplantation as standard kidneys, as shown in Fig. 12. In 2013, a large proportion of kidneys transplanted in the United States were no longer from standard donors, leading to a significant increase in the number of transplants [21].

Second, the US social welfare system is more comprehensive. In 2020, the average cost of a kidney transplant was $442,500, with the cost of transplant admissions, including the surgery itself, is the most expensive item, accounting for 34% of the total cost. In 2019, more transplant recipients had public health insurance (60%) than private insurance (32%). A minority of patients had Medicaid (6%), a state-run low-income individual plan, or other government (2%) insurance [22]. While Medicare is generally only available to people over the age of 65, in the United States, people with ESKD are automatically eligible [22].

Of course, in addition to these two factors, the United States has achieved a certain lead in many other aspects. It is because the foundations in the United States are solid enough that the allocation system can be used effectively. According to Fig. 13, it is clear that since 2000, the rate of KT to ESRD (KT: kidney transplantation; ESRD: End Stage Renal Disease) in the United States has been far ahead of other countries. As of December 2018, there were 229,887 kidney transplant patients in the United States, or 678 recipients per million people per year, a 40% increase since 2008. Figure 13 is still rising steadily [22].

Other countries, such as African countries, also use opt-in systems, but the data is very worrying. A critical, government-mandated analysis of the organ donation and transplant systems are not presented. The recent World Health Organization report on transplant activity in Africa shows a severe lack of transparency across the continent. In Africa, since registration is out of control in the first place, the allocation model would only have little effects. To make matters worse, because of the quadruple disease burden these countries encountered (infectious, non-infectious, infectious and maternal and neonatal), transplantation is the only option for many terminally ill patients [19]. However, Africa's population have already lost trust in the government,

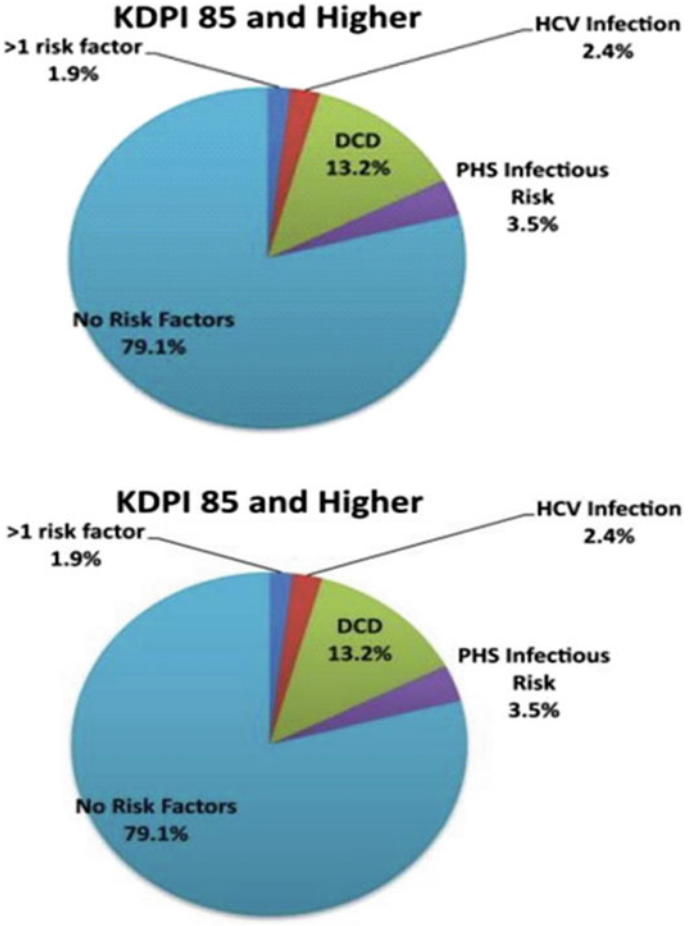
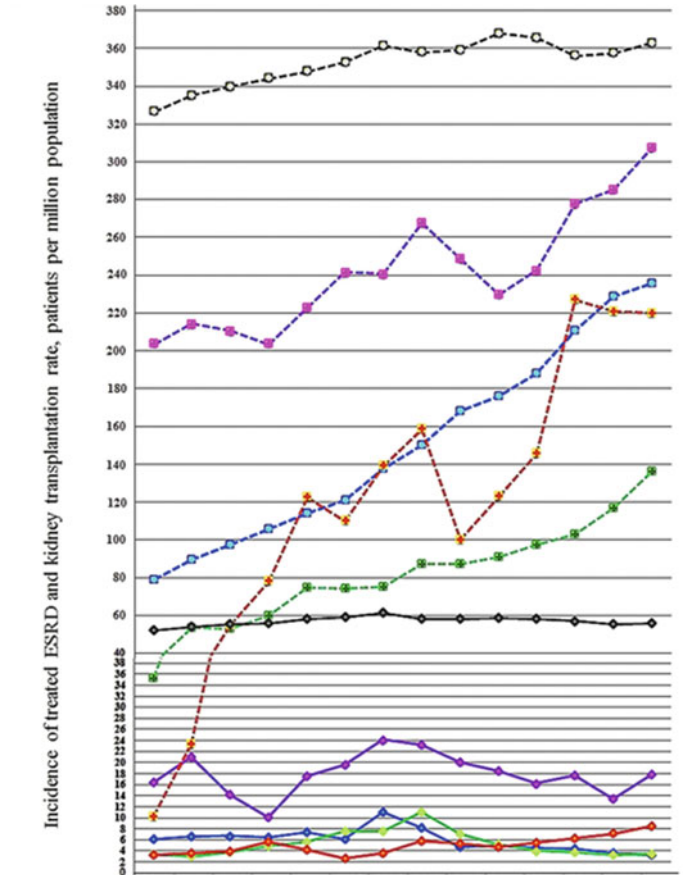


Fig. 12 Comparison of kidney donor who are not from standard criteria and who are from standard criteria right panel: KDPI > 85%; left panel: KDPI < 85%. KDPI, kidney donor profile index; PHS, public health service; HCV, hepatitis C virus; DCDD, donation after circulatory determination of death [21]

which cause donation rates dropped. The supply and demand are more unbalanced, and the mortality rate of patients is increasing year by year.

A country without developed infrastructure is just like a newborn baby, even if the tools are put in front of them, they can't pick them up. In order to solve the current difficulties regarding to kidney exchange, which allocation model is applied should not be a focus, but how to develop the physical, human, and technology capital should be the primarily emphasized.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Malaysia-ESRD	79.1	89.5	97.4	105.6	114	121	137.8	150.3	168.2	176	188.2	210.7	228.8	235.7
Malaysia-KT	6.1	6.6	6.7	6.4	7.4	6.2	11.1	8.2	4.7	5	4.5	4.4	3.6	3.3
Philippines-ESRD	35.2	53.5	53.1	59.8	74.8	74.2	75.3	87.5	87.2	91.1	97.3	103	116.8	136.2
Philippines-KT	3.5	3	3.7	4.9	5.6	7.5	7.5	11.1	7.1	5.2	4	3.8	3.3	3.4
Singapore-ESRD	203.7	214.1	210.4	203.8	222.6	241.4	240.5	267.7	248.7	229.8	242.3	277.9	285.3	307.5
Singapore-KT	16.5	21	14.2	10.1	17.6	19.6	24.1	23.2	20	18.5	16.2	17.7	13.4	17.9
Thailand-ESRD	10.3	23.4	55	78.4	122.8	110.2	139.4	158.9	100.3	123.2	146	227.4	221.1	220.2
Thailand-KT	3.3	3.6	4	5.7	4.3	2.7	3.6	5.9	5.4	4.8	5.5	6.3	7.2	8.5
US-ESRD	326.7	335.2	339.7	344.3	348	352.8	361.5	358.1	359.3	367.9	365.7	356.3	357.7	363.1
US-KT	52.3	53.9	55.2	55.8	58.1	59.1	61.6	58.1	58.1	58.5	58	57	55.4	55.7

Fig. 13 2000–2013 incidence of treated end-stage renal disease (ESRD) and kidney transplantation rates in Southeast Asia and the US, patients per million population [22]

5 Conclusion

The picture is clear: while the allocation model will initially facilitate kidney transplantation and pairing, its effectiveness is diminishing. Even if a country has chosen the most appropriate allocation model for its circumstances, the issue remains. Raising the country's fundamental strength, such as increasing the investment in

human capital, physical capital, and technology, and paying more attention to citizens' livelihood and social welfare, is the key to solving the problem. Of course, until now, the imbalance between the supply and demand of kidneys is still a major difficulty encountered by all countries. Whether it is the United States, which is already advanced, or African countries that are still at the starting point, they are all looking for better methods to improve the situation. The future research priorities for kidney transplantation in each country are different. For countries with complete infrastructure such as Singapore and the United States, technological development will be their core goal; for countries without a fully developed basic social construction, physical and human capital should be highly emphasized. Simultaneously, the allocation model, a critical tool, will also be included in the basic solution.

Acknowledgements Tianxiang Huang and Shuxin Zhu contributed equally to this work and should be considered co-first authors.

References

Bello AK (2017) Assessment of global kidney health care status. JAMA. https://jamanetwork.com/journals/jama/fullarticle/10.1001/jama.2017.4046

Chan-on C, Sarwal MM (2017) A comprehensive analysis of the current status and unmet needs in kidney transplantation in Southeast Asia. Frontiers. https://www.frontiersin.org/articles/10.3389/fmed.2017.00084/full#T1

Donantion and Transplantation Institute (IRODaT) (2017) The Nippon Foundation supporting JOT network to strength operating base, from https://www.nippon-foundation.or.jp/en/news/articles/2017/20170801-21218.html

Etheredge HR (2021) Assessing global organ donation policies: opt-in vs opt-out. Risk management and healthcare policy. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8128443

Ezaz G, Lai M (2019) How the "opt-in" option optimizes organ donation rates. Dig Dis Sci. https://link.springer.com/article/10.1007/s10620-019-05483-z#ref-CR4

Global Kidney Health Atlas (2019) International society of nephrology. https://www.theisn.org/initiatives/global-kidney-health-atlas

Kidney Transplant Donor Compatibility (2019) National kidney registry. https://www.kidneyregistry.org/for-patients/finding-the-best-match.

Lee C (2019) The matching problem using Stata. https://ideas.repec.org/p/boc/scon19/43.html

Monteiro T, Klimentova X, Pedroso JP, Viana A (2020) A comparison of matching algorithms for kidney exchange programs addressing waiting time. Cent Eur J Oper Res. https://link.springer.com/article/10.1007/s10100-020-00680-y

Roth AE (2004) Kidney exchange. Harvard University. https://dash.harvard.edu/bitstream/handle/1/2580565/Roth_kidneyexchange04.pdf

Senne T (2014) Email marketing: clarifying German opt-in requirements, from https://blogs.oracle.com/marketingcloud/post/email-marketing-clarifying-german-opt-in-requirements

The Enlightenment of American Property Tax to China's Property Tax

Qiwei Yan

Abstract In order to rid economic development of heavy reliance on land finance, China has tried to take property tax as a breakthrough point. In 2011, China launched a property tax pilot program in Shanghai and Chongqing, but had little effect. By drawing on the successful experience of America in implementing property tax, this paper attempts to explore the reasons for the impediment to the implementation of property tax in China and provide solutions from the interests of urban residents, the interests of the elite, repetitive taxation, the uncertainty of tax types, as well as the scope of the tax base.

Keywords Property tax · Land finance · Shanghai and Chongqing · America

1 Introduction

Since the implementation of the tax-sharing system, land fiscal revenue has become one of the main sources of China's local fiscal revenue over the past 30 years, and has made a tremendous impact on the development process of all aspects of the economy and society. Nevertheless, the land fiscal revenue collected from land transfer and real estate development is ultimately unsustainable, since there is less and less land available for transfer each year. Property tax, by virtue of its tax source stability, which enables local governments to obtain stable tax revenue, is a good tax choice for the government (Netzer 1966). In recent ten years, China has been trying to take the road of property tax.

American land fiscal revenue has shifted from the land asset income-dominant to the property tax income-dominant. The American property tax emphasizes flexibility and accurate reflection of market value in the collection process, which can effectively curb the real estate speculation in America, and has a reference role for revising China's property tax and curbing high-priced real estate.

Q. Yan (✉)
Department of Public Administration, Tamkang University, New Taipei City 251301, China
e-mail: 1084848419@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_110

2 Literature Review

The development and evolution of American land fiscal revenue can be divided into the following stages: the first stage was from 1776 to 1861, when land fiscal revenue was dominated by land sales; the second stage was from the beginning of the Civil War to 1900, when property tax began to be generally collected in various states, and the land fiscal revenue was mainly concentrated at the state level; the third stage was from 1900 to 1942, when the land fiscal revenue was transferred from the state to the local governments at the lower level; and the fourth stage was from the mid-1940s to the present, when the land fiscal revenue of the local governments below the state level is dominated by property tax. After these four stages of evolution, property tax has become one of the significant sources of American local government revenue, and accounted for a high proportion of local fiscal revenue.

China has implemented the tax-sharing system since 1994, which represents the separation of financial rights between the central and local governments, but this has caused a mismatch between local governments' financial and administrative powers, and local governments' search for funds has led to excessive reliance on "land finance". Irregular fiscal revenue seriously endangers the healthy and stable development of the real estate industry in my country. In order to establish a mature tax system, lay the foundation for reform and accumulate experience, the property tax reform has been a breakthrough to this problem (Bird and Bahl 2008).

However, in the more than 30 years of reform and opening up, China has enacted many reform proposals, and nothing seems to be more difficult than the property tax. At the beginning of the twenty-first century, the political, academic and business circles started to discuss the introduction of property tax. In 2003, the Third Plenary Session of the Sixteenth Central Committee of the Communist Party of China formally proposed to carry out property tax reform. But more than ten years later, the property tax plan has not come out. On January 28, 2011, Shanghai and Chongqing simultaneously announced the measures for the pilot program of property tax, by Interim Measures of Shanghai Municipality on the Pilot Program of Collecting Property Tax on Some Individual Housing and Interim Measures of Chongqing Municipal People's Government on the Pilot Program of Collecting Property Tax on Some Individual Housing, respectively. The property tax pilot project has finally kicked off.

With their own characteristics, Shanghai and Chongqing are highly representative. Shanghai is an economically developed area and a real estate hot spot, while Chongqing is one of the fastest-growing cities in the central and western regions in recent years, and the realization of its urban–rural integration is not only fast but also effective. Therefore, choosing these two cities can accumulate experience for the large-scale promotion of property tax reform. Yet, since property tax was implemented in Shanghai and Chongqing, the tax revenue has been relatively low, and the effect has not been obvious for the time being. The two cities began to levy property tax after the promulgation of the Measures, but the proportion of the total tax revenue

obtained so far in their fiscal revenue is almost negligible. The collection of property tax has little impact on China's current local fiscal revenue.

Since 2011, the implementation of property tax in Shanghai and Chongqing has not achieved ideal results, and the pilot project of property tax has failed to expand to more cities. As for why property tax is so difficult to be implemented in China, the following will analyze the reasons for the difficulty in implementing property tax in China from multiple perspectives, and seek to give solutions based on the corresponding specific experience of America.

3 Discussion: Reasons and Countermeasures for the Obstructed Implementation of Property Tax in China

3.1 The Implementation of Property Tax Touches on the Interests of Urban Residents

Since the founding of the People's Republic of China, the urban dwellings in my country have always been exempted from property tax. The imposition of property tax on private houses can easily touch the pain of the survival interests of urban residents and cause dissatisfaction with taxation. However, the collection of any tax touches on the interests of residents, as it's about taking money from residents' wallets. This cannot be the reason why property tax cannot be implemented.

In my view, this is related to the lack of clarity in the purpose of China's property tax reform. America introduced the property tax to increase local income and provide better public services for people (Fischel 1992). About 70% of American property tax is used to pay for compulsory education in school districts, improve public security and the public environment, so as to ameliorate the surrounding environment of the school district, increase housing prices, and enable the children of ordinary people to enjoy more than ten years of compulsory education after property tax paying. Hence, state, county and school district levies are all popular and contribute to government budgets. China's property tax is also included in the public budgets of local governments, but why is it not currently widely supported by residents?

In the property tax reform, an important issue is to consider the use and destination of the future property tax as well (Tiebout 1956). If Chinese residents also agree that the property tax is used to pay for education expenses and public expenses, then the government can follow the example of the America and make it clear that the property tax is used for this expenditure; if they do not agree, then policy makers should widely collect public opinion and make it clear that the property tax will be used for these expenditures; and if they disagree, policy makers should widely collect public opinion, make it clear that the property tax will be used for expenditures that the public more agree with, and do the deed to make the public feel that the property tax is "taken from the people and used for the people", rather than charging a huge

sum of property tax and then investing in expenditures that the public does not recognize or even know about (Hamilton 1975).

3.2 The Implementation of Property Tax Touches on the Interests of the Powerful

Another major pain point of the property tax is that the "hidden" properties of officials and merchants will be "public" due to taxation. Not only is the issue of the economic interests of these "rich classes" touched, but also the wealth relationship hidden behind these properties is exposed. After the reform and opening up, China's real estate industry has sprung up and has become the pillar of the national economy for more than 30 years. But at the meantime, incredible real estate economic corruption has also penetrated into this industry, forming a new corrupt mode of bribery by real estate developers and interest collusion between real estate developers and party and government officials. The collection of property tax is bound to directly affect the vital interests of the rich, especially the leading officials at all levels of relevant institutions and high-level government officials who master real estate policies, almost all of whom hoard a large amount of secret private property (Aaron 1975). The collection of property tax will undoubtedly make their dream of making a fortune in real estate in vain, and the collusion between the government and businessmen will be known to all due to real-name tax payment.

Some views hold that the essence of American land finance lies in first turning public-owned land that should belong to all the American people into state-owned land through reform, and selling the land to American capitalists, who then sell it back to the people at a high price. After the founding of America, the federal government owned more than 200 million acres of state-owned land in the west, and the government's land policy facilitated the purchase of land by land speculators and large corporation. They bought land from the government at a cheap price and sell it at a high one, so ordinary immigrants suffer a great deal therefrom. Western immigrants have been fighting for free access to land since the late eighteenth century. In 1860, both United States Senate and House of Representatives passed the Homestead Act, which was signed into law by President Lincoln in 1862. The Act established the principle of free allocation of state-owned land in the west, and more than 200 million acres of land was allocated to farmers. This is the land reform movement in America.

Personally, I think this is a kind of "liquidation" that relies on the law. Although we cannot accurately predict in what way China will justly liquidate those influential officials who seek private interests by black-box operations in land finance, this kind of "liquidation" is necessary, and the vested interests of the influential officials cannot be a stumbling block in the smooth transition of China's land finance to the next stage. In other words, the full implementation of the property tax requires China's central government to have enough resolution to lift the veil over China's real estate.

3.3 It Means Repetitive Taxation

At present, there are repetitive tax types in China's property tax. Property-related taxes include property tax, urban land use tax, contract tax, farmland occupation tax and administrative charges in real estate development.

Whereas, America has implemented a single land property tax for a long historical period, and later inheritance and gift tax (Madsen 2009). The repetitive taxation in China, along with the extremely unreasonable taxation mechanism that the land transfer link is more taxed and the retention link is less taxed, has resulted in a series of problems involving people's livelihood, such as rising real estate prices, abuse of farmland, blind urban expansion, and a large number of idle land. We should learn from the experience of America to consolidate, integrate and simplify tax systems for these repetitive taxes. Additionally, we should pay more attention to the taxes on real estate holdings, and reduce or abolish the tax on real estate transactions (Mieszkowski 1972).

3.4 There Is No Clear Legislation to Recognize Property Tax as a Local Tax

The collection of property tax aims to expand the local government's tax sources and revenue, thereby optimizing the public infrastructure and investment environment of the local government. According to the concept that tax is taken from the people and used for the people, China's property tax should be collected and managed from the lowest level—counties and cities.

In America, property tax is recognized as a local tax by legislation, and local governments at the state and county level formulate their own tax rates and collection methods (McCluskey 1999). The American federal and state constitutions have clearly stipulated property tax, making it have laws to abide by in both substantive and procedural aspects (Glaeser 1996). For example, California has formed a clear and complete tax law management system of "constitution—laws—administrative regulations—precedents—other sources".

Currently, the legal level of the Interim Regulations on Property Tax of the People's Republic of China belongs to administrative regulations, and the legislative level of taxation is low. After being poised to comprehensively promote property tax, China can also further clarify the power of local governments to collect and use property tax through formal legislation. (Specifically, in China's five-level government structure, its "local" should cover the four levels of provinces, regions (cities), counties, and towns other than the central government.)

3.5 The Tax Base of China's Property Tax Is Too Narrow

The taxation scope of property tax is too narrow, because the applicable object is single. At present, except for Shanghai and Chongqing, China's current Interim Regulations on Property Tax has an outdated tax system, and some of its contents are not compatible with social and economic development. For instance, the interim regulations stipulate that "all non-business properties owned by individuals are exempted from property tax", that is, residential properties are exempted from property tax regardless of the housing area. With the acceleration of urbanization, the improvement of residents' living standards, the rapid development of the real estate industry, and the enhancement of residents' investment awareness, residential properties have become not only an important consumer product for the urban public, but also an investment product for high-income groups to maintain and increase the value. Residential housing accounts for more than 80% of both the annual sales area and sales value of commercial housing in the country, providing a rich tax source for property tax. It would be unreasonable not to collect tax on property.

Furthermore, the Interim Regulations on Property Tax also stipulates that the taxation scope of property tax is cities, counties, designated towns and industrial and mining areas, excluding rural areas. Obviously, this regulation is no longer in line with the status quo of the integration of urban and rural economic development. It can be seen that the current property tax in China has a narrow tax base and a single applicable object, which can no longer meet the needs of current social and economic development.

By referring to the experience of property tax in America, we can appropriately collect tax on vacant properties and other special-purpose properties and implement the idea of "wide tax base and low tax rate" in the property tax reform (Hamilton 1975). "Wide tax base" refers to expanding the taxation scope of property tax to non-agricultural real estate in all cities and towns, that is, housings used by residents for personal use or business use, as long as they are not part of agricultural construction land, are included in the taxation scope of property tax and are levied on an ad valorem and quarterly basis according to the assessed value of the real estate market. "Low tax rate" refers to the setting of a proportional tax rate of 0.5–1.2% according to the use, geographical location, idle or value-added status and quantity of properties. The central government stipulates the highest tax rate, and local governments select different applicable tax rates according to the actual situation of local economic development. In this way, it not only ensures the central government has certain macro-control power, but also reflects and take into account the actual situation of different places.

4 Conclusion

To sum up, it seems to me that the implementation of property tax in China is surely in the offing, but it is difficult to realize due to various reasons. Analyzing the causes of this phenomenon based on the objective situation as well as comparing and learning from the experience of America in land finance and property tax can provide insights into the continued implementation of China's property tax.

References

Aaron HJ (1975) Who pays the property tax? Brookings Institution, Washington, DC
Bird RM, Bahl R (2008) Subnational taxes in developing countries: the way forward. Rotman School of Management, Toronto
Fischel WA (1992) Property taxation and the Tiebout model: evidence for the benefit view from zoning and voting. J Econ Lit 30:171–177
Glaeser EL (1996) The incentive effects of property taxes on local governments. Public Choice 89:93–111
Hamilton BW (1975) Zoning and property taxation in a system of local governments. Urban Stud 12:205–211
Madsen JB (2009) Taxes and the fundamental value of houses. Reg Sci Urban Econ 39:365–376
McCluskey W (1999) Property tax: an international comparative review. Ashgate Publishing, England
Mieszkowski P (1972) The property tax: an excise tax or a profits tax? J Public Econ 1:73–96
Netzer D (1966) Economics of the property tax. Brookings Institution, Washington, DC
Tiebout CM (1956) A pure theory of local expenditures. J Polit Econ 64:416–424

The Financial Statement Analysis of PepsiCo

Yueling Zhang

Abstract This article analyzes the business strategy and financial performance of PepsiCo. PepsiCo is the global branded leader in beverage and convenient food industry, including leadership positions in Mexico, China, and several Western European markets. Although the impact of the novel coronavirus has decreased in 2021, its profitability performance is getting worse while the beverage industry is growing at a compound annual growth rate of 1.7% in 2021. It is worth to take a deep look at PepsiCo's performance to gain an understanding of why PepsiCo's profitability performance is contrary to industry performance and whether PepsiCo has potential to seize opportunities and perform better in the future. We identify PepsiCo strategies by using SWOT analysis and give a general strategy that PepsiCo has been taken. Next, we demonstrate common-size analysis and ratio analysis on its financial statement. Finally, we project the following five years' revenue for PepsiCo. The analysis reveals the PepsiCo has ability to operate well and generate revenue in the future. Hopefully, the article could help companies that are experiencing the COVID-19 pandemic, and stakeholders could have a fresh and long-term perception on PepsiCo.

Keywords Strategy · Financial statements · Revenue projection

1 Introduction

PepsiCo is a global food and beverage company that produces, plans and sells Cereals, snack foods, beverages. Besides its iconic brands Lays and Pepsi-Cola, the products of Doritos, Cheetos, Gatorade, Mountain Dew, Quaker, and Soda Stream are

Y. Zhang (✉)
School of Economics and Management, University of Science and Technology Beijing, Beijing, China
e-mail: 41909076@xs.ustb.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_111

also enjoyed by consumers in more than 200 countries and territories around the world. The company has seven divisions: PepsiCo Beverages North America; Frito-Lay North America; Quaker Foods North America; Latin America; Europe; Africa, Middle East and South Asia; and Asia Pacific, Australia/New Zealand and Greater China.

1.1 Background

The name "Pepsi-Cola" was given by Caleb Bradham, a pharmacist and businessman from Duplin County, North Carolina in 1898. The Pepsi-Cola Company was founded in 1902 when the drink became popular. The company was incorporated in Delaware in 1919. Then from 1923 to 1931, the Pepsi-Cola Company had been purchased twice, the first was by Craven Holding Corporation and the second was by Roy Megargel and Charles Guth. In the early 1960s, Pepsi-Cola's product lines expanded with the creation of Diet Pepsi and purchase of Mountain Dew. In 1965, the Pepsi-Cola Company merged with Frito-Lay, Inc. to become PepsiCo, Inc.

The Coca-Cola Company has been PepsiCo's primary beverage competitor for a long time which lasts till now, but PepsiCo surpassed The Coca-Cola Company in market value for the first time in December 2005 since they began to compete with each other. In 2009, PepsiCo maintained a higher share of the U.S. refreshment beverage market (Pepsi Company history timeline 2022).

However, PepsiCo's profitability performance has become worse in the past three years due to the impact of novel coronavirus pandemic.

1.2 Motivation

PepsiCo has become a global branded leader for decades, it has mature strategies and operating systems, but in recent years when PepsiCo is experiencing serious challenges including global inflation, labor shortages and other regulatory associated with the novel coronavirus pandemic, whether it can maintain its leadership in industry is worth analyzing.

1.3 Contribution

Hopefully, this article could provide some operating implication to companies that are experiencing the COVID-19 pandemic. Also, some insight to potential future PepsiCo investors and lenders who would like to know the future financial performance and potential abilities could be brought by the analysis.

1.4 Remaining Structure

Remaining paper is structured as follows:

Section 2 includes several prior studies about PepsiCo's strategy and financial statement analysis.

Section 3 begins with PepsiCo strategy, including SWOT analysis and generic strategy. Next is financial analysis of PepsiCo, we demonstrate common-size analysis and ratio analysis on its financial statement. Finally, we project the following five years' revenue for PepsiCo.

Section 4 is the last section, which is a conclusion and discussion of analysis above.

2 Literature Review

During the COVID-19 pandemic, many food and beverage companies have been severely affected and PepsiCo is not alone. Mialon, Pinsky and Schmidt conduct an analysis on how companies in convenient food and beverage industry take advantage of the great recession from the COVID-19 pandemic. It also mentions that the top three food and beverage companies, Coca-Cola, PepsiCo and Nestlé, successfully emerged from the great recession and even became stronger in global markets than before (Mialon et al. 2021). It focuses on the external market environment but did not analysis the inside strategy and financial condition of PepsiCo when PepsiCo went through the great recession.

The Coca-Cola Company is PepsiCo's primary beverage competitor, so its common and necessary to make comparisons between two companies. Torkornoo and Dzigbede focus on comparing the two companies' sustainability practices in developing countries by using text analysis (Torkornoo and Dzigbede 2017). Venkataraman and Summers show whether PepsiCo's strategies that developing innovative products will work in an increasingly competitive environment, especially competing with Coca-Cola (Venkataraman and PepsiCo 2017). Besides, Ochoa focuses on comparing financial statements and industry between PepsiCo and Coca-Cola, but it did not analyze ratio differences and information behind ratios of the two companies (Errandonea Ochoa de Zabalegui 2019).

As the COVID-19 outbreak began, more and more articles began to analyze Pepsi's strategy and financial performance because it helps to understand the influence of novel coronavirus pandemic and Whether PepsiCo, as the industry leader, can maintain its industry position under the COVID-19 pandemic. Quan analyzes PepsiCo's strategy, accounting policy, financial statement analysis and forecasting, which based on PepsiCo's publicly financial reports in 2018–2019, but it did not put emphasis on the PepsiCo's changes when COVID-19 began to influence global economics (Quan

2018). Jallow focuses on analyzing PepsiCo's strategy from external to internal, including marketing strategies, SWOT analysis and value-chain models (Jallow 2021). But not analyze the financial factors of PepsiCo during novel coronavirus pandemic.

3 The Strategy Analysis of PepsiCo

3.1 Strategy

SWOT Analysis. Pepsi has been analysis by using SWOT Analysis model, as shown in Table 1.

Then using Tows matrix model to analysis, for SO strategies, Pepsi can increase differentiation between different brands within the company to target different customer groups, besides, using the sustainable supply chain to develop new products and support diversified production modes. For WO strategies, Pepsi can reduce un-healthy ingredients, strengthen the supervision of products' quality, and effectively respond to consumer preferences and trends, including increased consumer focus on health and wellness, besides, optimizing the company structure to better managed, which may help reduce management fee to have more money to seize potential markets.

Generic Strategies. The company has both differentiation and cost leadership strategies.

For differentiation, diversified products can indeed attract consumers with different preferences, and advertising star effect can also attract consumers, to open the popularity of the product. Launching related activities to attract consumers to participate also increased the sales of products.

For Cost leadership, PepsiCo, compared with other beverage companies, has an advantage in its wholesale price. PepsiCo's adoption of increasing the volume and not increasing the price is an effective measure to attract consumers.

Table 1 SWOT analysis

Strengths	Weaknesses
1. Cost advantage 2. Diversified products 3. Unique propaganda modes	1. Unhealthy 2. High management fee 3. Product quality and safety
Opportunities	Threats
1. The rapid changing market 2. Huge market potential 3. The improvement of information system	1. COVID-19 2. Supply chain disruptions 3. Competitive markets

Besides, we should mention that in 2021, PepsiCo announced pep + (PepsiCo positive), which is a strategic transformation of the company's overall business, with the aim of creating long-term sustainable value. The plan will start from three aspects: supply chain, value chain and product choice. This includes sustainably sourcing crops and ingredients; using and promoting more sustainable packaging; and continuing to grow the food and beverage portfolio. PepsiCo try to inspire people through their be-loved brands to make choices that create more smiles for people and the planet. There are reasons to believe that under such a strategy, consumers will better understand the company's positive impact on society. By establishing a stronger and more loyal connection with consumers, continue to stabilize the company's market leader status.

3.2 The Financial Analysis of PepsiCo

Common-Size Analysis. The article use PepsiCo's 10-k annual report 2019, 2020 and 2021 to take common-size analysis (PepsiCo fiscal year 2019 annual report 2019; PepsiCo fiscal year 2020 annual report 2020; PepsiCo fiscal year 2021 annual report 2021).

Common-Size Balance Sheet. This article uses total assets as the point of comparison (100%) and express other line items.

According to the common-size balance sheet in Excel (Pepsi balance sheet (CS)), total current assets, total liabilities and total equity accounted for 23.58%, 82.52% and 17.48% of total assets in 2021, respectively, which means the company have a high level of non-current assets and liabilities. As for non-current assets, Property, Plant and Equipment, goodwill and other indefinite-lived intangible assets are main items. As for liabilities, accounts payable and long-term debt are main items.

For the last three years, the ratio of total current assets and total liabilities to total assets showed an increase followed by a decrease, and the ratio of total equity to total assets showed an opposite trend. After analysis, for total current assets, the trend may led by cash and cash equivalents and short-term investments. For total liabilities, long-term debt obligations showed a same trend as total liabilities. At last, for total equity, the trend may caused by the change of retained earnings.

Common-Size Income Statement. This article use net revenue as the point of comparison (100%) and express other line items, because this allowed for a clearer reflection of gross profit margin and net profit margin.

According to the common-size income statement in Excel (Pepsi income statement (CS)), cost of sales and gross profit accounted for 46.65% and 53.35% of net revenue in 2021, respectively, and net income accounted for 9.66% of net revenue in 2021.

For the last three years, the percentage of gross profit and net income saw a downward trend, which means the decline of company's ability of making profit.

After analysis, we can see this downward trend may led by the increase of selling, general and administrative expenses, net interest expense and other.

Ratio Analysis. In order to better analyze the relevant ratios of the company, the Coca-Cola is selected as a comparison. Because Coca-Cola is the biggest competitor, which has similar products, organizational structure and production process with PepsiCo. All information below is based on PepsiCo's 10-k annual report 2019, 2020 and 2021, and Coca Cola Cos' 10-k annual report 2021 (Coca Cola Co fiscal year 2021 annual report 2021).

DuPont Analysis

Compared with Coca Cola, PepsiCo has a higher profit margin, about three times. In the case of similar selling prices, this means that PepsiCo has stronger control power over costs to generate more profit from sales. But Coca-Cola's assets turnover is twice than that of PepsiCo, which means that PepsiCo's ability to gain revenue with the same assets is not enough. It may be possible to increase investment in R&D funds through enhanced marketing to improve the efficiency of generating revenue asset from investment. Besides, PepsiCo has higher leverage than Coca-Cola, which means PepsiCo is likely to be more exposed to liabilities. In general, PepsiCo has a higher return on equity ratio, and a higher ratio is the desired outcome for the company. But Coca-Cola company has higher Return on capital employed than PepsiCo, which is 30.59% and 21.39%, respectively, as shown in Table 2.

But compared with PepsiCo's performance in 2020, as shown in Table 3, it shows worse profit margin, which may indicate less well controlled in cost of sales. And with a higher assets turnover and lower leverage, leading to the lower return on equity which is not desired by the company.

Table 2 Comparison between Pepsi and Coca Cola in DuPont analysis

2021	Pepsi	Coca Cola
Profit margin (%)	9.66	3.42
Assets turnover (%)	85.80	166.83
Capital structure leverage	5.74	4.68
Return on equity (%)	47.55	26.69
Return on capital employed (%)	21.39	30.59

Table 3 Pepsi's changes in DuPont analysis

Pepsi	2021	2020
Profit margin (%)	9.66	10.20
Assets turnover (%)	85.80	82.08
Capital structure leverage	5.74	6.33
Return on equity (%)	47.55	52.94

Table 4 Comparison between Pepsi and Coca Cola in profitability ratio

2021	Pepsi (%)	Coca Cola (%)
Gross profit margin	53.35	35.13
Operating margin	14.04	7.89
Net profit margin	9.66	3.42

Table 5 Pepsi's changes in profitability ratio

Pepsi	2021 (%)	2020 (%)
Gross profit margin	53.35	54.82
Operating margin	14.04	14.32
Net profit margin	9.66	10.20

Profitability Ratio

Compared with Coca-Cola, as shown in Table 4, PepsiCo are higher than Coca-Cola in all margins, so PepsiCo has a higher ability to create more profit than Coca-Cola in 2021.

However, compared with PepsiCo's performance in 2020, as shown in Table 5, each margin in 2021 are decreased to a certain extent, which means that the company's profitability has decreased, which may mainly relate to cost of sales and changes in other pension and retire medical benefits income, because there is 1.47% decline in it, but 0.28% in operating margin and 0.54% in net margin.

Liquidity Ratio

Compared with Coca-Cola, as shown in Table 6, we can see that Coca-Cola's Current ratio is closer to 2 than that of PepsiCo, so Coca-Cola has more ability to pay the current liabilities than PepsiCo in 2021. And Coca-Cola's Quick asset ratio is closer to 1 than that of PepsiCo, so without inventory, Coca-Cola still have more ability to pay the current liabilities than PepsiCo in 2021.

Compared with PepsiCo's performance in 2020, as shown in Table 7, the current ratio has a downward trend, so the PepsiCo's liquidity problems are getting worse in 2021, so the company should control their current liability or increase some current assets. And the quick asset ratio also has a downward trend, so the company must pay attention to their current liabilities and do some control measures.

Table 6 Comparison between Pepsi and Coca Cola in liquidity ratio

2021	Pepsi	Coca Cola
Current ratio	0.83	1.29
Quick asset ratio	0.66	0.93

Table 7 Pepsi's changes in liquidity ratio

Pepsi	2021	2020
Current ratio	0.83	0.98
Quick asset ratio	0.66	0.81

Efficiency Ratio

Compared with Coca-Cola, as shown in Table 8, PepsiCo has a longer holding period for inventory and accounts receivable than Coca-Cola, which means that the efficiency of using funds will be lower. However, PepsiCo have high bargaining power to suppliers, which is reflected in the longer days accounts payable, which also causes PepsiCo's working capital cycle to become a negative number, it also means that PepsiCo may need to spend more energy to maintain relationships with suppliers to keep this stability.

Compared with PepsiCo's performance in 2020, as shown in Table 9, there is a decrease in days accounts receivable, which means that the company may improve the management by checking credit on customers, effectively chasing up receivables, invoice on time and prompting payment discounts. Meanwhile, the days inventory held also reduced, which is desirable, however, it could lead to liquidity issue or cash problems to hold the optimum level of inventory. It also had a drop in days accounts payable, it may imply that the company has no difficulties to pay its debts as they due, and it could also mean that the company has taken less advantage of given credit period. But its working capital cycle has decreased, which means PepsiCo improve its ability of using their suppliers' money to invest and create more profit.

Gearing Ratio

PepsiCo has a higher gearing ratio than Coca-Cola, which shows that the company has higher long-term debt needs, and the PepsiCo's gearing ratio has a certain reduction

Table 8 Comparison between Pepsi and Coca Cola in efficiency ratio

2021	Pepsi	Coca Cola
Days accounts receivable	39.86	30.97
Days inventory held	41.93	26.70
Days accounts payable	96.81	32.26
Working capital cycle	− 15.02	25.41

Table 9 Pepsi's changes in efficiency ratio

Pepsi	2021	2020
Days accounts receivable	39.86	43.59
Days inventory held	41.93	43.10
Days accounts payable	96.81	101.62
Working capital cycle	− 15.02	− 14.93

in 2021, which shows that the company's financial risk has decreased, as shown in Tables 10 and 11.

Revenue Forecast. PepsiCo define organic revenue growth as a measure that adjusts for the impacts of foreign exchange translation, acquisitions and divestitures, and where applicable, the impact of an additional week of results every five or six years (53rd reporting week), including in 2022 financial results. The organic revenue growth provides useful information in evaluating the results of the business because it excludes items that are not indicative of ongoing performance or that impact comparability with the prior year, as shown in Table 12.

The line graph is drawn after selecting the organic growth rate of net revenue for different divisions in different years, as shown in Fig. 1. It can be found that the ratio changes are more drastic in the 2020 and 2021, which are epidemic-related years. And PepsiCo is also using various ways to adjust the abnormal data brought by this epidemic (COVID-19: see how we're working to ensure the health & safety of consumers and communities 2022; COVID-19 response at PepsiCo beverages North America 2022; PepsiCo insights platform fuels COVID-19 response 2022).

After extracting the key words in the description of the annual report, and combining with comparative analysis of quantitative data, came to the conclusion of the impact of the epidemic on the net revenue of different departments, as shown in Table 13. In subsequent forecasts, the organic growth rate during the epidemic will also be used as a value for this special period.

Table 10 Comparison between Pepsi and Coca Cola in gearing ratio

2021	Pepsi	Coca Cola
Gearing ratio	0.69	0.50

Table 11 Pepsi's changes in gearing ratio

Pepsi	2021	2020
Gearing ratio	0.69	0.75

Table 12 Organic revenue growth trends

	2021	2020	2019	2018	2017
FLNA (%)	7.00	6.00	4.50	3.00	3.00
QFNA (%)	0.00	11.00	1.00	− 2.00	− 1.00
PBNA (%)	10.00	2.00	3.00	0.50	− 2.00
LatAm (%)	15.00	3.00	7.00	8.00	5.00
Europe (%)	9.00	6.00	5.50	7.00	
AMESA (%)	12.00	1.00	6.00	5.00	
APAC (%)	13.00	8.00	9.00	8.00	
Total (%)	10.00	4.00	4.50	4.00	

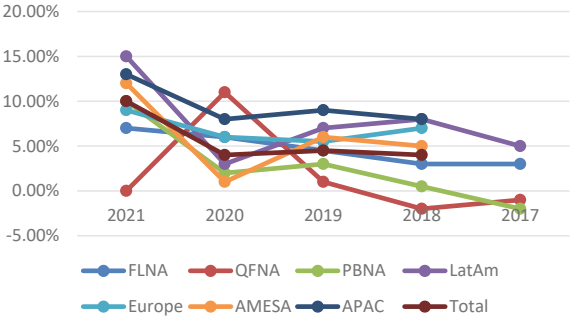


Fig. 1 Organic revenue growth trends

Table 13 Description of the epidemic impact

	2021	2020
FLNA	Unknown	Unknown
QFNA	Negative	Positive
PBNA	Positive	Negative
LatAm	Positive	Negative
Europe	Positive	Unknown
AMESA	Positive	Negative
APAC	Unknown	Negative

In order to forecast, this article assumes no significant change in the composition of net revenue over the next five years, there are no acquisitions and divestitures in the next five years, there are no favorable or unfavorable foreign exchange translations in the next five year, the same revenue growth pattern will be followed until the epidemic is over and the epidemic will end in 2025 (Pepsico's acquisition of pioneer foods 2022; PepsiCo and its many acquisition details 2022).

Then, 2021 and 2020 average net revenue growth rates for years supposed to still have epidemic (2022, 2023, 2024).

2019 and 2018 average net revenue growth rates for years supposed not to have epidemic (2025, 2026).

Because the 2022 fiscal results would include a 53rd reporting week, so there will assume to be a 2% larger in net revenue. The forecast ratio are shown in Table 14.

The net revenue results are shown in Table 15.

The Total 1 is obtained by adding up the data of each division. The Total 2 is calculated directly with the ratio.

There is a gap between the two results, because when PepsiCo announced the organic revenue growth rate, the data was reserved to the single digit, so it will be preferred to use the first result to increase the accuracy of the forecast.

In the face of the impact of the epidemic, PepsiCo has successfully achieved a greater increase in net income in 2021 through better response measures. And the proposed pep + (PepsiCo Positive) enables the company to maintain a more stable

Table 14 Forecast ratio results

	2022	2023	2024	2025	2026
FLNA (%)	8.50	6.50	6.50	3.50	3.50
QFNA (%)	13.00	11.00	11.00	− 0.67	− 0.67
PBNA (%)	8.00	6.00	6.00	0.50	0.50
LatAm (%)	11.00	9.00	9.00	6.67	6.67
Europe (%)	9.50	7.50	7.50	6.17	6.17
AMESA (%)	8.50	6.50	6.50	5.33	5.33
APAC (%)	12.50	10.50	10.50	6.33	6.33

supply channel, value chain, and closer relationship with customers in the foreseeable future. So it makes sense to think a few percentage points above the forecast results.

Because a company cannot operate without acquisitions, divestitures, foreign exchange translation activities, there is definitely a difference between the forecast and the actual net revenue results, however, by using the organic revenue growth rate, and adding in the additional yearly related activity impacts on net revenue it will get a more precise forecast, which is where this forecast makes sense.

4 Conclusion

In conclusion, PepsiCo has a great potential of growth in the future. Although PepsiCo does not have a really good performance in the current fiscal year, it still has strong power to recover from the impact of COVID-19 and maintain its leading position through Pepsi positive strategy and strong operating ability.

Table 15 Forecast results

	2021	2022		2023		2024		2025		2026	
FLNA	19,608	8.50%	21,274.68	6.50%	22,657.53	6.50%	24,130.27	3.50%	24,974.83	3.50%	25,848.95
QFNA	2751	13.00%	3108.63	11.00%	3450.58	11.00%	3830.14	− 0.67%	3804.61	− 0.67%	3779.24
PBNA	25,276	8.00%	27,298.08	6.00%	28,935.96	6.00%	30,672.12	0.50%	30,825.48	0.50%	30,979.61
LatAm	8108	11.00%	8999.88	9.00%	9809.87	9.00%	10,692.76	6.67%	11,405.61	6.67%	12,165.98
Europe	13,038	9.50%	14,276.61	7.50%	15,347.36	7.50%	16,498.41	6.17%	17,515.81	6.17%	18,595.95
AMESA	6078	8.50%	6594.63	6.50%	7023.28	6.50%	7479.79	5.33%	7878.72	5.33%	8298.91
APAC	4615	12.50%	5191.88	10.50%	5737.02	10.50%	6339.41	6.33%	6740.91	6.33%	7167.83
Total 1			86,744.39		92,961.61		99,642.91		103,145.96		106,836.48
Total 2	79,474	9.00%	86,626.66	7.00%	92,690.53	7.00%	99,178.86	4.25%	103,393.96	4.25%	107,788.21

References

Coca Cola Co fiscal year 2021 annual report. https://www.coca-cola.com. Last accessed 25 June 2022

COVID-19: see how we're working to ensure the health & safety of consumers and communities. https://www.pepsico.com/our-stories/story/covid-19. Last accessed 01 July 2022

COVID-19 response at PepsiCo beverages North America. https://www.indeed.com/cmp/PepsiCo/topics/covid-19-response. Last accessed 03 July 2022

Errandonea Ochoa de Zabalegui J (2019) Financial analysis of the financial statements and industry comparison: the COCA-COLA Company and PEPSICO

Jallow D (2021) A strategic case study on PepsiCo. Available at SSRN 3828353 (2021)

Mialon M, Pinsky I, Schmidt L (2021) How food and beverage companies leveraged the great recession: lessons for the COVID-19 pandemic. BMJ Glob Health 6(9):e007146

Pepsi Company history timeline. https://www.zippia.com/pepsico-careers-8950/history/. Last accessed 01 July 2022

PepsiCo and its many acquisition details. https://www.calcbench.com/blog/post/6566981235336151 04/pepsico-and-its-many-acquisition-details. Last accessed 01 July 2022

PepsiCo fiscal year 2019 annual report. https://www.pepsico.com. Last accessed 22 June 2022

PepsiCo fiscal year 2020 annual report. https://www.pepsico.com. Last accessed 22 June 2022

PepsiCo fiscal year 2021 annual report. https://www.pepsico.com. Last accessed 22 June 2022

PepsiCo insights platform fuels COVID-19 response. https://www.warc.cn/newsandopinion/news/pepsico-insights-platform-fuels-covid-19-response/43558. Last accessed 03 July 2022

Pepsico's acquisition of pioneer foods. https://ssa.pepsico.africa/about/pepsico-and-pioneer-foods-merger. Last accessed 01 July 2022

Quan J (2020) The trend of Pepsico by comparing PepsiCo's financial reports in 2018 to 2019 based on Harvard analytical framework. In: 2020 5th international conference on modern management and education technology (MMET 2020). Atlantis Press, pp 162–166

Torkornoo H, Dzigbede K (2017) Sustainability practices of multinational enterprises in developing countries: a comparative analysis of Coca-Cola and PepsiCo. Full Issue 11(2):19–30

Venkataraman S, Summers M (2017) PepsiCo: the challenge of growth through innovation. Darden Business Publishing Cases

The Good Offices of VW's Acquisition of Porsche and the Prospects for Post-acquisition Growth

Kaiqi Hu, Xiaoying Lin, and Yang Shan

Abstract This paper is about the family capital struggle: the "feud" between the Volkswagen Group and Porsche. Initially, Porsche wanted to acquire the Volkswagen Group and become the top shareholder but was prevented from doing so by the German government and the Volkswagen Act. In the midst of the global economic crisis in 2008, the Volkswagen Group embarked on a counter-takeover plan, and Porsche was eventually acquired by the Volkswagen Group. We analyze the acquisition intentions of both the Volkswagen Group and Porsche as well as the post-acquisition trends of Porsche and the impact on the Volkswagen Group based on exchange announcements, relevant annual and semi-annual reports, and early German Securities Acts, Volkswagen Act by-laws, and various amendments.

Keywords Volkswagen group · Porsche · Capital struggle · Acquisitions

1 Introduction

1.1 Volkswagen Group

Volkswagen Group is the largest automobile company in Europe. The Group was founded in 1938 and is one of the auto industry's most powerful multinational companies in the world. The headquarters in Wolfsburg, Germany, is in many countries

Kaiqi Hu, Xiaoying Lin and Yang Shan contributed equally.

K. Hu
Beijing Huijia Private School, Beijing 101101, China

X. Lin
The Hang Seng University of Hong Kong, Siu Lek Yuen, Hong Kong, China

Y. Shan (✉)
Stony Brook University, Stony Brook, NY 11794, USA
e-mail: yang.shan@stonybrook.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_112

around the world that have car activities of transnational automotive groups. It has 120 production factories in 19 European countries, another ten countries in the Americas, Asia, and Africa, and 153 countries to sell the cars. Besides, Volkswagen Group has two divisions: the automotive and financial services divisions. It offers extensive financial services, including customer financing and dealer, fleet management, insurance, banking, leasing, and mobility services. The Volkswagen Group brands include Volkswagen, Porsche, Lamborghini, Audi, Volkswagen Commercial Vehicles, Seat, Skoda, CUPRA, Ducati, and Bentley (Volkswagen Group 2022). The Volkswagen Group aims to provide good working conditions, create lasting value, and protect environmental resources. To achieve this goal, the Volkswagen Group firmly believes corporate social responsibility activities will have a durable and positive impact on the group's reputation and value (Volkswagen Group's 2020). Moreover, Volkswagen Group's strategic goal in 2030 is to shape a sustainable way of travel. Electric drive, autonomous driving, and digital connection will allow cars to be more secure, quieter, cleaner, and more intelligent. Meanwhile, it will provide a new driving experience for the customers (Volkswagen Advantage 2022).

Volkswagen Group is not only a company with significant influence in the world but also has established good partnerships with other brands to strengthen the group's position on the market. The 12 brands of Volkswagen Group form a larger business model (SWOT Analysis of Volkswagen 2022). At the same time, Volkswagen Group has focused on customer experience and control of product quality strictly, leading to the Volkswagen Group's business model of continuous expansion in the market. Volkswagen Group has many advantages over other companies on the market. The group has high brand awareness, and the brands of VW can satisfy consumers' different demands for products on various technical levels and prices that can contribute to customer service better at all levels (Volkswagen SWOT Analysis 2022). Secondly, the group has been focusing on product quality, product innovation, and customer satisfaction to build a good brand image for the products (Volkswagen Company Business Strategy 2022). The group's mission is to provide customers with a comprehensive service to give them a carefree and safe travel experience. The range of services ensures that customers receive the best quality, durability, and continuous mobility. The products of Volkswagen Group have high performance and are durable. Meanwhile, the group constantly improved the technical innovation and safety problems. Even though global auto sales are declining, the volume of Volkswagen Group's products remains the best in the market, which shows that Volkswagen Group has maintained a good brand image among consumers.

Volkswagen Group has a certain influence on the world. It is a multinational automotive group and is the largest automobile manufacturer in Europe. Therefore, it has 120 production factories and 153 countries around the world to sell cars (Volkswagen Company Business Strategy 2022). Besides, Volkswagen Group has cooperated with Ford Motor Company to expand the Chinese market and serve global consumers better (Volkswagen SWOT Analysis 2022). The product sales in a wide range of regions in different countries are also one of the Volkswagen Group's competitive advantages. Volkswagen Group manages its global supply chain network and has established many suppliers for a long-term stable cooperative relationship to

ensure the raw materials can supply (Volkswagen Sources of Competitive Advantage 2022). What's more, VW is using technology to reduce operating costs and increase production.

As the competition in the automobile industry becomes increasingly intense, Volkswagen Group conducts product research and develops product innovations, including automatic driving, sustainability, passenger safety, etc. Improve production technology to increase the competitive advantage. VW has also focused on management, giving employees more benefits to improve employee motivation and efficiency and recruit and retain excellent employees to stay in the company. However, in September 2015, the Volkswagen Group was exposed to the news about emissions problems, resulting in fines of more than 30 billion euros at Volkswagen factories in many countries (The Volkswagen emissions scandal explained 2022). Until now, the Volkswagen Group has struggled to regain consumers' trust. Then, the Volkswagen Group is headquartered in Europe. Even though the company sells products all over the world, the promotion effect of the product is far less than that in Europe, so the group has been adjusting its marketing strategy. In addition, though the group has many brands, the production quantity and quality can also reach a certain level. Today, car sharing, and rental cars are very popular in the market, and the group's products lack diversity.

1.2 Porsche

Ferdinand Porsche is a world-famous car designer who founded the Porsche Company in 1931. Porsche's headquarters was in Stuttgart, and it is one of the leading representative automobiles of European and America. Porsche is mainly famous for making high-grade sports cars and participating in motorsports (Porsche AG Homepage 2022). It is a high-performance car brand in the world. The Major models include 911, 718, Panamera, Cayenne, and Macan. Porsche company was not a car manufacturer originally and was an engineering company. In 1937, Ferdinand was summoned by the German government and asked to design a car for people. The Volkswagen Beetle resulted in one of the most successful car designs ever. Cause of World War II, the Volkswagen Beetle was not sold, and the Porsche company changed to making military vehicles during the war (Panzerkampfwagen VIII Maus Porsche Typ 205/Tiger II(P) 2022). After Germany's defeat at the end of World War II that the Beetle was sold.

Porsche signed a significant agreement with Volkswagen at the end of 1948, allowing Porsche to use the company's services in Austria and Germany. In 1951, Porsche company's reputation proliferated that the film stars, financiers, and shipping magnates became the company's consumers. In 1952, Dr. Ferry Porsche designed a logo that first appeared on the Porsche 356 in 1953. The logo had been on the front hood of every Porsche since 1954 (Porsche AG Homepage 2022). Porsche was explosive growth in 2000 due to the popularity of SUVs. For this reason, Porsche announced that it would acquire Volkswagen in 2005. Due to various reasons,

Porsche's acquisition plan failed. After that, the Volkswagen group acquired Porsche in 2012. Sustainability is the core business goal of Porsche. The company has committed to meeting climate targets agreed upon in Paris in 2015 and assumes responsibility for reducing emissions that are harmful to the environment (Sustainability Homepage 2022). Furthermore, Porsche seeks to reduce CO_2 emissions through innovative products and technologies. By 2025, half of all Porsche models will have electric motors. In addition to CO_2 emissions from vehicle production, the supply chain and the car lifetime emissions are also considered. Porsche uses the decarbonization Index (DKI) to calculate CO_2 emissions (in tons) per vehicle in its value chain. It has fallen by about 5% since 2019. As a result, Porsche is contributing to sustainable industrialization and achieving play a role in Sustainable Development Goals 13 and 9.

Porsche is famous for its sports cars, and it has a powerful brand image in the world. It has the most prominent automotive research and development center in the world and many years of experience (SWOT Analysis of Porsche 2022). Even though Porsche doesn't have many types of cars, they can extend the brand for them. Customers love Porsche not only for its price range but also for the power of its machines. Porsche has expanded the product range through SUVs and sedans and is competitive in the market with touchscreen, Bluetooth connection, and 3D audio systems. Because Porsche's product is of the best quality in the racing world, they also have a series of unique racing bases. Porsche has an innovation capacity for products and invites excellent designers to design the products. The company also emphasizes product research, development, and promotion, attracting many loyal brand customers for Porsche (SWOT Analysis of Porsche 2022). This is also one of Porsche's advantages. Porsche constantly optimizes its products and technologies to meet customers' demands. Porsche, with a relatively low price for other sports cars, has won consumers to buy. The company reduces product prices to increase sales and adopts various marketing strategies to attract consumers. Besides, Porsche promotion is one of the advantages also. During a disaster, the company donated money to aid in relief. This improves the brand's image and wins a good reputation in the market. Porsche uses celebrity power to hire celebrities as brand ambassadors to attract customers (Comprehensive Porsche Marketing Strategy 2022). Later, Porsche began to diversify the production of products, driving Porsche's sales growth. Porsche has a straightforward distribution channel, which is also a competitive advantage.

What's more, Porsche also gives excellent benefits to the company's talent management (Porsche AG Homepage 2022). The company to ensure the fairness of employees' base salary based on performance results, attractive additional compensation benefits are set up for employees. Select car rentals outside the Volkswagen program for all employees and set the standard for a wide range of employee pension services. On the Porsche anniversary, give the employees discounts and annual benefits (Attractive remuneration and additional benefits 2022). Porsche's talent management is better than other companies in retaining talented people to work for the company. However, Porsche is relatively cheap compared to other sports cars, but maintenance costs are not cheaper (Germany passes controversial "Volkswagen Law"

2022). Secondly, though Porsche has been improving its products, the fuel consumption problem has not been solved, and consumers still need to consume a lot of gasoline. Finally, due to the acquisition of Porsche by Volkswagen Group, the company's financial problems need to be restructured.

2 BATNA and the Possibility of Acquisition Negotiations

Volkswagen's takeover of Porsche was one of the most exciting battles in the world of capital. Porsche and VW originally wanted to take over each other because VW and Porsche's product lines and markets complemented each other perfectly. VW and Porsche have very different market positions. Porsche takes the luxury model route, which is more expensive and has higher profit margins per car. VW took the normal model route. Porsche, with annual sales of around $100,000, made more money than VW, which sold more than $6 m. Therefore, whether it's VW taking over Porsche, or Porsche taking over VW, they will be able to complete the comprehensive coverage of the product line of the automobile industry, and their profits and market share will be greatly improved.

Porsche and VW have a long history of family feuds and bad blood, and Porsche has wanted to take over VW for a long time. In 2004, due to some problems in Volkswagen's decision-making, there were major financial problems, resulting in high human and manufacturing costs and causing so many losses. VW's employees get high salaries, but they don't focus on their job, and the internal environment is rotten. VW's funding chain was on the verge of being cut off. VW had to sell a lot of its shares to stay afloat. Porsche seized the opportunity to buy up VW's shares in the secondary market. At that time, Porsche already owned about 18% of VW's shares. In 2006, Porsche paid another 4 billion yuan to buy 10% of VW's shares, and then bought some shares of VW through other channels. At that time, Porsche already owned about 30% of VW's shares and became the largest shareholder of VW. However, due to the VW law, Porsche cannot take over VW no matter how many shares it owns (Germany passes controversial "Volkswagen Law" 2022). Volkswagen law stipulates that a single party holding more than 20% of the shares will only have 20% of the voting rights. In addition, German law protects Volkswagen, which stipulates that only holding more than 80% of the shares can control the company, and the German state government owns 20.1% of the shares of Volkswagen. So, Porsche had become the largest shareholder of VW and cannot control VW. Porsche spent a lot of money suing Volkswagen for violating fair dealing, and an EU court ordered Germany to amend its rules and repeal the Law. But the German side didn't make a substantial change. Before the financial crisis in 2008, the stock market and the real estate market rose rapidly and the global economy advanced rapidly, so a large number of rich people were born. As a representative of high-end models, Porsche naturally achieved rapid sales growth and made a lot of money. Therefore, Porsche accelerated its plan to buy Volkswagen's share. Porsche already owns 42.6% of VW through borrowing money to buy it. Porsche began buying options on VW shares

and according to the Frankfurt announcement, these moves will not be shown, so it is unclear what Porsche did. It was all done in secret. Porsche's holding remained at 42.6% at the time, so many funds began shorting VW's shares heavily. But Porsche revealed that it had secretly acquired a 31.5% stake in VW through various options deals, adding to the 74.1% it now owns. The state owns 20.1% of VW's shares, while only 5.8% of VW's shares are in circulation. These funds started snapping up the floating shares, causing VW's shares to soar to 1005 euros per share. The foundations began pleading with Porsche, then Porsche eventually released 5% of its shares and sold them at a high price, earning a lot of money from them.

Then came the financial crisis of 2008, when a large number of companies declared bankruptcy, and the Great Depression. Sales of Porsche's luxury cars have plummeted, and the company has huge annual loan repayments. Porsche, which owns a large stake in VW, has fallen sharply since the last boom. Porsche ran out of liquidity. Porsche began to negotiate a peace deal with VW and stopped the takeover. At this time, Volkswagen also started a reverse takeover of Porsche, but the Volkswagen side didn't reply to Porsche's request. In the end, Porsche had no choice but to agree to VW's 100% acquisition of Porsche cars in 2009 by investing about 8.46 billion euros, which took three years to complete. But Porsche still owns a large stake in VW, because it is Porsche SE that bought VW's shares. This deal was finally ended. And this is a mutually beneficial outcome.

3 Post-acquisition Business Strategy and Analysis of Development Benefits

3.1 Business Structure

Since the acquisition of Porsche by VW, Porsche has changed its traditional strategy to align with VW's 2018 Strategy. Instead of production expansion, acquisitions, and licensing the original strategy was to offer the same products worldwide and to expand internationally through exports. Now VW Porsche and the other VW brands are developing harmoniously, making VW a leading global automotive company. Through multiple stages of development Porsche has gradually integrated into the VW family from technical production to product diversification, driving VW to achieve its goals and further accelerating its own diversification (Lin 2009). Porsche's corporate structure is functional, a traditional and common organizational form with a CEO and other employees with functional directors and a functional division of work (Table 1).

Table 1 Advantages and disadvantages of the functional structure of Porsche

Benefits	
1. Specialization	A specialized division of work promotes knowledge sharing between functional areas, and employees can focus more on specific areas. Examples include fields like product development and innovation
2. Centralization	Decision-making authority is delegated to functional personnel to reduce the cost of each departmental function and to implement a cost management strategy. In addition, a centralized workforce ensures that other cost reductions in one function have no impact on the level of other functions
3. Standardization	A type of activity by paying ministry, with very standardized rules and procedures for employees, which facilitates the exchange of training and therefore the improvement of skills
4. Integration	Use of functional structure to implement overall cost leadership and differentiation strategies. Have some flexibility in the organizational structure to achieve both within a certain amount of time
Limitations	
1. The heads of departments have been engaged in the management of a particular professional business for a long time, and view issues from a single perspective, this does not contribute to the development of senior managers	
2. Due to the different business nature of each department, they may only focus on themselves. As a result, there will be many conflicts and problems between different departments. This will affect the company's ability to achieve its overall goals	

3.2 Opportunity

The global strategy of the Volkswagen Group, the commonization of components, the power strategy, and the production of more models in China are crucial for the Volkswagen China Group. Powertrains or electrical modules common to Volkswagen are used in Porsche's new models Cayenne and Panamera (Lin 2009). In addition, the localization of Porsche begins an important step in the VW Group's global strategy. All of this will be in the fundamental interest of the Volkswagen Group while offering Porsche many prospects for growth. In the "2018 Strategy", Volkswagen expects to sell 2 million vehicles in China, and Volkswagen has achieved this goal ahead of schedule (Cai 2021). Porsche has a crucial role to play in achieving the global sales and profitability targets of the Volkswagen Group, and Porsche is rapidly capturing the Chinese luxury car market, which is a rare opportunity for both parties. The high cost of luxury cars from development to manufacturing is something that manufacturers cannot avoid, but it is not a problem for Volkswagen. The Cayenne is the largest selling SUV in the Porsche family. Porsche shares technology for large SUVs with other brands in the Volkswagen Group, sharing components and thus significantly reducing costs, while also improving product quality and technology. Regarding the European Union on exhaust emissions, Porsche cannot meet the EU requirements on its own (Lin 2009). But putting Porsche models into other VW Group brands has shared a lot for Porsche with the help of VW's many low-emission models and

low-emission technologies. The joint venture in China has become an important production base for Volkswagen outside the EU, and the Chinese plants and the joint venture have their own advantages in controlling costs in the production process, such as labor costs.

3.3 Challenges

As Porsche expands into overseas markets and grows, it has been met with a variety of resistance from the governments of the countries in which it invests, which has to some extent limited the stability and expansion of Porsche's strategic markets. Under the energy efficiency and environmental protection slogan, the U.S. government established the CAFE standard (Corporate Fuel Economy Standard), a non-tariff trade barrier for foreign countries. The standard has evolved over three decades to form a relatively tight system, and such "stringent" fuel economy standards have made the U.S. market difficult for automakers. This has increased the pressure on Porsche to compete with U.S.-based automakers. Since 2005, the Chinese government has been scrutinizing foreign investors and restricting foreign investment with increasingly restrictive requirements for foreign investment. Since these new restrictive regulations come with broader policy changes in China and are not merely stopgap measures to punish certain foreign companies, this may be a more worrisome development for foreign companies. Increasingly, savvy local Chinese companies are seizing this opportune moment to act to strengthen their competitiveness against overseas rivals. This adds to the uncertainty surrounding Porsche's investment in China. The challenge for Porsche also came from outside. After its acquisition by Volkswagen, Porsche had to comply with the company's strategic requirements. The VW Group wants to become the "world's leading automotive group", which requires Porsche to share its technology with other brands, increase its own production and promote product diversification. To cite an example, Porsche will launch the Cajun, a smaller model and more popularly priced SUV in the Cayenne midsize class. however, this is a major departure from Porsche's corporate image as a top sports car maker and will lead to a dilution of its brand heritage as it diversifies into sedans or sport utility vehicles (Lin 2009). For Porsche itself, it is in the midst of an eventful year of internal and external problems.

4 Conclusion

Porsche fails to swallow an elephant in the family struggle of the century, but there were no losers. The two families jointly control the new Volkswagen-Porsche Group. The acquisition of Porsche by VW and the start of full cooperation between the two companies gave the Volkswagen Group a leading position in the international automotive industry. Porsche is now the world's most profitable luxury car manufacturer,

while VW is also Europe's largest car manufacturer and the backbone of the German auto industry; the two sides complement each other's strengths and share resources, thus achieving a $1 + 1 > 2$ effect. For capital, it doesn't matter who acquires whom, what matters is better survival, and development in the right direction is the most important.

References

Attractive remuneration and additional benefits. https://www.porsche.com/international/aboutporsche/jobs/employer/additionalservices/. Last accessed 09 July 2022

Cai H (2021) The Porsche family VS the family feud behind the "snake swallowing elephant" of the Volkswagen group. China Acad J Electron Publ House CFBR

Comprehensive Porsche Marketing Strategy. https://iide.co/case-studies/porsche-marketing-strategy/. Last accessed 09 July 2022

Germany passes controversial "Volkswagen Law". https://www.history.com/this-day-in-history/germany-passes-controversial-volkswagen-law#:~:text=On%20July%2021%2C%201960%2C%20the,as%20the%20%E2%80%9CVolkswagen%20Law.%E2%80%9D. Last accessed 14 July 2022

Lin Z (2009) Porsche VS VW: to purchase & to be purchased. China Acad J Electron Publ House 41(5OAP)

Panzerkampfwagen VIII Maus Porsche Typ 205/Tiger II(P). http://www.achtungpanzer.com/panzerkampfwagen-viii-maus-porsche-typ-205-tiger-iip.htm. Last accessed 09 July 2022

Porsche AG Homepage. https://www.referenceforbusiness.com/history2/75/Porsche-AG.html. Last accessed 09 July 2022

Sustainability Homepage. https://newsroom.porsche.com/en/sustainability.html. Last accessed 09 July 2022

SWOT Analysis of Porsche. https://www.marketing91.com/swot-analysis-porsche/. Last accessed 09 July 2022

SWOT Analysis of Volkswagen (2022). https://strategicmanagementinsight.com/swot-analyses/volkswagen-swot-analysis/. Last accessed 09 July 2022

The Volkswagen emissions scandal explained. https://www.theguardian.com/business/ng-interactive/2015/sep/23/volkswagen-emissions-scandal-explained-diesel-cars. Last accessed 09 July 2022

Volkswagen Advantage. https://www.volkswagen.co.in/en/owners/volkswagen-advantage.html. Last accessed 09 July 2022

Volkswagen Company Business Strategy. https://business-essay.com/volkswagen-company-business-strategy/. Last accessed 09 July 2022

Volkswagen Group. https://www.volkswagenag.com/en/group.html. Last accessed 09 July 2022

Volkswagen Group's 2020 Sustainability Report. https://www.csreurope.org/newsbundle-articles/volkswagen-groups-2020-sustainability-report. Last accessed 09 July 2022

Volkswagen Sources of Competitive Advantage. https://www.notesmatic.com/volkswagen-sources-of-competitive-advantage-%EF%BB%BF/. Last accessed 09 July 2022

Volkswagen SWOT Analysis (2022) https://bstrategyhub.com/volkswagen-swot-analysis/. Last accessed 09 July 2022

The Impact of Corporate Social Responsibility on Corporate Financial Performance Under the Internal Control Adjustment

Yuanmei Luo

Abstract Corporate social responsibility (CSR) is always the focus of the government, society and enterprises. We selected the Shanghai and Shenzhen A-share listed companies from 2015 to 2019 as the object and researched the relationship between CSR, internal control (IC) and corporate financial performance (CFP). The empirical results show that with the size of the corporate, the nature of ownership, and the age of listing of the corporate as the control variables, CSR is negative and IC is positive for CFP. But at the same time, IC also has a positive impact on CSR. IC positively moderates the impact of CSR on CFP.

Keywords Corporate social responsibility · Corporate financial performance · Internal control

1 Introduction

Enterprise is an important force in social construction, and the issue of corporate social responsibility (CSR) has become the focus of attention. On the one hand, with the development of economy and the evolution of business culture, CSR and economic responsibility are increasingly showing a trend of integrated development. On the other hand, it is also one of the requirements of the times and one of the important characteristics of modern enterprises to establish a strong sense of social responsibility and value responsibility, and to promote the sustainable development of the social economy and the enterprise itself.

However, when discussing CSR, it is inevitable to mention corporate financial performance (CFP). The society's requirement for enterprises is to undertake their corresponding social responsibilities, but the ultimate goal of enterprises is to create wealth and increase profits.

Y. Luo (✉)
Business School, Yunnan University of Finance and Economics, 237 Longquan Road, Kunming 650221, Yunnan, China
e-mail: luoyuanmei18@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_113

This paper will discuss the relationship between CSR and CFP, while considering the impact of corporate internal control (IC) on the relationship. To make up the research gap, this paper will take Shanghai and Shenzhen's A-share listed companies from 2015 to 2019 as samples. With the size of the corporate, the nature of the ownership, and the age of listing of the corporate as the control variables, discuss whether and how CSR affects CFP, and after considering the IC of the enterprise, whether and how the impact of CSR on the CFP of the enterprise will change.

This paper is divided into five parts. The next step is to review the literature. It mainly starts from the different effects of CSR on CFP. Three different effects are that CSR has positive impact, negative impact and no impact on CFP. The third part of the article will focus on the research hypothesis and research model of this paper. The fourth part of the article will carry out the research results and analysis, and through data processing, get the relationship between CSR, IC and CFP. Finally, the fifth part of the article will summarize, through the previous conclusions to the enlightenment, the suggestions given, and the limitations of this text.

2 Theoretical Framework and Research Hypotheses

2.1 CSR and CFP

CSR has aroused extensive attention in the academic community. So far, there have been many discussions on CSR in the academic community, and research results have emerged in an endless stream. Regarding the impact of CSR on CFP, scholars have drawn three different conclusions. That is, positive correlation, negative correlation and no effect.

The starting point of CSR thinking is Adam Smith's "The Invisible Hand" in "The Wealth of Nations". The starting point of the idea of CSR is "The Invisible Hand" by Adam Smith in The Wealth of Nations (Smith 2018). British scholar Oliver Sheldon first put forward the view of CSR. He believes that enterprises cannot take profit maximization as the sole goal of operation, and the moral responsibility of enterprises is even more important than profit (Sheldon 1924). Stephen P. Robins, an American management master, believes that CSR refers to the responsibility that an enterprise undertakes to pursue social benefits in addition to legal and economic requirements (Stephen 1997).

Some scholars believe that CSR and CFP are positively related.

Waddock and Graves pointed out that CSR is positively correlated with the previous CFP, and CSR rating is positively correlated with the subsequent CFP. Furthermore, good social performance and good management practices can be correlated, so this in turn can lead to good CFP (Waddock and Graves 1997). Preston and O'bannon concluded that according to the data of 67 large American companies from 1982 to 1992, corporate social responsibility and CFP are strongly and positively connected. Through a study of 11,432 company annual data from 1999 to 2009

(Preston and O'bannon 1997). Sun, L. draws two main conclusions. Firstly, CSR is highly positively correlated with CFP, and secondly, the age of long-term assets is highly correlated with CSR (Sun 2012).

Other scholars believe that CSR is negatively related to CFP.

Friedman, a Nobel Prize winner and a famous economist, believes that CSR is an act of creating welfare for the whole society and stakeholders at the expense of shareholders resources. Thus, the fulfillment of CSR will promote the enterprise value (Friedman 1970). Friedman not only provided conclusions, but also provided a complete thinking and theoretical basis, and formed neoclassicism represented by him. Aupperle et al. questioned whether the benefits of investing in social responsibility outweigh the costs. Based on neoclassical theory, this research holds that social responsibility will lead to additional costs of the companies, which will lead to the company being at a disadvantage in the competition (Aupperle et al. 1985). Brammer explored the relationship between corporate social performance and stock returns in the UK, and found that companies with better social responsibility had lower earnings per share (Brammer et al. 2006). Manchiraju and Rajgopal found that CSR has reduced the company's value in the short time by studying India's compulsory social responsibility investment (Manchiraju and Rajgopal 2013). Hemingway and Maclagan believe that the purpose of management's over-emphasis on social responsibility is to strive to ensure their reputation in the community and improve their status among stakeholders, and the end result is to damage shareholder wealth (Hemingway and Maclagan 2004).

Of course, some scholars believe that CSR has nothing to do with CFP.

McWilliams and Siegel believe that the reason why many literatures find that CSR is positively related to corporate value is that companies that pursue social responsibility often also pursue differentiated strategies, so they put more attention on R&D. R&D will be beneficial to CFP, while CSR is not significantly related to corporate value. Therefore, this study believes that most of the literatures about CSP-CFP have model setting bias (McWilliams and Siegel 2000). Awaysheh et al. compared firms with their peers in the industry and found that the significant relationship between firm CFP and CSR disappeared when endogeneity was controlled for (Awaysheh et al. 2020).

According to the analysis, this paper puts forward the following assumptions:

H1: There is a significant positive impact on CSR and CFP.

2.2 IC and CFP

Kinyua et al. selected 38 companies from 62 companies listed on the NSE as a sample, and analyzed the primary data collected by the questionnaire and the secondary data extracted from public statements. It is found that IC is significantly related to CFP, and it is suggested to strengthen IC to improve the financial situation of companies listed in Nairobi Stock Exchange (Kinyua et al. 2015). Ashbaugh-Skaife et al. explored the impact of IC deficiencies and their remedial measures on accrual quality, and found

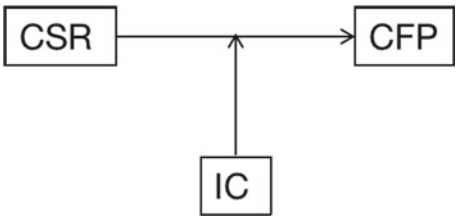


Fig. 1 Theoretical model

that companies with IC deficiencies had lower profit quality and improved profits after remediating IC deficiencies (Ashbaugh-Skaife et al. 2008).

According to the analysis, the assumption is proposed:

H2: IC has a significant positive impact on CFP.

2.3 CSR, IC and CFP

Aguinis believes that the most important factor affecting CSR is corporate governance (Aguinis and Glavas 2012) Ntim and Soobaroyen studied the relationship between IC and CSR based on the specific system of corporate governance, including IC, and believed that IC promotes CSR (Ntim and Soobaroyen 2013). Michael L. Barnett believes that the relationship between CSR and CFP varies with the nature of enterprises and their own development stages. The strengthening of corporate economic responsibility has a direct impact on managers' fiduciary responsibilities, enabling managers to clarify corporate business goals, thereby increasing the effectiveness of corporate IC, and improving the efficiency and effectiveness of business operations (Barnett 2007).

According to the impact of IC on CFP and CSR, this paper proposes the following assumptions:

H3a: IC can positively adjust the relationship between CSR and CFP.
H3b: IC plays a negative role in adjusting the relationship between CSR and CFP.

To sum up, the theoretical model is as follows Fig. 1.

3 Methods

3.1 Sample and Data Collection

Criteria is as follows: Exclude listed companies with financial abnormalities for 3 consecutive years; Exclude listed companies with missing data; Listed companies that were ST and *ST were excluded; Finally, 573 valid sample companies

were obtained. The data related to CSR in this article comes from Rankins CSR Ratings (RKS). CFP and other related data come from Cathay Pacific Financial Data (CSMAR). IC data comes from Dibo (DIB) IC and risk management database, and SPSS26.0.0.0 software is used for statistical analysis.

3.2 Variable Definition and Measurement

CFP. For the measurement of CFP, one is an accounting-based method, such as return on total assets (ROTA), return on equity (ROE), and the other is a market-based method, such as Tobin's Q value. Taking into account the particularity of China's capital market, it is more reasonable to use accounting-based methods to measure. Therefore, this paper chooses to measure CFP with ROTA, ROTA = net profit/net assets.

CSR. The measurement methods adopted in China mainly include the Runling Global CSR report rating, the Chinese Academy of Social Sciences CSR score, etc. This article adopts the rating score in Runling Global CSR Report Rating Database. Combine the five-year values from 2015 to 2019 and take the average value.

IC. The measurement of IC usually adopts the DIB IC index, which is based on domestic and foreign research results by Shenzhen DIB China listed companies. Based on the actual situation in China, it has a high degree of recognition in the academic circles. Shen and Dai (2014) also conducted a research on information content based on this. Under normal circumstances, the range of DIB IC index is between 0 and 1000 (Jingbin and Xingyuan 2014). The larger the index is, the higher the quality of IC of the enterprise is, and the index of 0 indicates that the enterprise has serious IC defects.

Listing age (Age): According to the China Stock Market and Accounting Research (CSMAR) Database, we determine the company's listing time, and the listing time is until 2019.

State of equity (State): CSMAR determines the nature of the company's equity, with 1 for state-owned enterprises and 0 for non-state-owned enterprises.

Company size (Size): The size of the enterprise is the natural logarithm of the total assets of the enterprise. The data source of the total assets of the enterprise is the CSMAR.

Table 1 Descriptive statistics (N = 574)

Variable	Min	Max	Mean
ROTA	− 5.193	1.353	0.023
CSR	20.842	87.274	42.294
IC	355.722	830.354	653.275
Age	0	28	15.38
State	0	1	0.58
Size	10.961	26.074	20.074

4 Data Analysis

4.1 Descriptive Statistics and Correlation Analysis

This paper uses SPSS Statistics 26.0 to make descriptive statistics and correlation analysis of sample data. The descriptive statistics show that the overall level of CSR performance is relatively low. The full score of CSR is 100 points, and the average value of CSR is 42.294. The maximum value of CSR is 87.284, while the minimum value is only 20.842, which indicates that there is a large disparity among enterprises. The IC index also has a similar situation. The full score of IC index is 1000. When the average value of IC is 653.275, the huge difference between the IC values of 830.354 and 355.722 indicates that there are great differences in the IC capabilities of enterprises. The average value of CFP is 0.023, the maximum value is 1.353, and the minimum value is − 5.193, which indicates that the financial levels of the sample enterprises are quite different. The average value of national equity is 0.58, indicating that the sample enterprises are mostly state-owned enterprises (Table 1).

4.2 Correlation Analysis

In this paper, the variance inflation factor (VIF) value test is firstly performed on the relevant data. Troubleshoot multicollinearity and autocorrelation between variables.

According to the correlation coefficient matrix, CFP is significantly negatively correlated with CSR, age to market, and State of equity, and significantly positively correlated with IC index and corporate size (Table 2).

4.3 Regression Analysis

Table 3 is the basic regression results, which respectively test the relationship between CSR, IC and corporate performance. The results denote that all the variables are significantly related to ROTA. The results denote that CSR is highly related to ROTA

Table 2 Correlation for continuous variable

Variable	ROTA	CSR	IC	Age	State	Size
ROTA	1	− 0.053	0.064	− 0.072	− 0.088	0.08
CSR		1	0.249	− 0.006	0.132	0.19
IC			1	0.006	0.08	0.073
Age				1	0.299	0.167
State					1	0.259
Size						1

(B = − 0.065, $p < 0.01$). It is the opposite of H1. IC has a significant relation with ROTA (B = 0.064, $p < 0.01$) which is strongly supporting H2. A company can significantly improve its performance by improving the quality of its IC.

Table 4 is the regression model of IC on CSR, revealing the impact of IC on CSR, the results indicate that IC is significantly correlated with CRS (B = 0.231, $p <$ 0.001). It shows that IC has a significant role in promoting CSR. That is, the higher corporate IC level, the better CSR performance.

Table 5 illustrates the regression results of pairs after introducing the interaction terms of CSR and IC. It mainly studies whether there is sufficient interaction between CSR and IC, and the relationship between the interaction terms and CFP. First, it reports the regression results of CSR and IC acting on corporate performance at the same time. The results show that its significance level and correlation coefficient are basically the same as the previous one. Secondly, on this basis, the interaction term of CSR and IC is introduced. The interaction terms' regression coefficients are all

Table 3 Analysis of the impact of CSR and IC on CFP (basic regression)

Variable	ROTA	ROTA
CSR	− 0.066**	
	− 1.539	
IC		0.064**
		1.546
N	574	574
R^2	0.027	0.026

Notes *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$, one-tailed test

Table 4 Analysis of the impact of IC on CSR (basic regression)

Variable	CSR
IC	0.231***
	5.763
N	574
R^2	0.100

Notes *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$, one-tailed test

Table 5 Analysis of the impact of CSR and IC on corporate performance (introducing interaction terms)

Variable	ROTA	ROTA
CSR	− 0.085**	− 0.043**
	− 1.962	− 2.087
IC	0.084**	0.085**
	1.968	1.998
CSR*IC		0.036**
		0.855
N	574	574
R^2	0.033	0.035

Notes *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$, one-tailed test

significantly positively correlated. That is, CSR and IC have an interactive effect, and with the improvement of the quality of IC, the negative effect of CSR on CFP is weakened.

Therefore, IC can act as a moderator variable to weaken the negative impact of CSR on CFP, and H3a is supported.

5 Conclusion

5.1 Discussion

According to the 2015–2019data of listed companies, this paper takes CSR-IC-CFP as the research framework and tests whether CSR will improve CFP. Taking IC as the regulating variable, this paper further discusses the regulating effect of IC on CSR and CFP, the empirical results show that CSR negatively affects CFP, and IC positively affects CFP. At the same time, IC also has a positive impact on CSR. IC positively moderates the impact of CSR on CFP.

The results denote that CSR will have a significant negative impact on CFP, which is inconsistent with the hypothesis. The reasons may be as follows. First of all, the previous conclusions are all based on those of listed companies in the European and American markets. We use the data of A-share listed companies in Shanghai and Shenzhen of China. From the conclusion, it can be seen that the nature of the enterprise has a great influence on CFP. In addition, compared with non-state-owned enterprises, state-owned enterprises are subject to stricter constraints and supervision due to their special corporate nature. So, whether CSR will have different influences on CFP in different types of enterprises.

Secondly, compared with the development time of European and American countries, the development time of China's market economy is relatively short. In the process of rapidly developing the market economy in a short period of time and pursuing market goals, there are cases of negligence of social goals. The fulfillment

of social responsibilities by enterprises will inevitably increase their costs. Management costs will also bring a good social reputation to the company, but the company has not gained more profits because of this. Does this mean that consumers in the Chinese market do not pay attention to whether the company has fulfilled its social responsibilities, and they will not pay for the good reputation.

China's supervision of listed companies is also gradually improving. The New York Stock Exchange has been established for more than 200 years, while the Shanghai Stock Exchange has been established for less than 20 years in 2019. The regulatory mechanism and standards are not perfect, and there are inconsistent conclusions. There are a total of 4,884 A-share listed companies in Shanghai Securities and Shenzhen Securities, but less than 900 have disclosed their social responsibility performance statements, and half of them are required to disclose instead of voluntary disclosure, which shows that Chinese companies attach great importance to CSR. There is room for improvement, and new questions are also raised. Is CSR not having a positive impact on CFP? Is it related to its willingness to disclose corporate attitudes when facing CSR?

5.2 Recommendation

China's listed companies have a big gap between CSR performance and IC level, and there is also a big gap between the best companies and the worst ones. IC standards have a certain relationship, and relevant Chinese departments and agencies should issue relevant requirements as soon as possible and formulate and improve unified standards.

Enterprises should speed up the improvement of the IC system. The quality of IC has a positive impact on the CFP and output of the enterprise. To achieve sustainable and healthy development, enterprises must not neglect IC. In addition, the IC of an enterprise, as a corporate governance method, can incorporate CSR into the management of IC, and combine the performance of social responsibility with IC management to improve CFP and help the sustainable development of the enterprise.

Established listed companies should actively fulfill their corporate social responsibilities. The time to market of a company is negatively correlated with its CFP, which shows that companies that have been listed for a long time have not set an example for companies that have been listed in recent years in terms of CSR performance, which is detrimental to the sustained and healthy development of the market economy. We should pay attention to social goals while pursuing economic goals, so as to achieve a good and harmonious relationship between enterprises and society and between enterprises and stakeholders.

5.3 Limitation

First of all, different industries depend on and attach different importance to social impact. However, the research in this paper is not carried out among different industries. Secondly, under the special economic nature of China, there is no analysis of enterprises with different natures. Finally, the sample only selected A-share listed companies, and the sample range may be expanded in the future to get more accurate conclusions.

References

Aguinis H, Glavas A (2012) What we know and don't know about corporate social responsibility: a review and research agenda. J Manag 38(4):932–968

Ashbaugh-Skaife H, Collins DW, Kinney WR Jr, LaFond R (2008) The effect of SOX internal control deficiencies and their remediation on accrual quality. Account Rev 83(1):217–250

Aupperle KE, Carroll AB, Hatfield JD (1985) An empirical examination of the relationship between corporate social responsibility and profitability. Acad Manag J 28(2):446–463

Awaysheh A, Heron RA, Perry T, Wilson JI (2020) On the relation between corporate social responsibility and financial performance. Strateg Manag J 41(6):965–987

Barnett ML (2007) Stakeholder influence capacity and the variability of financial returns to corporate social responsibility. Acad Manag Rev 32(3):794–816

Brammer S, Brooks C, Pavelin S (2006) Corporate social performance and stock returns: UK evidence from disaggregate measures. Financ Manage 35(3):97–116

Friedman M (1970) A Friedman doctrine—the social responsibility of business is to increase its profits.

Hemingway CA, Maclagan PW (2004) Managers' personal values as drivers of corporate social responsibility. J Bus Ethics 50(1):33–44

Jingbin D, Xingyuan S (2014) Research on information content of dibo internal control index. Friends Account 31:6

Kinyua JK, Gakure R, Gekara M, Orwa G (2015) Effect of internal control environment on the financial performance of companies quoted in the Nairobi securities exchange. Int J Innov Financ Econ Res 3(4):29–48

Manchiraju H, Rajgopal S (2013) Does corporate social responsibility (CSR) create shareholder value? Evidence from the Indian companies act 2013. J Account Res 55(5):1257–1300

McWilliams A, Siegel D (2000) Corporate social responsibility and financial performance: correlation or misspecification? Strateg Manag J 21(5):603–609

Ntim CG, Soobaroyen T (2013) Corporate governance and performance in socially responsible corporations: New empirical insights from a neo-institutional framework. Corp Gov Int Rev 21(5):468–494

Preston LE, O'bannon DP (1997) The corporate social-financial performance relationship: a typology and analysis. Bus Soc 36(4):419–429

Robbins SP (1997) Management. Renmin University of China Press, pp 96–97

Sheldon O (1924) The philosophy of management. Sir Isaac Pitman and Sons Ltd., London, pp 70–99

Smith A (2018) An inquiry into the nature and causes of the wealth of nations

Sun L (2012) Further evidence on the association between corporate social responsibility and financial performance. Int J Law Manag 54(6):472–484

Waddock SA, Graves SB (1997) The corporate social performance-financial performance link. Strateg Manag J 18:303–319

The Impact of COVID-19 on US Tech Companies

Xiaoyu Fu, Yule Shi, and Jingyi Yang

Abstract The sudden outbreak of COVID-19 in 2020 has had an indelible impact on the global economy. In the face of the challenges posed by the pandemic, it is significant to analyze the impact of the pandemic on the technology industry. This paper mainly discusses the impact of the novel coronavirus on the American technology industry by studying three American technology companies, IBM, Apple and Intel. Mainly divided into the company's finance, staff and product manufacturing three aspects. After collecting relevant literature, the following conclusions are drawn: The US economy has suffered a severe blow and the technology industry is stagnating. The mental health and computer skills of employees who work from home for long periods of time are challenged. On the product side, disruptions in the global supply chain have slowed production, and while factories are reopening, production difficulties remain. The significance of this study is to find out the difficulties faced by the company in the development of the epidemic, so as to find solutions to the problem.

Keywords COVID-19 · Work from home · Technology company

1 Introduction

In 2020, a new coronavirus pandemic swept the world. The coronavirus pandemic has certainly affected US tech companies in different ways. The butterfly effect of the U.S. tech industry's global reach is so powerful that it has already caused

Xiaoyu Fu, Yule Shi and Jingyi Yang contributed equally.

X. Fu (✉)
Jinan Xinhang Experimental Foreign Language School, Jinan 250000, China
e-mail: 15040240245@xs.hnit.edu.cn

Y. Shi
TSH Experimental School, Changsha 410000, Hunan, China

J. Yang
JXUT High School, Nanchang 330001, Jiangxi, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_114

shutdowns in Silicon Valley, stock market circuit breakers and potential delays to many new products. The US tech industry has been growing rapidly over the past decade, including during the COVID-19 pandemic. Overall, the industry, made up of four digital services and two slower-growing tech manufacturing sectors, grew 47% in the 2010s, adding more than 1.2 million jobs in terms of employees. That brings total employment in the industry to 3.9 million jobs in 2019. Even the coronavirus pandemic hasn't really stunted the industry's growth. While the expansion of the industry slowed during the initial pandemic-related lockdown, it has posted positive growth for most of the pandemic. In terms of product impact, silicon Valley has been shut down and production chains have been delayed. Us technology companies with hardware businesses, such as Apple, Microsoft and Google, have been continuously affected by the COVID-19 pandemic. As many of the contract factories are located in mainland China, the delay in resuming production has reduced capacity. On the financial front, U.S. stocks tumbled, with a combined $416.6 billion wiped off the value of technology companies. The pandemic has had a profound impact on a wide range of INDUSTRIES in the United States, with short-term debt held by non-financial companies at historically high levels. This assay mainly studies the impact of COVID-19 on the US technology industry from three aspects: finance, employees and products.

Jarunee Wonglimpiyarat analyzed the technology strategies and standards competition of the best companies shows that the use of innovation strategies is consistent with the potential of platform creation. Arguably, technology can give innovators a competitive advantage. However, as time goes on, technology competing platforms tend to be open, allowing plug-ins for a variety of applications, which will create more value (Wonglimpiyarat 2012). Attaran and Woods analysis Cloud computing technology means using the Internet to improve the performance of small businesses. Cloud Computing (CCT) is an unprecedented new method. Using the Internet to provide software and solutions for enterprises, this paper presents a successful conceptual model. It is very important for enterprises to transform their business, and the digital revolution can help enterprises to participate better. Liaise with suppliers, customers and employees. Create a positive and interactive work environment (Attaran and Woods 2019). Gupta uses recurrent Neural networks (RNNs), and he is working to explore a machine learning approach to predicting the stock market of large tech companies. This kind of effective, accurate and reliable stock market prediction system can provide relevant information about the direction of the stock market, so that investors can invest to obtain the highest possible return (Gupta 2018).

Cochrane uses Palm/3Com microcosm to observe general tech stock in order to find out factors that cause the increase and decrease of tech stocks' prices. He finally found out that the convenience yield view linked all these between high trading volume, high volatility, small stock supply, large differences of opinion and restrictions on long-term short selling (Cochrane 2002). Maksyshko and vasylieva used R\S-analysis to diagnose the persistence attribute of stock quotation time series of leading companies in the high-tech industry: Apple, Microsoft and Samsung Electronics. It proves that the stock price dynamics of these companies are persistent.

However, the time series of profitability do not have the properties of persistence (Maksyshko and Vasylieva 2019). IBM's corporate strategy is to operate for a long time, create new markets and face the future. In this process, it divested its commodity business, acquired new businesses, and recombined them to obtain higher value. As part of its globalization strategy, IBM has transformed itself into a so-called global integration enterprise (Adhikari 2018).

NCR, known as "cash" about 50 years before World War II, is one of the most outstanding companies in American business. For a century, it has been the leading manufacturer of cash registers in the world. Many American executives believe that NCR is one of the best operated companies in the United States; Its alumni have been scattered on the list of American companies since its inception 6. Its business practices and marketing methods became standard at IBM. Therefore, for these reasons, it is difficult to overestimate the importance of NCR in the early history of data processing (Samuel 2018). Of course, with the emergence of more and more start-ups and the continuous introduction of new ideas by large companies, IBM plays an important role in the growing crowd that seems to be growing every day. Although there are some distinctive features, they all have a lot in common. Dave Fick, chief technology officer of mythic, a deep learning chip startup, said: "these solutions are determined by the shape of the problem". Therefore, "everyone is converging on similar solutions" is reasonable. Mythic and other start-ups IEEE spectrum set 2019 as a year of real customer satisfaction (Cortada 2018). He et al. studied the impact of COVID-19 on employee resilience. This study focuses on the effect and mechanism of CSR on employee resilience. Through a questionnaire survey of 895 employees at the peak of COVID-19 outbreak, the study finds that CSR can effectively improve employee resilience through response satisfaction, and employees' reflective orientation also enhances the impact (He et al. 2020).

Therefore, this paper studies several technology stocks in American stock market, analyzes their business and investment value.

2 Company Description

2.1 IBM

IBM is an international business machine company. It is a leading computer manufacturer in the United States and has a large market share in the United States and abroad. Its headquarters are located in Armonk, New York. In 1911, it merged into three smaller companies as a computer tabulation and recording company, producing punched card tabulators and other office products. The company was renamed as the current company under the leadership of Thomas Watson in 1924. Thomas Watson became general manager in 1914 and took full control of the company in 1924. Watson built the struggling company into the leading manufacturer of punch card tabulation system in the United States, which was used by the government and

private enterprises. He also developed a highly disciplined and competitive sales team to make the company's customized tabulation system meet the needs of specific customers.

2.2 Apple

Apple is a global consumer electronics giant. Founded in Silicon Valley in 1976, Apple is known for its innovative industries and high-tech products. Apple's core products include iPhone, iPad, iMac, wearable Apple Watch, AirPods, Beats, etc., and its core software products include Appstore, etc. Subscription services include Apple Care, Apple Music, iCloud, Apple Pay, Apple TV+ and others. Its core revenue comes from the iPhone business. According to financial reports for 2017–2021, the iPhone accounted for more than 50% of Apple's total revenue, and Apple has made a lot of money from its iPhone products. However, with the rapid development of wearable business and service business, Apple also needs to establish a more comprehensive industrial chain and development model. Reducing the reliance on the iPhone as a single business will also help reduce the negative impact of the iPhone product on the company's revenue.

2.3 Intel

Intel firm is a multinational company and technology corporation established in America with which headquartered in Santa Clara, California. Calculated by net revenue, it is the largest semiconductor chip manufacturer in the world, at the same time, the developer of the x86 series of microprocessors—the processors found in most personal computers (PCs). Intel not only supplies microprocessors for computer system manufacturers such as Dell, Lenovo and Acer, but also manufactures network interface controllers, integrated circuits, motherboard chipsets, graphics chips and other devices related to communications and computing. Playing an essential component of Silicon Valley's development, Intel created the world's first commercial microprocessor chip in 1971; then it invested largely in new microprocessor designs facilitating the rapid growth of the IT industry during the 1990s. Intel gradually became the dominant provider of PC microprocessors and was known for its aggressive and anti-competitive tactics to defend its marketplace. On March 23, 2021, Pat Gelsinger, Chief Executive Officer, unveiled new plans for the company—IDM 2.0. This contains investments in manufacturing facilities, utilization of both internal and external foundries, and construction of Intel Foundry Services, an independent business unit which supplies a combination of wrapping and proceeding technology.

3 The Impact of COVID-19 on American Technology Companies

3.1 Finance

A decade into the global financial crisis and the great recession, the COVID-19 pandemic strike the American's economy severely. According to the statistics in 2020, America's GDP declined by 3.5%. No matter what type of business, they all invested more in technology. On the basis of McKinsey's survey, an expected phenomenon was confirmed: about the impact of the crisis on a range of measures, funding for digital initiatives has increased more than anything else—more than increases in costs, the number of people in technology roles, and the number of customers (McKinsey and Company 2020). Although the leisure and hospitality industries did take a heavy toll, technology industries had little growth. As COVID-19 pandemic forced people to keep indoors, they probably have to rely more on integrated telephone services, video conferencing, and messaging applications. A sharp increase in the proportion of consumers in the North American who communicate digitally was found, which rises by over 58% as a result of the crisis.

3.2 Operating Situation

In the context of the Novel Coronavirus outbreak, the global economy entered a downturn, with 36.4 million americans claiming unemployment benefits in just a few weeks. Tech startups have laid off more than 56,000 workers as a result of the pandemic, and their revenues have declined, forcing them to reduce the size of their workforce or their salaries. When wages fall to a certain extent, some employees may choose to resign and collect unemployment benefits. Secondly, the working mode of employees is also changing. The computer operation skills make some employees face elimination. Companies are moving more work overseas to lower-cost workers. The job market correction could mean that people with sought-after expertise will find new jobs in the post-pandemic tech economy, increasing the need for people with expertise at a time when companies are becoming extraordinarily conservative, recruiters and tech workers say. Under the epidemic situation, employee innovation is crucial for enterprises to turn crisis into opportunity. However, the negative emotions caused by the epidemic will negative emotions, leaders also need to implement interpersonal management (He et al. 2020). Another point worth paying attention to is that in the face of the threat of the epidemic, the uncertainty of income and the change of working style, enhancing the resilience of employees is the spiritual support for the organization to deal with the major epidemic and successfully resume work and production. Thus, COVID-19 has brought both challenges and changes to employees.

3.3 Product

The global supply chain disruption led to a slowdown in production. Cash flow challenges will test companies with insufficient capital, which may need alternative procurement and/or subsidies during the crisis to confirm their post crisis preparedness. As companies seek business solutions to address the needs of remote work, social distance and in store alternatives, the demand for developers and engineers may increase. Retaining top talent is crucial. Due to its labor-intensive supply chain, it is expected to have a relatively high impact on the smart phone industry. It is estimated that the server revenue in the first quarter of 20 years will decrease by 16% year-on-year; It is expected that the output of smart phones will decrease by 12% year-on-year in the first quarter of 20 years. Due to supply chain constraints, the launch of new smartphones may be delayed. Due to the decline in consumer confidence, contract mobile phone users may delay the replacement of devices. Although factories in Asia are reopening, enterprises are facing challenges in full production. The short-term and potential long-term impacts can be huge. Compared with the shortage of parts and the unpredictability of the supply chain, the software that drags down the industry is the catalyst for growth. As enterprises improve their teleworking capabilities, companies with teleworking technology have seen more and more demand. As enterprises compete to protect endpoints, especially cloud based tools, log management and VPN, the expenditure of security software on security software will increase. Hardware companies may see the main demand coming from enterprises, which are ordering a large number of notebook computers and mobile devices to support employees who now work from home. Shared economic inventory is impacted. Some component manufacturers rely on one or two major suppliers. Additional containment areas around the world have created additional transportation and delivery bottlenecks.

4 Investment Analysis

Apple Inc, IBM, and Intel are three typical examples of the Information technology department. Those stocks can be analyzed from three different perspectives. The first one is risk ratio. In this category, market cap helps small-cap investors to decide whether to invest or not. Market cap is the aggregate value of all equities in a company. This provides investors an understanding of the relative size of one business in regard to another. Market cap measures what a company is worth on the open market, as well as the market's perception of its future prospects. Small cap refers to stocks between $300 million and $2 billion. None of these three companies belongs to this category, so small-cap investors won't invest (Table 1).

Debt ratio and total debt measure the extent of a company's leverage. The higher the total debt, the higher the debt ratio, the lower the borrowing capacity of a firm. Beta is one statistical method to show the volatility of the whole market. A beta

Table 1 Risk ratio—market cap

	AAPL	IBM	INTC
Market cap	2.327 T	122.697 B	177.79 B

Table 2 Risk ratio—beta

	AAPL	IBM	INTC
Beta	1.19	0.89	0.6

equals to 1 means a stock's volatility is equal to the market. A beta over 1 indicates higher volatility relative to the market and vice versa for a beta below 1. Considering the beta value as a vital portion, momentum investors try to capture the volatility by taking short-term positions in rising stocks and selling them as soon as there are signs of a decline."Herding effect" is the main principle of them. In order to lower the risk, momentum investors will chose to invest in stocks with a beta under 1. When the momentum investors look at the beta ratio, they will prefer INTC most due to the low beta value–0.6. IBM is also a good choice since the beta is lower than 1 (Table 2).

There is another statistic that momentum investors pay close attention to. This then draws forth another perspective–market ratio. Belonging to this category, momentum is the acceleration rate of bond price–the velocity of changing security price. When the momentum investors look at the momentum value, they are more likely to invest in AAPL and INTC. Their 100 days' momentum is larger than the current price (Table 3).

Value investing is another investment approach that seeks to profit from identifying undervalued stocks. They also need market ratios to analyze. People buy the stocks at a discount price and expect them to back to the average. The principle behind is people's irrational mentality. 23.43 P/E indicates that AAPL needs at least 23 years to equal the share's cost at the company's current earnings. Value investors may not invest in any of them since neither PEG ratio nor P/B ratio is below 1. A PEG above 1 will be indicated as an overvalued stock (Table 4).

Table 3 Market ratio—momentum

	AAPL	IBM	INTC
Momentum	162.77(100D) > 146.77	131.47(100D) < 142.50	47.22(100D) > 43.83

Table 4 Market ratio—P/E, P/B, PEG

	AAPL	IBM	INTC
Price/earnings	23.43	13.66	7.22
P/B	32.98	6.07	1.67
PEG ratio	2.49	1.42	2.34

Table 5 Market ratio—dividend yield

	AAPL	IBM	INTC
Dividend yield	0.87	4.91	3.36

Table 6 Profitability ratio

	AAPL	IBM	INTC
Total asset turnover	1.042208	0.434474	0.469247
Profit margin	0.258817	0.100137	0.251417
ROA	0.269742	0.043507	0.117977
ROE	1.500713	0.302327	0.208279
Net earnings	101.935 B	57.35 B	20.899 B

Dividend investors will also consider this chart. Dividend is the reward companies give to their shareholders in any possible form. A dividend of 2–4% is considered as a good investment, not to mention dividend yields above 4%. The higher the dividend yield is, the more likely investors are going to purchase. Therefore, dividend investor prefers IBM first, then INTC. They will probably not invest in AAPL due to the low dividend yield (Table 5).

Investors may also look at the profitability ratio, that is the third perspective (Table 6).

Obviously, the larger the values in this table, the more likely people are going to invest. Lots of people seek high-earning companies and future potential growth. As shown in the graph, AAPL is the most profitable. It has the highest net earnings and profit margin. IBM is the least profitable. So this kind of investors prefer AAPL most.

5 Conclusion

As the COVID-19 pandemic ravages the globe, the world's economy has taken a dramatic battering. By analyzing three typical American technology companies, IBM, Apple, and Intel, this essay principally analyzes the impact of novel coronavirus on the American technology industry. Investigating those companies' finance, operating situation, and product manufacturing three aspects, we eventually conclude that although the US economy has suffered a severe blow, the technology industry actually enjoyed a small boom due to the frequent usage of online applications and accounting machines. Nevertheless, continuous telecommuting requires high computer techniques and long screen time. This will challenges employees in both physical and mental health. As for the product manufacturing perspective, the interruption in the global supply chain slowed down the production process though technology industries did experience a thriving time. Entrepreneurs are now positively seeking new production possibilities while factories are reopening. At the same time, they tend to

focus more on employees' mental health in order to keep productive efficiency and companies' profitability. As companies seek business solutions to address the needs of remote work, social distance, and in-store alternatives, the demand for developers and engineers may increase. Therefore, retaining top talent is their priority.

References

Adhikari A (ed) (2018) Strategic marketing issues in emerging markets. Springer, Berlin

Attaran M, Woods J (2019) Cloud computing technology: improving small business performance using the Internet. J Small Bus Entrep 31(6):495–519

Cochrane JH (2022) Stocks as money: convenience yield and the tech-stock bubble. In: Asset price bubbles: the implications for monetary, vol 175, pp 1–25

Cortada JW (2018) Change and continuity at IBM: key themes in histories of IBM. Bus Hist Rev 92(1):117–148

Gupta S (2018) Deep learning: big tech stock predictions using recurrent neural networks (RNN), pp 1–5

He J, Mao Y, Liang B et al (2020) Human resources development. Ann Tour Res 37(8):13 (in Chinese)

Maksyshko N, Vasylieva O (2019) Diagnostics of a persistence property for quotations dynamics on high-tech stock markets. In: SHS web of conferences, vol 65, p 06009

McKinsey and Company (2020) How COVID-19 has pushed companies over the technology tipping point—and transformed business forever, Oct 2020 https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

Moore SK (2018) IBM's new do-it-all deep-learning chip. IEEE Spectr

Wonglimpiyarat J (2012) Technology strategies and standard competition—comparative innovation cases of Apple and Microsoft. J High Technol Managem Res 23(2):90–102

The Impact of Higher Education Expansion on the Labor Force Absorption Capacity for College Graduates in China: A Panel Data Analysis

Shan Liu

Abstract China's higher education enrollment expansion policy has engendered both applauds and criticisms since its implementation in 1999. Among all the voices that criticize the expansion policy, the one that blames it for ballooning the unemployment pressure on college graduates prevails. This paper examines the impact of the expansion policy on the labor force absorption capacity for college graduates. The panel data of 31 provincial-level regions in China from 2002 to 2020 were applied in the study to conduct regression analyses based on fixed effect models. The outcome suggests that there exists a statistically significant positive relationship between the expanded scale of high education and the absorption capacity for labor force of college graduates. It indicates that the expansion of higher education scale itself facilitates the growth of job opportunities for college-level educated labor force. The result also illustrates that the aiding impact aforementioned shows an incessant trend of climbing up, according to analyses based on the existing data.

Keywords Higher education expansion · Employment of college graduates · Labor force absorption capacity · Investment of human capital

1 Introduction

The size of labor force with a college or higher level degree in China has experienced exponential growth over the past decades, resulting from the higher education enrollment expansion policy (hereinafter "the expansion policy") inaugurated since 1999. According to official figures between 1999 and 2021, China's gross enrollment ratio of higher education saw a nearly 450% leap from 10.5 to 57.8%. In effect, China stepped into the stage of universal higher education back in 2019, with the

S. Liu (✉)
Capital University of Economics and Business, 121 Zhangjiakou Road, Huaxiang Xincun Subdistrict, Fengtai District, Beijing, China
e-mail: NinaLiuShan@outlook.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_115

ratio having reached 51.6%, as indicated in Martin Trow's theory of higher education development (Trow 1973). However, as the expansion of higher education goes, employment challenges for college graduates appear to loom larger. Statistics show that in 2020 the ratio of college graduates who have succeeded in getting employed after six months of graduation to the sum of all college graduates is 67.7%, marking the fifth year of decline since 2016, according to a survey conducted by MyCos, a research organization focusing on higher education (Wang and Wu 2021). This has stirred concerns about whether the higher education expansion policy causes an oversupply of college graduates, i.e. skilled labor force, as categorized by Acemoglu (2002).

Thus, this paper aims to elucidate whether the expansion policy has hindered, or, inversely, subserved the labor force absorption capacity for college graduates in China via empirical research. By navigating through and raveling out the relations between them, this paper can offer a novel reference to the government's human capital investment policy-making, in that the expansion policy was proposed in the first place with one of its purposes being accelerating China's high-quality human capital accumulation.

2 Literature Review

In reality, after experiencing a period of rapid growth from 1999 to 2011 with an average annual growth rate of around 17%, the expansion of higher education has already slowed down to an average annual growth rate of approximately 3% since 2012. This deceleration implicates a shift of focus, signaled by the government, in higher education development policy. Since then, more weight has been placed on improving qualities of higher education rather than the increase of size (Zhang and Zhang 2021).

Amid new waves of industrial structure upgradation and supply-side structural reforms, high-quality and skilled labor forces are in growing demands. Based on existing research, labor force with college or higher level of education background plays an aiding role in promoting industrial structure upgradation in urban areas (He and Li 2019). More importantly, as the degree of upgradation deepens, more and more employment opportunities for college graduates will be released (Hu et al. 2018). In other words, higher education expansion is theoretically conducive to the growth of labor for absorption capacity for college graduates. Discussions on the relationship between higher education expansion and employment of college graduates abound in existing researches, with divisions of opinion from varied perspectives of analysis.

Those who take a positive stance have concluded from their studies that expansion of higher education has actively contributed to rapid human capital accumulation, thereby accelerating the pace of technology innovation in China (Liu et al. 2018). Technological development and supply of high-level intellectual talents are essential to the upgrade of industrial structure. Upgraded industrial structure has created larger demands for skilled and high-quality labor force and expedited economic growth,

whereby it has produced significant facilitating effect on employment absorption of college graduates (Li and Meng 2014). Moreover, expansion of higher education bears fruit in the field of pushing forward the urbanization progress in China (Chu 2016), and higher degree of urbanization leads to more employment opportunities for college graduates. Thus, based on research conclusions above, it is rational to reason that the expansion of higher education has fostered the labor force absorption capacity of college graduates. In addition, the expansion policy relates to the dynamics of labor force market through lowering the overall supply of future labor force. It is proved the total fertility rate (TFR) has tumbled because of boosted labor participation rate, and late marriage and late childbearing result from influences of higher education expansion (Li 2021). In other words, for the long-term, the expansion policy helps to lessen job competition in the job market.

Some studies adopt a less rosy viewpoint on the expansion policy. Yun Zhai argued that drastic growth of student population gave rise to an unbalanced teacher-student ratio and added burden to teaching faculties of universities and colleges, and the overly burdened faculties would eventually result in sliding teaching qualities. In plain words, the radical expansion of higher education is attained at the expense of education quality (Zhai 2007). Another concern closely related to the large scale higher education expansion regards the "devaluation" of college level credentials, which is one of the key reasons for which the expansion policy is frowned upon by the public. Liu propounded that the huge expansion incurred over-education on labor force and devalued competitiveness for college-level degrees. This could force college graduates to fight for the jobs that could have been done by people without college level education. Moreover, the huge expansion also threatens to dampen higher education credentials' function of screening out high-end talents (Liu 2015). Furthermore, extensive discussions were also made on how higher education expansion impacts the return of individuals' higher education investment. Sun's research on the difference of higher education return between urban and rural areas reveals that, under the expansion policy, college graduate labor force in urban areas boast higher income (Sun 2019), whereas samples from rural areas enjoy higher rate of return from high education than that from urban areas (Liu and Hu 2019).

So far, no empirical analysis has been conducted to examine and quantify the direct relationship between the scale of high education expansion and labor force absorption capacity for college graduates. Thus, this study uses the panel data across 31 provincial regions of China from 2002 to 2020 to explore the relationship and proposes a hypothesis that the expansion policy poses positive impacts on the absorption capacity.

3 Methodology

This study utilizes a two-way fixed effects model and annual provincial level panel data to address the research question: What kind of role does the high education expansion policy play in boosting or frustrating the labor force absorption capacity

for college graduates (hereinafter "absorption capacity")? Following subsections provide detailed explanations on the data, variables, and econometric model selected to achieve research objectives.

3.1 Data Specification

Annual panel data of 31 provincial level regions in China from 2002–2020 are used for the analysis. Although the expansion policy technically started in 1999, data before 2002 are inaccessible. All data are sourced from China's National Bureau of Statistics and China Yearbook of Labour Statistics. Contrasted with cross-sectional and time-series data, panel data allows an analysis of multiple subjects over different time periods (Zhang 2010). Another advantage of the panel data method is its controlling of these individual observed and unobserved differences (heterogeneity) (Mwangi 2013).

3.2 Variables

Based on the theoretical framework and the accessibility of the data, 5 variables have been formulated.

The Dependent Variable is the labor force absorption capacity for college graduates (LFAC), which is indicated by the ratio of employed labor force with college or higher level educational attainment to the overall employed labor force. These data are retrieved from the China Yearbook of Labour Statistics.

The Core Explanatory Variable i.e. independent variable, is an indicator for the resulted scale of higher education expansion (ES), which is obtained by calculating the ratio of the number of all college graduates in a certain year to the number of year-end resident population of that year (Ma and Hu 2022). With the objective of minimizing bias in the estimation results brought about by heteroscedasticity, the natural logarithm of LFAC is taken in the econometric model (Ma and Hu 2022).

Control Variables. In addition, considering that there exist other factors related to the absorption capacity, control variables are incorporated to represent some of them, including the scale of public financial expenditure (PFE), degree of industrial structure upgrade (ISU), and degree of economic development (ED). PFE is presented as the ratio of local governments' general budgetary expenditure to their gross region products of the same year; ISU is quantified as the ratio of local governments' annual value-added of the tertiary industry to that of the secondary industry (Ren and Cui 2016); ED is indicated by per capita gross region products (Table 1).

Table 1 Descriptive statistics of all variables

VarName	Median	Mean	SD	Max	Min
lnY	2.481	2.420	0.700	4.142	− 1.371
X	0.421	0.400	0.200	1.029	0.047
ED	1.090	1.640	1.800	11.115	0.016
ISU	104.625	120.120	64.000	524.401	52.705
PFE	20.931	25.240	18.700	135.378	8.110

3.3 Model Specification

A two-way fixed effects model is decided to be utilized in this study through a statistical test. The panel method combines cross-sectional data with time series, making it possible to cancel effects of omitted variables (Lima et al. 2020). When it comes to panel data, two of the most commonly used models are the fixed effect model and the random effect model. The fixed effect model allows region-specific time invariant effects to be correlated with the independent variables (Dubey 2019). Furthermore, since the unit of analysis defined in this study is individual provincial regions, unobservable factors within regions are expected to bias the variables. This is a characteristic consistent with the fixed-effects model (Mwangi 2013). Therefore, the fixed model is theoretically the most appropriate. To verify the inference made above, the Hausman Test was conducted to compare the fixed effects and random effects models under the null hypothesis that the individual effects are uncorrelated with the other regressors in the model (Hausman 1978). The results of this test showed a *p*-value of 0.0000, rejecting the null hypothesis that the random effects model is preferred; hence, the fixed effects model was chosen. Thus, the structural model for the study is constructed as follows:

$$\ln Y_{it} = \beta_0 + \beta_1 \cdot X + \beta_x \cdot \vec{X}_{it} + f_i + \mu_t + \varepsilon_{it} \tag{1}$$

where Y_{it} denotes the labor force absorption capacity for college graduates (LFAC) across 31 regions from 2002 to 2020; X, as the core explanatory variable, is a proxy indicator for the resulted scale of higher education expansion (ES); $\vec{X}_{it}$ is the vector of all control variables taken into consideration in the study, including the scale of public financial expenditure (PFE), degree of industrial structure upgrade (ISU), and degree of economic development (ED); β_0 is the intercept coefficient; f_i represents the time-invariant unobservable characteristics; μ_t denotes time specific fixed effects; ε_{it} is the error term; i and t are indices for individual units of region and time; β_1 is the coefficient for ES; β_x is the coefficient for each of control variable aforementioned. The panel model exhibited in Eq. (1) depicts the theoretically constructed relationship of variables. The model is a strongly balanced one. It contains the same number of observations for each sectional unit, where the cross-section units ($i = 1, \ldots, n$) have $n > 1$ and time periods ($t = 1, \ldots, T$) $T > 1$ (Johnston and Dinardo 2001).

Table 2 Stationarity test

Variable/indicator	T-value	Adjusted T-value	*P*-value	Stationary
Y	− 15.2395	− 4.6988	0.0000	Yes
LnY	− 17.4589	− 7.0162	0.0000	Yes
X	− 10.5983	− 2.0219	0.0216	Yes
ED	− 10.1572	− 3.9467	0.0000	Yes
PFE	− 8.9524	− 3.8584	0.0001	Yes
ISU	− 11.9076	− 2.7563	0.0029	Yes

Moreover, in order to verify the stationarity of variables discussed in this study, a LLC unit root test was conducted with StataSE 15. The results, as shown in Table 2, illustrated that all variables are stationary in their levels.

4 Results and Empirical Analysis

4.1 Correlation Analysis

Table 3 demonstrates the matrix of the correlation among variables involved. It is worth noting that coefficients of the correlation manifested below only reveal one-on-one correlations within a pair of variables, excluding influences from other acting elements. From Table 3, we can see that the expansion of higher education is positively correlated with the absorption capacity of college graduates labor force, i.e. the expansion policy has so far facilitated the market's capacity of taking in more skilled labor force. The degree of industrial structure upgrade (ISU) and the degree of economic development (ED) also evidence different levels of positive correlation with the absorption capacity. The scale of public financial expenditure (PFE) is slightly negatively correlated with the absorption capacity. This can be explained by the findings in Feldmann's research on government size and unemployment, evincing that increased government spending in public expenditure leads to a "squeezing effect" on employment (Feldmann 2009).

Table 3 Correlation results

Variables	LFAC	ES	ISU	PFE	ED
LFAC	1				
ES	0.667	1			
ISU	0.666	0.287	1		
PFE	− 0.011	− 0.109	0.238	1	
ED	0.358	0.384	0.036	− 0.291	1

Table 4 Regression results

	OLS	RE	FE
X	2.142***	1.224***	0.431**
	(0.121)	(0.130)	(0.188)
ED	0.068***	0.148***	0.067***
	(0.013)	(0.014)	(0.014)
PFE	− 0.001	0.027***	0.027***
	(0.001)	(0.002)	(0.002)
ISU	0.002***	0.001	− 0.003***
	(0.000)	(0.000)	(0.000)
Constant	1.209***	0.918***	1.452***
	(0.062)	(0.091)	(0.100)
N	589	589	589
R^2	0.531	0.731	0.846
Hausman test		Prob > chi2 = 0.0000	

Standard errors in parentheses
*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

4.2 Regression Analysis

As manifested in the column titled as "FE" in Table 4, the results of the panel data regression under fixed effects show that the expansion of higher education has a positive impact on the absorption capacity at a 5% significance level, in line with the initial theoretical inference. All three control variables display statistically significant correlations with the dependent variable at a 1% significance level. Moreover, despite the fact that a Hausman Test has already been conducted to prove that the fixed effects model suits this study better than the random effects model, the panel data were regressed respectively in the OLS, random-effects (RE) and fix-effects (FE) models to provide a straightforward demonstration of the explanatory power of each model. By observing the value of R^2 in Table 4, we can see that the fixed effects model has the highest explanatory power when compared with the other two.

4.3 Robustness Test

In pursuit of checking whether the regression results are robust, a robustness test has been performed by replacing the core explanatory variable X with X′ as another proxy indicator for the scale of higher education expansion. Data for calculating the specific values for X′ were sourced from the China Population and Employment Statistical Yearbook (2001–2021). X′ is in the form of a ratio as well, and its fractional expression is presented as below:

Table 5 Regression results of robustness test

	(1)	(2)
	lnY	lnY
X	0.431**	
	(0.188)	
X′		0.032***
		(0.009)
ED	0.067***	0.063***
	(0.014)	(0.014)
ISU	− 0.003***	− 0.003***
	(0.000)	(0.000)
PFE	0.027***	0.026***
	(0.002)	(0.002)
Constant	1.452***	1.455***
	(0.100)	(0.090)
N	589	589
R^2	0.846	0.848
Adjusted R^2	0.831	0.833
Hausman Test	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

Standard errors in parentheses
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

$$X' = \frac{\text{The number of college graduates in a certain year (10,000 persons)}}{\text{The number of working age population (10,000 persons)}}$$

As shown in Table 5, regression results of the robustness test have evidenced that after substituting the core explanatory variable, its coefficient remains positive and is statistically significant at 1% level. Thus, findings made in the original regression are robust.

5 Conclusion

This paper explores how the labor force absorption capacity for college graduates is affected by the higher education expansion policy. The author utilizes the panel data of 31 provincial-level regions from 2002 to 2020 and the two-way fixed effects model. Results of correlation and regression analysis show that higher education expansion is positively correlated with the absorption capacity, providing empirical evidence to substantiate the hypothesis proposed in the study. The correlation matrix also reveals that the degree of industrial structure upgrade and degree of economic growth respectively have correlations with the expanded scale of high education. A following robustness test further verifies that the analysis results are robust. These

findings are in line with the conclusions made by previous studies presented in former sections of this paper. In conclusion, the expansion policy factually amplifies the absorption capacity of college-graduate labor force. Without the expansion, a lot more under-educated young labor force will be fighting for less jobs in the secondary industry, i.e. the labor-intensive industry, and they will be paid at even lower levels of wages because the industrial structure upgrade proceeds at a much slower pace.

Moreover, this study is limited by the availability of data before 2002 for several variables. Since the expansion in reality was initiated in 1999, it would be more appropriate to include provincial-level data from 1999 so as to generate a more intact perspective and to include the data 20 years ahead of 1999 in order to provide a comparison between the trends of absorption capacity change in the two decades before and after 1999 respectively. It is also worth noting that this paper does not deny the fact that not everything about the results of higher education expansion is rosy. Sliding of higher education quality and student quality, insufficient funding, and the mismatch of skills and knowledge between curriculum and working-place demands are issues that have to be and will be resolved and optimized through policy revisions and reforms in the future. But they are not among focuses in this study.

References

Acemoglu D (2002) Technical change, inequality, and the labor market. J Econ Lit 40(1):7–72

Chu S (2016) Higher education development and population urbanization: evidence from Chinese higher education expansion. China Demogr Sci 4:8

Dubey S (2019) Impact of public education expenditure across different levels on higher education access in India: a panel data study. In: Bhushan S (ed) The future of higher education in India. Springer, Singapore (2019). https://doi.org/10.1007/978-981-32-9061-7_11

Feldmann H (2009) Government size and unemployment: evidence from developing countries. J Dev Areas 43(1):315–330. http://www.jstor.org/stable/40376286

Hausman JA (1978) Specification tests in econometrics. Econometrica 46(6):1251–1271

He Y, Li MY (2019) The impact of college enrolment expansion on urban industrial structure upgrading. Theory Pract Financ Econ 40(5):11

Hu YY, Zhou Y, Wang F (2018) Whether upgrading the urban industrial structure can boost the employment for college graduates in China? J Beijing Normal Univ Soc Sci 5:13

Johnston J, Dinardo J (2001) Econometric methods, 4th edn. McGrawHill

Li ZL (2021) College enrollment expansion and fertility: a reinterpretation on the change of China's fertility rate. J Educ Stud 17(6):14

Li FJ, Meng XD (2014) Reflection and outlook: employment of college graduates amid industrial transformation and upgrade. Popul Econ 6:11

Lima F, Maria M, Marques JB (2020) Access to private higher education in Brazil: empirical analysis of growth with panel data (1995–2017). Braz J Dev 6(2):7180–7194

Liu JS (2015) Reflection caused by "credential depreciation" on the reform of higher education enrollment expansion. Forum of Higher Education

Liu SL, Hu AG (2019) Efficiency and equality: expansion of higher education and the quantile treatment effects of return to higher education. Acad Res 4:14

Liu YJ, Zhou J, Zeng XM (2018) College enrolment expansion, human capital accumulation and innovation ability promotion. J Hunan Univ Financ Econ 34(1):13

Ma JF, Hu YG (2022) The scale effect and turning point of China's higher education in the new development stage. Jiangsu High Educ 1:10
Mwangi C (2013) The impact of state financial support on the internationalization of public higher education: a panel data analysis. Rev High Educ 10(10):61–77
Ren D, Cui YB (2016) Effect of high-quality labor force agglomeration on upgrading industrial structure. J Publ Financ Res 2:8
Sun CD (2019) The Urban-rural difference in the return on education and the differentiation of Urban-rural income classes—an analysis based on regression discontinuity. Mark Wkly 8:3
Trow M (1973) Problems in the transition from elite to mass higher education. Educ Probl 57
Wang BQ, Wu YL, Wang M (2021) Chinese 4-year college graduate employment's annual report. MyCos Research Institute
Zhai Y (2007) Analysis on the benefits and costs of higher education enrollment expansion. Coll Sci Educ 07S:2
Zhang L (2010) The use of panel data models in higher education policy studies. In: Smart J (ed) Higher education: handbook of theory and research, vol 25. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-8598-6_8
Zhang DM, Zhang X (2021) From the extension development to the connotative development: historical changes and future trends of higher education policy in the past 20 years of enrollment expansion. J Hebei Energy Coll Vocat Technol 21(1):4

The Impact of the COVID-19 on the Mood of Hotel Employee

Moxuan Yao

Abstract The COVID-19 that started at the end of 2019 has brought great changes to people's lives. Social and economic development is at a standstill, and people's work is facing great challenges. Among them, the hotel industry has been greatly affected. Under the COVID-19, people have many risk concerns about travel plans and travel to other cities, so hotel occupancy rates will be affected. Although the hotel will usher in a peak in tourist traffic during some special festivals and holidays, most of the flattening situation is not optimistic. As the core of the hotel, hotel employees have different changes in their working environment and their own state. This article focuses on hotel employees under the COVID-19 and conducts research on the emotional state that affects hotel employees. This article organizes and studies the influencing factors from three aspects: cognitive outcome, emotional outcome and behavioral outcome. The COVID-19 has had different effects on the job satisfaction, job performance, and work enthusiasm of hotel employees.

Keywords COVID-19 · Mood · Hotel employee

1 Introduction

Since ancient times, major infectious diseases have threatened people's lives, affected people's normal life, but also brought bad influence to the social and economic development. In December 2019, COVID-19 was discovered in Wuhan, Hubei Province, China. This infectious disease spreads extremely fast, can be transmitted through the air, but also can be transmitted from person to person, so after COVID-19 was discovered in Wuhan, the virus spread to many other parts of China. This is the beginning of China's national fight against the epidemic. By July 1, 2022, a total of 4,367,515 cases had been confirmed, 19,425 overseas, 297,969 cured, and 21,400 died. (National and provincial health commissions). After the discovery of the COVID-19, China began

M. Yao (✉)
City University of Macau, Taipa 999078, Macau
e-mail: Hopecc223@poers.edu.pl

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_116

a series of epidemic prevention measures. On January 23, 2020, Wuhan was closed down, and Qinghai and Xizang were the only provinces (autonomous regions and municipalities) among China's 29 provinces (autonomous regions and municipalities) that had not reported the disease. The Ministry of Transport has notified the country to suspend passenger traffic on roads and waterways entering Wuhan. With public transport suspended, flights canceled and schools delayed, the flow of people is low, and the mood is uneasy, tense and depressed. After several months of tough fighting against the epidemic, it is time to return to normal life and work across the country. However, masks need to be worn at all times and nucleic acid test certificates need to be tested across provinces. Lives into normalization, people began to also need time to adapt to the normal work, the work state of recovery is a difficult problem that led to the economy, many companies after the return to work, is adjusted to the state of the company as a whole, including the adjustment of employees, staff's mood is as one of the focus of the work under the outbreak content (Morens et al. 2009).

COVID-19 gradually brings influence to people's lives, this effect in the tourism hotel industry is particularly significant, as is given priority to with people working mechanism, the customer for the hotel industry is one of the important source, but based on the existence of the outbreak, the hotel to store rate actually by a lot of influence, and this effect is about the employees (Peng 2020). Staff's heart health level during the outbreak is not stable, even the most tend to worse trend, employees based on job stress, job change, will produce negative emotions, depression and anxiety psychological sub-health state, such as emotional exhaustion, irritability, no enthusiasm, inability to concentrate, etc., during the outbreak of the hotel staff are reflected. Emotion is a very sensitive alarm, and an employee's negative emotion is likely to affect the people around him. The hotel makes clear that the psychological changes of employees are very important in the operation and management of the hotel during the epidemic. The performance of employees will bring benefits to the operation of the hotel, and relatively speaking, it will also bring negative impacts. Therefore, from the perspective of employees, it is the most important thing to thoroughly manage employees during the epidemic to clarify their emotional states and analyze the causes of different emotions.

In order to fill the knowledge gap, this article aims to explore the antecedents and behavioral consequences of the impact of the epidemic on hotel staff. This paper proposes a framework for the direct relationship between the factors that indirectly affect employees' emotions and cognitive, emotional and behavioral results. The epidemic will affect employees' job satisfaction from three aspects: work task, work attitude and job numbness. The epidemic will also affect the work performance of employees from internal environment, self-efficacy and opportunity. Secondly, the positive emotions, negative emotions and behavioral outcomes of employees have brought changes to employees themselves under the epidemic (Fig. 1).

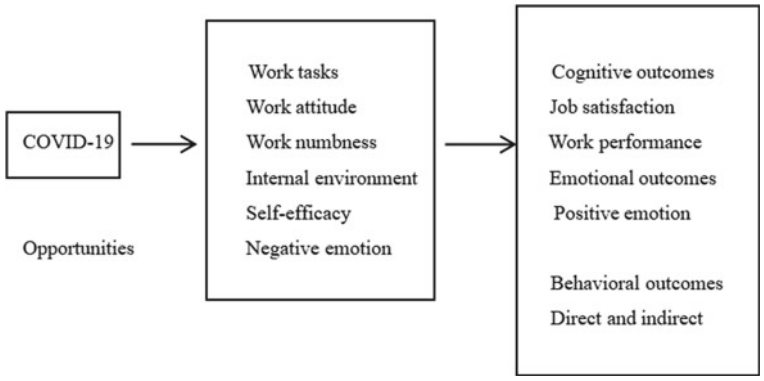


Fig. 1 The emotional influence model

2 How the COVID-19 Affects Hotel Employee

2.1 Cognitive Outcomes

The Impact of the COVID-19 on Job Satisfaction

Indirect Impact—Work Tasks. There are many different departments in the hotel, such as the front office department, the guest room department, the catering department, the financial department, etc. Each department has its own tasks, and their working hours, work content, work efficiency, etc. are all different. Before the epidemic, each department of the hotel played its own role and could complete daily work tasks, and sometimes the work content exceeded the daily basic workload, which was a sign of the stable development or improvement of the hotel industry. For all employees in each department, completing daily work tasks is to achieve daily goals, so that they will be consistent with their job satisfaction, and furthermore, job satisfaction will be improved. However, after the epidemic, the work tasks of various departments of the hotel have declined significantly in terms of quantity and quality. The completion of work tasks is based on workload, and the amount of work content is the premise of work quality. Under the epidemic, the hotel industry is relatively sluggish, and some hotels are in a freezing period. The occupancy rate is one of the core of the hotel. Without guests, there is no profit. Under the epidemic, most of the current situation is that the occupancy rate is usually low. Only during some holidays, more people will travel, such as family travel and group building, so the occupancy rate will increase. The increase in occupancy rate can make Hotel employees will enrich their work, and job satisfaction will increase. However, short-term job satisfaction improvement is far from enough. Under the epidemic, it is difficult to maintain employee job satisfaction. However, employee job satisfaction is one of the important results of employees themselves working in the hotel. When job satisfaction is high, they will stay in the hotel. On the contrary, low job satisfaction will lead to the resignation of hotel employees, which will also cause human losses to the hotel (Davahli et al.

2020). With less work, hotel employees have nothing to do, and most of the time at work is meaningless if there is no clear task to complete, then job satisfaction will drop. There is work content, but the quality of this content is not high, and it will also reduce the job satisfaction of hotel employees. The most intuitive impact of the epidemic on the hotel industry is that there are no guests. For hotel employees, the object of work and service is the guests, which directly affects the job satisfaction of hotel employees.

Indirect Impact—Work Attitude. The epidemic will affect the work attitude of hotel employees, thereby affecting job satisfaction. First of all, the epidemic will have a positive impact on the work attitude of hotel employees. Under the epidemic, the business status of the hotel is in a state of depression most of the time. During the holidays when the occupancy rate is relatively improved, all departments of the hotel will be busier than usual. Promoted to some hotel staff. Some hotel employees will be in poor working condition because of the unoptimistic hotel business situation, but the sudden increase in job opportunities will make them actively perform work content and complete work tasks, which is a kind of enhancer, so that hotel employees are satisfied with their work. There is an improvement (Gursoy and Chi 2020). Conversely, the epidemic will also have a negative impact on the work attitude of hotel employees. Continued hotel industry downturn, the lack of work for hotel employees can cause them to lose their career goals, lack of job responsibility, and thus greatly reduce job satisfaction. After the epidemic began, under the general environment of the epidemic, many tourists will consider many factors before deciding whether to travel and whether to live in a hotel. For some hotel employees, the restrictions on tourists coming to hotels make them feel uneasy about their work (Ntounis et al. 2022).

Indirect Effects—Work Numbness. The term "employee numbness" refers to a state of unresponsiveness, low efficiency, and indifference to work when employees work in the unit. During the epidemic, the operation and operation of the hotel have been in a lower and slower state than before the epidemic. Such a long-term development will bring physical inertia to the hotel staff, do not want to work, and have no positive feedback on the work content, and the work is completed. Low degree, unsatisfactory work quality, etc., will become problems for hotel staff. In the long run, the lack of energy and work enthusiasm will lead to numbness of employees' work, and then the job satisfaction of hotel employees will be reduced.

The Impact of the COVID-19 on Work Performance

Indirect Impact: Internal Environment. Changes in the internal environment can have a direct impact on employee job performance. The internal environment includes the physical environment of an organization, the physical conditions of the site, the provision of equipment required for work, wages and benefits, and corporate culture. As the name suggests, the physical working environment of hotel employees is the entire hotel. After the epidemic, the hotel environment has changed, and this change is reflected in the flow of personnel. Due to the large number of resignation behaviors brought about by the epidemic, compared with the relatively stable development of

the hotel industry before the epidemic, many people will automatically or passively resign during the epidemic, resulting in a hollow working environment and low employee performance (Alonso et al. 2020). Salary changes are also one of the important reasons. The hotel industry experienced an oversupply situation during the epidemic, which led to some corresponding policies for hotels to try to keep employees and salaries as close to a balance as possible. However, the fluctuation of salaries, especially the reduction of salaries, It will reduce the work performance of hotel employees, because one of the ultimate goals of employees' work is salary, which is one of the essential factors to promote labor development.

Indirect Effects: Self-efficacy. Self-efficacy is the ability of a person to perform an expected behavior in a given environment. Believing in one's own self-efficacy and making the most of it are essential to success. Self-efficacy is a state that is related to specific situations and work tasks, and self-efficacy changes with the change of work content and situation. The autonomy of the hotel staff to the work, the perception and feedback of the importance of the work content can make them experience the meaning of the work, have a sense of responsibility for completing the work, and understand the results of the work, which is also the improvement of self-efficacy, which will make the hotel staff have High-quality job performance (Etehadi and Karatepe 2019). But under the epidemic, self-efficacy tends to develop in two different outcomes. One is that in a short period of time when the hotel's business conditions are ideal, employees have higher self-efficacy because they will complete many work tasks, so their work performance is also improved; Performance is regional average or lower.

Indirect Effects: Opportunities. Opportunity is a highly contingent factor, and it is very beneficial for employees to improve their abilities, innovate independently, and grow and develop. If hotel employees can complete specific work content, that is, achieve high-quality work performance than cannot be achieved in previous positions. Although the work content of the hotel tends to be stable under the epidemic, there are many opportunities for expansion. With the promotion of opportunities, employees can develop in some areas and deepen their self-performance improvement.

2.2 Emotional Results

Positive Emotions. The epidemic will promote the positive emotions of employees in some aspects. The generation of such positive emotions is inseparable from the training of employees by managers. It is very important for managers such as department general managers to improve the work ability and work quality of employees. Under the epidemic situation, due to the sometimes depressed situation of the hotel industry, it is normal for employees to have low emotions. This is normal, but the ability and quality of employees should be recognized and praised first, and then

corrected and improved to a certain extent. In this way It will make employees more confident and stimulate their desire for self-improvement (Boz and Koc 2021). Self-improvement during the stagnant period can play a key role when the hotel situation improves in the future. This accumulation will make it easier to use in future work, satisfy customers, and at the same time gain self-identification.

Negative Emotions. The most direct negative emotion that the epidemic brings to hotel employees is job burnout. This kind of job burnout comes from two reasons. The first is that the work pressure caused by the epidemic has increased. This situation mostly occurs when the hotel is open during the holidays. The occupancy rate of the hotel industry tends to be relatively flat. During the holidays, the sudden surge in occupancy rate will cause some employees to not adapt to the high-intensity work state, and many jobs will be backlogged together and cannot be solved quickly, especially some employees in key positions, who are responsible for a large amount of work. Influence, there will be attention at all levels, so it will especially cause the pressure to increase, and if this pressure is relieved to a certain extent at the time, it will cause them to become tired. The second situation is brought about by the lack of work due to the low workload. In this case, the work cannot bring satisfaction to the employees, resulting in low innovation of the work, and the single repetitive work will make the employees have no expectations for the work, little room for improvement, and no interest, which leads to burnout (Yang et al. 2020).

2.3 Behavioral Results

Direct Impact. The epidemic has affected the motivation of hotel employees to work. Under the epidemic, most of the time the hotel industry is in a situation where the occupancy rate is relatively flat and the number of customers is small. Work enthusiasm can be viewed from two aspects, one is long-term reasons, and the other is short-term reasons. From the perspective of long-term reasons, the competitiveness of hotels has become weak in the few years from the beginning of the epidemic to the present. However, the existence of the epidemic has made the competitiveness among employees lower, and the reduction of the quantity and quality of work content will affect the enthusiasm of employees, lack of motivation, and reduce enthusiasm, which is very common (Lv et al. 2021). For short-term reasons, such as sudden personnel changes in a period of time, the mental state of employees will be unstable, and employees will affect their self-focus due to personnel changes, so they are worried about their own situation and whether they will encounter personnel changes. Such suspicion and low concentration can also lead to their lack of motivation to work.

Indirect Influence. The resignation of hotel employees is a very common situation under the epidemic. Although this is a loss for the employees themselves and the hotel organization, in the state of the epidemic, resignation is inevitable. The epidemic will make hotel staff have a pessimistic attitude, which mostly comes from

the negative reception of the impact on life. Problems such as improper communication between employees and hotel management personnel, market shrinkage, customer loss, etc., will cause employees' pessimistic attitudes, which will lead to their turnover behavior.

3 Conclusion

Through reading and sorting out the literature, this paper concludes that the mood of hotel employees has been affected in many ways under the epidemic. The number and completion of work tasks, the change of work attitude and work numbness will affect the teaching situation of hotel employees themselves. Positive and negative attitudes also affect their behavior. Travel under the epidemic is now normalized, hotels are facing many difficulties in the operation of the epidemic, and hotel employees are also facing a lot of pressure under this situation. Emotional adjustment is very necessary for hotel employees. They need to deal with customers, communicate, and serve, and they all need to satisfy customers, so self-emotional adjustment is in an important position. After knowing the factors that affect emotions, hotel staff can adjust and change themselves on this basis, which will bring benefits to their body and mind and also complete the service work. In the context of COVID-19, hotels should pay close attention to the emotional state of their employees, which is very important for their own mental health, and at the same time, a stable employee emotional state can bring benefits to the hotel. If hotel employees have mood swings, hotel managers can conduct appropriate emotional counseling for employees, so that employees can work in a more stable emotional state.

References

Alonso D, Kok K, Bressan A (2020) COVID-19, aftermath, impacts, and hospitality firms: An international perspective. Int J Hosp Manag 91:102654–102664

Boz E, Koc E (2021) Service quality, emotion recognition, emotional intelligence and Dunning Kruger syndrome. Total Qual Manag Bus Excell 32(11–12):1201–1214

Davahli R, Karwowski W, Sonmez S (2020) The hospitality industry in the face of the COVID-19 pandemic: current topics and research methods. Int J Environ Res Public Health 17(20):7366–7385

Etehadi B, Karatepe M (2019) The impact of job insecurity on critical hotel employee outcomes: the mediating role of self-efficacy. J Hosp Market Manag 28(6):665–689

Gursoy D, Chi G (2020) Effects of COVID-19 pandemic on hospitality industry: review of the current situations and a research agenda. J Hosp Market Manag 29(5):527–529

Lv X, Liu Y, Xu S (2021) Welcoming host, cozy house? The impact of service attitude on sensory experience. Int J Hosp Manag 95:102949–102958

Morens M, Folkers K, Fauci S (2009) What is a pandemic? J Infect Dis 200(7):1018–1021

Ntounis N, Parker C, Skinner H (2022) Tourism and Hospitality industry resilience during the Covid-19 pandemic: evidence from England. Curr Issue Tour 25(1):46–59

Peng M (2020) Outbreak of COVID-19: an emerging global pandemic threat. Biomed Pharmacother 129:110499–110512
Yang E, Wang C, Yang J (2020) Hotel restaurant service employees' sources of positive and negative emotions. J Qual Assur Hosp Tour 21(5):542–563

The Importance of Celebrity Endorsement: A Case Study in China

Siye Wu

Abstract The cosmetics industry is keen to choose celebrities to endorse their products. On the one hand, the high popularity of celebrities can sufficiently increase the exposure of products. On the other hand, the personal charisma of celebrities can stimulate many consumers' desires to buy. Now, the number of beauty brands in China is starting to increase. So many Chinese cosmetics products started to use celebrities to endorse beauty products. This paper aimed to investigate how celebrity endorsement influences customer purchase behavior in the Chinese cosmetics industry. This article evaluated the celebrity endorsement theory to provide basic answers to the above questions. To more thoroughly examine the internal and external strengths, weaknesses, opportunities, and threats of the impact of celebrities on beauty goods, a qualitative SWOT analysis was also used. Thus, the marketers could choose celebrities more correctly to endorse beauty products which affect Chinese consumers' awareness and purchase behavior of beauty products.

Keywords Cosmetics · SWOT analysis · Purchasing behavior · Celebrity endorsement

1 Introduction

1.1 Research Background

Online social networks are growing rapidly in today's world of rapid advances in science and technology. Social media disseminate information to consumers through images, products, and ideas. Every day people are exposed to thousands of advertising messages, some of which pass through the consumer's mind. Customers' perceptions of products and their desire to buy are linked to relevant stimuli. As a result, the

S. Wu (✉)
The Chinese University of Hong Kong, Shenzhen, Shenzhen 518000, China
e-mail: 120020419@link.cuhk.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_117

market has relied on marketing strategies to attract conumers. However, if marketers rely solely on traditional marketing methods, on the one hand, the brand cannot meet consumers' demand for "speed" in the current information age; on the other hand, a single marketing effect will not be perfect. Therefore, people combine online marketing to promote their products' marketing better. At the same time, today's cultural integration has brought cultural prosperity to the world's people. Cultural integration has led togreater acceptance of products and easier acceptance of foreign goods. Different cultures bring different products. As a result, marketing strategies began to change with the times: celebrity endorsement.

Celebrity endorsements have been used in more recent marketing to promote and advertise. A study of global television advertising found that celebrity endorsements are common in television commercials, although their popularity varies widely from country to country (Praet 2008). It can positively or negatively influence purchase decisions: credibility, appeal, and power (Jatto 2014). In advertising, testimonials are the equivalent of ambassadors. They help the message flow smoothly to the crowd, conveying a desirable image. The celebrity is connected to the brand in this way and joins the advertising communication process. Celebrity endorsement boosts the new brand's reputation by giving the public a sense of the celebrity and widening the image of the product's quality. Because the celebrity is involved, the product benefits from the consumers' favorable perceptions of the celebrity, which boosts sales and promotes favorable perceptions of the product and the company. Additionally, the usage of celebrity endorsers to promote products both offline and online is growing (Wood and Burkhalter 2014).

1.2 Research Gap

Some scholars, such as Erdogan; Kara Chan and Fei; and Amos et al., have shown great interest in celebrity endorsement (Erdogan 1999; Chan and Fan 2022; Amos et al. 2008). Although much research on celebrity endorsement exists, the factors influencing celebrity endorsement to consumers have changed from previous findings due to cultural and technological developments. Advances in science and technology have changed the traditional marketing strategy of celebrity endorsement from a single offline endorsement to a dual online and offline model. The rise of online media and cultural cross-fertilization have caused Chinese people to become more open to foreign cultural makeup and more discerning in their choice of products. The changing environment has influenced the factors that beauty brands need to consider when choosing testimonials and developing marketing strategies. However, there are few case studies on celebrity endorsements in Chinese consumers' consumption of cosmetics.

This study aims to answer: "How do celebrity endorsements influence the cosumtion behavior of Chinese cosmetics consumers?".

In China, celebrities have high status, and celebrity worship is widespread. People often show their love and support for celebrities by buying the brands they represent,

as access to information becomes easy for them. Celebrities can appear in commercials for anything from necessities to luxury goods. The influence of overseas culture and the Internet led the Chinese to seek different cosmetics and makeup styles. As consumers became more receptive, Chinese beauty brands began to combine features of overseas beauty products with features of Chinese makeup to create brands more suitable for Chinese consumers. The Chinese cosmetics sector, however, realized that product variety alone was insufficient and started using celebrity endorsements as a display tool to push its products throughout more holidays and occasions. A younger generation of consumers is on the rise. Researching the association between Chinese consumers and celebrity endorsements can play a significant role in further promoting brand marketing for beauty marketers.

1.3 Structure of the Paper

The structure of this paper is: First, a literature review, hypotheses, and conceptual model are presented. Second, the SWOT analysis will help analyze internal and external factors to establish product positioning. Finally, the conclusion analyzes the context of the results and draws conclusions. This study provides a concise illustration of the impact of people's everyday needs on marketing strategies and is of great use to marketers, researchers, students, and advertisers. It can be further used for study and research purposes.

2 Literature Review

2.1 Celebrity Endorsement Theory

Celebrity endorsement is a powerful marketing and advertising tactic to raise brand awareness. It is a strategy for raising a brand's authenticity and credibility. Celebrity endorsements have been employed by several businesses to grow their customer base. According to McCracken, a celebrity endorser is "any individual who enjoys public recognition and who uses that recognition on behalf of a consumer product by appearing with it in an advertisement" (McCracken 1989). A celebrity is a well-known individual who stands out from the crowd by possessing special attributes that appeal to the audience (Erdogan 1999). The celebrity represents as someone who have certain fame in a different field and can also be a cartoon character (Friedman and Friedman 1979). Marketers use celebrity fame in their advertisements to promote products to increase sales and exposure. The presence of celebrities in advertising is also evidence of the link between celebrities and advertising. Celebrities are employed in many other sorts of communication outside advertising. Celebrities, for instance, post photographs or brand names via social media (Wood and Burkhalter

2014). Thus, celebrity endorsement refers to the employment of famous people by brands to advertise their products. Celebrities have been utilized in marketing since the late 1800s, notably as Queen Victoria's association with Cadbury Coco. (Sherman 1985). At the time, the availability of celebrities was limited, as people were skeptical about the prestige of "celebrities" and saw them as a "brand showcase" (Kaikati 1987). When talking about the quality of mess media in the late 1970s, the stigma of commercial exploitation faded. Celebrities are now crucial in attracting customer attention to themselves and their advertising. For renowned businesses and luxury brands, maintaining a positive perception of a celebrity in business has been commonplace (Rai and Sharma 2013). Of course, marketers should choose spokespeople based on previous research; wrong choices can lead to advertising failures, sending the wrong message and thus altering consumers' purchase intentions (Farrell et al. 2000). When choosing a celebrity, the target audience's popularity, experience, and demographics are considered.

In spite of the extensive literature on celebrity endorsements, the majority of current academic research on the topic is focused on just one of the three endorsement theories. This type of research typically considers that the main premises for influential endorsements are credibility, attractiveness, and match-up. There is considerable discussion in the literature regarding whether endorser attributes should be matched to particular brands and which theoretical concepts are most helpful. This study will delve deeper into the important endorsement theories in the parts that follow.

2.2 Important Results

The Source Credibility Model. The psychologist Carl Hovland and his colleagues found that the source credibility could influenced the effectiveness of persuasion (Hovland and Weiss 1951). In theory, credibility comprises two dimensions: expertise and trustworthiness stated that credible message senders influence message receivers' attitudes toward products/brands through internalization (Ohanian 1990; Kelman 1961).

Expertise reflects the knowledge and experience of the sender of the message. A good celebrity can be considered trustworthy in terms of the level of competence. Credibility reflects the spokesperson's objectivity, honesty, and integrity (Erdogan 1999). However, it is often not enough to judge professionalism from the spokesperson's perspective; what matters most is whether the recipient perceives the spokesperson's stated knowledge as accurate and reliable (Erdogan 1999). Between the late 1970s and the middle of the 1990s, numerous research were done to determine how endorser credibility affected shifts in consumer attitudes. The most researched aspect of celebrity endorsements has been source credibility (Choi and Rifon 2007). Consumer attitudes and intentions have been demonstrated to be significantly influenced by credibility (Erdogan 1999).

However, research findings on the importance of the sub-dimensions of credibility: competence and trustworthiness are ambiguous and inconsistent. McGinnies and Ward, for example, discovered that sources of trustworthiness induced better attitudes than levels of knowledge (McGinnies and Ward 1980). Ohanian, on the other hand, asserted that a source's credibility had little bearing on a consumer's intention to make a purchase (Ohanian 1990). He argued that viewers would not feel comfortable giving their choice to well-paid testimonials; therefore, source credibility is not a significant factor in influencing respondents' purchase intention.

According to research, expertise and credibility may help to increase the efficacy of endorsements, but their influence is dependent on the intended customer.

The Source Attractiveness Model. According to research, physically beautiful persons can help attitude change (Chaiken 1979). Height, weight, and appearance can all contribute to physical attractiveness (Albert et al. 2017). Celebrities who are attractive are always more loved. Numerous studies have examined the link between physical beauty and the success of advertising.

McGuire asserts that attractiveness includes similarity, familiarity, and likeability in addition to physical appearance (McGuire 1985). Customers will perceive a product/brand positively if the physical beauty of a celebrity aligns with the marketed product/brand (Kahle and Homer 1985). Customers with strong attribution needs, according to Escalas and Bettman, seek to satisfy their attribution needs by consuming businesses supported by attractive celebrities (Escalas and Bettman 2017). In the example of a woman, she might purchase a cosmetic item advertised by a stunning celebrity in order to stand out among other stunning women, satisfying her sense of belonging. "Followers not only want to know more about celebrities, but they also want to be like them: how they dress, how they eat, how they live," claim Zhu and Chen (2015, p. 341). Erdogan asserts that appealing brand ambassadors positively affect consumers' perceptions of advertising and products (Erdogan 1999). It is unknown, though, whether an attractive spokesperson can directly affect purchase intentions by influencing more than just perceptions. For instance, Liu et al. demonstrated that in terms of Chinese customers' purchasing intentions, a beautiful but inappropriate spokesperson fared better than an unattractive but appropriate spokesperson (Liu et al. 2007).

The Match-Up Hypothesis. Mowen and others proposed the match-up concept: the endorser will be more effective with congruence among the target audience, brand, and the endorser (Mowen Brown Schulman 1979). Congruence consists of two parts: expectancy and relevancy. Expectancy is the level of correspondence between a communication's stimulus and the previously established pattern that the subject has created (Heckler and Childers 1992). Relevance refers to how much the celebrity's message contributes to the communication's goal's crystal clear articulation. Customers rate the endorser, the product, and the advertisement favourably based on their impression of the consistency between the symbolic that brought by celebrity endorsers and endorsed product (Kamins 1990).

The efficiency of tight collaboration between celebrity endorsers and brands in several dimensions. Choi and Rifon, for example, examined celebrity images (Choi

and Rifon 2007). They propose a framework of four dimensions for aligning celebrity and brand image: genuineness, competence, excitement, and sociability. If a brand needs a fun and likable image, it should choose a celebrity endorser who scores high on excitement and sociability.

2.3 Summary

Numerous research have offered convincing evidence showing how effective the particular endorsement model is. It clarifies the celebrity endorsement hypothesis and aids in the identification of successful endorsers. The results show a connection between source attractiveness and source trustworthiness as well as shifts in consumer sentiments.

All three celebrity endorsement theories put forward have proven to be valid. It seems absurd to expect a single theory to explain the various promotional campaigns in today's fast-paced marketing world.

Because of the variety of endorsement activities, combining the three theories may provide a normative framework to explain influential endorsements today.

3 Method

3.1 Research Design

The principal method used in this article to obtain test results is SWOT analysis. It evaluates them by comparing the four aspects to the concept of SWOT analysis and then generates a series of conclusions. Using this strategy, the paper can do a thorough and systematic investigation of the research subject's scenario and design related development strategies, plans, and countermeasures for the brand based on the study's findings. Chen and Zhong used SWOT analysis to demonstrate factors the brands need to be concerned about when choosing celebrities (Chen and Zhong 2022). SWOT analysis is a supportive tool for a company to choose the right solution. This research topic is similar to the paper above. It is suitable to use SWOT analysis in this research paper combined with the research question. Using SWOT analysis, the paper can analyze the situation from internal and external factors to conclude how celebrity affects female purchasing decisions.

3.2 Cosmetics Industry

In recent years, the consumption of beauty products has intensified as beauty and skincare awareness has increased. As the global beauty market continues to expand, beauty brands are experiencing an overall increase in advertising spending. Among marketing positioning channels, platforms such as Tiktok, Weibo, and WeChat are the main channels that brands want to position. Celebrity-based content on these platforms is more likely to attract users' attention and brand influence. The spokesperson hierarchy is divided into a global spokesperson, Asia–Pacific spokesperson, Greater China spokesperson, and China spokesperson.

In terms of international and domestic brands, while the overall trend of celebrity influenced beauty product consumption was lower in the third quarter of 2020, the consumption shares of domestic beauty products exceeded that of international brands for the first time. The post-2000s celebrity group is the most popular category for makeup products. By choosing these young celebrities to collaborate with, makeup brands also indirectly influence young consumers and help popularize the consumption of sophisticated beauty.

3.3 SWOT Analysis

Strength. Appropriate and attractive celebrities help brands build their brand image. Today's beauty brand endorsements are dominated by social stars and celebrities, with the halo and following added to their every word and action. When they endorse a brand, people's attention shifts to the brand, increasing the exposure of the brand/product. Combining a celebrity's well-known image and the brand can give the brand an approachable and trustworthy image. Moreover, it can beautify the brand with the excellent image temperament of the spokesperson. It is easier for the public to transfer their trust and love for the spokesperson to the brand products. The natural sensuality of female consumers will make them fall in love with the products endorsed by their favorite celebrities. In today's traffic era, celebrities have become a hot spot for brand endorsements. Not only because of the popularity but also because the current fan economy can be directly translated into purchasing power, stimulating the enthusiasm and involvement of the fan base.

According to the advertising spokesperson effect data, since January 19, 2022, Armani officially announced the beauty global brand spokesperson Jason Yi. Due to the official announcement of the new spokesperson and the increase of related publicity and promotion, Armani's brand popularity increased a lot in the two days after the official announcement. Among them, beauty global brand spokesperson Jason's endorsement contribution heat index to Armani reached 90.49, exceeding the average value of endorsement contribution heat index of all new endorsements and new endorsements of the same category in December 2021. Of the voice gained after the official announcement, 88.51% of the heat was contributed by beauty global

brand celebrity Jason Yi, exceeding the average value of the heat contribution share of all new endorsements and new endorsements in the same category in December 2021 (Armani et al. 2022).

Weakness. In celebrity endorsements, a low match between the endorser and the product and too much attention from the endorser themselves negatively impact the brand.

When using celebrity endorsement, the image of the celebrity must be highly consistent with the brand image. However, people have different opinions about celebrities and judge their images differently. Without comparative research among target customers to determine the most suitable endorser, companies often make wrong judgments about the image of celebrities. Assume there is no inherent or obvious link between the celebrity and the promoted product. In that situation, it will develop a speculative and untrustworthy impression. Some corporations frequently locate unconnected celebrities to support them, reducing the credibility and influence of celebrity ads.

At the same time, because celebrities have a high rate of visual appeal, they tend to distract people from the advertised products and overwhelm them. Consumers tend to remember the personal image of the celebrity more quickly and lose sight of the merchandise itself. The situation harms the value of the merchandise. Worse, celebrity endorsements are often expensive. When the celebrity is the main focus of the advertisement, its quality is subpar and its message lacks inspiration. The advertisements are probably of subpar quality. The quality of the ads is likely to be poor. For example, in 2001, the famous brand Chanel had signed Coco Lee as the spokesperson in Asia. Nevertheless, unfortunately, this endorsement only lasted for a year. The reason is that Coco Lee's image is "dynamic, sexy and bold," while Chanel, a high luxury product, represents "noble and elegant." The image of the two personalities is not related, so the Hong Kong ladies have been opposed and dissatisfied. They even indicated they would sign a joint protest and buy strike against Chanel. Therefore, celebrity endorsement requires careful investigation of targeted consumer preferences and product positioning to select the right celebrity in the early stage of spokesperson selection.

Opportunity. Celebrity endorsements often mean high costs. In addition to inviting celebrities to endorse their products, brands can also consider inviting KOLs—also known as Netflix endorsements—which means Key Opinion Leaders. This person has a certain amount of influence and offers an opinion in a specific subject. Netflix anchors frequently have a large fan audience, and their ability to bring in commodities is based on their fan base. For example, lately popular beauty blogger Li Jiaqi has a strong ability to bring items and once sold 14,000 lipsticks in one minute, demonstrating KOL's immense power (The Apocalypse of Li Jiaqi Netflix with Goods 2019). At the same time, KOL marketing can help to improve brand image. Many brands can raise brand recognition by enlisting key opinion leaders (KOLs) to serve as brand spokespersons or promotional ambassadors. This marketing strategy can make many people who do not know the brand or do not know much about

the brand enhance the brand's awareness to promote the relevant products. Therefore, the product can consider the combination of celebrity endorsement and Netflix endorsement to achieve high promotion and low cost.

Threats. Celebrity endorsement also has great pitfalls. Today, many beauty brands choose men to endorse their products, and often the followers of these endorsers are women. If the endorser generates negative publicity or does something illegal, the brand's reputation can be damaged, and a group of female consumers can be lost. Therefore, brands should conduct a thorough risk assessment and be prepared for unforeseen situations before choosing a spokesperson. In the case of Wu Yifan, although he has a significant flow effect, the 2016 Gina incident revealed his "high risk" (Congli 2021). The brands have ignored this warning sign. As a result, 15 endorsements were affected by the rape case in 2021. Nowadays, with the promotion of 5G, the metaverse concept is being introduced. Because of the perfect development of virtual technology, avatars have become more tangible and realistic, and users' trust in avatars has become more assertive. In 2021, the virtual IP "Yoo Night Hee" emerged, defined by the brand as a virtual beauty expert who can catch demons. In just a few days, she has attracted over 3 million fans with her two videos, and the numbers are still rising (Lin and Zhu 2022).

4 Results and Discussion

Celebrity endorsement can bring exposure to a brand/product while maintaining the brand image and increasing purchase rates. However, celebrity endorsements can also damage a brand's reputation. Scandals or mismatches between celebrity and brand image can affect the campaign's effectiveness. In addition to celebrity endorsements, brands can also consider using netizens to promote their products. At the same time, brands should also be aware of the impact of other avatars coming online on the effectiveness of celebrity endorsement campaigns.

There are several things that celebrity endorsers and marketers should pay attention to develop their advantages together. For celebrity-endorsers, they need to create a persona that shares the same image as the brand they are endorsing and be strict with themselves to establish good values. This way, brands/products with similar images can better choose celebrities to endorse them. This will achieve good publicity for the brand and maintain the partnership to increase exposure for both. For marketers, the selection of spokesperson should be well researched in the early stage, based on market research and the target consumers' preferences to choose the right spokesperson to avoid signing endorsements with unsuitable spokespersons, which wastes money and loses brand reputation.

While developing and promoting marketing strategies, marketing planners should adopt a dual combination of online celebrity endorsements and celebrity endorsements to target the consumer precisely. The combination of Netflix endorsement and celebrity endorsement can promote the brand more.

During the endorsement process, the market crowd should monitor the changing beauty market and make emergency responses according to what happens. At the same time, marketers should launch creative endorsement ads to attract consumers' attention according to the changes in social hot spots. They should be adept at incorporating the Internet to cast a good light on the brand and consolidate a good image.

The beauty brands were examined using SWOT analysis and compared to the previous literature review. The conclusions in the methodology portion of this research are compatible with the points indicated in the literature review. First, this paper describes the benefits of celebrity endorsement in the literature review and discovers that current beauty products in China have begun to establish endorsements in conjunction with celebrities. Second, this article discovers that celebrity endorsements are reliable in source, appealing, and match all effect consumer buying behavior—consumers' purchase intention—for the three key theories of celebrity endorsement in the literature review. With the profusion of cosmetic brands on the market, people make purchasing decisions based on the brand image rather than the product itself. Therefore, it is essential to have a great spokesperson.

5 Conclusion

This paper uses SWOT analysis to briefly introduce the benefits and draw-backs of celebrity endorsement on the Chinese cosmetic industry and the impact on consumer purchasing behavior. The conclusion is that celebrity endorsement can influence consumer consumption behavior. Second, the popularity of celebrity endorsement will grow with fan behavior and their commercial value. The fan economy is the primary force driving celebrity endorsements.

This paper explains four things using SWOT analysis: how to grow the advantages, how to avoid the drawbacks, how to change better, and how to avoid emergencies. Then, in the literature review, this paper verifies the Celebrity Endorsement Theory. The conclusion of the SWOT analysis is similar to that of the previous study. The primary addition is that the report incorporated earlier research in the cosmetics sector. It used SWOT analysis to give a better suggestion for choosing celebrities in the beauty industry. The paper concluded that celebrity personalities are more influential than the brand itself and that marketers can expand the scope of endorsements by adopting a virtual endorsement image. This is an important finding because it will inspire brands when developing their marketing strategies. The following recommendation is offered: When selecting celebrity endorsements, marketers in the cosmetics industry should examine not only the celebrity's suitability for the brand, but also whether the celebrity's image causes bad public opinion.

This paper also has limitations. First, the paper contains personal opinions and summaries. Therefore, future research should produce practical proof through data analysis. Second, this article is limited to Chinese beauty brands, so future research should study more brands, such as clothing brands and FMCG products.

More research will produce even more matching conclusions. Finally, this article only examines a single celebrity endorsement method; there are more endorsement methods such as Netflix endorsement and virtual IP endorsement. Different endorsement methods can have different impacts. Future research on other endorsement methods will be more enlightening for marketers, such as adopting a combination of endorsement methods for endorsement.

References

Albert N, Ambroise L, Valette-Florence P (2017) Consumer, brand, celebrity: which congruency produces effective celebrity endorsements? J Bus Res 81:96–106

Amos C, Holmes G, Strutton D (2008) Exploring the relationship between celebrity endorser effects and advertising effectiveness: a quantitative synthesis of effect size. Int J Advert 27(2):209–234

Armani, Xuanmei, Yi Y, Emmanuel Data (2022) Advertising spokesperson effectiveness data report: Armani officially announces beauty global brand spokesperson generation contribution hotness index over 90, 21 Jan 2022. Retrieved June 25, 2022, from https://xw.qq.com/cmsid/20220121A06SE900

Chaiken S (1979) Communicator physical attractiveness and persuasion. J Pers Soc Psychol 37(8):1387–1397. https://doi.org/10.1037/0022-3514.37.8.1387

Chan K, Fan F (2022) Perception of advertisements with celebrity endorsement among mature consumers. J Mark Commun 28(2):115–131

Chen Y, Zhong Y (2022) The influence of male idols endorsing beauty brands on Chinese female consumers. In: 2022 7th international conference on social sciences and economic development (ICSSED 2022). Atlantis Press, pp 1555–1561

Choi S, Rifon N (2007) Who is the celebrity in advertising? Understanding dimensions of celebrity images. J Pop Cult 40(2):304–324. https://doi.org/10.1111/j.1540-5931.2007.00380.x

Congli G (2021) Wu Yifan abandoned by all brands, will brand endorsement become a dead end? Sales Mark (Manag Ed) 09:54–55

Erdogan BZ (1999) Celebrity endorsement: a literature review. J Mark Manag 15(4):291–314

Escalas JE, Bettman JR (2017) Connecting with celebrities: how consumers appropriate celebrity meanings for a sense of belonging. J Advert 46(2):297–308

Farrell KA, Karels GV, Montfort KW, McClatchey CA (2000) Celebrity performance and endorsement value: the case of Tiger Woods. Manag Financ 26(7):1–15

Friedman HH, Friedman L (1979) Endorser effectiveness by product type. J Advert Res

Heckler SE, Childers TL (1992) The role of expectancy and relevancy in memory for verbal and visual information: what is incongruency? J Consum Res 18(4):475–492

Hovland CI, Weiss W (1951) The influence of source credibility on communication effectiveness. Public Opin Q 15(4):635. https://doi.org/10.1086/266350

Jatto O (2014) Consumer attitude towards celebrity endorsements on social media. Doctoral dissertation, Dublin Business School

Kahle LR, Homer PM (1985) Physical attractiveness of the celebrity endorser: a social adaptation perspective. J Consum Res 11(4):954–961

Kaikati JG (1987) Celebrity advertising: a review and synthesis. Int J Advert 6(2):93–105

Kamins MA (1990) An investigation into the "match-up" hypothesis in celebrity advertising: When beauty may be only skin deep. J Advert 19(1):4–13. https://doi.org/10.1080/00913367.1990.10677317

Kelman HC (1961) Processes of opinion change. Public Opin Q 25:57–78

Lin YH, Zhu LP (2022) Research on brand scene marketing communication strategy in the context of metaverse. Natl Circ Econ 05:40–42. https://doi.org/10.16834/j.cnki.issn1009-5292.2022.05.046

Liu TM, Huang Y-Y, Minghua J (2007) Relations among attractiveness of endorsers, match-up, and purchase intention in sport marketing in China. J Consum Mark 24(6):358–365. https://doi.org/10.1108/07363760710822945

McCracken G (1989) Who is the celebrity endorser? Cultural foundations of the endorsement process. J Consum Res 16(3):310–321

McGinnies E, Ward CD (1980) Better liked than right. Pers Soc Psychol Bull 6(3):467–472. https://doi.org/10.1177/014616728063023

McGuire (1985) Attitudes and attitude change. In: Lindzey G, Aronson E (eds) Handbook of social psychology, vol 2. Random House, NY, pp 233–346

Mowen JC, Brown SW, Schulman M (eds) (1979) Theoretical and empirical extensions of endorser effectiveness. In: 1979 Educators' conference proceedings

Ohanian R (1990) Construction and validation of a scale to measure celebrity endorsers' perceived expertise, trustworthiness, and attractiveness. J Advert 19(3):39–52. https://doi.org/10.1080/00913367.1990.10673

Praet CLC (2008) The influence of national culture on the use of celebrity endorsement in television advertising: a multi-country study. In: Proceedings of the 7th international conference on research in advertising (ICORIA), vol 1

Rai SK, Sharma AK (2013) Celebrity attributes and influence on consumer behaiour: a study of Shekhawati region of Rajasthan. Pac Bus Rev Int 5(11):57–64

Sherman SP (1985) When you wish upon a star. Fortune, 19 Aug 1985, pp 66–71

The Apocalypse of Li Jiaqi Netflix with Goods. Jianshu, 17 Dec 2019. Retrieved 25 June 2022, from https://www.jianshu.com/p/171ffbb0e342

Wood NT, Burkhalter JN (2014) Tweet this, not that: a comparison between brand promotions in microblogging environments using celebrity and company-generated tweets. J Mark Commun 20(1–2):129–146

Zhu YQ, Chen HG (2015) Social media and human need satisfaction: implications for social media marketing. Bus Horiz 58(3):335–345

The Influence of Culture on International Business Negotiation

Shiyang Shen

Abstract With the deepening of economic globalization, international economic and trade exchanges have become more and more frequent, and the most important way to carry out trade exchanges has just been negotiated. Cultural differences are a factor that must be considered for successful international business negotiations, so it is necessary to understand the cultures of various countries in international business negotiations. The article analyzes how cultural factors affect negotiation mindset, negotiation pattern, negotiation style and negotiation structure, and lists more representative negotiation styles. As a result, the effect of culture should be taken into consideration during international commercial negotiations. Successful negotiations can only be accomplished by genuinely comprehending cultural differences, respecting cultural differences, and looking for common ground while reserving distinctions.

Keywords Culture · International business negotiation · Different regions

1 Introduction

Our age is definitely one of negotiation as already pointed out by Zartman. With the development of economic globalization, trade exchanges between countries have become more frequent. The development of communication technology and transportation has also brought people closer together and facilitated joint discussions. In the end, negotiation is a kind of communication between individuals, thus subjective components must be include. The formation of each individual's subjective thoughts is influenced by the cultural background in which they are located. Therefore, international business negotiation not only strengthens the economic ties between countries but also the exchange and collision of different cultures. Culture intervenes as an influential variable on researchers on negotiation as well as on negotiators (Faure

S. Shen (✉)
School of Tourism and Cultural Industry, Guizhou University, Guiyang 550000, Guizhou, China
e-mail: 160110101111@stu.suse.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_118

1999). In international business negotiation, in addition to acquiring fundamental negotiation skills, it is also necessary to comprehend the potential impact of cultural variances on negotiating activities and make adequate preparations. This helps predict the behavior of the other party and supports negotiators in achieving better outcomes in their negotiations (Faure 1999).

International business negotiation has been produced since the emergence of international business activities, but the systematic research on international business negotiation started relatively late. In the latter half of twentieth century, the majority of research on the impact of cultural differences on international business negotiation emerged. This research is first credited to Fisher, who suggested that miscommunications are more likely to occur the more culturally diverse the parties to a negotiate are. At the end of the twentieth century and the beginning of the twenty-first century, due to the acceleration of economic globalization, there have been numerous study results on the role of cultural elements in international business negotiations. Faure and Sjostedt formulated the influence of culture on negotiation from five aspects. Stella Ting-Toomey proposed face negotiation theory to help explain cultural differences in people's responses to conflict. Research shows that in the face of the same conflict, people with different cultural backgrounds have different ways of thinking and values, and their ways of resolving conflicts are also very different. Adair, Okumura and Brett conduct research on the negotiations between the United States and Japan, the United States and the United States, and between Japan and Japan, and analyze the impact of cultural variances between the United States and Japan on the negotiation results. Stephen Weiss proposed 12 variables for cross-cultural business negotiation. Gavin Kennedy believes that different negotiation cultures will lead to completely different negotiation results, so cultural differences should be properly recognized and appropriate negotiation strategies should be selected (Wang 2014).

This paper starting from the concept and characteristics of international business negotiation, the concept and content of culture, explores the influence of cultural differences on international business negotiation from four aspects: negotiation mindset, negotiation pattern, negotiation style, and negotiation structure. The negotiation styles of several representative regions are summarized through case studies. This article helps to help negotiators develop appropriate strategies when negotiating to gain an upper hand in international business negotiations.

2 The Influence of Different Cultures on International Business Negotiation

2.1 Concept and Characteristics of International Business Negotiation

Concept of International Business Negotiation. International business negotiation is common in foreign economic and trade activities. Different stakeholders involved in international commerce transactions must bargain on issues of shared concern or interest. Coordinate and modify their respective economic or political objective, and reach a eventually consensus. And resolve the inevitable conflict of economic interests between governments and commercial institutions in different countries and regions, so as to achieve common interests. International business negotiation does have something in common with general negotiation, but it has its uniqueness.

Characteristics of International Business Negotiation
Powerful Policy. International business negotiation is not only commercial in nature, but also belongs to the realm of international engagement. Because negotiating parties often represent the overall economic relationship of their countries or regions, negotiations often involve political and diplomatic aspects. International business negotiations must be carried out on the premise of adhering to national policies. And at the same time, the policy of dealing with different countries on their own merits is also an important basis for negotiations.

More Difficult and Complex. Because the negotiating parties belong to different countries or regions, they have different social and cultural backgrounds and political and economic systems. Differences in habits of mind, values, behaviors, and religions increase the difficulty and complexity of negotiation.

High Risk. The current situation and the international market is ever-changing, so international business will be disturbed by many uncertain factors. Such as political and legal risks (political stability), economic uncertainty (exchange rate fluctuations), etc. Therefore, the risk of international business negotiation is higher than that of general negotiation.

2.2 Concept and Content of Culture

Because of differences in perspective, people's understanding of culture varies. Stern H. H. Stern divides culture into 'Culture of a big C' and 'culture of a small c' according to the structure and category of culture. 'Culture with a big C' is the whole material wealth and spiritual wealth that has been accumulated by human beings through social and historical practice. The ideology of society, as well as the related

structures and institutions, is known as 'culture with a small c'. Generally speaking, culture is the common thinking of a society as a whole.

Common thinking arises from what people hear, say, think, and feel on a daily basis. Therefore, the content of culture is also all-encompassing and is generally divided into four levels: physical culture, institutional culture, behavioral culture, and mentality culture. Physical culture is the substantive things that can be experienced, such as food, clothing, housing, and transportation. Institutional culture is a binding norm created by people in the process of practice. Behavioral culture is conventional behavior in interpersonal communication; mentality culture is people's social psychology and ideology, such as values, ways of thinking, and aesthetic tastes.

2.3 The Influences of Cultural Differences on International Business Negotiation

The Influence of Culture on Negotiation Mindset. The gap in thinking is a result in cultural variations, and thinking is the driving force of negotiation, which makes negotiators show different orientations in decision-making. A country with traditional collectivist culture attaches great importance to cooperation and relations with each other. Consequently, they prefer to spend a lot of energy on building a good relationship and then negotiate on the basis of it, rather than focusing on the contract itself (Carnevale and Radhakrishnan 1994). They also put more emphasis on groups that include individuals and focus more on national and collective interests when negotiating. On the contrary, countries that emphasize individualism pay more attention to their own interests. They regard negotiation as a confrontational competition and pay more attention to the actual benefits that negotiation brings to them. Individualism leads to decisions that are often made by the senior levels alone, rather than collective adjudication in collectivist countries.

The characteristics of some traditional countries or Muslim countries make them extremely dependent on security and formal ceremonies. They are uncomfortable with uncertainty and ambiguity. Therefore, in the negotiation process, it is difficult for them to establish a sense of trust with the other party, and they tend to determine every detail during the negotiation. Countries with a high degree of openness are more tolerant of uncertainty and more willing to try risky things. These countries favor taking risks and solving problems. Moreover, it is simpler for them to build a rapport of trust with their counterparts, which is conducive to the smooth development of the negotiation.

Eastern culture emphasizes comprehensive thinking and units various parties of the object as a whole; while Western culture stresses analytical thinking, often dividing things into multiple parts for analysis. For example, when faced with complex negotiation problems, Western countries often break down the problems they face into small problems and solve them one by one. From the beginning to the finish, concessions are made. The final agreement is the summary of each

small problem. Eastern countries consider the issue as a whole, and often make no concessions until the negotiation is over.

The Influence of Culture on Negotiation Pattern. The influence of culture on the way of negotiation is extensive and far-reaching. It affects the way people make plans and solve problems. Negotiations are divided into horizontal negotiation and vertical negotiation according to the negotiation sequence. Horizontal negotiation is to first outline the answering framework for the agreement and then negotiate the specific content item by item after reaching an agreement in principle. Skip matters on which both parties disagree. Negotiations go on and on until all the issues are settled. In vertical negotiation, the identified issues are negotiated in sequence. Western countries are more inclined to vertical negotiation. The United States is the representative of vertical negotiation. Their negotiation process is linear, and each small problem is solved in turn. This simplifies complex issues, which is conducive to solving the problem completely and avoiding discussion without reaching a decision. The negotiation process in the East is cyclical, which avoids the negotiation from entering a deadlock to a certain extent.

Different cultures have different preferences for the process of reaching an agreement. For example, France prefers top-down discussions, dealing with principled issues first, and then discussing details after a principled agreement is reached. They believe that reaching a consensus is the best way to protect their own interests. On the other hand, the United States believes that details are fundamental to solving problems, and is more willing to spend more time and energy on details. For them, the negotiated agreement was made by compromising and revising a series of details. In terms of the form of agreement, the United States generally prefers very detailed contracts to avoid possible problems in the future, while France prefers contracts in principle.

The Influence of Culture on Negotiation Style. The negotiation style refers to the main issues and style characteristics that negotiators can tolerate in the negotiations. Negotiation style has deep cultural brands. Different cultural backgrounds lead to the ever-changing negotiation styles and various behaviors of negotiators in the actual negotiation process. Grasping the negotiating style of the opponent is the key to choosing the right negotiation strategy.

Navian culture countries such as the United States and Germany are typical low context cultures, and people are more accustomed to using explicit words to communicate. As a result, negotiators in these countries tend to be frank and direct in their language style. And at the same time, they want to be told everything clearly when listening. Hofstede divides the use of time by different cultural groups into two categories, the monochronic and the polychronic (Adair and Brett 2005). The orientation towards time displayed by the Navian cultural group is mostly linear and continuous. They prefer to stick to a strict schedule, start and end on time, and take breaks at the appointed times. Being late is impolite and a lack of respect. They rely more on specific, explicit communication, and speaking in sequence. Only do one thing at a specific time, stressing thoroughness and rigor.

In countries with high contextual culture, such as China, Japan, and other countries around the Mediterranean Sea, the language itself contains less information. The negotiators from high context cultures have a message that cannot be understood without a great deal of background information (Danciu 2012). Negotiators in these countries speak more implicitly and are more sensitive to environmental cues and situational awareness, and much of the information is reflected in facial expressions or hand movements. These countries are coming from a polychronic culture, where many things can be done at the same time without being overly dependent on timetables. They will flexibly adjust the start and end time of the meeting according to the actual situation, and choose a suitable time to rest during the negotiation. It is vague and flexible in expression, and they will always have repeated expressions for one thing.

The Influence of Culture on Negotiation Structure. The negotiation structure mainly includes personnel structure, issue structure, and rights structure. Culture can also subtly influence these factors. Negotiators are the main factor in business negotiation, and personnel are not only on the negotiating table, but also include unseen members under the table. The characteristics of international business negotiation also make it necessary for both parties to negotiate not only with the members at the negotiating table, but also directly or indirectly negotiate with the relevant person in charge or the government.

Among the 12 variables of Stephen Weiss's cross-business negotiation, 3 variables are related to negotiators, that is the selection criteria, focus, and individual role. In terms of personnel numbers, countries with collectivist cultures are more likely to form large negotiating groups. Countries that pursue individualism, such as the United States, are better at independent work. And the negotiating team is smaller, generally composed of a senior decision-making authority and several negotiators. With fewer members in the negotiating team, it is easier to reach an agreement, and it is easier to complete the negotiation in a shorter time. It is common for China to have twice as many negotiators as the United States in international business negotiations. Therefore, these countries pay more attention to professional competence when selecting negotiating members, irrespective of their status.

One of Hofstede's cultural dimensions is the differences across national cultures. Hofstede believed it is useful to take it into account in international business negotiations (Lebaron 2003). The degree of respect and acceptance of unequal rights among people is measured by power distance. People who are viewed as superior to others due to their social rank, gender, race, and other factors are said live in high power distance societies; while low power cultures tend to believe that people are equal. In countries with a high power distance, negotiators take more consideration into the choice of positions and identities in personnel selection, and the personnel allocation is a vertical structure. Second, they prefer a top-down decision-making approach, where people with high status have absolute authority, and subordinates are more likely to follow orders. On the other hand, countries with a low power distance have a bottom-up decision-making method. People from these countries frequently feel ease with democratic decision-making, and flat organizational hierarchies, which

is showed characteristics of parallelism, dispersion, and no center. Therefore, when selecting negotiating members, more emphasis is placed on professional competence, irrespective of their status.

2.4 Negotiation Styles in Different Regions

American Style of Negotiation. America's sense of superiority as a great power and its tendency to individualism make them enter the topic and illustrate their views directly when negotiating. They tend to come to the table with an impossible offer, giving themselves a fall-back position. They are competitive in their approach to negotiations because their first offer may anchor the opponents to some extent. At the same time, they like to negotiate exactly according to plan and schedule, hoping to reach an agreement as soon as possible. Any delay is considered disrespectful. They are confident, persistent, and their discussions of issues are direct and clear. They like to divide the questions into small parties and discuss them one by one. All questions are discussed at one time. During the discussion of each issue, they will have various degrees of concessions. Like closure and certainty, negotiation is more inclined to implement every detail and manifest in an agreement. Americans have always regarded profit as the only measure of business. For relationships, they prefer informal relationships without ceremony. In negotiations, they believe that business is business, friends are friends, and they act according to official principles (Luo 2009).

Japanese Style of Negotiation. In stark contrast to the US is Japan's negotiating style. Japan is deeply influenced by Eastern culture, and it improves and innovates on this basis, and it is reflected in daily behaviors. Therefore, Japan's negotiation style not only reflects the basic negotiation thinking in Asia but also has its characteristics. Japanese negotiation culture is very representative. Japan is a typical vertical organizational structure with many decision-making procedures, so it is one of the reasons for the long negotiation time in Japan. Second, they have strong patience and can wait without complaint about the success of the negotiation. The collectivist culture makes the Japanese focus more on group goals than on individual interests. They are more inclined to express their views softly and implicitly, and research shows that Japanese negotiators are less articulate about their goals. In the aspect of information transparency, the Japanese seem to be the least willing to provide information. Japanese negotiators place more emphasis on face and politeness, which is one reason why they underline establishing a friendly partnership before negotiations begin (Graham 1994). In order to avoid confrontation, they often express their disagreement in silence and express their opposition indirectly.

European Style of Negotiation. Due to differences in geography, languages, and other aspects, European negotiating techniques are very diverse. But most European countries are seen as strong and aggressive when negotiating. The study found that

France often uses threats, warnings, and interruptions in negotiations to show it's dominant position and reach its own goals (Adair et al. 2001). They are less susceptible to emotions and better at hiding their emotions at the negotiating table. Both Germany and the United Kingdom are very careful with details, strictly abide by the peace treaty after signing, pay attention to planning, and have poor flexibility (Hamburg 2011). Germany is more concerned with negotiating formality than most other countries. With certain xenophobia, it is difficult for them to establish friendly relations. France, on the other hand, is more humane and values friendships with mutual trust. Negotiations do not pay attention to details. After reaching an agreement on principled issues, specific issues can be flexibly revised in the future through negotiation.

African Style of Negotiation. Africa is a country with a high power distance index, emphasizing relationships and hierarchies which are considered as a sign of respect to sending a high-ranking person to negotiate. The strict hierarchical system makes most of the people engaged in business belong to the noble family, so they pay great attention to etiquette. They have a slow pace of life, so they are less efficient and lack the concept of time.

3 Conclusion

Due to the existence of cultural differences in international business negotiation, negotiators in different cultural backgrounds have formed specific negotiation thinking, negotiation methods, negotiation styles, and negotiation structures. The encounter of two cultures increases the uncertainty of the negotiation system, so cross-cultural negotiation is more complex and challenging than single-cultural negotiation. In cross-cultural international business negotiation, it should be correctly understood and analyzed in order to find the most suitable negotiation strategy and achieve negotiation goals. Cultural learning can also predict the behavior of others to a certain extent, which can reduce uncertainty in negotiations.

Before negotiating, it is necessary to be well prepared and understand the customs, cultural norms, and taboos of the other party. Learn to tolerate and respect cultural differences, and avoid a sense of cultural superiority and racial arrogance. This is not conducive to the conduct of negotiations and the establishment of friendly and cooperative relations. Face up to cultural differences and build awareness of cross-cultural negotiation. In the face of different negotiation styles, it is useful to adopt negotiation strategies that adapt to them, learn to look at problems from the other side's perspective, and not judge the culture of other nations by your own code of conduct. Empathy can help negotiators negotiate better.

Culture is dynamic and changes accordingly with the passage of time, historical changes, technological development, and changes in the social environment, so it is complex. The preconceived thinking mode of cultural stereotypes has caused people to hinder the cultural research of other groups to a certain extent. Although there are

a lot of achievements in the international research on cultural factors in negotiation, most of them list the influence of culture and compare different countries. And a systematic theoretical system has not yet been formed. The theoretical research on the influences of cultural factors in international business negotiation lags behind the actual development.

References

Adair WL, Brett JM (2005) The negotiation dance: time, culture, and behavioral sequences in negotiation. Organ Sci 16(1):33–51

Adair WL, Okumura T, Brett JM (2001) Negotiating behavior when cultures collide: the United States and Japan. J Appl Psychol 86(3):371–385

Carnevale P, Radhakrishnan P (1994) Group endowment and the theory of collectivism. University of Illinois at Urbana-Champaign, Department of Psychology

Danciu V (2012) International business negotiation under the impact of cultural distance. Rom Econ J 14(42):175–195

Faure GO (1999) The cultural dimension of negotiation: the Chinese case. Group Decis Negot 8(3):187–215

Graham S (1994) Negotiating behaviors in ten foreign cultures. Manag Sci 40(1) (1994)

Hamburg A (2011) Comparative analysis of Romanian and German negotiation style based on cultural differences. Ann Univ Petrosani Econ 11(2):127–138

Lebaron M (2003) Culture-based negotiation styles

Luo P (2009) Analysis of cultural differences between West and East in international business negotiation. Int J Bus Manag 3(11):103–106

Wang LL (2014) The analysis of effect and strategy of China and foreign culture difference on international business negotiation. Dissertation. Jilin University

The Influence of Digital Marketing on the Traditional Fashion Industry and Its Prospects

Xinyu Wang

Abstract The development of the internet, with half of the world now using social media, and the emergence of digital marketing has compelled the traditional fashion industry to reform. At the same time, Covid-19 has largely accelerated the pace of change in the traditional fashion industry due to sudden external factors that have limited the experience and purchases people can make in physical shops. This paper discusses the current problems confronting the traditional fashion industry and how digital marketing can be used to combat them. In the meantime, companies can undertake to enhance and improve the relevant campaigns and services through comparison with the standard values of the market.

Keywords Digital marketing · Traditional fashion industry · Digital marketing tools

1 Introduction

There are currently 4.62 billion users of social media throughout the world, comprising nearly 58.4% of the world's population. In the previous year, 424 million new users joined the internet (DATAREPORTAL-Global Digital Insights 2022). It is legitimate to claim that individuals are taking in digital material daily. The phrase "digital marketing" has not been used since the 1990s. However, the digital era did not start to blossom until the advent of the Internet and the subsequent development of Web 1.0 platforms (Pencarelli 2019). When we talk about "digital marketing," we're referring to the practice of promoting goods and services to customers using various online platforms. Websites, mobile devices, social media, search engines, and other online channels are some examples of marketing types that fall under this category. Because of how digital marketing developed during the 1990s and into the twenty-first century, the way brands and businesses sell themselves through technology

X. Wang (✉)
The University of Manchester, Manchester M13 9PL, UK
e-mail: xinyu.wang-17@student.manchester.ac.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_119

and digital marketing has undergone significant shifts. Digital marketing efforts are becoming more commonplace as digital platforms are included in marketing strategies. More consumers utilize digital gadgets rather than going to brick-and-mortar stores to buying things. As a direct consequence, digital marketing has emerged as an essential strategy for companies working to include as many cutting-edge practices as possible in their contemporary operations to boost their income.

Since the beginning of the twenty-first century, technology has advanced swiftly, resulting in changes to many aspects of our lives. Businesses are unavoidably impacted by these developments and have increased their current information and communication technology use. Even the retail industry witnessed a significant drop between 2008 and 2009 as e-commerce proliferated. In addition, meeting and satisfying customers' needs have become more challenging as their demands have escalated. By contrast, the rise of technology has altered how consumers are aware of their surroundings. Concurrently, the Internet's online purchasing options have revolutionized the traditional garment retailing sector. Consumers may now locate and compare various goods and services, particularly on social media.

The substantial changes in the external environment brought forth by COVID-19 have had a variety of repercussions on the retail fashion sector. The unexpected epidermolysis bullosa in 2020 resulted in a 1.9% drop in overall retail sales volumes compared to 2019, the most significant yearly drop on record. Clothing retail volume sales are expected to fall by 21.5$ in 2020, particularly in the fashion industry. Despite this, online sales increased by 33.9% during the pandemic, setting a new high for the total amount of money spent in retail stores (Office for National Statistics 2022). Because of this, merchants started using a new business plan that included online and traditional storefronts to bring in more customers. The study significance of this essay is to provide practical recommendations or direction for restructuring the fashion industry. In the following paragraph, I will define "digital marketing" and discuss the various digital marketing strategies. In the third section, I will analyze the situation and massive issues confronting the traditional fashion industry and discuss how to transition to digital marketing using digital marketing tools.

2 Methodology and Literature Review

Over time, the meaning of the phrase "digital marketing" has evolved from that of a particular term defining the use of digital channels to advertise products and services to that of a generic term expressing the action of utilizing digital technology to recruit consumers, create customer preference, promote brands, and customer retention. Digital marketing methods such as Search Engine Optimization (SEO), Search Engine Marketing (SEM), content marketing, influencer social media optimization, e-commerce, etc. According to the firm-centric definition of marketing provided by the American Marketing Association (Definitions of Marketing American Marketing Association 2022), digital marketing can be comprehended as activities, institutions, and processes made possible by digital technologies to generate,

communicate, and deliver value to customers and other stakeholders. The process of adaptation made possible by digital technology creates value in new and different ways inside the new digital environment. Institutional organizations empowered by digital technology develop the essential competencies necessary to co-create this value for their customers and themselves. Creating new customer experiences and consumer interactions is how digital technology-enabled processes contribute to value creation. Processes produce value. The practice of digital marketing is made possible by a variety of adaptable digital touchpoints. These touchpoints include marketing campaigns, marketing agencies, marketing procedures, and clients. The consumer, the process, and the agency. It is important to remember that the total number of touchpoints is increasing by more than twenty percent every year due to the increasing number of offline clients who are turning to digital technologies (Kannan 2017). Customers who purchase in traditional stores are increasingly moving to digital technologies, particularly as younger customers enter the market (Jacques 2014).

The purpose of doing research in the area of digital marketing is because it seems vast, intimidating, and foreign. Businesses are looking for a clearer picture to start but do not know where and how to start doing digital marketing. In today's time, social media channels such as Facebook, Twitter, Google, and other social media firms have successfully transformed the attitudes and perceptions of consumers and in the end, helped revolutionize many businesses. This was done through the vast measurable network of customers with reliable data with real-time feedback on customer experiences.

This paper will use multiple cases to analyze the main problem of the traditional fashion retail industry, especially under the pressure of epidemic, and how to overcome these through using digital marketing tools.

3 Discussion

3.1 The Trend of Digital Marketing

Digital marketing has grown in popularity since it was first launched in the nineteenth century, as it utilizes mass media devices such as television, radio, and the internet. Search engine optimization (SEO), often known as "optimization for search engines," is the digital marketing tactic most commonly utilized nowadays. That is because SEO enhances how search engines like Google locate your website by increasing the number of search engines that find it. Digital marketing allows businesses to acquire and analyze information about their target audience. Furthermore, customers might search for knowledge and suggestions regarding what they wish to purchase. Digital marketing uses digital technology to assist in marketing efforts to increase consumer understanding by reasonably explaining their

demands (https://www.smartinsights.com/digital-marketing-strategy/online-marketing-mix/definitions-of-emarketing-vs-internet-vs-digital-marketing/).

Consequently, the reliance on labor in manufacturing can be substantially alleviated through information and connectivity technology to accommodate the individual demands of users and reduce the cost of distribution and production cycle of products. This means that in the future, consumers can enjoy exclusive personalized fashion products and services at a lower price than individual customization, saving too much waiting time. Conversely, corporations may use customer feedback to better satisfy consumers' requirements by implementing necessary changes. Simultaneously, Internet search grew exponentially in 2006, and optimization has gained traction with major corporations such as Google (Inetasia 2022). Mobile devices have significantly boosted mobile internet usage, and individuals are beginning to interact more readily through social media. As a response, more businesses have realized the importance of digital marketing to satisfy their consumers' requirements (Marketing 1996).

The popularity of digital technology has contributed to the rapid growth and development of online fashion retailing. VFR is one of these technologies that provide a virtual product fitting experience through a virtual model based on the physical measurements of the user (Blázquez 2014). VFR can fix the problems inherent in online shopping by meeting consumer expectations for a functional fitting and providing them with an emotional experience. This can be accomplished using virtual models and the associated features, including picture enlargement, mix and match, and system suggestions (Blázquez 2014). This seems particularly important for fashion consumers who are more inclined to seek entertainment when shopping. Simultaneously, it can provide a comfortable and enjoyable fitting experience for offline consumers by positioning them in an easily accessible area, facilitating quick fitting, and increasing engagement (Lee 2019; Jang 2013). Thus, it has largely solved the problem of long waiting times in fitting rooms and can primarily address the issue of fitting room closures during pandemics. Furthermore, for fashion companies, VFR can minimize returns and boost sales by ensuring a proper fit and increasing consumer interest in the product (Beck 2018). As one example, ASOS announced a trial of See My Fit's Augumented Reality tool in 2019 to provide customers with a fantastic view of products in different sizes and body types, helping them to make more informed buying choices by better showing how products look on a model that better reflects the individual customer.

3.2 The Predicament of the Traditional Industry Today

In the year 2020, owing to the emergence of the pandemic, traditional retail establishments suffered significant financial losses. Due to the rise of Covid-19 instances, many customers are reluctant to attend major retail locations. Even maintaining social distance has made it more difficult for physical stores to survive caused of government restrictions. According to relevant statistics, approximately 10,000 chain stores will

vanish from the retail scene of the United Kingdom by 2020 (PWC 2022). In fact, during the pandemic, several corporations have begun to reduce their employees' salaries and have conducted significant layoffs. As a result, an increasing number of individuals stay home daily and dress formally less frequently. This has resulted in a system where individuals often purchase their clothing before big occasions, such as weddings and holidays. As a result of the decline in social events, the frequency of shopping has decreased significantly. This has led to a reduction in consumption, with individuals increasingly purchasing for needs rather than fashion.

With a high level of homogenization and overcapacity, the fashion sector is currently facing intense inventory-related competitive pressure. While the number of consumers has remained the same, the inventory delay has resulted in price dumping. Concurrently, the growth of digital marketing and the Internet have increased this vicious cycle.

Currently, customers tend to purchase in a manner that is more diverse, multi-level, and individualized, and they are also more individualistic. For instance, customers' requirements for physical stores may be expressed in various characteristics, including the store's location, the way it is exhibited, and its style and design. The customer experience depends on several circumstances; thus, it is more difficult for physical stores to function when catering to the individualized preferences of consumers.

3.3 How to Address and Ameliorate These Issues by Transforming into Digital Marketing

The fashion industry, from global discount retailers to exclusive luxury brands, drives a significant part of the worldwide economy. Fashion is one of the most challenging fields, highly impacted by global economic uncertainty, distinct trends, and industrial changes. The arrival of the significant data era leads a round of revolution in fashion demand forecasting, which not only poses a significant challenge but also provides an opportunity for the industry.

Precision Segementation. Companies must alter their segmentation strategies, shifting from a focus on the mainstream market to a niche market. As internet usage and penetration continue to increase, the online experience becomes increasingly tricky. Customers are eager to gain knowledge from their user experience online and across all media. The most critical part of precision marketing is comprehensively analyzing customers' consumption behaviors. Data mining technology is required to subdivide customers' consumption behaviors (Guoan 2019). As with more extensive client segments, businesses must employ database marketing to customize messaging and goods for specific markets. Segmentation enables businesses to enhance the traits and behaviors of relevant clients by understanding their core and, consequently, the marketing messages that may resonate with them. Customer segmentation gives firms increased digital marketing flexibility, effectively targeting the most profitable

clients. This method is more participatory and, as a function, attracts and maintains clients. Increased relevance leads to improved conversion rates, which eventually results in more sales and a more significant contribution to the bottom line.

Customers could be segmented in several ways, including by region, demographics, behavior, and psychographics. Geographic segmentation is based on the concept that customers in the same region have a variety of interrelated desires and demands that may be vastly different from those in other areas of the world. Demographic variables such as age, race, nationality, employment, etc. are utilized for demographic segmentation. The classification for psychographics is "the study of personality, values, attitudes, interests, and lifestyles" (Martin 2011). Behavioral segmentation is the process of dividing consumers into groups depending on their behaviors. Actual market segmentation is demonstrated by Victoria's Secret and their brand PINK, geared towards adolescents. Victoria's Secret focuses on ladies, whereas PINK mostly targets adolescent girls and women. Given the brand's cost, Victoria's Secret also caters to an upscale clientele with disposable cash for lingerie or mid-priced lingerie.

The Impact of Search Engine Optimization. Search Engine Optimisation (SEO) is the process of optimizing a website's technical configuration, content relevancy, and link popularity in an effort to make its pages more discoverable, relevant, and popular in response to users' search queries. Search engine recommendation initiatives will help the user's search experience and ranking pages containing the user's search demands. In particular, most people are now accustomed to utilizing search engines, frequently using Google to locate items or services before making a purchase. According to Nielsen-NetRatings (Search Engine Watch 2022), the typical SEO-engaged brand increased organic traffic by 19.8% from 2013 to 2014. In 2014, natural search accounted for 21% of all internet traffic, a significant increase from 18.1% in 2013. In terms of added value, the digital economy will represent more than 38% of China's GDP in 2020, particularly in light of the global epidemic. In the same year, over one-fourth of China's retail sales of tangible items were conducted online, far higher than the worldwide average of 18% (Statista 2022). When looking for the official Gucci website on Google, the complete page of Gucci material, social network pages, and photographs appear. Another benefit is the site links that are produced. The fact that the advertisement is on the front page increases its prominence. Second, the increased use of space makes it less likely that competitors will appear on page one.

The Influence of Social Media, Like Blogging, Influences. Social media has steadily become the hottest trend in the fashion business, attributed to the increasing number of internet users. According to worldwide social statistics, by January 2022, 58.4% of the world's population uses social media, and 424 million new users will have joined in the past year (Global Social Media Statistics Research Summary 2022 Smart Insights 2022). Therefore, most firms have doubled their social media followers in the previous year. Based on a global study performed by Young Adult Revealed, 18-to 24-year-olds from 26 countries were polled to assess the frequency with which young people interact with companies online. The findings found that

28% of individuals discuss companies in online forums, and 19% upload brand-related content to their preferred social networking profiles. A company might establish a relationship with its customers or potential customers using social media. This is owing to the belief that social media allows firms to attract more prospective consumers, gather feedback, and enhance their products or services, hence fostering brand loyalty. Concurrently, the connection with the consumer will not only boost the buy rate but will also leave a positive impression of the brand in the customers' minds. forever21 has devised a distinctive campaign to increase sales. Forever 21 urged consumers to contribute images of their summer ensembles using the hashtags #F21xMe or #F21SummerCool and the tag @Forever21 to promote them across the brand's social networks and its mobile-optimized website, along with links to purchase highlighted goods. Forever makes consumers feel appreciated by putting them at the center of the campaign through brand interaction.

According to Lee (Mashable 2022), the emergence of fashion bloggers has significantly affected the fashion industry. Companies can engage with fashion bloggers to quickly market their products since fashion bloggers are more likely to swiftly create relationships, followers, and other forms of credibility. Adidas is a good example. They work with famous people, like Selena Gomez, Lionel Messi, Mesut zil, and Naomi Campbell, who are TV actresses, singers, and athletes. Adidas' browsing will increase by collaborating with a different group of circles in every case.

The Digital Marketing Metric. Digital marketing key performance indicators (KPIs) are quantifiable numbers that a marketing team uses to monitor whether or not its requirements are fulfilled. KPIs are laser-focused on a target or aim, such as growing income or website referral traffic, and explain the goals and activities required to get it.

Traffic on the Web is measured in visits. The bigger the number of website visitors, the greater the number of prospective customers a firm has. The amount of visitors to a business's website represents a chance to create an impression, generate qualified leads, spread brand awareness, and develop partnerships. Creating connections and trust eventually results in the sale of products or services, the acquisition of new customers or clients, and the expansion of a firm. More website traffic equals more money, business expansion, a broader product portfolio, the opening of new locations, and the creation of new services and products.

Cost per lead is an internet advertising pricing strategy in which the advertiser pays for an explicit sign-up from a customer interested in the advertiser's offering. CPL offers organizations crucial information to see if they are efficiently getting new clients.

Conversion rate is the proportion of website visitors who accomplish the desired objective out of the total number of website visitors. The clothes conversion rate is 2.77%, predicated on conversion rate benchmarks. The webpage might be optimized to enhance the conversion rate. Adidas searches convert at a rate of 4.1%, while Nike searches convert at a rate of 4.3%, which are over the marketing benchmark.

The click-through rate can measure the performance of business keywords and advertisements. CTR (CTR = Clicks + Impressions) is the number of clicks on company advertisements divided by the number of times the advertisements are displayed.

4 Conclusion

The traditional fashion industry has been experiencing a significant number of serious problems recently compared to the new fashion industry, such as the fact that the new fashion industry can attract more potential customers more quickly and even respond to them faster, with which to get closer to them by having to use a range of social platforms, such as commenting on each other products, as well as the development of the internet forcing the traditional fashion industry to transform. Therefore, we present how to transition from a traditional business to digital marketing and several related methods, such as SEO, blogs, and influencers. Simultaneously, digital marketing metrics are introduced at the end of the main paragraph, such as CPC, CPA, and conversion rates, which measure the effectiveness of those digital marketing means. Companies can even understand and analyze the parts they need to improve by comparing them with benchmark data. Therefore, achieving higher sales conversion rates.

A limitation of this study is that we have not considered the expenditure of businesses running digital marketing tools, especially for small businesses currently facing a collapsing trend due to several external factors. Consequently, it is unreliable for all small companies to spend significant amounts of money on transformation. Furthermore, digital marketing requires a lot of time and patience. For example, money spent on advertising or social media will take a long time to recoup, or even worse, there may be no return. In addition, some people are still afraid to buy online as they need to enter their credit card details when paying, especially older people. Indeed, some older people do not know how to buy online as they need to choose from various websites or apps. In the future, businesses could use security systems to prevent security issues. For instance, websites could use passwords as a form of authentication to be sure that the person using the site is authorized to access the account. As well as conducting a range of promotions and publicity on how to use their shopping site, companies should optimize their shopping pages to be as simple and straightforward as possible.

References

Beck M (2018) I Virtually try it … i want it! virtual fitting room: a tool to increase on-line and off-line exploratory behavior, patronage and purchase intentions. J Retail Consum Serv 40:279–286

Blázquez M (2014) Fashion shopping in multichannel retail: the role of technology in enhancing the customer experience. Int J Electron Commer 18(4):97–116

DATAREPORTAL-Global Digital Insights, https://datareportal.com/reports/digital-2021-october-global-statshot. Last accessed 16 July 2022

Definitions of digital marketing versus internet marketing versus online marketing smart insights, https://www.smartinsights.com/digital-marketing-strategy/online-marketing-mix/definitions-of-emarketing-vs-internet-vs-digital-marketing/. Last accessed 16 July 2022

Definitions of Marketing American Marketing Association, https://www.ama.org/AboutAMA/Pages/Definition-of-Marketing.aspx. Last accessed 16 July 2022

Global Social Media Statistics Research Summary 2022 Smart Insights, https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/. Last accessed 18 July 2022

Guoan Z (2019) Precision retail marketing strategy based on digital marketing model. Sci J Bus Manage 7(1):33

Inetasia, https://www.inetasia.com/resources/articles-the-history-of-digital-marketing.html. Last accessed 16 July 2022

Jacques B (2014) Brand success in an era of digital Darwinism. J Brand Strategy 2(4):355–365

Jang H (2013) Keep the social in social media: the role of social interaction in avatar-based virtual shopping. J Interact Advert 13(1):14–26

Kannan P (2017) Digital marketing: a framework, review and research agenda. Int J Res Mark 34(1):22–45

Lee H (2019) Classification of virtual fitting room technologies in the fashion industry: from the perspective of consumer experience. Int J Fashion Des Technol Educ 13(1):1–10

Martin G (2011) The importance of marketing segmentation. Am J Bus Educ (AJBE) 4(6):15–18

Mashable, http://mashable.com/2009/12/21/social-media-fashion/. Last accessed 16 July 2022

Office For National Statistics, https://www.ons.gov.uk/economy/grossdomesticproductgdp/articles/impactofthecoronaviruscovid19pandemiconretailsalesin2020/2021-01-28. Last accessed 16 July 2022

Parsons A, Zeisser M, Waitman R (1996) Organizing for digital marketing. McKinsey Q 4:185–192

Pencarelli T (2019) The digital revolution in the travel and tourism industry. Inf Technol Tourism 22(3):455–476

PWC, https://www.pwc.co.uk/press-room.html. Last accessed 16 July 2022

Search Engine Watch, https://www.searchenginewatch.com/2015/03/12/natural-searchs-growth-explosion-and-what-it-means-for-seo-in-2015/. Last accessed 16 July 2022

Statista, https://www.statista.com/topics/1007/e-commerce-in-china/. Last accessed 16 July 2022

The Influence of New Media on Consumers in the Information Age

Jason-Feng Pei Hao

Abstract The abstract should summarize the contents of the paper in short terms, i.e. Since the twenty-first century, the rise of new media, for hundreds of years has been to newspapers, broadcasting, and other ways to obtain information for consumers, such a change span is undoubtedly very huge. This paper aims to explore the impact of the rise of new media on consumers and the reasons behind it. This paper will take the travel information transmission mechanism represented by new media as an example to illustrate the impact of this mechanism on consumers.

Keywords Informatization · New Media · Consumer · Information transfer mechanism

1 Introduction

Analysis international, a new study suggests that by 2011 China's online travel service providers the income scale will reach 7.57 billion yuan, from 2003 to 2011 online tourism market scale of average annual compound growth rate will reach 43.63%, online travel industry chain gradually mature and the popularity of electronic ticket to become the biggest power to promote the growth of online travel market. Map service, search engines, the 3 g mobile Internet and a variety of means of payment and other new technology breakthroughs constantly help online travel service providers to develop the new functions of the service plat-form, provides the new travel service products, at the same time will further im-prove the overall quality of service. The CCTV survey showed that 21.8% of Internet users logged on travel websites, 43.2% of netizens said will travel web-site; In Internet users, has a travel website, 3.8% of Internet users have made online booking related to tourism, 54.2% of netizens said they would try to Inter-net booking. CCTV study has found that in terms of tourism information, about 62.6% of college students has been through the "related

J.-F. Pei Hao (✉)
Hainan University, 58 Renmin Dadao, Meilan District, Haikou City, Hainan Province, China
e-mail: 1102142100@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_120

pages" for tourist information, located on the first. Visible status gradually increased in tourist information acquisition, the Internet network space for tourist flow guiding role has become increasingly apparent. Before the digital age, consumer behavior has a significant driving force behind, as the consumers want to get a new car, high-grade consumer goods such as television, refrigerator and furniture to improve their social status, social scientist John Kramer (John Clamme R) observed "shopping is not just for some items, it also reflects the people of a kind of personality", at that time, these goods are usually middle-class status symbol. Today, however, most consumers have to buy the life everyday items, they begin to focus on the purchase of items, namely those who make their life happy, wealthy, and meet the opportunity and experience. In the new economy, likely to be the most successful companies are those who can make consumers are willing to spend time, attention and money on their products, and can benefit the company. Today, the meaning of consumption is to satisfy consumers' thoughts and desires and is not only to meet their basic needs.

2 The Impact of New Media on Consumers

A popular science video has been viewed five million times on YouTube, and the keyword "flight" generated nearly a billion Google searches a second. Generally speaking, scientific knowledge is generally explained by professionals, such as lectures, to make ordinary people understand some complicated scientific principles (Miller 1998). However, in today's information age, no matter scientists, scientific institutions, and even teachers in charge of science courses in primary schools are inevitably in contact with the media of the information age. These include YouTube (a video-sharing platform founded in 2005 and owned by Google), Facebook (a social platform created in 2004), and a host of other new media plat-forms. Scientists are allowed to discuss their findings with professional and non-professional people on these platforms, even beyond the scope of their research (Coson 2011). The most interesting part is that anyone can express their opinion on a subject by making videos and writing articles (Berger and Milkman 2012). If your work is good enough, the information you provide will spread exponentially to many people's electronics products.

Because of the above examples, I put forward a question as an introduction to the research: Does the Internet have a great impact on consumers' access to in-formation, and is the information provided by new media more important to consumers than in previous ways?

Books, magazines, and radio have been the mainstream sources of information for consumers for nearly a century. However, the decline of the global print and broadcast industries in the past decade has been inevitable. The Internet has provided consumers with richer information and the ubiquitous web advertising areas have provided agencies with sufficient platforms to promote. Since the twenty-first century, the printing industry trend of layoffs is growing every year, in addition to national-level journals, any traditional media have to rise to the new network power to compromise, create

their website on the Internet, to promote their products to consumers, it particularly in the area, for example, Washington, at 6:00 Radio ratings for 00 dropped 37% between 1997 and 2007 (Farhi 2008).

By providing more than 30 years ago, when online media are now just beginning to develop on a large scale and consumer information differences can be seen, Internet access to the low level of citizens access to information goods, that is, the emergence of the Internet narrow information access and interpretation of information by high intellectuals and others (Cacciatore et al. 2014). However, according to a 2010 survey of a representative sample of the US population, time spent online does correlate positively with growth in scientific knowledge, taking into account the effects of education, age, and several other explanatory variables. Thus, it may not be time spent on the Internet that has an impact on information acquisition, but rather exposure to different types of content through different online information sources. Viewers can also take advantage of additional information hyperlinked in articles, or provided by discussion groups and other types of online experts.

3 The Impact of Travel Information Transmission Mechanism on Consumers

Kwan, etc. analyzed the Internet user online behavior and Web data digging according to the influence of the Internet market, think it is very important data mining application in the network market, the practical application is also very successful. Hanna, etc. designed a demand model to test the online tourists demand for a trip to Europe. Model provides important information online visitors need, it involves the sensitivity of the tourism product price changes in travel demand. Conclusion shows that for countries such as France, Italy, the tourist price competition is very important for American tourists. Pointed out that under the condition of the tourism product is the same price not the choice of online visitors has great influence on. Wan through the research on international hotels and travel agents website, found that Taiwan's tourism industry use the Internet mainly advertising, not directly facing the market by 50 sites, analyzed the net-work to provide travel service travel agents, show different information for travel agents and public travel information Website is different I. Yong looked at the web site to attract users to visit tourist destination information flow, and information flow model is established, and points out that the timing and applicability are information through two indicators; information experience is closely related to the user to acceptance of tourism destination information; information experience can lead to changes in consumer behavior and attitude. Andrew analyzed from the perspective of western tourists to Taiwan for tourism destination 36 travel website content, points out the potential of information flow to provide guidance for the tourists. Maria, etc. investigated the tourism developers and travel agents through tourism website information flow for the tourists to provide services to promote the importance of purchase.

The 2006 Greater Triangle Family Travel Survey surveyed 5107 households, 11,953 family members and 10,245 vehicles. The average household size was 2.34 persons and the number of cars owned by a household was 2.01. The median annual household income was between $50,000 and $74,999, and the entire sample did not use a miniature model. Thus, doing so preserves higher values rather than throwing them away. The frequency distribution of travel time based on trip is positively skewed. For work-related travel, the mean travel time was 22.1 min, and the standard deviation was 30.4 min. However, for non-work-related travel, the average was 17.9 min, with a standard deviation of 22.8 min. + Frequency and descriptive statistics of responses are shown in Table 1. The frequencies used by traffic information are re-encoded into approximate interval data sets.

About half (49%) of informants stated that they never obtain travel information through electronic channels and never seek regional travel information (N = 5107). These people may have limited information needs, or informants may not be aware of the availability of these sources of information. Considering the entire sample, the

Table. 1 Descriptive statistics of travel surveys

The selected variables	Category	Frequency	The percentage
Travel frequency use the information (N = 5107)	By no means	2523	49.40
	At least once a week	504	9.87
	2 to 4 times a week	438	8.58
	Five or more times a week	1642	32.15
	And	5107	100.00
Specific information technology (N = 2584)	The Internet	607	23.49
	Commercial radio	1245	48.18
	TV	1762	68.19
	Variable information marker	153	5.92
	Highway information station	52	2.01
	Passenger Information Hotline (511)	0	0.00
	Other	39	1.51
	And	3858	149.30a
Information quantity source of access (N = 5107)	There is no	2523	49.40
	1	1613	31.58
	2	732	14.33
	3	180	3.52
	4	54	1.06
	Five or more	5	0.10
	And	5107	100.00

Percentages are over 100% because multiple responses are allowed
Data Source 2006 Greater Triangle Family Travel Survey

median frequency of travel information use was at least once a week. The median captured by reports from different sources is one travel source. In addition, 31.6% of households use one source of information, 14.3% use two sources and a small number use more sources. In addition, 78.6% (2584) of those who received traffic information changed.

They make travel decisions based on the information they receive (39.6% of informants). In terms of travel message, 1770 out of 5107 informants (34.6%) chose another route. In terms of specific message technology, it is easier for people to obtain travel message through Television Commercial radio and the Internet followed. 68.2% of the informants (who had access to electronic message) had obtained traffic message through Television, followed by commercial radio (48.2%) and the Internet (23.5%). Other public message sources, including VMS, HAR, and 511, had properly low access rates (about 8%). Part of the reason for this result may be the limited deployment of these systems in the North Carolina Triangle. Surprisingly, however, none of the informants used 511 as a source of travel message. There are several factors that can lead to non-use. First, 511 services were recently implemented in North Carolina (summer 2004). Second, the survey used the term "passenger message hotline". Informants did not understand that the reference to the term 511 was justified. Third, based on call statistics from North Carolina's 511 system, there seems to be a general consensus that 511 is considered a source of travel message, mostly in this context. Major destructive events such as ice storms, coastal evacuations and major accidents. As a result, most travelers probably don't do this when considering message about frequent travel.

Currently, VMS and HAR are not statistically significantly associated with shifts in travel decisions, likely due to their low level of deployment in the North Carolina Study Triangle and availability only during the route travel phase. It is worth noting that there are 182 surveillances in this variety, where there is some overlap between VMS and HAR.

Time of travel was a key control variable, suggesting that travelers traveling longer distances may be more slpoed to change routes in the face of in determination. The results show that travel time has a remarkable positive impact on people's travel decisions. Work-related travel time had a greater affection on change than work-related travel time itself.

4 Conclusion

New media refers to interactive tools such as Wei Xin, Weibo and Momo. Through these online new media platforms, consumers can develop knowledge and trust in each other without contact. Through these non-contact services to contact services, can effectively improve business efficiency. New media should be the media forms that appear under the new technical support system, such as digital magazine, digital newspaper, digital broadcast, mobile phone short message, mobile TV, network, desktop window, digital TV, digital movie, touch media and so on. Compared with

traditional media such as newspaper, outdoor, radio and television, new media is vividly called "the fifth media".

New media has the advantages of both interpersonal media and mass media: completely personalized information can reach almost countless people at the same time; Each participant, whether publisher, disseminator, or consumer, has reciprocal and reciprocal control over the content. It also eliminates the disadvantages of interpersonal media and mass media: when disseminators want to personalize unique information to each recipient, they are no longer limited to one person at a time; When communicators want to communicate simultaneously to the masses, it is no longer impossible to personalize content for each recipient. He also points out that new media rely entirely on technology, not innate human skills. Without digitalization and other technologies, new media is completely impossible.

In 2008 Beijing Olympic Games, new media was first incorporated into the Olympic communication system together with traditional media as an independent Olympic communication organization. The official inclusion of the Internet and other new media platforms into the broadcast channels fully reflects the social and commercial value of new media as a new communication channel. The huge business opportunities brought by the Olympic Games have promoted the layout and development of new media, and the copyright protection of new media has been highly valued.

New producers: in the early 1970s, Alvin Toffler is put forward in the best-selling "future shock" "production" this concept, anticipate customers will soon be facing an unprecedented amount of standardized goods and services. The traditional boundaries between producers and consumers have blurred, consumers are changing from passive recipients for the active participation of producers, and production for interest, like those who choose to published online writers, the product itself cannot earn money is not important, the important is that it exists, to share with people. Consumers can be producers, also can be a communicator, from this Angle, they play the role of the professional commentators. Collaborative production created the eBay, Wikipedia, YouTube…

All in all, mastering information technology, the new digital era consumers living in complex, needs to experience, understand the marketing, are very picky, have their own point of view, to express, and by the growing media and channels of purchase, free to change suppliers, and participate in the product in the process of production, transmission and distribution.

References

Berger J, Milkman KL (2012) What makes online content go viral. J Mark Res XLIX:192–205

Cacciatore MA, Scheufele DA, Corley EA (2004) Another (approach) looks at knowledge gaps and the potential of the Internet to bridge those gaps. Public Underst Sci

Coson V (2011) Science blog as a competitive channel for science communication. Journalism 12(7):889–902

Farhi P (2008) Don't blame journalism. Am J Rev

Miller GJ (1998) Public science: communication, culture and credibility

Orrick P (2003) Variable message signs
Reed TB (2006) Commuter perception of commercial radio traffic information. American Intelligent Transportation, Association, Washington, D.C.
Swan N, Baker S, Hintz R, Trimble T (2004) 511 Virginia assessment
The greater triangle tourism study: a household tourism survey. Summary report. NuStats, LLC, Austin, Texas (2006)
Wanat J (1998) Highway information station

The Influential Factors on Consumer Purchase Intention: A Case Study on MINISO

Shuya Lin

Abstract Since 2017, the trend of Intellectual Property (IP) co-branding collaboration has become popular in China, meaning that different brands join forces to create new products and give them new brand meaning. Businesses employ brand licensing and international co-branding to fast expand the market and draw clients. MINISO, a listed company in the Chinese retail market, has taken advantage of this trend wisely and become a winner in the IP co-branding market. The aim of this paper was to investigate whether and how the IP marketing strategy implemented by MINISO has had an impact on consumer purchase intentions. This paper used the 4Ps of Marketing Mix and SWOT analysis to conduct a validated factor analysis to examine the relationship between the IP marketing strategies implemented by MINISO and consumer purchase intentions. The research concluded that MINISO's use of IP marketing tactics has influenced consumer purchase intentions and positively impacted MINISO's annual sales and company size. Therefore, the IP marketing strategy adopted by MINISO, which adapts its marketing approach to market trends, is conducive to increasing consumers' purchase intentions. The paper also made several targeted recommendations based on the results of this study.

Keywords Consumer purchase intention · Intellectual property · IP marketing strategy

S. Lin (✉)
ESCP Business School, Heubnerweg 8-10, 14059 Berlin, Germany
e-mail: Shuya.lin@edu.escp.eu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_121

1 Introduction

1.1 Background

Driven by millennials and Generation Z in China's retail consumer market, consumption trends are gradually shifting from functional to personal and emotional needs, especially among consumers in Tier 1 and 2 cities (Pengpai News 2020). In addition, Generation Z is more sensitive to trends and social hotspots (Vision Star 2021). Since 2017, an increasing number of brands in the Chinese retail market have chosen to work with intellectual property, which means that various designers or brands are creating new products together. These brands use brand licensing, crossover co-branding, and other strategies to quickly open the market landscape, effectively enhancing product competitiveness. So far, from the Intellectual Property (IP) cooperation frequency, Pikachu, Doraemon, Hello Kitty, and other popular common IPs, with lasting vitality and strong fan base to maintain a stable market cooperation volume. For example, the oral care brand BOP launched a series of products co-branded with Cherry Mariko, including mouthwash, toothpaste, and mouth spray. In terms of the purchasing power of consumers in different cities, consumers in first and second-tier cities are the main consumers of IP products. Moreover, gender differences in IP consumption are also more apparent, with male consumers preferring sports and gaming IP, while female consumers prefer cartoon images (Meilin 2021).

MINISO is the world's leading retailer of private label lifestyle products. The company offers a wide range of quality, low-cost, design-led lifestyle products. MINISO was established in China in 2013 and launched its IP marketing strategy in 2017, targeting the brand's consumer base at young people of Generation Z. The co-branded IPs cover six segments, including global top stream IPs, secondary yuan IPs, national trend IPs, creative hipster IPs, sports/gaming IPs, and art and fashion IPs, with a With an average frequency of four times a year, MINISO has collaborated with Hello Kitty, Marvel, Disney, Coca-Cola, Honor of the King, NBA, China Aerospace and many other famous IPs to launch co-branded products, and is constantly trying to maximize the real value of IP co-branding through innovative marketing (Finance-Guancha 2022). The IP co-branding has brought MINISO not only a rejuvenating effect on the brand and a reinforcement of the user's mind but also solidly in terms of traffic and sales. The market potential for IP co-branding is clear given that domestic sales of IP products have climbed by 79% during the past two quarters of 2021 compared to the same period in 2020 and by 59% compared to the same quarter in 2019 according to MINISO's fourth-quarter FY2021 data (SINA 2022).

In 2016, MINISO's global shop count exceeded 1800 and its revenue was nearly $10 billion (Xiaobao and Guofu 2022). From 2017 onwards, MINISO's business size has changed significantly. Compared to 2016, MINISO's revenue increased by $2 billion in 2017, with 800 more shops worldwide (Bawuping 2017). 2018 saw MINISO grow even more rapidly, opening more than 900 shops in one year and reaching $17 billion in revenue (Finance Media 2022). And MINISO is listed on the New York Stock Exchange in 2020. As can be seen, 2017 was an important time

for MINISO compared to the previous years. On the other hand, there are several reasons for choosing high tier cities as the main market for the study. Firstly, MINISO is currently in an expansion phase and consumers in higher-tier cities are more willing to discover new brands. On the other hand, for this period so far in 2017, MINISO has focused its shop openings on higher-tier cities, which is conducive to increasing brand awareness and paving the way for subsequent saturation of shops in higher-tier cities and then moving to third and fourth-tier cities for expansion.

While there have been many studies on MINISO's business model as well as its marketing strategy, MINISO has been focusing on IP marketing since 2017 due to the increasing number of IP co-branded products that have appeared in the retail market in recent years and has continued to create new products with pace and content. Moreover, MINISO's sales and corporate scale have changed significantly.

In addition, most research websites have not yet featured studies or papers on the new marketing strategies implemented by MINISO after 2017. Therefore, based on the positive impact of this shift in marketing strategy for the company, this paper will explore whether the IP marketing strategy adopted by MINISO in high-tier cities so far in 2017 has affected consumer purchase intention.

Due to MINISO's rapid growth, it has attracted the interest of many researchers and many research reports on MINISO have emerged, such as an in-depth business analysis of MINISO, including business models, distribution models, etc.

1.2 Research Gap

While there have been many studies on MINISO's business model as well as its marketing strategy, MINISO has been focusing on IP marketing since 2017 due to the increasing number of IP co-branded products that have appeared in the retail market in recent years and has continued to create new products with pace and content. Moreover, MINISO's sales and corporate scale have changed significantly.

In addition, most research websites have not yet featured studies or papers on the new marketing strategies implemented by MINISO after 2017. Therefore, based on the positive impact of this shift in marketing strategy for the company, this paper will explore whether the IP marketing strategy adopted by MINISO in high-tier cities so far in 2017 has affected consumer purchase intention.

1.3 Structure

To explore the above research questions, the following section will analyze MINISO's marketing strategies through SWOT to verify that the IP marketing strategies adopted by MINISO in high-tier cities have influenced consumer purchase intention.

2 Literature Review

2.1 Definition and Development

Marketing activities considered by marketers require the help of marketing theory to understand the basic facts about the impact of marketing. One of the most common marketing theories is the Seven Ps of Marketing Mix (Sam 2022).

The concept of the Seven Ps of Marketing Mix began in 1960 with E. Jerome McCarthy's 4Ps—product, place, price, and promotion. But two academics, Booms, and Bitner, expanded the theory in 1981 to include three additional elements—physical evidence, people, and process (Lukasz 2022).

The 4Ps of Marketing Mix, which were first defined by E. J. McCarthy in 1960 in his book "Basic Marketing—A Managerial Approach," will be applied in this essay (Alexandra 2022). It helps marketers to develop effective marketing strategies that focus on all major factors related to products, pricing, distribution, and promotional activities.

2.2 Important Results

Product and Product Quality. Seven components make up a product, according to Kotler and Armstrong: variety, quality, design, features, brand name, packaging, and services (Kotler and Armstrong 2016). This section focuses only on the relationship between quality and purchase intention.

Haryanti et al. in 2019 clarified the impact of product quality on customers' willingness to buy (Kristiana et al. 2019). Using SPSS version 20, the study gathered data from 181 Lasem batik purchasers in Central Java, Indonesiac (Kristiana et al. 2019). The results showed a favorable and significant correlation between product quality and purchasing intent (Kristiana et al. 2019).

In 2020, Paulssen et al. investigated the relationship between product quality and purchase intention (Das Guru and Paulssen 2020). To assist manufacturers in using product quality to promote business performance, the two academics created and validated the Customer Experience Product Quality (CEPQ) indicator, a new multidimensional product quality scale (Das Guru and Paulssen 2020). The study was conducted online in India and the US with customers in four product categories including cars, smartphones, headphones, and running shoes (Das Guru and Paulssen 2020). The results found that Customer Experience Product Quality (CEPQ) drives customer behavior in terms of purchase intention (Das Guru and Paulssen 2020).

The factors influencing the buying intentions of consumers of Bono brand tile were researched by Mirabi et al. in 2015 (Vahidreza et al. 2015). Confirmatory factor analysis and multiple regression analysis were used to assess the study's validated data from 384 respondents who completed a specified questionnaire (Vahidreza et al.

2015). The results found that there was a significant effect of product quality on purchase intention (Vahidreza et al. 2015).

Price. Price is a real cue that consumers use in their purchasing decisions. This variable is the opposite of purchase intention; usually, the higher the price, the less likely a purchase is.

Chaerudin et al. in 2020 examined the effect of price perception on purchase intention (Septiani and Chaerudin 2021). The purpose of this research is to examine how consumer perceptions of brand image, price perception, and quality affect consumers' intention to purchase footwear brands in Bandung, Jakarta, and Yogyakarta. Multiple linear regression and descriptive analysis were both employed in this study to analyze the data. Female residents of Bandung, Jakarta, and Yogyakarta participated in the survey (Septiani and Chaerudin 2021). The results of the research verify that customers' perception of price benefits the purchase intention of footwear brands (Septiani and Chaerudin 2021).

Ayub et al. conducted research in 2021 to ascertain how pricing perception affects buying intention (Ayub and Kusumadewi 2021). A 120-person purposive sample was employed in the study. Regression analysis was the method of data analysis applied (Ayub and Kusumadewi 2021). The findings of this study demonstrate that price perception increases purchase intention (Ayub and Kusumadewi 2021).

In the mobile and portfolio sectors, Juha Munnukka looked at how customers' perceptions of price affect their willingness to buy mobile services (Munnukka 2008). The study was carried out in the Finnish market for mobile services. Explanatory factor analysis, linear regression analysis, and analysis of variance were all used to analyze the empirical data (Munnukka 2008). The findings revealed a sizable correlation between customers' perceptions of pricing and their intentions to make purchases (Munnukka 2008).

Place. Xin et al. in 2021 examined the effect of Multi-Channel Integration on Customer Purchase Intention (Xin et al. 2021). Drawing on the Stimulation-Organism-Response theory, this study examines how consumers' perceptions of the dimensions of multichannel integration influence purchase behavior (Xin et al. 2021). The results show that consumers' efficacy in a multichannel environment has a positive impact on their purchase intentions (Xin et al. 2021).

Hati et al. in 2021 analyzed how Multi-Channel Integration affects Purchase Intention (Muhammad and Sri 2020). This study developed an initial model to explain omnichannel consumer behavior using variables used in UTAUT2 and other previous studies on omnichannel consumer behavior (Muhammad and Sri 2020). The results of the study show that the omnichannel context significantly influences purchase intention and that three factors in particular—habit, encouraging environment, and personal—are significant (Muhammad and Sri 2020).

Promotion. Angela Ya-Ping Chang in 2017 examined the relationship between sales promotion and purchase intention (Angela 2017). 1000 surveys were given out to attendees of the 2014 Kaohsiung International Travel Fair, and 421 valid questionnaires—or 42% of the total—were returned (Angela 2017). The results of the study

showed that there was a significant correlation between sales promotion and purchase intention, sales promotion, and purchase intention (Angela 2017).

In 2013, Obuya and Zaccheaus Okoth demonstrated whether sales advertising influences consumers' intention to make purchases favorably (Obuya 2022). The sample size for the study, 72 valid data, was determined using a stratified random sampling procedure (Obuya 2022). In addition, the coding of the data was done using Microsoft Excel and SPSS (Obuya 2022). The survey also revealed that findings showed that promotions increased customer loyalty and customer retention, with a positive correlation with consumer purchase intentions (Obuya 2022).

2.3 Summary

According to the above study, product, price, place, and promotion do have an impact on consumer purchase intention, such as product quality, price Perception, multi-channel integration, and sales promotion, and may also include product packaging, price, advertising, and marketing methods. etc.

The following is a brief analysis of MINISO's 4P strategy in these four areas. In terms of products, MINISO's design style is simple and natural, with everyday items as the main focus. In terms of price, MINISO is low-cost and low-priced. From a place perspective, MINISO adopts a short-channel physical retailing, directly from the factory to the shops, as well as a networked management model, which integrates resources from all sides with the help of the Internet to maximize efficiency. In terms of promotion, MINISO adopts new media marketing and internet interaction.

3 Method

3.1 Research Design

To achieve the research topic, this article will use the SWOT analysis method. The SWOT acronym has Strength, Weaknesses, Opportunities, and Threats. In the late 1960s and early 1970s, Albert Humphrey created it at the Stanford Research Institute (SRI) (Sam 2022).

As this paper will explore the relationship between the purchase intentions of consumers of the IP marketing strategy adopted by MINISO in high-tier cities so far in 2017, using the SWOT analysis to sort out the strengths, weaknesses, opportunities, and threats, and through the analysis of the results, summarize the actual situation in the process of adopting this marketing strategy by MINISO, including the changes in the purchase intentions of consumers, as well as the market development orientation, and then make relevant suggestions regarding the appropriate adjustment of the IP marketing strategy and the development direction of the company.

According to Steven Cohen, by using SWOT analysis, companies can position their marketing efforts more effectively to better meet the needs of existing and other customers (Steven 2017). Using SWOT, companies can understand how each element of the SWOT analysis affects the four elements of the 4Ps and then make strategic adjustments.

3.2 Data Collection

In a situation where the traditional brick-and-mortar retail industry is struggling to operate, MINISO has emerged with a new marketing model that is strategically designed and implemented with the consumer as the starting point. In terms of pricing strategy, MINISO adopts a low-cost, low-price, high-quality pricing strategy against the backdrop of a retail industry that is low-cost but cannot guarantee high quality. In terms of product strategy, MINISO's products are designed to be simple and close to life. To ensure a high-quality and low-price model, MINISO chooses suppliers who have high requirements and standards for their goods (Qian 2019).

In terms of the market, the common form of co-branding has always been the collaboration between brands and celebrities. In recent years, many brands have adopted IP co-marketing, taking advantage of the fact that IPs carry their traffic and collaborating across borders with IPs that have a certain level of popularity in the market to increase brand exposure at a low cost.

Due to the changing market demand, standardized products can no longer meet the consumption demands of contemporary consumers. MINISO has adopted IP co-marketing since 2017, based on the original marketing model, to capture the young and trendy characteristics of the mainstream consumer group, and collaborate with their familiar and favorite anime images and movie IPs to launch new products with success.

From 2016 to 2018, MINISO's annual revenue jumped from $10 billion to $17 billion and the number of shops worldwide grew from 1800 to 3500 (SINA 2022; Xiaobao and Guofu 2022). Although MINISO's revenue fell sharply due to the epidemic, MINISO's CEO, Mr. Guofu Ye, said that although the epidemic hit brick-and-mortar retail hard, it was also a time when rents in malls and shops were at their lowest, making it a great opportunity for MINISO to continue expanding its shops. in the second half of 2020, MINISO increased the pace of its expansion in overseas markets. Not only that, but MINISO was also listed on the New York Stock Exchange in October 2020 and established its sub-brand TOP TOY in December 2020, positioning itself as a global hip-hop collection shop. As of the third quarter of the fiscal year 2022, the cumulative number of TOP TOY shops reached 92 and revenues reached $110 million (Nanzao 2022).

3.3 SWOT Analysis

Strength. The advantages of MINISO's IP strategy are reflected in both product and promotion.

MINISO uses limited edition IP products to create scarcity and uniqueness of the product. In fact, limited edition products from merchants with certain restrictions on the time, place, and quantity of sale are a form of hunger marketing. The scarcity and uniqueness of limited-edition products often stimulate consumers' curiosity and desire to buy, especially in the luxury industry. 17 April 2021, MINISO collaborated with Disney to create Toy Story co-branded products, which were only available in a limited number of over 800 designated shops nationwide. During the same period, fans were guarding the entrance of shopping malls every morning after 7 am, waiting for the shops to open for a mad rush (Airui Internet 2022). This shows that this limited-edition IP co-branded product has captured the attention of Disney's fans, attracted a lot of attention and inspired a strong desire to buy.

MINISO's co-branded promotions are not a short-term sales boost, but rather a marketing strategy to gain ongoing consumer attention, with new co-branded collaborations every year and new products launched at regular intervals, constantly renewing MINISO's presence in the minds of consumers. With each IP branding buzz, MINISO's impression and position in consumers' minds are consolidated. Domestic IP product sales in the last two quarters have climbed by 79% compared to the same period in 2020 and by 59% compared to the same period in 2019 (Tianming 2022). It is evident that expanding IP collaboration resources and launching new IP products at intervals has had a positive impact on consumer purchase intention.

MINISO creates offline immersive and interactive events to enhance and upgrade the brand's consumer experience. MINISO's core consumers are mainly young people of the Z generation, who are more willing to pay for hobbies and give their time and money. 2021 saw MINISO hold a co-branded event with Yin Yang Shi, a mobile game developed in-house by Chinese gaming company NetEase and popular with young people. Compared to overall users, Yin Yang Shi was used up to 11.2 times per capita per day by shared users and up to 58.3 min per capita per day, making users sticky (Jagger 2022). In this co-branded campaign, MINISO chose different game images according to different cities offline to create a parade, with a large number of KOLs and cosplayers present, as well as a large number of interactive sessions The campaign is designed to create an interactive atmosphere for players. In 2021, MINISO will also create a cosplay-themed shop, recreate the image of the Tang Dynasty banquet characters offline, create an immersive experience, and increase the shop's punch card function to provide consumers with a fun and popular experience (Dailyeconomic 2022). MINISO captures the interests of consumers and gives them a rich experience that inspires them to spend money. Therefore, purposeful offline experience activities can gain brand traffic and thus increase consumers' willingness to buy.

Weakness. MINISO product quality controls are inadequate. Companies make profits from the products and services they provide to consumers to stay afloat. From the perspective of business development strategy, excellent product quality is the key for a company to be able to survive in the fierce market competition (Hai 2022). MINISO's core selling point is low cost and high quality, but in recent years, MINISO has often experienced problems with quality failures. In the "Results of Product Quality Supervision and Sampling of Protective Masks in Guangzhou in 2020" published by the Guangzhou Municipal Bureau of Market Supervision, the 2nd batch of disposable masks produced by MINISO was detected to have failed in the item of breaking strength at the connection between the mask strap and the mask body. This problem can cause the product to become unusable and lose its function (Investor Internet 2022). In terms of product strategy, MINISO's sales slogan is low cost, low price, and high quality, and quality problems will have a negative impact on the company's brand image. In contrast, Yenni Aryani examined the influence of product quality on consumers' purchase intentions using both survey and causal methodologies. The results of the study indicated that the Purchase Intention variable is significantly influenced by the Product quality variable (Aryani 2020). In fact, following the appearance of children's tableware that was tested for substandard substances on 18 June 2020, the matter generated 85,000 discussions on Twitter. Moreover, fans of the celebrity at the time believed that MINISO had infringed on the artist's reputation and even threatened the star's agency to terminate their cooperation with MINISO (Investor Internet 2022). This shows that problems with the quality of MINISO products will certainly have a negative impact on consumer purchase intention.

Opportunity. Seize the new trend of e-commerce platform development in the Chinese market to achieve multi-channel marketing and sales. The Chinese e-commerce market is the largest in the world. Growing at an average rate of 6%, China's e-commerce revenue is expected to reach US$2 trillion by 2025 (Tenba Group 2022). The company is positioned as an offline retail brick-and-mortar shop, focusing on offline sales. It is not enough for a business to rely on brick-and-mortar sales alone if it wants to keep growing. Although MINISO has started to implement online marketing in 2021, including employees live-marketing and selling products, and cooperating with takeaway platforms to launch contactless delivery services to quickly deliver products to consumers, the IP marketing models still focuses on offline consumer experience, including some IP display booths and offline interactive activities. The combination of online and offline IP marketing model is still immature. Based on the uniqueness of IP marketing products and the characteristics of indirect updates, MINISO can develop limited experience activities with brand IPs through multi-channel e-commerce platforms, including T-mall and JD, so that consumers can experience IP products online and also discover more potential consumers and attract them to learn about the brand, thus increasing their willingness to buy.

Threaten. The number of alternative products has increased. With the rapid growth of MINISO and the popularity of its products, many MINISO imitations have emerged. Also, some consumers have the impression that MINISO is an imitation of Japanese

products. There is nothing innovative about the product design and it is also easy to counterfeit. On the other hand, the IP market is highly competitive and many companies have seized on the trend of IP co-branding to launch new products, and substitutable products can also work with IP. the positioning of MINISO's products includes low prices, and the main consumer groups are most concerned about prices. The price of the substitutable products is lower than the price of MINISO, and consumers' willingness to consume MINISO products will naturally shift to substitutable products with both low price and IP.

4 Results and Discussion

4.1 Results

For the IP strategy implemented by MINISO, the overall strengths are the uniqueness and scarcity of limited IP products, the intermittent speed of product updates, and the increasing number of immersive and interactive activities that can enhance the consumer experience. The overall disadvantage is the lack of quality of certain products. All these aspects have a positive or negative impact on MINISO consumers' willingness to buy.

4.2 Discussion

The change in MINISO's marketing strategy to an IP-based marketing model has had a real impact on consumers' willingness to buy in terms of product, price, place, and promotion. The uniqueness and scarcity of the products stimulate the curiosity and desire to buy. Regular product updates generate regular traffic, retain existing consumers, and explore potential consumers, and offline marketing interactions triggered by IP co-branding generate interest and attract target consumers.

4.3 Recommendation

Based on the SWOT analysis, the following is where I will make recommendations based on the results of the analysis.

When referring to the uniqueness and scarcity of limited-edition IP products, MINISO can not only use the existing limited-time and limited-region offering, but can also use limited-time discounts to enjoy special prices during the campaign time and within the campaign's limited quantity, with the original price reverting to the original price if the purchase is made outside the campaign time or the

campaign's limited quantity. Limited-time discount campaigns take advantage of both the uniqueness and scarcity of limited-edition IP products while emphasizing the short time frame, strong discounts, and small quantities. These restrictions will give users a stronger sense of urgency, shorten their purchasing decisions and stimulate consumers' willingness to buy.

MINISO could also set a fixed time of year with intermittent collaborations on new IPs and the launch of new products. For example, January, June, and September are the months of the year when new IP brands collaborate and products are updated, creating suspense for consumers and stimulating customer curiosity. At the arrival of each renewal month, increase the publicity of the new IP brand collaboration to stimulate consumer purchase intention.

In terms of Promotion, MINISO can continue to develop offline immersive and interactive activities. Depending on the image of each IP combined with the IP's target audience and MINISO's mainstream consumer base, it is also possible to tailor offline activities specifically to the geographical characteristics of the event location to ensure uniqueness and stimulate customer purchase intention.

Regarding the poor quality of individual products, MINISO can set up a quality inspection team within the company or hire the head of the quality inspection bureau, who is specifically responsible for checking the factory production process. Or collaborate with better production manufacturers to improve manufacturing levels.

To capture the new trend of e-commerce platform development in the Chinese market and to achieve multi-channel marketing and sales, MINISO can develop experiential activities with different brand IPs to enable the online experience of IP products and attract user interest. Take advantage of the characteristics of different e-commerce platforms in China to develop different marketing and sales approaches.

When it comes to the problem of the increase in substitutable products, it is essentially the fact that MINISO's designs are more generic; MINISO's product designers are able to conduct deep research into the Chinese market, consumers, and culture, and integrate product development and design with local Chinese culture to achieve a higher level of product innovation, creating surprising experiences for consumers and stimulating customers' willingness to buy.

4.4 Similarities and Differences with Previous Studies

According to the analysis of the results of the literature review, product quality, price perception, multi-channel integration, sales promotion all affect consumer purchase intention. Comparison with the findings of this paper revealed the same conclusions regarding product quality and multi-channel integration. Low product quality has a negative impact on consumer purchase intention. In addition, based on the positive influence of multi-channel integration, this article also suggests that MINISO adopt a multi-channel marketing and sales approach to seize the opportunity.

5 Conclusion

This article explores whether the IP marketing strategy implemented by MINISO has had an impact on consumer purchase intentions in the context of the Chinese market so far in 2017. The 4Ps of Marketing Mix and SWOT analysis were combined, and it was discovered that MINISO's 2017 implementation of its IP marketing strategy had an effect on consumers' propensity to purchase. This report also suggests that MINISO implement time-limited discounts on limited-edition products, schedule a certain time for the launch of new products, and keep advancing offline experience activities in light of the findings. For the Chinese market e-commerce platform, MINISO could tailor online experience activities with different brand IPs. Furthermore, MINISO can address the issue of product quality and substitution by hiring someone to be responsible for quality control and product innovation.

This article proposes modifications and refinements by integrating the application of different theories to the company's newly implemented marketing strategy. Although there are many studies on MINISO, the review found that previous researchers have not looked specifically at the IP strategies introduced by the company and that the current state of research in this area is not balanced. This paper only includes the time after 2017, which is time-limited.

References

Airui Internet (2022) MINISO conducts interactive marketing to create super-themed shops, Airui internet. Last accessed 12 May 2022

Alexandra T (2022) The 4 Ps of Marketing, Investopedia, https://www.investopedia.com/terms/f/four-ps.asp. Last accessed 24 June 2022

Angela C (2017) A study on the effects of sales promotion on consumer involvement and purchase intention in tourism industry. WURASIA J Math Sci Technol Educ 13:8328–8330. Modestum Publishing LTD, Eastbourne. https://doi.org/10.12973/ejmste/77903

Aryani Y (2020) The effect of brand image, product quality, and price on purchase intention. https://doi.org/10.2139/ssrn.3642536

Ayub MTTJ, Kusumadewi NMW (2021) The effects of price perception, product knowledge, company image, and perceived value on purchase intentions for automotive products. Eur J Bus Manage Res 6(5):47–50. https://doi.org/10.24018/ejbmr

Bawuping (2022) MINISO's 2017 revenue of 12 billion employees exceeds 23,000. 360DOC. Last accessed 23 June 2022

Dailyeconomic (2022) MINISO is once again playing the "national trend" with IP co-branded goodies + offline immersion. Last accessed 25 June 2022

Das Guru RR, Paulssen M (2020) Customers' experienced product quality: scale development and validation. Eur J Mark 54(4):645–670. https://doi.org/10.1108/EJM-03-2018-0156

Finance media (2022) MINISO's annual revenue of $17 billion is still hot amidst criticism. Bay Area Financial Media. Last accessed 24 June 2022

Finance-Guancha (2022) Brandon gives full play to the power of IP co-branding to capture the hearts of Generation Z. Rizhao Daily News. Last accessed 30 June 2022

Hai N (2022) The importance of product quality. Last accessed 02 June 2022

Investor Internet (202) MINISO in the midst of quality and infringement controversy, following toxic products and suspected copycats. Last accessed 25 June 2022
Jagger (2022) China mobile internet spring report, ZHIHU. https://zhuanlan.zhihu.com/p/136540821. Last accessed 01 June 2022
Kotler P, Armstrong G (2016) Principles of marketing, 16th edn. Pearson Education Limited, England, Boston
Kristiana H, Theresia D, Andreas L (2019) The relationship between product quality and brand image with willingness to buy: a study on batik lasem consumer. In: 5th International conference on opportunities & changllendes. Management, Economics & Accounting, Germany, pp 1–13
Lukasz S (2022) From 4Ps to 7Ps: towards an Integrated Marketing Mix, ExportPlanning, https://www.exportplanning.com/en/magazine/article/2021/03/03/from-4ps-to-7ps-towards-an-integrated-marketing-mix/. Last accessed 03 June 2022
Meilin L (2021) IP co-branded consumption report: total local IP sales in China to grow nearly twofold by 2021. 21st Century Business Herald. Last accessed 10 Jan 2022
Muhammad O, Sri R (2021) Analysis of omnichannel consumer behavior: purchase intention on omnichannel restaurants in Indonesia. In: Nusantara science and technology proceedings, 1st ICEMAC 2020: international conference on economics, management, and accounting, international conference partner, Pakisaji, 2021. https://doi.org/10.11594/nstp.2021.1037
Munnukka J (2008) Customers' purchase intentions as a reflection of price perception. J Prod Brand Manage 17(3):188–196. Emerald Group Publishing Limited, England. https://doi.org/10.1108/10610420810875106
Nanzao (2022) MINISO earnings release: top TOY revenue up nearly fourfold year-on-year as hipster play explodes with huge growth. Last accessed 27 May 2022
Obuya ZO (2022) Relationship between sales promotion and consumer buying behavior for insurance products in Kenya. Digital repository, http://erepo.usiu.ac.ke/handle/11732/6207;jsessionid=5724B2FEA455FFD8506274AB26334B4D. Last accessed 17 June 2022
Pengpai News (2020) How to play with IP licensing under consumer change. Last accessed 11 Oct 2020
Qian T (2019) MINISO's marketing strategy, 21KS. https://www.21ks.net/lunwen/scyxlw/133941.html
Sam M (2022) 6 Important marketing theories—and how to apply them in social media campaigns, PR Solutions, https://www.agilitypr.com/pr-news/public-relations/6-important-marketing-theories-and-how-to-apply-them-in-social-media-campaigns/. Last accessed 15 June 2022
Ika Septiani DI, Chaerudin R (2021) The effect of customers' price perception, perceived quality and brand image toward purchasing intention in bandung local shoe brand. KnE Soc Sci 4(6):1242–1254. https://doi.org/10.18502/kss.v4i6.6674
SINA (2022) When co-branding is everywhere, how does Masterpiece tell the new story of IP-enabled brands. Deep Burn Finance. Last accessed 20 June 2022
Vision Star (2022) Six trends for brand & IP co-branding in 2021, come and find out. Last accessed 15 Mar 2022
Steven C (2017) Swot analysis for smart marketing strategy, strategus. https://www.strategus.com/blog/swot-analysis-smart-marketing-strategy
Tenba Group (2022) 12 China E Commerce market trends 2022. Last accessed 09 May 2022
Tianming O (2022) MINISO: a sample of new consumer growth, TENGXUN. https://xw.qq.com/cmsid/20210824A0D23F00. Last accessed 01 June 2022
Vahidreza M, Hamid A, Hamid T (2015) A study of factors affecting on customers purchase intention. J Multi Eng Sci Technol (JMEST), 2:267–237
Xiaobao C, Guofu YE (2022) MINISO: $10 billion in annual sales from a small $10 shop, that's the secret of the business model. 360DOC. Last accessed 18 June 2022
Xin X, Wu J, Huang L, Shang S, Chen P (2021) Effect of multi-channel integration on customer purchase intention. J Comput Inf Syst. Talyor & Francis Online, London.https://doi.org/10.1080/08874417.2021.1965052

The Relationship Between Frequency of Problem Exposure, Purchase Intention, and Price Premium for Sustainable Attires Among Chinese Commuters

Haotian Xiang, Eric Xu, Zhaoning Huo, and Juyao Lee

Abstract In most developed Chinese cities, due to excessive heat, commuters can suffer from problems related to perspiration and body odour after commuting. Due to the functional features, sustainable attires show effectiveness in sweat absorption, UV protection, and body odour control, which helps to solve these problems. In this research, we intend to study the relationship between the frequency of problem exposure and commuters' purchase intention and willingness to pay a premium price for sustainable fashion. A questionnaire is used to gather information from commuters and the data collected is analyzed with linear regression. After analyzing the data collected, we find that the frequency of commuters' problem exposure has a positive and significant impact on their purchase decision, while this influences commuters' price premium negatively and significantly. Overall, Chinese commuters show great interest in a sustainable fashion that solves their problems and are willing to pay a significant premium price.

Keywords Sustainable attire · Purchase intention · Price premium · Frequency of exposure · Price perception · Chinese commuters

H. Xiang (✉)
School of Tourism, Hainan University, Hainan, China
e-mail: Haytishayton@gmail.com

E. Xu
Institute of Education, University College London, London, UK

Z. Huo
College of Science and Technology, North China Electric Power University, Beijing, China

J. Lee
BeiJing NO.80 High School, Beijing, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_122

1 Introduction

As the pandemic generally subsides across China, office workers are returning to the office instead of working from home, leading to a revitalization of the population of commuters, especially in developed cities (Slotta 2021). Most developed cities in China (Shanghai, Hongkong, Shenzhen, Guangzhou etc.) are located near the coast where the average annual temperature is higher than in other regions; thus, commuters are likely to perspire during their commute, while also producing unpleasant body odour. However, new sustainable attires using innovative materials and production processes may help these individuals to solve this experienced pain point. Textile for sustainable attires are normally made from completely reusable materials like coffee or plastic and is proven to be twice more effective in sweat absorption, UV protection as well as body odour control. However, these materials often come at a higher price than other textiles (Lerpiniere 2020; Cafe 2022). Thus, consumers' purchase intention as well as willingness to pay a premium for sustainable clothes need to be studied.

In this research, firstly, two hypotheses are made related to the relationship between problem exposure rate and purchase intention as well as price premium. Then a questionnaire was used to collect data from commuters in developed regions in China. Data collected is analyzed by linear regression, and the results are shown and discussed in later pages. Finally, conclusions and recommendations for further research are made.

2 Literature Review

This literature review aims to explore how a consumer's frequency of exposure to problems and their corresponding solutions affect their purchase intentions and price perceptions within the context of sustainable fashion. Given our research focus on the importance of problem exposure in potentially affecting purchase intentions and price perceptions, we specifically focus on commuters in areas with hot climates, who likely share a concern on environmental issues and green initiatives. The market of sustainable fashion, we argue, may benefit from marketing sustainable fashion to these commuters, enabling them to travel and exercise conveniently, comfortably and efficiently whilst at the same time, promising a positive sustainable net impact on the environment.

The consumer profile consists mainly of commuters and active exercisers who hold values of environmental protection. Their pain points can be attributed to three main concerns: performance efficiency, convenience and sustainability concerns. Commuters who have to endure long and uncomfortable rides on public transport in hot and humid climates suffer from poor breathability and general discomfort in their clothing. Other commuters who have more active ways of getting to and from work, such as cyclists, joggers or even walkers suffer from performance limitations

in their clothes, or having to bring a separate change of clothes to work to change into after their commute. Consumers, regardless of their preferred method of commute, also have concerns on how their lifestyles and consumptions affect the environment.

2.1 Frequency of Exposure

Frequency in a consumer's exposure to problems and their corresponding solutions has shown to be strong indicators of positive influences in consumers' price perception and purchase intention. Firstly, younger commuters in previous surveys mostly use public transportation and sweat more frequently (Kim and Ulfarsson 2008; Nurul Habib et al. 2009). It follows that these commuters have a high frequency of exposure to this problem, due to the very nature of commuting being a regular occurrence in one's lifestyle and routine.

Separately, Ottman (1993) suggests that consumers of all types have growing concerns and awareness about the environment and the climate crisis. These days, it is indeed a global rising concern, and companies have collectively agreed to pursue a more sustainable route with their marketing and production. Polonsky (1994) defines green or environmental marketing as "activities that are designed to generate and facilitate any exchanges intended to satisfy human needs or wants, with minimal detrimental impact on the natural environment". Furthermore, research has shown repeatedly that media has had a large impact on the global discourse of climate issues (Lowe and Morrison 1984; Lowe and Rudig 1987).

A customer's perceived frequency of exposure to a problem can also be informed by their exposure to advertisements which convey the significance of those problems. Zileske (1959) found that consumer response increased alongside the frequency of exposure to advertisements which showed solutions to their problems. More specifically, over a 13-week period, when relevant advertisements were repeated to them, their response rate peaked, dropped quickly after the campaign ended. Following that, when campaigns were spaced over a monthly basis across a year, the response rate of consumers increased gradually, reaching similar highs but decaying more gradually. Although media and advertisement may have minimal effects on a consumer's beliefs and intentions on an individual scale, when repeatedly exposed to them, their impact builds in an cumulative way. Over time, a consumer's exposure to their everyday problems, as well as the media and advertisements that demonstrate the solutions to these problems increases, this will likely affect their behaviors and intentions. The remainder of the literature review aims to convey how the solutions that our products will provide will affect both purchase intentions and price perceptions of consumers, drawing on this model of exposure frequency.

2.2 Purchase Intention

Purchase intention is a kind of decision-making that studies the reason to buy a particular brand by consumers (Shah et al. 2012). We can define purchase intention as a situation where consumers are inclined to buy a certain product in certain conditions. Customers' purchase decisions are a complex process. Ghosh (1990) states that purchase intention is an effective tool to predict the buying process. By analyzing and critically thinking about the underlying processes behind customer intentions, we can make our best efforts to predict which customers want which products, and for what reason. Having this information then immensely aids us in our prediction of our product or brand's success.

In terms of our solution to performance limitations, it is important to consider the third variable which the metric of "performance value" brings into the question. For an initial customer base, it is crucial to establish a brand image which reflects the high performance value from the customer's perspective. This means a shift away from the technology and textiles of the product, and more towards the marketing and communications between the company and the initial customer base. Baltas and Argouslidis (2007) state that the improved quality of store brands as well as affordable pricing are the main factors for a customer acceptance of a store brand. Building a retailer-based image with product image and pricing, and proceeding in fostering a confidence in our products performance within customers will have a significant impact on their purchase intention (Calvo-Porral and Lévy-Mangin 2017). Communicating this brand through frequent exposure of advertisements and solutions will therefore facilitate an increase in consumer response and purchase intention.

As mentioned previously, there is a growing global trend in concern for the climate and planet, translating to a growth of demand for sustainable products in the market. Customers who have similar values for sustainability will have a stronger purchase intention for products which they recognise as genuinely sustainable. However, this correlation is negatively affected when the customer's concerns on "greenwashing" are considered (Rausch and Kopplin 2021). To avoid the "greenwashed" products, customers look for certifications of authentic sustainable factors. The Green Tick is an example of an eco-label or certificate of sustainability that is independent of any company or supplier (Harris 2007). It provides a level of authenticity and integrity to any product, with transparent scientific evidence and explanation behind the product's sustainability. It is crucial that the elements of sustainability about the product and its production are clearly communicated from the company to the consumers, and this often means through a third independent party. Frequently communicating to consumers an authentic and transparent product that guarantees sustainability outcomes that aligns with consumer values will therefore have a positive impact on their purchase intention.

Therefore, if consumers are frequently exposed to problems of uncomfortable commutes and imminent environmental catastrophe through their everyday routines and media consumption, providing consumers with the solutions to this in our product

and its marketing will have a positive influence on their purchase intention. Thus, it is posited that.

H1: Frequency of problem and solution exposure positively and significantly influences Chinese commuters' purchase intention toward sustainable fashion.

2.3 Price Perception

It is well established that a positive perceived value of a product from an initial customer standpoint will create a high price perception (Winsky 2017). A significant and positive relationship exists between customers' price perceptions and their purchase intentions, and that the formation of price perceptions is significantly influenced by satisfaction with pricing and services (Cooper and Emory 1995). Price transparency was found to be negatively associated with customers' price perceptions. Furthermore, gender, age, and experience of service use were found to explain the differences in customers' perceptions (Goldsmith and Newell 1997). Price has been observed as an important element affecting the diffusion of new products and services, but pricing of a new product or service is particularly difficult (Foxall 1984). For being able to make accurate pricing decisions for new products or services a detailed knowledge of the potential customers' perceptions and characteristics is needed (Engel et al. 1986).

Literature has suggested through different behavioral and psychological theories that consumers' price perceptions are affected by their situational contexts. Specifically, that the information processing behind the decision making of buyers are influenced in varying ways, depending on the context of the purchase (Alexis et al. 1968; Bettman 1970). Adaptation level theory (Helson 1964) describes the ways in which a person's behavioral response is affected by their previous adaptations to past stimuli. It suggests that the way in which our previous experience has adjusted to our context is relevant and informative of our price perceptions. Consumers may find higher prices to be more acceptable given whatever their adapted contexts have implicated for their informational processing (Monroe et al. 1977). Thus, it follows that, when an individual's context has been shaped by a high frequency of exposure to a specific problem, their informational processing, and therefore, their price perception of goods is affected to be more accommodating of higher prices as well.

However, the conclusions of this literature fails to recognise an element of consumer behavior which changes the conclusive findings regarding price perception. Specifically, that the literature does not distinguish between the differences in price perception for a perishable good, as opposed to a non-perishable good. Perishable-goods, such as clothes, pencils or food lose their value over time as they are used, and are not forever-lasting. Therefore, consumers form a concept of expected use when making the decision to purchase a specific perishable good, which they relate with a notion of diminishing value over time. In this situation, when the value of a good is only temporary, there is an expected decrease in price perception. Therefore, it can be hypothesized that, within the context of perishable goods, a consumer's

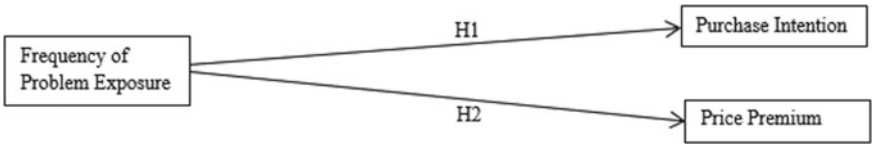


Fig. 1 Research model

frequency of problem exposure can lead to a decrease in price perception. Thus, it is posited that:

> H2: Frequency of problem and solution exposure negatively and significantly influences Chinese commuters' price perception (Fig. 1).

3 Method

3.1 Philosophy

According to the classifications on research philosophy, this research is positivist (Bouma and Ling 2000). A questionnaire was conducted by Questionnaire Star (a questionnaire app in China) in June 2022. The questionnaire conducts 22 questions and is divided into three parts to collect demographic information, purchase intention, as well as price premium willing to pay for sustainable clothes.

3.2 Design

In the first part, information including gender, age, region, occupation and industry, income, commute mode and price of outfits is collected. In addition, a scale question is used to test whether commuters share pain points that could be possibly solved by sustainable commuting outfits. Then, in the second part, commuters are asked to write the percentage they expect to pay above the cost of an equivalent product used exclusively for fitness or work if there exists a garment available on the market that is sustainable. Finally, in the last part, we ask commuters to choose between two types of clothes (one with a certain feature of sustainable textile, one without).

3.3 Subjects

The intended population of this research included commuters in developed regions in China. Due to historical as well as geographical reasons, developed cities including

Shanghai, Guangzhou, Shenzhen and Hong Kong in China are mostly coastal, thus commuters in these regions are more likely to have this kind of pain point mentioned above.

3.4 Sampling

According to the classifications on sampling techniques, this research is probabilistic (Churchill and Iacobucci 2002). A random method was used for sampling. The survey was sent to x# of individuals, from which 295 surveys were returned. Of the 295 responses, 66 of these were eliminated due to incomplete or inconsistent data, leaving 229 survey responses for the analysis.

4 Results

4.1 Demographic Information

Metro Commuters. In this section, men account for 34%, women 66%, and mostly fall into the 18–15 and 26–30 age groups. People with a monthly income of 1,000 to 5,000 accounted for 8.2%, while the number for 5001–10,000 and 10,001 to 15,000 accounts for 62.9% and 20.6% respectively. 86.6% of them are with exercising habits, and the price for their outfits is mostly between 100 and 500 and 500–1000.

Car Commuters. People who drive to work aged mainly between 18 to 25 and 26 to 30, accounted for 14.3% and 72.7% respectively while around 9% are aged 31 to 40. People with a monthly income of 1,000 to 5,000 accounted for 7.8%, while those with a monthly income of 5,001 to 10,000 and 10,001 to 15,000 takes up 41.5% and 28.6%. Over 20% of subjects have an income higher than 15,000. 89.6% of people said they exercise a lot. Over half of car commuters buy clothes from 100 to 1000, while there are 23.6 of them whose cloth takes over 1500 per set.

Bicycle Commuters. 70% of the bicyclers are female. In this session, people are aged mainly from 26 to 30 and with an income between 5000 and 10,000. 82.4% have the habit of fitness. For clothing, 100–500 accounted for 64.3% and 501 to 1000 accounted for 35.7% (Table 1).

Commuting By Walking. 70% of them are female, 40% of them are 18–25 years old and 60% of them are 26–30 years old. Those with a monthly income of 1000–5000 account for 30%, 5001–10,000 for 60%, and 10,001–15,000 for 10 percent. People whose attire takes between 100 to 500 accounted for 18.4%, 50–1000 accounted for 25%, 1001–1500 and more than 1500 both accounted for 8.3%, respectively.

Table 1 Demographic information

Commuting Mode	Metro (n = 97)	Private Car (n = 77)	Bicycle (n = 17)	Walk (n = 20)	Taxi (n = 8)	Others (n = 10)
Gender						
Male	34.0	49.4	29.4	30.0	37.5	40.0
Female	66.0	50.6	70.6	70.0	62.5	60.0
Age (years)						
18 ~ 25	23.7	14.3	17.6	40.0	37.5	10.0
26 ~ 30	73.2	72.7	76.5	60.0	50.0	80.0
31 ~ 40	1.1	9.1	0	0	12.5	10.0
41 ~ 50	2.1	3.9	5.9	0	0	0
51 ~ 60	0	0	0	0	0	0
Income (monthly): CNY						
1000 ~ 5000	8.2	7.8	35.3	30.0	0	30.0
5001 ~ 10,000	62.9	41.5	52.9	60.0	75.0	70.0
10,001 ~ 15,000	20.6	28.6	11.8	10.0	0	0
15,001 ~ 20,000	5.2	15.6	0	0	25.0	0
> 20,000	3.1	6.5	0	0	0	0
Exercise habits						
Yes	86.6	89.6	82.4	60.0	50.0	80.0
No	13.4	10.4	17.6	40.0	50.0	20.0
Price of the outfits (per set)						
100 ~ 500	40.5	42.6	64.3	18.4	50.0	100.0
501 ~ 1000	40.5	27.9	35.7	25.0	50.0	0
1001 ~ 1500	4.7	5.9	0	8.3	0	0
> 1500	14.3	23.6	0	8.3	0	0

Taxi Commuters. In this session, 37.5% of them are male, and 62.5% of them are female. 37.5% are aged between 18 and 25, 50% are aged between 26 and 30, and 12.5% are aged between 31 and 40. Those with a monthly income of 5001–10,000 account for 75%. 15,001–20,000 accounted for 25%. Half of them have exercise habits, while others do not. Clothing prices in 100–500 and 501–1000 groups accounted each for 50%.

Other Commuters. In this session, 5 of them commute by motorcycle, 3 of them take unit shuttle, and 2 of them take bus. 40 of them are male, and most of them are aged between 26 and 30. Those with a monthly income of 1000–5000 account for 30%, and those with a monthly income of 5001 to 1000 account for 70%. 80% of them have exercise habits. All of them buy clothes from 100 to 500 per set (Table 2).

Table 2 Average purchase intention and price perception

Commuting Mode	Frequency of problem exposure (0–10)	Purchase intention (0–10)	Price Premium (%)	Salary (monthly)	Outfit price
Walk	6.7	7.85	28.75	7455	622.08
Metro	6.9	8.7	22.57	10,983.49	918.63
Car	6.7	8.18	41.35	14,858.81	1299.39
Bicycle	8.18	8.24	34.12	7117.65	450.71
Taxi	5.88	6.13	28.75	11,187.5	450
Others	4.99	6.9	32.89	6777.78	323.33
All	6.64	8.27	31.34	11,511.47	967.95

4.2 Frequency of Problem Exposure, Purchase Intention, and Price Premium

In addition, the average frequency of all commuters' problems (e.g. sweat after commuting and feeling uncomfortable, wanting to exercise after work but do not want to bring extra attire to change etc.) exposure is 6.64, ($\mu = 6.64$), ranging from 0 to 10, while their average purchase intention for a certain product to solve these question is 8.27 ($\mu = 8.27$), ranging from 0 to 10. People who cycle to work are exposed to problems most frequently ($\mu = 8.18$), while people who take bus and unit shuttle to work said they do not have these questions that often. Metro commuters are with the highest purchase intention ($\mu = 8.7$). The average price premium for sustainable attire is 31.34% (0–100%), and car commuters are willing to pay more than other commuters. The average income is 11,511.47, and car commuters earn 3,000 more per month. The average outfit per set costs 967.95, while care commuters spend 300 more per set.

From the data gathered, we find that people who cycle to work have the highest exposure score ($\mu = 8.18$), rating from 0 to 10, to the identified problems (e.g. sweat after commuting and feel uncomfortable, want to exercise after work but do not want to bring extra attire to change etc.), while people who take metro to work has the highest purchase intention ($\mu = 8.7$) followed by people who cycles ($\mu = 8.24$), rating from 0 to 10. This might be affected by their commuting mode, as people who commute by metro or bicycle normally need to walk a few miles from the metro station or cycle from home to the office building (compared with car/taxi commuters). However, people who walk to work are with an exposure score and the purchase intention score of 6.7 and 7.85 respectively, lower than metro and bicycle commuters. This could be explained by the distance as they normally live closer to the station and thus are with a shorter commuting time (Rastogi and Krishna Rao 2003).

In addition, we found that the average premium price that Chinese commuters are willing to pay for sustainable clothes ($\mu = 31.3$) is higher than the world level (μ

= 25.7) (Smith 2022). This indicates that Chinese commuters in developed regions are more attracted by this kind of attire and with a relatively higher price perception level. Moreover, we also found that people who drive to work have the highest price premium ($\mu = 41.35$) among the commuters. In this case, it is mainly affected by their income level. With the highest average income ($\mu = 14{,}858.81$), their price premium is higher than the other groups (Wei et al. 2014).

5 Discussions

To analyze our hypothesis, linear regression is used. The first hypothesis explains the impact of frequency of problem exposure on Chinese commuters' purchase intention for sustainable clothes. The fitted regression model was: Purchase Intention = 5.214 + 0.46 Frequency. The overall regression was statistically significant (= 0.233, $F(1227) = 68.8$, $p < 0.000$). It was found that the frequency of problem exposure positively and significantly predicted purchase intention ($\beta = 5.214, p < 0.000$) (Table 3).

The Second hypothesis explains the impact of frequency of problem exposure on Chinese commuters' price premium on sustainable clothes. The fitted regression model was: Price Premium = 43.514–1.832 Frequency. The overall regression was statistically significant (=0.02, F (1227) = 3.96, p = 0.048). It was found that the frequency of problem exposure negatively and significantly predicted Chinese commuters' price premium on sustainable clothes ($\beta = 43.514$, p = 0.048) (Table 4).

Following Winsky (2017) in the literature review, a positive perceived value pf a product creates a high price perception. We found that Chinese commuters show great interests in sustainable attires and are willing to pay a premium 10% higher than the world average level. With a growing frequency of problem exposure, Chineses commuters are showing a increasing pruchase intention. However, we also find that the premium price that Chinese commuters willing to pay is also affected by their frequency of problem exposure. As the frequency of problem exposure goes up,

Table 3 Leaner regression purchase intention

Purchase intention	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf	Interval]	Sig.
Frequency	0.460	0.055	8.29	0.00	0.351	0.570	***
Constant	5.214	0.385	13.54	0.00	4.455	5.973	***
Mean dependent var	8.271		SD dependent var		1.930		
R-squared	0.233		Number of obs		229		
F-test	68.800		Prob > F		0.000		
Akaike crit. (AIC)	893.375		Bayesian crit. (BIC)		900.242		

***$p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4 Leaner regression price premium

Price premium	Coef.	St.Err.	*t*-value	*p*-value	[95% Conf	Interval]	Sig.
Frequency	− 1.832	0.920	− 1.99	0.048	− 3.645	− 0.019	**
Constant	43.514	6.388	6.81	0.00	30.927	56.101	***
Mean dependent var	31.345		SD dependent var		28.284		
R-squared	0.017		Number of obs		229		
F-test	3.964		Prob > F		0.048		
Akaike crit. (AIC)	2179.673		Bayesian crit. (BIC)		2186.540		

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

commuters' purchase intention for sustainable clothes that solves their problem rises while the premium amount they are willing to pay reduces.

6 Conclusion

In summary, this paper used linear regression to test the impact frequency of problem exposure has on commuters' purchase intention as well as price premium for sustainable clothes in Chinese developed cities. Sustainable clothes are clothes made from reusable materials, and many of them are proven to be more effective in sweat absorption as well as body odour control. We found that the frequency of problem exposure positively and significantly predicted Chinese commuters' purchase intention to sustainable attires, while it negatively and significantly predicted their price premium. As the frequency of problem exposure goes up, commuters' purchase intention for sustainable clothes that solves their problem rises while the premium amount they are willing to pay reduces.

Meanwhile, the results also indicate that there exist sweating as well as body odour controlling problems for commuters in developed cities in China that are desperate to be solved. Most Chinese commuters in these regions are interested in sustainable clothes and are willing to pay a sizable premium price.

However, the sample proportion of different types of commuters is imbalanced. Data collected is mainly from Metro commuters as well as car commuters. For further studies, we suggest that the purchase intention and price premium for sustainable attires of commuters be further explored based on various commuting modes. In addition, in this research, we have more female subjects than males. It is also suggested for the following research to study gender impact on commuters' purchase intention and premium price of sustainable attires.

References

Alexis M, Haines GH, Simon L (1968) Consumer information processing: the case of women's clothing, American marketing association. In: Proceedings of Fall Conference, pp 197–205

Baltas G, Argouslidis PC (2007) Consumer characteristics and demand for store brands. Int J Retail Distrib Manage 35(5):328–341

Bettman JR (1970) Information processing models of consumer behavior. J Mark Res 7:370–376

Bouma GD, Ling R (2000) The research process (5th ed). Oxford University Press

Cafe S (2022) S.Cafe fabric function. S.Café®- about S.Café®. Retrieved 18 June 2022, from https://scafefabrics.com/en-global/about/particular

Calvo-Porral C, Lévy-Mangin J-P (2017) Store brands' purchase intention: examining the role of perceived quality. Eur Res Manag Bus Econ 23(2):90–95. https://doi.org/10.1016/j.iedeen.2016.10.001

Churchill GA, Iacobucci D (2002) Marketing research: methodological foundations. Harcourt College

Cooper D, Emory W (1995) Business research methods, Richard D. Irwin, Inc., Chicago, IL

Engel JF, Blackwell R, Miniard PW (1986) Consumer Behavior, 5th edn. The Dryden Press, New York, NY

Foxall G (1984) Corporate innovation: marketing and strategy. St Martin's Press, New York, NY

Ghosh A (1990) Retail management. Dryden press

Goldsmith RE, Newell SJ (1997) Innovativeness and price sensitivity: managerial, theoretical and methodological issues. J Product Brand Manage 6(3):163–174

Harris SM (2007) Does sustainability sell? Market responses to sustainability certification. Manag Environ Qual 18(1):50–60. https://doi.org/10.1108/14777830710717712

Helson H (1964) Adaptation-Level Theory. Harper Row, New York

Kim S, Ulfarsson GF (2008) Curbing automobile use for sustainable trans-portation: analysis of mode choice on short home-based trips. Transportation 35(6):723–737. https://doi.org/10.1007/s11116-008-9177-5

Lerpiniere C (2020) Value definition in sustainable (textiles) production and con-sumption. Palgrave Stud Bus Arts Humanit 85–107.https://doi.org/10.1007/978-3-030-37035-0_5

Lowe P, Morrison D (1984) Bad news or good news: environmental politics and mass media. Sociol Rev 32:75–90

Lowe PD, Rudig W (1987) Review article: political ecology and the social science—the state of art. Br J Polit Sci 16:513–550

Monroe KB, Della Bitta AJ, Downey SL (1977) Contextual influences on subjective price perceptions. J Bus Res 5(4):277–291.https://doi.org/10.1016/0148-2963(77)90016-9

Nurul Habib KM, Day N, Miller EJ (2009) An investigation of commuting trip timing and mode choice in the Greater Toronto Area: application of a joint discrete-continuous model. Transp Res Part A: Policy Pract 43(7):639–653. https://doi.org/10.1016/j.tra.2009.05.001

Ottman J (1993) Green marketing: challenges and opportunities for the new marketing age. NTC Business Books, Lincolnwood, Illinois

Polonsky MJ (1994) Green marketing regulation in the US and Australia: The Australian Checklist. Greener Manag Int 5:44–53

Rastogi R, Krishna Rao KV (2003) Travel characteristics of commuters ac-cessing transit: case study. J Transp Eng 129(6):684–694. https://doi.org/10.1061/(asce)0733-947x(2003)129:6(684)

Rausch TM, Kopplin CS (2021) Bridge the gap: consumers' purchase intention and behavior regarding sustainable clothing. J Clean Prod 278:123882. https://doi.org/10.1016/j.jclepro.2020.123882

Shah H, Aziz A, Jaffari AR, Waris S, Ejaz W, Fatima M, Sherazi K (2012) The impact of brands on consumer purchase intentions. Asian J Bus Manage 4(2):105–110

Slotta D (2021) China: Ideal future work environments 2021. Statista. Retrieved 18 June 2022, from https://www.statista.com/statistics/1235093/china-ideal-future-work-environments/

Smith P (2022) Premium consumers willing to pay for sustainable fashion products worldwide 2018. Statista. Retrieved 17 June 2022, from https://www.statista.com/statistics/1010137/premium-consumers-willing-to-pay-for-sustainable-fashion-products-by-amount-worldwide/

Wei C-F, Lee BCY, Kou T-C, Wu C-K (2014) Green marketing: the roles of appeal type and price level. Adv Manage Appl Econ 4

Winsky G (2017) Customer perceived values, understanding what appeals to the customer. Customer Happiness. https://aircall.io/blog/customer-happiness/customer-perceived-val-ue/#:~:text=When%20comparing%20the%20difference%20between,perceived%20value%20of%20their%20product

Zielske HA (1959) The remembering and forgetting of advertising. J Mark 23(1):239–243

The Relationship Between GDP Growth Rate and Stock Market During the Two Epidemic Outbreaks in China

Yuning Zhang

Abstract China's economy and stock market face great uncertainty amid the COVID-19 pandemic. There is a different relationship between China's stock market and the GDP growth rate during the two epidemic periods. In this paper, CSI 300 Index was used as the sample by comparative analysis method to collect data from the National Bureau of Statistics and The China Securities Index. This paper aims to analyze the relationship between GDP growth rate and CSI 300 Index during the two epidemic periods. The analysis results indicate that GDP growth rate and CSI 300 change in the same direction during 2020, while CSI 300 Index and GDP growth rate change in the opposite direction during 2022. The exceptional performance of the CSI 300 Index may be due to the synergies of the Russia-Ukraine conflict, the Fed's interest hike expectations, and the recession in China's real estate sector. The conclusions of this paper may inspire a new relationship between China's GDP growth rate and the stock market.

Keywords COVID-19 · GDP growth rate · CSI 300 Index

1 Introduction

1.1 Background

Since the beginning of 2020, the massive outbreak of COVID-19 has brought uncertainty to the global financial system. China experienced a second major outbreak of COVID-19 in 2022 after the first in early 2020. During the first outbreak of the epidemic in 2020, China reported a rare negative GDP growth, and the stock market, as an embodiment of economic development, also experienced a significant decline and fluctuation. China reported positive GDP growth despite being struck during the

Y. Zhang (✉)
UNSW Business School, University of New South Wales, Sydney 1466, Australia
e-mail: z5247363@ad.unsw.edu.au

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_123

second outbreak of COVID-19 in 2022. According to experience, the stock market should also show slight growth, but the stock market showed a downtrend on the contrary. This paper intends to explore the reasons for the disharmony between China's GDP growth rate and the stock market during the second epidemic.

1.2 Related Research

Habibi et al. study fill in the gaps in the impact of COVID-19 on China's economic growth. This study mainly uses statistical methods and collected WHO, World Development Indicators (WDI), and China's economic data to analyze the relationship between the epidemic and China's economy. The results show that China's economy reported a rare negative growth in the first quarter of 2020. However, after the outbreak subsided, China's economy showed explosive growth, with the GDP growth rate exceeding before the outbreak in 2019. China's GDP growth rate is expected to slow gradually as the retaliatory growth fades. This study shows the relationship between the first outbreak of COVID-19 in 2020 and GDP growth and supports the study of China's stock market's response to the outbreak of COVID-19 (Habibi et al. 2022). Khan et al. Studied the dynamic interaction between economic indicators and Chinese stock market returns. Khan et al. research mainly include CPI, interest rate, Exchange Rate, and Shanghai Stock Exchange Composite Index. The Autoregressive Distributed lag (ARDL) approach was used to ensure the reliability of the results. Short and long-term ARDL results show that China's stock market returns are closely correlated with fluctuations in economic factors. Usually, exchange rates and inflation are positively correlated with stock market returns. Interest rates are negatively correlated with stock market returns. This study provides evidence for the correlation between China's stock market returns and economic factors. It also provides a theoretical basis for studying the relationship between China's GDP growth rate and CSI 300 index (Khan et al. 2017). Wang et al research explored the response of The Chinese stock market to supply chain disruptions caused by the epidemic. The paper adopted the Event Study Method (ESM). Collected data from 406 listed companies and 99 companies with an enormous scale in the Transportation and Retail Industries were selected as supplementary samples. The findings of this paper show that supply chain disruptions caused by the pandemic hurt China's stock markets. However, the degree of impact by the location of the enterprise and the industry is also differentiated. In summary, apart from the medical industry, almost all enterprises are negatively affected, with the transportation industry bearing the brunt. In addition, in terms of regional differences, the closer to the outbreak center, the more severely affected enterprises are. The finding reveals an underline relationship between China's supply chain and the stock market performance (Wang et al. 2022).

Rababah et al. study further analyzed the impact of the COVID-19 pandemic on Chinese listed companies. Using pooled Ordinary Least Square (OLS) Regression as the benchmark, this study shows that small and medium-sized enterprises are most affected by COVID-19. In addition, the more severely affected the region is,

the more significant the decline in performance. This result is consistent with other similar studies, which provide a complete picture of the impact of COVID-19 on China's stock market (Rababah et al. 2020). Guo et al. research fill the gap in the research on the relationship between Market sentiment and stock price in China. By collecting user comments on Xueqiu, a Chinese investor community, this paper uses semantic analysis to measure investors' sentiment towards different stocks. Then, the Thermal Optimal Path (TOP) method analyzes the relationship between the stock market and sentiment. According to the analysis of TOP results, investor sentiment is correlated with stock prices but does not always dominate stock prices. Only when the stock market's attention is at a high level, and the sample of investor sentiment has a certain universality and representativeness. Investor sentiment can have a maximum effect on the stock price. This study provides support for analyzing the impact of the pandemic on China's stock market. The COVID-19 outbreak has caused investors to increase their attention to the stock market. Therefore, the impact of the sentiment factor has indicator significance (Guo et al. 2017).

Wang and Liu examined the relationship between the COVID-19 pandemic and China's stock market. Fundamental factors, psychological factors, and industrial factors were analyzed. In order to better explore the impact of the epidemic, this paper selected the data from February 3–25, 2020, and adopted quantitative methods to analyze these data. The results reveal the impact of the COVID-19 outbreak on China's stock market and spreading panic and increasing volatility in the Chinese stock market. In addition, the Chinese stock market is overreacting to the COVID-19 outbreak (black swan events). The study further broadens the understanding of the impact of the COVID-19 pandemic on China's stock market in 2020 and provides psychological research (Wang and Liu 2022). Dash and Maitra's study analyzed the impact of the pandemic on stock markets by examining daily data on stock markets in G7 countries and world equity markets. The study expands the understanding of the impact of the pandemic on stock market behavior in two aspects. The first is whether there are co-movements and lead-lag relationships between fear sentiment and pandemic uncertainty. Second, after controlling fear, whether a pandemic's uncertainty will still affect the four aspects of stock market behavior (return, volatility, liquidity, and illiquidity). Dash and Maitra adopted wavelet-based time–frequency analysis, which can be used to analyze the problem comprehensively. The results shows that the pandemic accelerated the spread of fear worldwide. There is a time-varying lead-lag relationship between pandemic uncertainties. In addition, the pandemic still impacts stock markets when the fear sentiment is controlled. The study inspires studying the impact of the epidemic on the stock market. Even after the pandemic, the pandemic will continue spread fear in the stock market and influence stock market behavior (Dash and Maitra 2022).

1.3 Objective

This paper intends to analyze the relationship between China's GDP growth rate and CSI 300 Index by collating data from the two epidemic outbreak periods in 2020 and 2022. Furthermore, find out the difference between the two time periods and the possible reasons. Section 1 includes an introduction, related research, and objective. Section 2 contains data and methods. Results will be illustrated in Sect. 3 and discussed in Sect. 4. Finally, Sect. 5 will summarize.

2 Data and Method

2.1 Sample Selection

The CSI 300 index was chosen as a sample. The CSI 300 index combines 300 securities with large-scale and superior liquidity in the Shanghai Stock Exchange and Shenzhen Stock Exchange (CHINA SECURITIES INDEX). The calculation formula is as follows (Exchange 2022):

$$\begin{aligned}\text{CSI 300 INDEX} = &(\text{adjusted market capitalization of the constituents} \\ &\text{in the reportingperiod/base period}) * 1000 \end{aligned} \tag{1}$$

$$\text{adjusted market capitalization} = \sum (\text{stock price} * \text{adjusted issued shares}) \tag{2}$$

The portfolio of 300 securities is adjusted semiannually. Each adjustment proportion is less than 10%. The index was officially released on April 8, 2005. Due to the long existence and wide range of sample selection. CSI 300 index is representative of the overall Chinese stock market.

In order to better explore the impact of the pandemic on China's stock market, the research periods are respectively selected as the first quarter of 2020 and 2022. According to the WHO statistics, the two major outbreaks in China occurred in the first quarter of these two years (World Health Organization 2022). In addition, some Chinese economic statistics are released quarterly. Using the first quarter as the analysis interval can better match the corresponding data.

2.2 Methodology

This paper analyzes the relationship between GDP growth rate and CSI 300 Index during two pandemic periods in 2020 and 2022. Through comparative analysis, the

paper analyzes the performance of China's stock market in the face of the second wave of the pandemic.

3 Results

The following table shows China's sequential and year-on-year GDP growth rates in the first quarter of 2020 and 2022. Details of the CSI 300 Index from January to the end of March (1st quarter), as well as absolute and percentage changes.

Table 1 illustrates China's GDP's sequential and year-on-year growth rate in the first quarter of 2020 and 2022. There is significant negative growth in 2020, while in 2022 is not.

Figures 1 and 2 show the trend and changes in the CSI 300 Index in the first quarter of 2020. The CSI 300 Index dropped slightly at the beginning of the outbreak. However, with the beginning of the nationwide lockdown. The CSI 300 index dropped significantly. The decline gradually recovered with the gradual easing of the epidemic.

Figures 3 and 4 show the trend and changes of the CSI 300 Index in the first quarter of 2022. During the first quarter of 2022, the CSI 300 index showed a stable downward trend without significant fluctuations.

Table 1 GDP growth rate

The year-on-year GDP growth rate	
2020 Q1	2022 Q1
− 6.90%	4.80%
The sequential growth rate of GDP	
2020 Q1	2022 Q1
-10.30%	1.30%

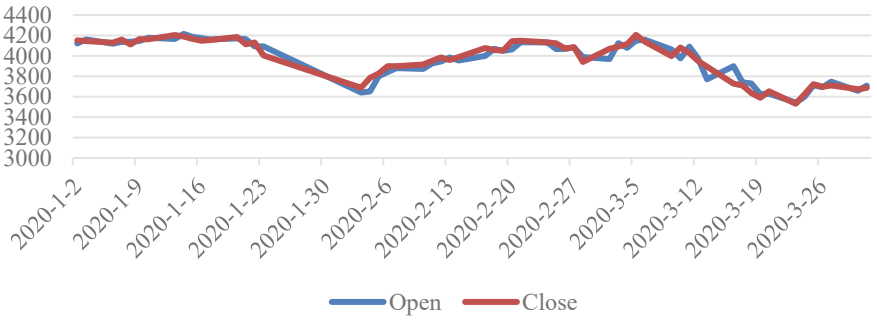


Fig. 1 The open and close prices of 2020 Q1 CSI 300 index data

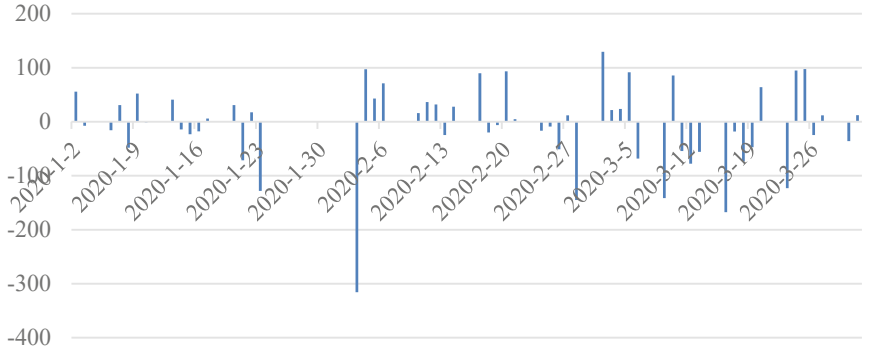


Fig. 2 The daily change of 2020 Q1 CSI 300 index data

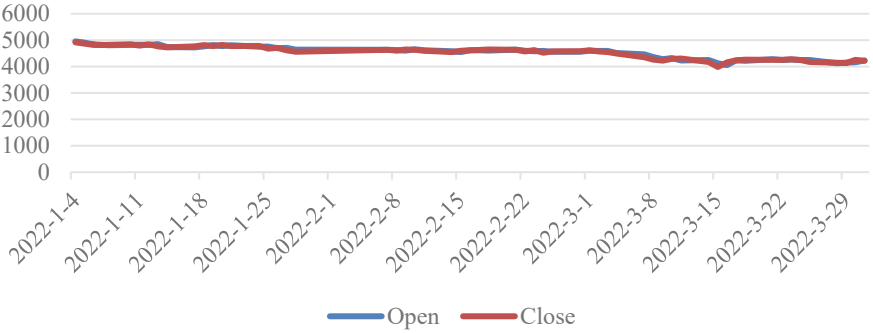


Fig. 3 The open and close prices of 2022 Q1 CSI 300 index data

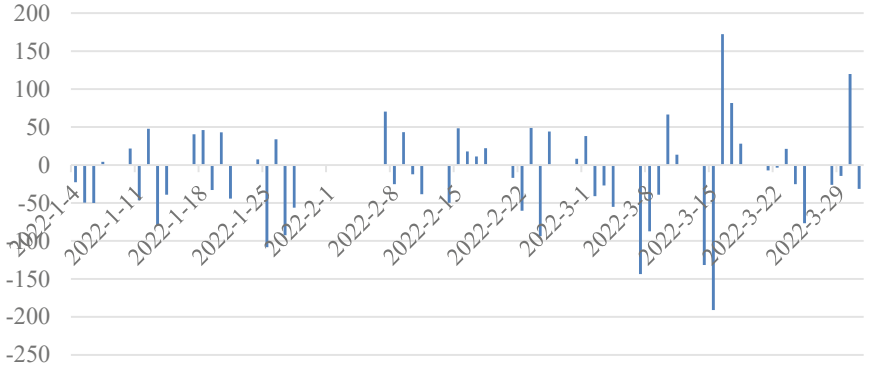


Fig. 4 The daily change of 2020 Q1 CSI 300 index data

4 Discussion

The data from Table 1, Figs. 1 and 2 illustrate the relationship between China's GDP growth rate and the CSI 300 Index during quarter 1 of 2020. In this quarter, China reported rare negative GDP growth of − 6.9% on a year-on-year basis and -10.3% on a sequential basis. Correspondingly, CSI 300 index also appeared to have a significant drop and shock. Since China discloses GDP growth data quarterly, studying the relationship between GDP growth and CSI 300 Index day-to-day variation is challenging. The problem can be inferred indirectly through the transmission relationship between epidemic and economic factors and between the economy and the stock market. The transmission mechanism of the impact of the epidemic on the economy is the isolation or closure policies issued by the local governments for the prevention and control of the epidemic will significantly weaken logistics and production activities, and the reduction of these activities will directly lead to the contraction of economic development (Khan et al. 2017; Wang et al. 2022). The transmission mechanism of the economy to the stock market mainly reflects that stock price can be used as an economic indicator. The transmission mechanism of the economy to the stock market mainly reflects that stock price can be used as an economic indicator. There are two primary sources. First, the stock price is directly related to an enterprise's profitability, while an enterprise's profitability is linked to the economy. Second, stock prices are affected by market sentiment, and pessimism spreads through the market as the economy fluctuates (Guo et al. 2017; Wang and Liu 2022; Dash and Maitra 2022). According to the figures released by the WHO (World Health Organization 2022), the Chinese outbreaks in early February ushered in explosive growth. At the same time, a nationwide lockdown policy has also begun. In response, the CSI 300 index fell sharply at the same time and fluctuated to a significant extent with the development of the epidemic (Habibi et al. 2022). The relationship between epidemic development, GDP growth rate, and CSI 300 index during the first quarter of 2020 confirms other literature's conclusions (Rababah et al. 2020; Wang and Liu 2022).

The data in Table 1, Figs. 3 and 4 show the GDP growth rate and CSI 300 index in the first quarter of 2022 during the second major outbreak in China. Although China was affected by the epidemic and nationwide lockdown, the GDP growth rate is still reported as positive. The reason for positive GDP growth despite the outbreak may be that this is the second time China has faced a significant outbreak, and enterprises are more experienced and prepared to deal with the outbreak. Unlike 2020, the CSI 300 Index in 2022 quarter one did not follow the GDP growth rate. It showed a gradual downward trend (Fig. 3). The perverse pattern contradicts the theory that China's stock prices are the leading economic growth indicator (Liu and Cinclair 2008). There are three possible reasons for the abnormal performance of the CSI 300 Index. From the external environment perspective, there are two main reasons for the continuous decline market: the War between Russia and Ukraine and the Interest rate hike by the Federal Reserve. From the internal environment, it is the slowdown of China's economic development, mainly reflected in the real estate industry.

The Russia-Ukraine conflict in early 2022 is undoubtedly a black swan event. The outbreak of war brought great uncertainty to global financial markets. According to Schneider and Troeger, international markets generally react negatively to war and are hit differently depending on their region and political environment (Schneider and Troeger 2006). Furthermore, Yousaf et al. research shows that the conflict was severe for countries in Eurasia (Yousaf et al. 2022). The black swan events spread pessimism to the Chinese stock market at a time when it is sensitive to the outbreak of COVID-19.

U.S. economic indicators have acted as leading indicators for The Chinese stock market (Goh et al. 2013). Figure 5 illustrates the trend of the S&P 500 in 2020 Q1. The S&P Index and CSI 300 Index almost simultaneously entered a period of decline. The performance of the two indexes demonstrates the link between the U.S. and Chinese stock markets. In 2022, the Federal Reserve repeatedly released interest rate hike expectations to control inflation in the United States. Expectations of a rate rise have dramatically affected the U.S. stock market. The Fed's rate hike reduces the flow of hot money into the market, which reduces investment in the stock market. In addition, the interest rate hike has caused companies to shrink their balance sheets, affecting their stock prices.

Figure 6 shows the price changes of the U.S. S&P 500 Index in the first quarter of 2022, The drastic fluctuations of the U.S. stock market are apparent. The volatility of the U.S. stock market will transmit to the Chinese stock market and cause volatility.

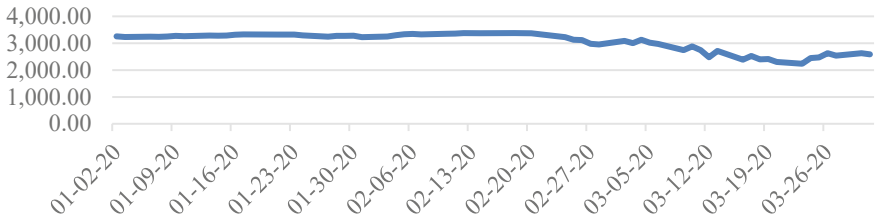


Fig. 5 The prices of 2020 Q1 S&P 500 index data

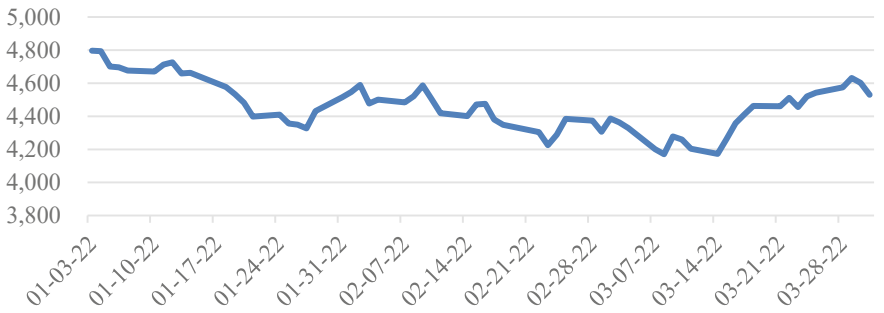


Fig. 6 The prices of 2022 Q1 S&P 500 index data

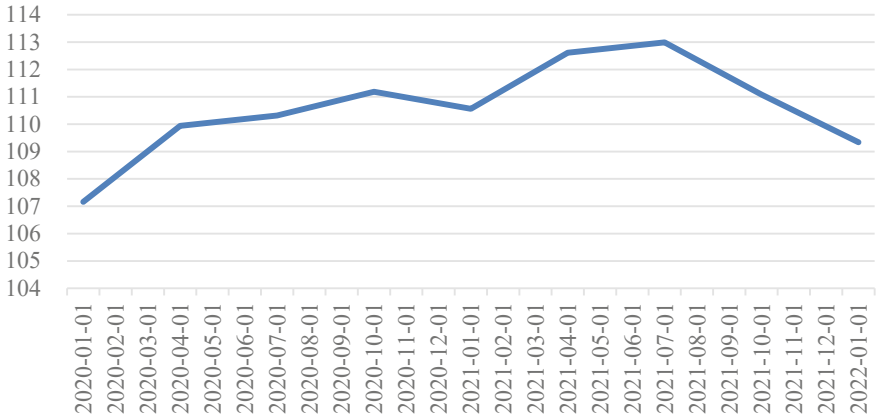


Fig. 7 2022 Real residential property prices for China

From the perspective of China's domestic economic development, China's economic development has also encountered difficulties. Most prominent in 2022 are the difficulties faced by China's property sector. Real estate has played a crucial role in China's economy since 2008. China has been able to drive the development of hundreds of property-related upstream and downstream industries by developing of the real estate business. Much of China's growth over the past decade has been driven by real estate.

Moreover, the relationship between the real estate market and the stock market in China tends to be integrated, and the real estate market takes the lead over the stock market in some cases (Gao et al. 2012). China's property and stock markets tend to move constantly (Burdekin and Tao 2014). By 2022, China's real estate bubble has reached a hazardous level, and the Chinese government has issued policies to restrain the development of the real estate bubble. However, as Evergrande defaulted on its two trillion-yuan debt, China's domestic real estate crisis began to emerge.

Figure 7 shows Real Residential Property Prices for China. China's housing price has entered a turning point after July 2021. This turning point signals a downturn in the property sector, and it is logical that China's stock market, which is binding to real estate, should fall.

5 Conclusion

This paper summarizes and compares the relationship between China's GDP growth rate and CSI 300 index in the first quarter of 2020 and the first quarter of 2022 during the two large-scale epidemics in China. Based on the data released by the National Bureau of Statistics of China and the China Securities Exchange Index, we summarized the growth rate of China's economy and the trend of the CSI 300

index in two periods. By comparison, the outbreak of COVID-19 in 2020 hit China's GDP growth rate, and China once reported a rare negative growth rate. The CSI 300 index also fell in line with the economic situation. In 2022, the epidemic also brought a blow to China's GDP growth, but China still reported growth, but the CSI 300 index did not show consistency with THE GDP growth rate but showed a long-term downward trend. This paper puts forward three factors that may explain the abnormal performance of the CSI 300 Index: the interest rate hike expectation of the Federal Reserve, the conflict between Russia and Ukraine, and the Chinese real estate market. This paper explains the relationship between China's GDP growth rate and the CSI 300 index in the first quarter of 2022, when China is facing the second outbreak. China managed to report positive GDP growth during the second outbreak in 2022. However, the stock market has not kept pace with GDP as usual. The results indicate a possible new relationship between China's GDP growth rate and the stock market, which the correlation between GDP growth rate and CSI 300 Index gradually weakened.

References

Burdekin RCK, Tao R (2014) Chinese Real Estate Market Performance. Chinese Economy 47(2):5–26

Dash SR, Maitra D (2022) The COVID-19 pandemic uncertainty, investor sentiment, and global equity markets: Evidence from the time-frequency co-movements. The North American Journal of Economics and Finance 62:101712

China Financial Futures Exchange, http://www.cffex.com.cn/en_new/zswd/20101124/15110.html. Lasted accessed 13 July 2022

Gao S, Liu J, Gu AY (2012) The relationship between Chinese real estate market and stock market. J Int Bus Res 11(1):73–79

Goh JC, Jiang J, Wang Y (2013) Can US Economic Variables Predict the Chinese Stock Market? Pac Basin Financ J 22:69–87

Guo K, Sun Y, Qian X (2017) Can investor sentiment be used to predict the stock price? Dynamic Analysis Based on China Stock Market, Physica a: Statistical Mechanics and Its Applications 469:390–396

Habibi Z, Habibi H, Mohammadi MA (2022) The potential impact of COVID-19 on the Chinese GDP. Trade, and Economy, Economies 10(4):73

Khan MK, Jian T, Parviaz J, Chaudhary SK (2017) Nexuses between economic factors and stock returns in China. Int J Econ Financ 9(9):182–191

Liu X, Cinclair P (2008) Does the linkage between stock market performance and economic growth vary across Greater China? Appl Econ Lett 15(7):505–508

Rababah A, Haddad LA, Sial MS, Zheng C, Cherian J (2020) Analyzing the effects of COVID-19 pandemic on the financial performance of Chinese listed companies. Public Affairs 20(4)

Schneider G, Troeger VE (2006) War and the World Economy: Stock Market Reactions to International Conflicts. The Journal of Conflict Resolution 50(5):623–645

Wang Q, Liu L (2022) Pandemic or panic? A firm-level study on the psychological and industrial impacts of COVID-19 on the Chinese stock market. Financial Innovation 8(1):36

Wang Z, Dong Y, Liu A (2022) How does China's stock market react to supply chain disruptions from COVID-19? Int Rev Financ Anal 82:102168
World Health Organization, https://covid19.who.int/region/wpro/country/cn. Lasted accessed 13 July 2022
Yousaf I, Patel R, Yarovava L (2022) The reaction of G20+ stock markets to the Russia-Ukraine conflict 'Black-Swan' event: evidence from event study approach

The Situation, Problems and Solutions to Chinese Banking

Jiayue Tang

Abstract Under the background of economic and financial liberalization, integration and globalization, it is of great theoretical and practical significance to study the current situation and problems of Chinese banks. Based on the development history and current situation of China's banks, this paper analyzes the current supervision and summarizes the problems. Finally, the paper puts forward effective countermeasures to improve the security and efficiency of China's banking system.

Keywords Bank · China · Supervision

1 Introduction

With the rapid development of the financial market, competition is increasingly fierce, and the risk is obviously great. Banks play an important role in the whole financial market. In China, banking assets account for more than 90% of the total financial assets, and economic growth largely depends on the steady operation of banks, and thus the security of the banking system ensures the market security of a country. In addition, under the background of opening to the foreign banks, China is gradually moving from separate business to financial mixed business operation, during which bank risks will accumulate. The average efficiency of Chinese banks is only 63%, lower than the 80% of US banks, saying that despite years of reform, Chinese banks are still largely subject to intervention and control (Yao et al. 2011). Therefore, an in-depth study of the current situation and problems of Chinese banks can improve the operation efficiency of banks in the future, ensure that supervision is in place and can avoid bank risks, reaching the goal of safety and efficiency.

J. Tang (✉)
The Central University of Finance and Economics, Changping District, China
e-mail: 2019311185@email.cufe.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_124

2 Current Situation

2.1 The Banking System

The history of banking in China can be traced back to the Yan an's period. Nowadays, China's modern banking system consists of the People's Bank of China (PBC), China Banking and Insurance Regulatory Commission, policy banks and commercial banks, and the commercial banks can be divided into multiple types, including five state-owned banks, Postal Savings Bank of China, credit cooperatives and etc. The large commercial banks account for the largest proportion of the whole assets for banking system, as the main body of the banking industry, commercial banks are the main source of income of the banking industry.

The total assets of China's banking industry are steadily increasing, and the size of the banking market is constantly expanding. According to the announcement of the People's Bank of China, in 2021, the total assets of Chinese banking system reached 344.76 trillion yuan, an increase of 7.8%; the total debt was 315.28 trillion yuan, up 7.6 percent (Homepage 2022). Overall, China's commercial banks have seen steady growth in their net profit, but in 2020, their income declined due to the impact of the epidemic, and the annual average non-performing loan ratio has been less than 2% in recent years, which shows a steady and safe situation in loans.

Apart from that, Chinese banking system is affected by the supply of money and the scale of social financing. Firstly, In the contemporary era, China's monetary aggregate has been on a steady upward trend. The People's Bank of China has used monetary tools to maintain reasonable and abundant liquidity and enhance the stability of credit aggregate growth. In 2021, China's money and M2 supply reached to 238.300 trillion yuan, an increase of 8.97% compared with 2020 (http://m.sinotf.com/News/index/id/356113.html). Ensuring fund liquidity is an important prerequisite for the development of the banking industry. Secondly, the scale of social financing in China is increasing year by year. Financial institutions issue more loans, government bonds are gradually increasing, bank acceptance bill transactions are increasing, and the banking industry is more flexible in capital operation.

2.2 Digital Transformation of Banks

Since the popularization of electronic computer applications, the banking industry has never stopped the construction of digital capacity, so digitalization is one of the most important genes of the banking industry. Over the years, with the progress of science and technology, the change in the business environment and the upgrading of customers' demands, the banking industry has constantly promoted the expansion of digital boundaries. From the earliest electronic business operation, to the later informationization of the management process, and to the mobile customer interaction in

recent years, the definition of digitalization is continuously expanding and stepping into a new stage of comprehensive digitalization of operation.

At present, forced by COVID-19, the digital transformation of Chinese commercial banks is accelerating, and more and more commercial banks are using fintech to reshape the banking system. Large commercial banks, including state-owned banks and national joint-stock commercial banks, rely on their own resources to reshape the technological structure and layout of digital finance. Small and medium-sized banks depend on technology companies or cooperate with large commercial banks to achieve digital transformation from differentiation and localization. Technology and finance have shifted from complementing each other to deep integration, extending from financial services to non-financial services, and creating a diversified financial ecosystem covering production and life to build core competitiveness in the digital era. It is clear that since 2020, China's banking industry continues to increase investment in fintech. The proportion of fintech income of large commercial banks in revenue is generally between 2.7 and 3.15%, even some banks have invested nearly 100 billion yuan in technology. In this way, banks use data to gain insight into customer needs, because it is strategically important for the industry to provide quality services and products to customers with their needs. At the same time, digital transformation can effectively resist the impact of emerging technology enterprises. It can be seen that the internet enterprises represented by mobile payment provide consumers with convenient financial services by virtue of their own advantages, has caused an impact on traditional banking institutions. With digital transformation, banking institutions can reshape their business processes and offer consumers more digital products and financial services.

2.3 Literature Review of Chinese Banking

Undoubtedly, there are many scholars who have examined the system and situations of Chinese banking. Du introduced western institutional theory into financial history for the first time in the Comparison of Two Financial Systems in Modern China and proposed two financial systems seen a free-market system and a monopoly system. He believed that China used a free-market financial system before 1927, and a state monopoly financial system after 1927 (Du 2000). Based on data from the annual reports of 157 commercial banks from 2010 to 2018, Wang and Xie found that the development of digital finance can promote the management innovation and product innovation of banks (Wang and Xuan 2021). Liu pointed out that credit risk is the main risk faced by China's commercial banks. At present, domestic commercial banks need to formulate forward-looking development strategies according to the regulatory requirements and trends of Basel III to guide the reform and construction of banks (Liu 2012). Li and Tian believed that China's financial regulatory system has blind spots in the supervision of non-bank financial institutions, products and credit derivatives market, and these problems need to be quantified (Li and Tian 2011). Ma believed that bad loans of Chinese banks are an important problem, and

the reasons can be divided into macro and micro aspects. At the macro level, China's special economic system and supervision system are not perfect, which contributes to non-performing loans. On the micro-level, the weak risk awareness and imperfect incentive system of commercial banks directly affect the production of bad loans (Ma 2015). Wang reckoned that there is a certain gap between China's commercial banks and international standards in information disclosure, which is manifested in untruthful information disclosure, non-standard information disclosure, and the lack of specific norms for information disclosure (Wang 2002).

To sum up, currently, there exist certain deficiencies in the Chinese banking system as shown above, including the credit risk, the degree of disclosure, supervision and bad loans that need to be comprehensively considered to guarantee a safe and steady banking system, and thus it is essential to come up with effective solutions from these aspects.

3 Problems

Although the Chinese government has made some achievements in the supervision of banks, with the deepening of the reform of China's financial system, the expansion of financial opening to the world and the popularity of online banking, banks are faced with more risks in the development process, and the supervision is not yet able to fully achieve the expected goal. It can be seen that the bad loans and corruption in the banks continue to affect the safety of the entire banking system.

3.1 The Coverage of Supervision Policy

It is known that people will use some indicators to examine the risk of banks to supervise, including credit risk indicators, liquidity indicators, efficiency indicators, capital adequacy indicators and market indicators, but with the expansion of business scope and business types of commercial banks, some indicators cannot fully reflect the operation of banks. For example, the non-interest income of banks is summarized in the efficiency index, but the non-interest income cannot fully represent the income of the intermediary business, so the blind spot in supervision leads to some illegal behaviors in the intermediary business of commercial banks, such as arbitrary pricing and unreasonable charges. In addition, the head office has the pricing power, and the charging standard only needs to be reported to the CBRC, which does not conduct supervision and examination on cost and other factors, so the charges for intermediary businesses are unknown.

Apart from that, there is insufficient emphasis on the market exit mechanism for banks, but this aspect is important for the stability of financial markets. Central bank market regulation of commercial Banks has the effect of dissolving the bank risk the last line of defense, as sometimes received a recession or economic crisis, there will

be a large number of small banks encounter the bankruptcy, it not only harms the interests of creditors, but also impair these institutions themselves, and thus produce an adverse effect to the whole national economy. For example, Hainan Development Bank, the first bank to fail in China, was excluded during the financial storm in 1998 due to its poor operation, which resulted in a large proportion of non-performing loans. The central bank mobilized $3.4 billion to bail it out, but it still failed on June 21, 1998.

4 The Organization System of Supervision

China's banking supervision organization system is not perfect. Separate management and supervision have not adapted to the trend of international economic development. From the perspective of internationalization, with the development of financial innovation, many financial institutions are no longer operating separately, but in mixed operations. Banking, insurance and securities agencies already overlap in some areas. The same financial institution may wear several hats, from banking to insurance and even securities. For China's entry into the WTO, only by changing the way the financial industry operates can it take advantage in the competition. The decrease in supervision cost and the improvement of supervision efficiency are bound to make more profits for China's financial industry. China's traditional regulators pay attention to the compliance supervision of banks, but ignore the risk supervision of risky banks. Risk supervision refers to the regulatory authorities taking corresponding regulatory measures according to the results of the risk assessment of banks and examining risks in detail to ensure that banks establish a sound risk management system and avoid business loopholes or even bankruptcy. Therefore, all kinds of adverse consequences caused by risks can be reduced to the minimum at the least (Kong et al. 2012).

4.1 The Method of Supervision

Effective regulatory methods need to combine theory with practice and make corresponding adjustments in regulatory methods considering the current business model. With the development of online banking and digital transformation, China's current regulatory methods for commercial banks are relatively outdated and need to be followed up.

First, the authenticity of information cannot be guaranteed due to the regulatory approach. Due to the need to provide multiple materials, China still uses the inspection method of advance notice, but rarely spot check, resulting in each bank having enough time to prepare, so the authenticity cannot be guaranteed. However, in countries with highly developed banking supervision, regulatory authorities will

take a series of measures like introducing social audits to ensure the authenticity and accuracy of information data collected from off-site supervision.

Second, the regulation method is outdated. Nowadays, regulators need to conduct supervision in a high-tech way. If they still only regulate banks which are in the traditional mode, many people will make profits from big data and computers. For example, the paperless operation of online banking makes it difficult to track online transaction records, and the disclosure content is not clearly stipulated, so the transparency of information disclosure is not high. In addition, legislators and online banking customers lack awareness of privacy protection, which leads to the dissemination of commercial resources focusing on customer privacy, and customer rights and interests cannot be protected. Therefore, regulatory agencies should legalize and concretize supervision on digital platforms to be effective ones.

5 Conclusion and Solutions

5.1 Conclusion

In conclusion, the Chinese banking system lacks an exhaustive approach to supervising the business, to make sure the method can keep up with the pace of the new era. The coverage of supervision needs to be expanded, to make sure that all the members and details in this system can be bound by a uniform standard, and the organization system needs to be improved to transform the focus into the right point. To alleviate these problems, this paper puts forward several practical and effective solutions to improve the efficiency of the entire banking industry in China.

5.2 Establish and Improve the Information Disclosure System

Information asymmetry in the banking industry will make the banking system vulnerable, so establishing a sound information disclosure system is crucial to maintain the stability of the banking industry and supervision. On the one hand, banks should be required to fully disclose their own information. If banks have weak binding force and insufficient enforcement, financial consumers will not be able to obtain accurate information. For example, the pricing process and pricing method disclosure of derivatives are concerned by consumers. Second, the CBRC needs to conduct all-around supervision over the authenticity of information, rather than making supervision just a form only. The disclosed information can be integrated and released to the public, and the disclosure can also be used as an assessment standard, then ranking the group of banks according to the disclosure situation. If the information between banks and the public is symmetrical, the credibility of banks in the society

will be enhanced and the stability of the banking system will be enhanced, which is conducive to the sound development of the whole economy.

5.3 Bring Innovative and Employ Talents

In today's financial globalization with the deepening reform of the banking industry, the goals, contents, and modes of banks are changing. Therefore, it is of vital importance to update the regulatory concept and innovate the management mode of banks in a timely manner. First, banks can bring in talents. Nowadays, more people are exposed to advanced banking operation modes and management concepts domestically and abroad, and thus recruiting such talents can inject innovation force into the banking industry, keeping pace with time and creating new systems and platforms. Also, some individuals are good at computers and data, who can devote themselves to online banks. Second, the concept of regulation should be changed from function-oriented to target-oriented. China's banking supervision is still functionally oriented, but as the functions of financial institutions gradually increase, the cost of this mode will rise significantly, so target-oriented will be more suitable. Generally speaking, the goal of Chinese banks is to advance stability and promote the development of banks while preventing risks.

Third, Strengthen international cooperation on banking supervision. This is the inevitable choice of financial globalization. Financial supervision and coordination under financial globalization depend more on the cooperation of governments, the role of international financial organizations and the rules of international industry organizations. Therefore, China's financial authorities should establish a new international framework of financial supervision, from the legal system, scientific metal, etc., to integrate resources, optimize the allocation, and make it adapt to the international development situation.

5.4 Strengthen the Oversight of Intermediary Business

Due to the rapid development of intermediary businesses, the banking supervision center also needs to be transformed, which should emphasize the supervision of the fee-for-service business. China has no specific legal provisions on the supervision of intermediary businesses, so there is serious crisis hidden dangers in intermediary businesses that cannot be connived at. Therefore, the banking regulatory authorities should establish the relevant banking supervision system, seriously and strictly carry out the approval, filing and coordination of intermediary business. Especially the information disclosure system of intermediary businesses, because of the poor information transparency of intermediary businesses in China, the People's Bank of China is difficult to effectively supervise and manage the intermediary business activities of commercial banks. Therefore, standardizing the information disclosure

system of intermediary businesses is the prerequisite for the macro supervision of the intermediary business.

References

Du X (2000) Comparison of two financial systems in modern China. Soc Sci China (02):191–204+209

Kong L, Jiang W, Yuan W (2012) Research on China's banking supervision system, Modern Bus (09):25+24

Liu Y (2012) Research on measurement and management of credit risk of commercial Banks in China. Thesis for doctor's degree

Li J, Tian G (2011) A Probe into the top-level design of shadow banking system regulatory reform. Macroeconomics 08:24–28

Ma Z (2015) Research on the influencing factors of non-performing loans of commercial Banks in China under the new economic situation. Thesis for master's degree

Tengxun Homepage, https://xw.qq.com/cmsid/20220315A0DDP300. Last accessed 24 June 2022

TradeFinance Homepage, http://m.sinotf.com/News/index/id/356113.html. Last accessed 24 June 2022

Wang S, Xuan X (2021) In the economic pressure or social pressure: digital finance development and digital innovation of commercial Banks. Economist (01):100–108

Wang X (2002) Research on Information disclosure of commercial Banks in China. Stud Int Finan 04:53–37

Yao S, Jiang C, Feng G (2011) An empirical analysis of the efficiency of China's banking industry. Econ Res J 08:4–14

The Technology and Applications of RIE and DRIE Processes

Jiangpeng Li

Abstract The research progress of etching technology is closely related to modern processing technology and is inseparable from people's lives. In recent decades, with economic development and social progress, especially the increasing demand in the semiconductor industry, etching has become more and more widely used, and etching technology has almost reached unprecedented development. This article starts from the angle of principle, process and influencing factors, and introduces two etching methods, RIE and DRIE. Two applications are listed, namely black silicon preparation and a device in MEMS fabrications. The study found that compared with other etching technologies, these two technologies have advantages such as reducing loss and improving yield respectively. However, as the size of the substrate continues to increase and the size of the device structure continues to shrink, high etching speed and high uniformity will become the key direction of the development of microfabrication technology, and the improvement of process and technology will inevitably become a future issue.

Keywords Etching · Reactive-Ion etching technology · Deep reactive ion etching technology

1 Introduction

Integrated circuit manufacturing is an indispensable part of the integrated circuit industry. Its development speed is fast, and it involves a wide range of disciplines and huge industrial investment. In recent years, with increasing demand and increasing social attention, integrated circuit manufacturing production lines have continued to grow. Etching is an important process step of the integrated circuit manufacturing process, and its process quality directly determines the performance of the

J. Li (✉)
School of Electrical Engineering and Automation, Harbin Institute of Technology, Harbin 150006, Heilongjiang, China
e-mail: 1180610504@stu.hit.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_125

final chip. Etching was first used to manufacture copper plate, zinc plate and other printed embossing plates. It is also widely used in the processing of weight reduction instrument panels, nameplates, and thin workpieces that are difficult to process by traditional processing methods. After continuous improvement and development of process equipment, it can also be used for the processing of precision etching products for electronic thin parts in the aviation, machinery, and chemical industries. Especially in the semiconductor manufacturing process, etching is an indispensable technology. In order to show the effect and application of etching technology, this article introduces two etching technologies and lists their applications.

2 Features of Etching Technology

As a key technology in integrated circuit technology, etching technology has many characteristics that are not limited to the following:

1. Etching technology has changed the way of machining metal parts.
2. Etching technology can process large-area microporous filter screens used in traditional industry equipment, and small parts that are almost difficult to distinguish by the eyes.
3. The production process has no external impact, no deformation, and good flatness. Short production cycle, fast response time, no need for mold design and manufacturing. The product has no burrs, no bumps, and both sides are the same smooth and flat.

3 Reactive Ion Etching Technology (RIE)

Reactive ion etching technology is a highly anisotropic and highly selective technology. It uses molecular gas plasma for etching in a vacuum system and ion-induced chemical reactions to achieve anisotropic etching. That is to use ion energy to form an easily etched damage layer on the surface of the etched layer and promote chemical reactions. At the same time, ions can also remove surface products to expose the role of a clean etched surface.

3.1 Principle of Reactive Ion Etching Mechanism

Reactive ion etching (RIE) is one of the etching processes in the integrated circuit manufacturing process. It has the characteristics of anisotropy, good etching uniformity, and small etching line width loss. It is especially suitable for low line width crafts where high etching accuracy is required. In addition, it can also facilitate end-point control without causing over-corrosion and affecting process quality.

The etching quality involved in the reactive ion etching process mainly includes etching rate and etching uniformity. Among them, the etching rate is more critical, and many of the problems in the etching process are related to the etching rate. The etching rate formula is as follows:

$$R_v(t) = \frac{dT_{OX}}{dt} \tag{1}$$

In formula (1), is the etching rate, which is a function of time, is the thickness of the film, and is time.

3.2 The Application of RIE—The Preparation of Black Silicon

Silicon is the main element of minerals in nature. The content of silicon in the earth's crust is second only to oxygen, accounting for about 25.7% of the total weight of the earth's crust. It has the characteristics of easy purification and stable chemical properties. Because of its abundance and excellent properties, silicon is widely used in semiconductor, aerospace, energy, chemical, transportation, food, medical, agricultural and other industries, and plays a vital role in human contemporary life. However, the band gap of crystalline silicon is about 1.12 eV, and the corresponding absorption wavelength is about 1.1 μm. And due to the indirect band gap of silicon itself, the silicon-based battery absorbs the light of the entire solar spectrum poorly, which in turn affects the photoelectric conversion efficiency of the battery. In order to improve the photoelectric conversion efficiency of the battery, many technologies have been developed, such as surface texturing, back surface passivation, passivation emitter and other technologies. Among them, the preparation of black silicon can effectively reduce light reflection, enhance light absorption, and essentially compensate for the defects of silicon materials.

Black silicon is a silicon material that can maintain high absorption in the near-ultraviolet to infrared bands (Crouch et al. 2004). At the end of last century, Professor Eric. Mazur and others of Harvard University in the United States (Her et al. 1998) accidentally discovered when studying the catalytic effect of laser on the surface of semiconductors. In the SF6 atmosphere, pulsed lasers are used to irradiate the surface of silicon wafers, and the ionized F ions will be It reacts with the silicon surface, causing the change of the surface morphology of the silicon wafer.

Preparation of Black Silicon by RIE Method. There are physical and chemical effects in the process of preparing black silicon by the RIE method (Lei 2017). The equipment is shown in Fig. 1. First, the silicon wafer is placed on the substrate plate of the cathode, and the vacuum degree of the chamber is pumped to 10–4 Pa through a mechanical pump and a molecular pump. Then, the etching gas is introduced, and the glow discharge of the etching gas generates plasma under the action of the

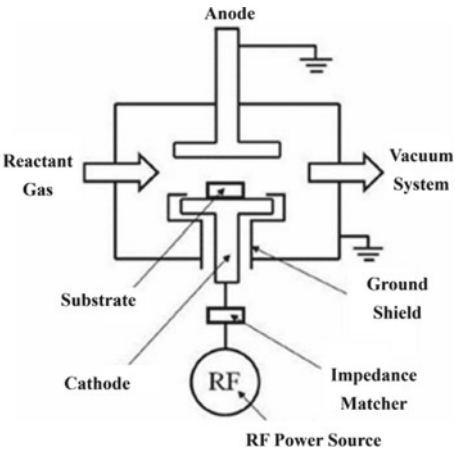


Fig. 1 Schematic diagram of RIE equipment (Lei 2017)

radio frequency source, and the potential drops near the cathode. A large number of charged particles are accelerated under the action of an electric field, and have greater momentum when they contact the surface of the silicon wafer, which bombards silicon atoms on the surface of the silicon wafer out of the crystal lattice, thereby realizing physical etching. At the same time, the ionized active groups will chemically react with the silicon atoms on the surface of the silicon wafer to generate volatile gases and be drawn out of the chamber to achieve chemical etching. With different etching gases, the active groups produced by ionization have different lifetimes. Changing the etching gas can reduce the life of the active group, inhibit the diffusion of the active group on the surface of the silicon wafer, and reduce the side etching effect, thereby improving the anisotropy during the etching process and changing the morphology of the black silicon.

However, the energetic particles in this technology will cause certain damage to the silicon surface, and a certain thickness of damage layer is formed on the silicon wafer. Therefore, the black silicon needs to be de-damaged after the preparation of the black silicon by this method, and the method requires an expensive plasma vacuum Equipment, used in industrialized production causes cost increases. Generally, the reactive gas used to etch silicon materials is SF6 or CF4. In order to obtain the light trapping structure, a mask needs to be prepared on the surface of the silicon wafer, and the masked area will not be etched. The preparation of the mask can generally be done by nanosphere photolithography or the preparation of a metal template. This method is called the mask method (Nositschka et al. 2003; Zhang et al. 2012; Chanseob et al. 2014; Tan et al. 2016). Passivation can also be achieved by passing in O_2. When SF_6 and O_2 are passed in at the same time, the ionized O will form a layer of SiFxOy on the surface of the silicon wafer, reducing the etching rate of F ions and achieving anisotropic etching. For the purpose of etching, this method is called the maskless method (Dekkers et al. 2000; Yooa et al. 2011; Murias et al. 2012; Steglich et al. 2014; Chen and Hong 2016).

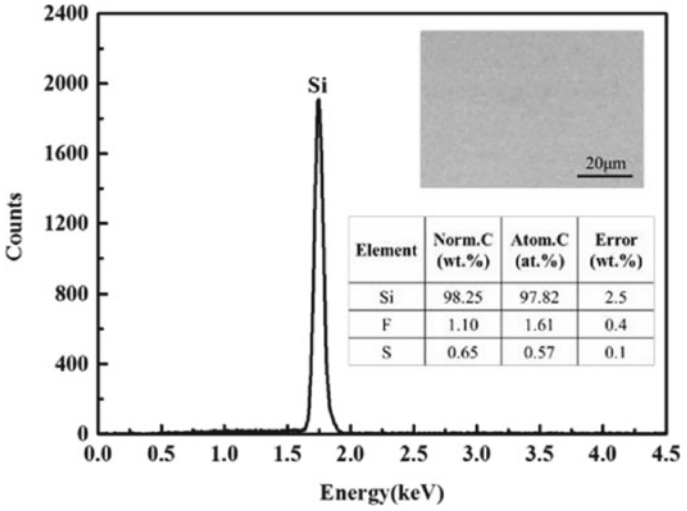


Fig. 2 Black silicon surface energy spectrum (Lei 2017)

The Mechanism of RIE Mask Method for Preparing Black Silicon. In the process of preparing black silicon by RIE, the etching of Si is mainly based on the reaction of F ions with Si and the impact of energetic particles. F and S elements may enter the Si lattice, which is similar to ion implantation. Figure 2 is the surface energy spectrum of the sample after removing the SiO_2 microspheres on the black silicon surface with HF. It can be seen from the figure that the sample mainly contains Si elements and traces of F and S elements. Due to the error caused by the test accuracy of the instrument, the existence of F and S can basically be ignored, that is, when the black silicon sample prepared by the RIE mask method is processed by HF, the black silicon does not contain the two elements of F and S. No ion implantation occurred during the etching process.

According to the experimental results, the mechanism diagram of preparing black silicon by RIE mask method is given, as shown in Fig. 3. Generally speaking, when SF_6-O_2 atmosphere is used to prepare black silicon, it can be divided into two parts. First, the fluorine radical F* reacts with the atoms on the surface of the silicon wafer to form gaseous SiF_4, which is drawn out of the chamber. Then, the SiFy + formed during the etching process reacts with oxygen radical O* to form a layer of silicon oxyfluoride (SiOxFy). SiOxFy is an unstable compound that is easily decomposed under plasma bombardment, but it can act as a protective layer and reduce the etching effect of F* on silicon. SF_6 and O_2 form F* and O* through glow discharge, and F* and O* vertically bombard the surface of the silicon wafer under the action of an electric field. With the progress of ion bombardment and chemical reaction, the SiO_2 nanospheres gradually decrease, and part of the silicon wafers are exposed to plasma to be etched. At the same time, the impact of ion bombardment on the sidewall of the silicon wafer surface structure is relatively small, and SiOxFy passivation layer

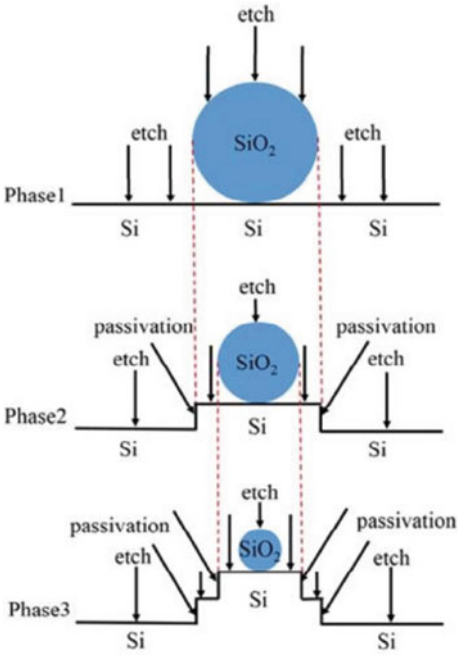


Fig. 3 The mechanism picture of using the RIE mask method to prepare black silicon (Lei 2017)

is easily formed on the sidewall, which further reduces the etching effect of ion bombardment and F* on the sidewall of the structure. When the SiO_2 nanospheres are completely etched, a cone-shaped structure is formed. Since the etching rate of F* on silicon dioxide is much lower than that of silicon, the size change in the vertical direction is greater than that in the horizontal direction. So we can prepare nanostructures with high aspect ratio.

Advantages of RIE Method to Prepare Black Silicon. The chemical preparation of black silicon depends on the crystal orientation of the silicon material itself. Studies have shown that in the process of preparing black silicon by chemical methods, there will be a loss of tens of micrometers in the silicon layer, which will cause huge waste. Compared with chemical methods, reactive ion etching of silicon wafers can effectively reduce this loss. Relevant studies have shown that, compared with chemical methods, RIE method can reduce the loss of silicon material by about 67%, and can be applied to the etching of thin film materials. In addition, the crystal orientation of the silicon wafer has a relatively small effect on the structure of the prepared black silicon, which can be used in polysilicon (Ruby et al. 2000).

4 Deep Reactive Ion Etching Technology (DRIE)

Deep reactive ion etching (DRIE) is a special reactive ion etching technique that can process high aspect ratio structures with steep sidewalls. This technology was first developed based on patents owned by Robert Boaach Gmbh and Texas Instruments (TI). British STS company has developed the ASE (Advanced Silicon Etching) technology based on the Bosch method and applied it to the dry etching equipment produced by the company.

4.1 Principle of Deep Reactive Ion Etching

The deep reactive ion etching technology divides the deposition of the polymer passivation layer and the etching of the single crystal silicon into two independent processing processes, which are performed alternately, so as to avoid the mutual influence between the deposition and the etching. The most typical Bosch process is to use SF_6 and C4F8 to achieve the etching process at room temperature. SF_6 is an etching gas used to etch the sidewall and bottom of the trench, and C_4F_6 is a protective gas. By growing a layer of (CF_2) organic polymer protective film on the sidewall surface, the etched sidewall can be protected effect. The etching process is as follows: first deposit a layer of passivation film on the side wall; then pass in C_4F_8 gas, C_4F_8 is decomposed into ionic state CF_2 groups and active F groups in the plasma state, of which the CF_2 groups react with the Si surface to form high molecular passivation film; then etching is performed, gas SF_6 is introduced to increase the dissociation of F ions, the passivation film is etched away, and then the Si substrate is etched. In the etching step, part of the sidewall polymer attached to the previous adhesion layer will be separated from the sidewall and moved again under the influence of non-vertical ions colliding with the sidewall, and then reattach to the deeper sidewall. In this way, the polymer film on the sidewall is continuously driven to adhere downward, thereby forming a local anisotropic etching.

4.2 The Application of DRIE—Device in the MEMS Fabrications

Deep reactive ion etching (DRIE) equipment is mainly used for deep trench etching of Si materials in the manufacture of MEMS devices. In 2006, the 48th Research Institute of CETC in China designed a DRIE equipment for the manufacture of MEMS devices (Chen et al. 2006). An important method of bulk silicon MEMS manufacturing technology is DRIE, which is more and more widely used in MEMS manufacturing process technology. Its main feature is good verticality and high aspect ratio, which plays a key role in the development of bulk silicon MEMS. In particular,

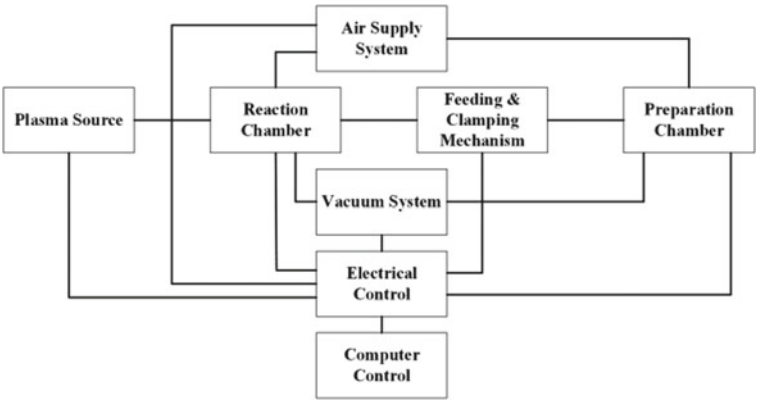


Fig. 4 Equipment composition diagram (Chen et al. 2006)

the inductively coupled plasma source (ICP source) that has emerged in recent years has enabled the high-density reactive ion etching process to truly develop into a practical etching technology. The key to this technology is the use of separate and fast switching processes for etching and polymer deposition. At the same time, the radio frequency power phase control technology is used to synchronize the phases of the ion source power supply and the bias power supply to ensure that the bias voltage reaches the highest when the ion density reaches the highest, so that the advantages of high-density plasma etching can be fully utilized (Jun et al. 2001).

Design of DRIE Equipment. The equipment is mainly composed of nine parts: plasma source, reaction chamber, preparation chamber, feeding mechanism, clamping mechanism, vacuum system, air feeding system, electrical control and computer control. The device is a vertical structure. The plasma source is in the upper part of the reaction chamber, and the substrate is in the lower part of the reaction chamber. The equipment composition is shown in Fig. 4.

Advantages of Using DRIE. For the industry, cost reduction is the key to the success of MEMS products. DRIE equipment manufacturers are constantly optimizing equipment costs while maximizing production efficiency. For DRIE equipment, the etching rate is a key process parameter that determines whether it can achieve high production efficiency. The long-term research to improve the etching rate has achieved a major breakthrough. Another key factor is the process yield, which determines the maximum number of effective chips that can be obtained on a single piece of silicon. The improvement of the degree of automation also provides the necessary conditions for the improvement of the production capacity of silicon wafers. Using the cost-effective DRIE process module on the platform can achieve high yield and high throughput at the same time.

5 Conclusion

This article mainly introduces the etching technology and its characteristics and briefly describes the principles and applications of RIE and DRIE. This article also explains the advantages of these two etching techniques. Now, the shortage of chips has become the key issue that bears the brunt of the world. Etching technology has played an important role in chip manufacturing. Therefore, more countries will devote more resources to the development of etching technology. As two more mature etching technologies, RIE and DRIE still have space for improvement. Meanwhile, the latest dielectric etching technologies such as Vantex are gradually entering the sight of humans. Etching technology will become an immortal topic in the chip manufacturing industry in the future.

References

Chanseob C, Kong D, Oh J et al (2014) Surface texturing method for silicon solar cell using reactive ion etching with metal mesh. Phys Status Solidi Appl Mater 211(8):1844–1849

Chen W, Hong F (2016) 0.76% absolute efficiency increase for screen-printed multicrystalline silicon solar cells with nanostructures by reactive ion etching. Solar Energy Mater Solar Cells 157:48–54

Chen TH, Yu QR, Gong JH, Zhang DY, Wi B, Li JZ (2006) Deep reactive ion etching (DRIE) device in the MEMS fabrications. Chin J Sens Actuators 2006(05):1415–1418

Crouch CH, Carey JE, Warrender JM et al (2004) Comparison of structure and properties of femtosecond and nanosecond laser-structure silicon. Appl Phys Lett 84(11):1850–1852

Dekkers H, Duerinckx F, Szlufcik J et al (2000) Silicon surface texturing by reactive ion etching. Opto-Electron Rev 8(4):311–316

Her TH, Finlay RJ, Wu C et al (1998) Microstructuring of silicon with femtosecond laser pulses. Appl Phys Lett 73(12):1673–1675

Jun L, Shao-rong X, Zhen-bang G (2001) Micro-fabrication technologies for micro-electro-mechanical system. Electromachining Mould 05:1–6

Jin L (2017) Preparation and properties of black silicon by RIE mask method and SIS solar cell. Nanjing Univ Aeronaut Astronaut

Murias D, Reyes-Betanzo C, Moreno M et al (2012) Black Silicon formation using dry etching for solar cells applications. Mater Sci Eng, B 177(16):1509–1513

Nositschka WA, Beneking C, Voigt O et al (2003) Texturisation of multicrystalline silicon wafers for solar cells by reactive ion etching through colloidal masks. Sol Energy Mater Sol Cells 76(2):155–166

Ruby DS, Zaidi SH, Narayanan S (2000) Plasma-texturization for multicrystalline silicon solar cells. In: 28th IEEE photovoltaic specialists conference, Anchorage

Steglich M, Kaseebier T, Zilk M et al (2014) The structural and optical properties of black silicon by inductively coupled plasma reactive ion etching. J Appl Phys 116(17):173503-1–1735012

Tan Q, Tang L, Mao H et al (2016) Nanoforest of black silicon fabricated by AIC and RIE method. Mater Lett 164:613–617

Yooa J, Yu G, Yi J (2011) Large-area multicrystalline silicon solar cell fabrication using reactive ion etching (RIE). Sol Energy Mater Sol Cells 95(1):2–6

Zhang X, Sushkov AB, Metting CJ et al (2012) Silicon Patterning Using Self-assembled PS-b-PAA Diblock copolymer masks for black silicon fabrication via plasma etching. Plasma Process Polym 9(10):968–974

Theoretical Development of an International Carbon Auction Mechanism

Haoping Qiu

Abstract Climate change is a global problem, with some places able to carry out abatement at much more cost-effective rates. Thus far international attempts to create a mechanism that would utilize this fact to incentivize abatement activities have seen limited success, with the collapse of carbon prices 10 years ago leaving many projects underfunded. This paper attempts to develop the foundations of an international mechanism that would incentivize and fund countries in abatement projects. This mechanism is based off of a reverse version of a first-price sealed bid auction and this paper briefly analyzes, mathematically, an equilibrium strategy under such conditions. This paper further goes on to discuss the steps that must be taken and potential weaknesses that ought to be guarded against in such a mechanism.

Keywords Climate change · Auction theory · Carbon auction

1 Introduction

1.1 Research Background and Motivation

There is growing consensus that climate change constitutes an existential threat and that collective action is required to prevent catastrophic consequences. The impacts of climate change are increasingly perceptible through the manifestation of noticeably deadlier heat waves, hurricanes, droughts, floods and a variety of other natural disasters occurring at alarming frequency. The 6th Assessment Report (AR6) released by the Intergovernmental Panel on Climate Change (IPCC) shortens the timeline for the world stopping short of 1.5 °C of warming above pre-industrial levels to two decades and reiterates the dire need for "immediate, rapid and large-scale" reductions in greenhouse gas (GHG) emissions. The latest UNEP Emissions Gap Report,

H. Qiu (✉)
Westminster School, London SW1P 3PB, UK
e-mail: davin.qiu@westminster.org.uk

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_126

published in 2021, further quantifies that to achieve the 1.5 °C goal set out by the Paris Agreement, "the world needs to halve annual GHG emissions for the next 8 years" (www.unep.org/resources/emissions-gap-report-2021). In 2015, 196 counties adopted the Paris Agreement with the overarching goal to "limit warming to no more than 1.5 °C." The period between 2015 and 2017 saw the submission of "climate action plans known as nationally determined contributions (NDCs)" from parties to the agreement. These initial commitments, however, would have only been enough to "slow warming to 3°" (www.un.org/en/climatechange/net-zero-coalition). This trend of inaction persisted over the following years. Despite many countries beginning to revise their NDCs with several now pledging to a 2050 net zero target, mitigation efforts have continued to fall short of expectation, particularly the lack of commitment and resolve from major carbon emitters across the world (House of Commons Library 2022). Examples include the U.S. temporarily leaving the Paris Agreement, countries such as Australia and India backing away from more restrictive pledges and China refusing to pledge to the 2050 net zero target (www.scientificamerican.com/article/countries-back-away-from-pledge-to-update-climate-goals-this-year/).

Climate change is a global problem and as such, requires a coordinated, global response. The current "country by country" negotiation of mitigation efforts results in heightened tensions in international relations (https://www.dni.gov/files/ODNI/documents/assessments/NIE_Climate_Change_and_National_Security.pdf). Increasingly, reduction commitments are seen as a political tool on the international stage, a bargaining chip between individual countries or with the UN. China, for example, has been suspected of delaying the submission of renewed NDCs before COP26 so as to use it as leverage to pressure foreign governments in other areas (https://asia.nikkei.com/Opinion/Will-China-use-climate-change-as-a-bargaining-chip). A significant number of countries classified by the UN Framework Convention on Climate Change as non-Annex I nations, i.e. mostly developing countries, are similarly reluctant to commit to emission reductions, have also made their commitments "conditional upon receiving international support (finance, technology transfer and/or capacity building)" (Pauw et al. 2019). The reasoning behind conditional NDCs is a serious issue of equity and fairness. Given that as of 2015, Annex 1 countries are responsible for 90% of excess historical emissions, it is understandable why non-Annex 1 countries are reluctant to take on an equal share of the costs to reduce emissions (Hickel 2020).

However, negotiating conditional NDCs seriously impedes international cooperation and in general slows down action. Such was the motivation behind a number of carbon markets that have been developed to incentivize and fund abatement schemes. However, the collapse of carbon prices in 2012 left behind a vacuum of funding. With the understanding that climate change is a global problem and requires a global solution, there is hence an opportunity to construct an international mechanism to provide funding, with every nation pitching in, for the most cost-effective abatement actions.

1.2 Research Contents and Framework

This paper will attempt to develop an international auction mechanism, hereafter refer to as the International Carbon Auction mechanism (ICA mechanism). It will first focus on existing international schemes to trade carbon or provide funding for abatement efforts, many of which have been developed to incentivize optimal abatement activities, through a brief analysis of their underlying theory, strength and weaknesses. The second section, building upon the first, will then present and discuss qualitatively the ICA mechanism based upon a First-Price Sealed Bid Auction (FPSBA) model with an aim to incentivize and enable optimally efficient abatement activities.

2 Existing International Systems

2.1 EU ETS

The EU Emissions Trading System is a "cap and trade" scheme which limits, or "caps", emissions within an area which companies are then allowed to "trade". Initially, emission allowances are auctioned off and then subsequently traded freely. The underlying theory is that the profit motive will incentivize companies to reduce emissions so as to be able to sell emission rights for extra profit. Although the ETS is an international scheme across the entire EU, it is no different from a domestic scheme given that the EU operates within the single market with a single currency. This system relies on the idea that the cost of abatement differs between industries. For example, it would be far less costly for a software company to switch to green energy than an airline. Hence, it would theoretically find the most efficient pathways for reducing emissions as companies that are able to easily reduce emissions have a financial incentive to do so since the cost of abatement would be cheaper than paying for the emission allowances.

Despite carbon markets in general being very difficult to regulate, the ETS has been a relative success partially because it's within a single market. Initially including 45–50% of EU total emissions, mostly from "energy production and large industrial polluters" (www.epa.ie/our-services/licensing/climate-change/eu-emissions-trading-system-/). Estimates find that the ETS has prevented over "1 billion tons of CO_2 between 2008 and 2016" which equates to 3.8% of total EU emissions in a world without the ETS (Bayer and Michaël 2002).

2.2 UN CDM

The UN Clean Development Mechanism, on the other hand, is an international carbon offset program developed by the UN under the Kyoto Protocol of 1997. In the early and mid-2000s, before the Paris Agreement, non-Annex 1 countries had almost no emission reduction targets while Annex1 countries were struggling to meet their Kyoto targets. Under the CDM, greenhouse gas (GHG) reduction projects in no countries are eligible for saleable Certified Emission Reduction (CER) credits, or offsets, each representing the GHG reductions equivalent to one ton of CO_2 (https://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf; Burniaux et al. 2009). It is essentially an accounting mechanism which utilizes the globalized nature of pollution to offer alternative pathways for countries to achieve net zero targets. As Anja Kollmuss, a policy analyst in Zurich who studies emissions trading puts it, "You can reduce emissions anywhere you want and if you have a limited amount of money at your disposal, it makes sense to reduce emissions where it's cheapest and easiest to do them" (https://www.vox.com/2020/2/27/20994118/carbon-offset-climate-change-net-zero-neutral-emissions).

However, the CDM is generally viewed as a failure, especially after the carbon crash of 2012 when the UN issued warnings that the system was "in dire need of rescue" (https://voxeu.org/article/collapse-clean-development-mechanism). One of the most significant problems with the CDM is the lack of a reliable process to determine a baseline of emissions from which additionality can be determined (https://www.vox.com/2020/2/27/20994118/carbon-offset-climate-change-net-zero-neutral-emissions). Additionality refers to abatement projects that would not have taken place without the financial excitation. If non-additional, the CDM serves only to reallocate emissions between countries and becomes nothing more than income transfer to recipient countries (Burniaux et al. 2009). This has proven to be a significant problem, with an independent assessment concluding that fully 85% of the CERs between 2013 and 2020 were unlikely of being additional or accurate (Cames et al. 2016).

In addition, in practice, the CDM lacked participation from some of the largest emitters of the time. The US had refused to ratify the Kyoto Protocol and China, India and Mexico, as non-Annex 1 countries, didn't have any reduction obligations, leaving EU the only major source of demand for CERs.

2.3 World Bank Climate Auctions Program

The World Bank Climate Auctions Program was built off of the Pilot Auctions Facility (PAF) which was developed by the World Bank Group and is perhaps the most similar out of all three programs discussed thus far to the mechanism that will be proposed is this paper. The goal of the PAF goal was to create a financing mechanism that would "stimulate private-sector investment" in developing countries. It does so using a

climate auction which allocated funds to the most cost-competitive projects in developing countries through the provision a "guaranteed price floor" on carbon reduction credits (World Bank 2022). It further uses a results-based payment mechanism to "ensure delivery of climate outcomes" and builds off the remaining infrastructure of the World Bank (2014). The motivation behind the PAF was the lack of private sector funding for emission reduction projects left behind by the collapse of carbon prices in 2011 (https://voxeu.org/article/collapse-clean-development-mechanism). In 2013, the G8 requested for a "innovative pay-for-performance" approach to address methane reduction after the collapse of the UN CDM left many projects underfunded and wished to avoid the weaknesses regarding verification that contributed to the collapse of the UN CDM (ndcpartnership.org/funding-and-initiatives-navigator/pilot-auction-facility-methane-and-climate-change-mitigation-paf).

One weakness with the PAF is potentially the use of carbon credits which is volatile in price. Despite the guaranteed floor price of carbon credits, a limited number of countries entered into carbon markets and an even more have discontinued its use after the collapse of credit prices.

3 The ICA Mechanism

In brief, the proposed ICA mechanism involves an international fund, contributed to by governments across the world. Governments from around the world would then bid, under a FPSBA model, for a certain amount of CO_2 emission reduction, refered to as one Abatement Unit (AU). The bid would be the cost of reducing the equivalent of 1AU worth of CO_2 plus however much profit they would like to make, multiplied by the time it would take to for 1 AU worth of reduction. The country with the lowest bid, i.e. the fastest and cheapest abatement, would then be given the amount of money their bid was which can then be used to carry out the 1AU worth of abatement.

3.1 Underlying Assumptions

To set out the theoretic basis of the mechanism more rigorously, several assumptions have to be made. First, we can construct a hypothetical scenario where the ICA mechanism is agreed to in one of the annual meetings of the Conference of the Parties (COP), the decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC) which has 197 states parties, much like the Glasgow Climate Pact that was adopted during COP26. This would be one of the most reasonable formations of the ICA mechanism and to ensure participation from as many states as possible. Second, as with any concept in economics, a necessary requirement to the First-Price Sealed Bid Auction (FPSBA) model is the assumptions of economic man, namely "rational decisions, maximization of utility, and a self-interested orientation", are applied to all participating nations. Finally, it is assumed

that all nations have complete information regarding their own costs of abatement and the number of bidders but have no information about other's costs.

3.2 ICA Fund

The ICA fund, which will be created alongside the ICA mechanism, will require each participating country to donate some pre-determined proportion of their GDP with the exact number to be negotiated. In addition, the ICA fund could potentially draw on UN funds dedicated towards battling climate change or other international organizations or charities. The details of the remaining infrastructure is not the focus of this paper and can be negotiated at a later time but can utilize a number of the infrastructure left by UN CDM. One key assumption here is that bids by countries are independent of contributions made to the fund. Such may be achieved through separation of the fund-raising process and the auction process.

3.3 Verification Process

Although the ICA fund acts in the belief that all nations shall come together to combat climate change, it is naïve to blindly trust the integrity of governments across the world to effectively prevent misuse of the funds. Hence, it is necessary to set up a verification mechanism which would ensure the prompt delivery of the promised abatements. Here, lessons can be drawn from both the EU ETS and the UN CDM. The first key aspect to the verification process is determining the additionality of reductions which, as explained previously, was a fatal weakness in the UN CDM. The second is to account for all leakages which is when countries outsource industries to elsewhere, the emissions are still present on a global level but have decreased within said country. In practice, it may be easier to measure the current and projected emissions level of a country compared to an individual project, hence simplifying the verification process.

However, such details are beyond the scope of this paper and for the purposes of developing the theoretical foundation of the ICA mechanism, such a verification process will be assumed to be complete with all countries.

3.4 Mathematical Layout

The ICA mechanism is the exact reverse of the FPSBA mechanism in that the bidder with lowest bid wins. Hence, the layout of the basic mathematical environment is as such (https://personal.lse.ac.uk/nava/Materials/EC319%20Handout.pdf).

- N potential bidders
- 1 indivisible unit of abatement (1 AU)
- The cost of reducing 1 AU's worth of CO_2 for bidder i is x_i.
- x_i is independent and identically distributed.

Under these rules, the mechanism is as such

- All bidders submit sealed bids $b_1, \ldots, b_N$.
- Lowest bid wins the abatement unit and receives the amount bid
- For any profile of bids $b = \{b_i\} \forall i \in N$, payoffs are

$$\Pi_i = \begin{cases} b_i - x_i \text{ if } b_i < \min\limits_{j \neq i} b_j \\ 0 \qquad\quad \text{if } b_i > \min\limits_{j \neq i} b_j \end{cases} \tag{1}$$

As with the FPSBA model, it is possible to find a symmetric equilibrium strategy that's a strictly increasing, continuous, and differentiable function of a bidder's costs of abatement. The equilibrium strategy is one which would maximize the expected value of the payoff based off of how much one shade's their bid and the probability of winning. To put it mathematically,

$$E[b_i] = (b_i - x_i) \Pr[b_i < \min_{j \neq i} b_j] \tag{2}$$

Here, we must guess the form that optimal strategy, i.e. an equation for b_i that would maximize the expected value, $E[b_i]$, would take.

Given that the strategy must be linearly dependent on x_i, let us assume that,

$$b_i = \alpha x_i + \delta \tag{3}$$

Hence, we have,

$$\begin{aligned} \max_{b_i} E[b_i] &= \max_{b_i} (b_i - x_i) \Pr\left[b_i < \min_{j \neq i} b_j \right] \\ &= \max_{b_i} (b_i - x_i) \Pr\left[b_i < \alpha \min_{j \neq i} x_j + \delta \right] \\ &= \max_{b_i} (b_i - x_i) \Pr\left[b_i < \alpha \min_{j \neq i} x_j + \delta \right] \end{aligned} \tag{4}$$

Since x_i is independent and identically distributed,

$$\Pr\left[\min_{j \neq i} x_j > \tfrac{b_i - \delta}{\alpha} \right] = \left(\tfrac{b_i - \delta}{\alpha} \right)^{N-1} \tag{5}$$

Hence, the first order conditions can be found by taking the derivative of $E[b_i]$

$$\frac{dE[b_i]}{db_i} = 0 \tag{6}$$

$$\Rightarrow 1 - \frac{b_i}{\alpha} + \frac{\delta}{\alpha} + (N-1)\left(-\frac{1}{\alpha}\right)(b_i - x_i) = 0 \tag{7}$$

$$\Rightarrow \alpha - b_i + \delta - (N-1)(b_i - x_i) = 0 \tag{8}$$

$$\Rightarrow b_i = \frac{N-1}{N} x_i + \frac{\alpha+\delta}{N} \tag{9}$$

Now, we must refer back to our original formulation for b_i.

$$b_i = \alpha x_i + \delta = \frac{N-1}{N} x_i + \frac{\alpha+\delta}{N} \tag{10}$$

$$\alpha = \frac{N-1}{N}, \delta = \frac{\alpha+\delta}{N} \tag{11}$$

$$\Rightarrow \delta = \frac{1}{N} \tag{12}$$

Hence we have,

$$b_i = \left(\frac{N-1}{N}\right) x_i + \frac{1}{N} \tag{13}$$

4 Discussion

4.1 The Equilibrium Strategy

The bidding strategy is fairly simple in form and fairly intuitive. It shows that even when one's cost reaches zero, one would still bid a non-zero amount to gain profit. It also shows that when the number of bidders become very large, the amount one would shade one's bid less, i.e. bid closer to one's true cost, so as to take less risk.

4.2 ICA Mechanism Versus PAF

While similar in concept of auctions, there exists a few key difference between the proposed ICA mechanism and the PAF developed by the World Bank.

First, the ICA is motivated by the concept that "everything that can be done, should be done" and hence is a system to aid and fund countries in emission reduction projects. This means that it operates using a financial transfer where the winning bid receives the money which can be used to fund whatever abatement activities

whereas the PAF utilizes a "pay-for-performance" program, i.e. it rewards countries for abatement which may then draw other sources of funding.

Additionally, the PAF's main aim is to encourage private emission reduction projects, hence the utilization of carbon credits and the infrastructure left behind by the UN CDM. The ICA mechanism, on the other hand, is aimed towards direct funding for abatement projects on the same scale as foreign aid transfers often made by developed countries.

4.3 Weaknesses

The ICA mechanism will not be free of criticisms and failure for whenever assumptions are made, it suggests that reality is far more complicated. This section is then dedicated to evaluating the assumptions made to so as to deal with the complications of reality and consider how they affect the ICA mechanism.

Absence of Key Members. There is little point discussing the plausibility of the hypothetical scenario under which the ICA mechanism is created. However, it is worth considering the ramifications of the absence of key members or blocs of nations from the agreement. There are two points where countries may choose refuse to participate, first the creation of the program and the actual auction. If major countries refuse to join in the creation of the program, it could potentially lead to insufficient funding. However, given that it does not rely on market forces, hopefully it would avoid the vulnerabilities of the UN CDM. If countries withdraw from the auction, i.e. fewer bidders, then there would be changes to the bidding strategies. In general, fewer bidders means less chance of being out-bided which allows countries to take more risk and shade their bids more which then leads to increased surplus.

Assumptions of Rationality. The most fundamental assumption made is that of homo economicus. While the assumption of rationality is barely applicable for individuals who are affected by emotions and habits, it is relatively accurate when applied to countries. It is well within reason to expect a delegation of a country to be utility-maximizing and self-interested, especially those of developing countries who seek to expand their economies. However, strong domestic climate change denialistic sentiment may similarly impact a nation's foreign policy. The US, is a highly representative example. Widening divides in political views over climate change has led to an inability for the biggest economy in the world and second biggest CO_2 emitter to act against climate change. More specifically, former US president Donald Trump actively pull the US out of the Paris Agreement, current president Joe Biden was unable to pass his Build Back Better bill, his flagship piece of policy aimed at climate change (https://www.nytimes.com/2022/01/20/climate/build-back-better-climate-change.html). It is not beyond reason that countries like the US may be reluctant to be as, for lack of better word, cooperative, especially seeing as its unlikely they stand much to gain from the auction mechanism.

Assumption of Perfect Information. In the mechanism development, it was assumed that countries would have perfect information regarding their own costs of abatement and no information regarding other's costs of abatement. Reality is evidently different. It's far more likely that a countries government would have imperfect information in terms of detailed abatement costs, e.g. costs of specific projects but would be in a better position to give an estimate of a national costs of abatement. Furthermore, it is also unlikely that governments would have no information regarding costs of abatement in other countries. Given that in general this is not sensitive information, it may be the case that countries will have a general idea of which countries they may be able to outbid. This then shifts the pressure onto countries to compete in reducing costs of abatement.

Strength of Regulation. Drawing lessons from the EU ETS and UN CDM, one of the most important aspects of any mechanism designed to incentivize abatement is strength of regulation. It was assumed that countries would "follow the rules" in the construction of the mechanism. The PAF uses a "pay-for-performance mechanism" that means the money will only be received after the abatement activity has been independently verified (www.worldbank.org/en/topic/climatechange/brief/pilot-auction-facility-methane-climate-mitigation). However, the purpose of the ICA mechanism is to provide funding that can be directly used to engage in abatement activities instead of an reward. There is a risk of rule-breaking behavior, e.g. mismanagement of funds, failure to deliver reduction promises etc. However, compared to individuals or private companies who are potentially more profit drive and have hence a higher incentive to "cheat the rules", countries who may be under domestic pressure or international scrutiny are likely to be more compliant.

Potential Backlash. A significant number of countries have already engaged in abatement activities, a few even going net-zero. Whether this has been due to a sense of moral responsibility or domestic and international pressure, they have done so for free. Should an international mechanism be put in place that puts a price on abatement, their responses may not be fully supportive. This is because by linking abatement activities with financial transfers on an international level, one is removing the ethical obligation and replacing it with a financial one. This is a double-edged sword. On one hand, the goal is for countries where abatement is not cost-effective to bear their fair share of the costs. On the other, an increasing number of countries may be reluctant to engage in abatement activities and would rather contribute monetarily. Research indicates that in individuals, guilt or social norms are often more effective in achieving compliance than market norms (www.npr.org/2008/03/31/89233955/dan-ariely-takes-on-irrational-economic-impulses). Whether the same holds true for countries remains to be seen.

5 Conclusion

This paper sets out the background and foundation of the International Auction Facility (ICA), which aims to finance national emission reduction activities. Such a mechanism is deemed necessary and beneficial because of the lack of funding for CO_2 reduction projects that had previously relied upon the carbon markets and the UN CDM following the collapse of carbon prices in 2012. Building upon a first-price sealed bid auction model, we were able to set out the mathematical foundations for the ICA mechanism from which one can derive an equilibrium strategy for nations. The paper then evaluates, in theoretical terms, the potential weaknesses of such a mechanism. These are mostly focused around the accuracy of the various assumptions and strength regulation and verification. These details, however, are beyond the focus of this paper as they are best worked out in practice. Such triviality is then left to as an exercise for the reader.

References

Bayer P, Michaël A (2002) The European Union emissions trading system reduced CO_2 emissions despite low prices. Proc National Acad Sci 117(16):8804–8812

Burniaux J-M et al (2009) The economics of climate change mitigation: how to build the necessary global action in a cost-effective manner., working paper, https://www.oecd-ilibrary.org/economics/the-economics-of-climate-change-mitigation_224074334782

Cames M et al (2016) How additional is the clean development mechanism? Analysis of the application of current tools and proposed alternatives. Study Prepared for DG CLIMA

EC319 Handout, https://personal.lse.ac.uk/nava/Materials/EC319%20Handout.pdf. Accessed 25 July 2022

Environmental Protection Agency, www.epa.ie/our-services/licensing/climate-change/eu-emissions-trading-system-/. Accessed 26 July 2022

Hickel J (2020) Quantifying National responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. Lancet Planet Health 4(9):e399–e404

House of Commons Library, commonslibrary.parliament.uk/global-net-zero-commitments/. Accessed 26 July 2022

National Intelligence Council, https://www.dni.gov/files/ODNI/documents/assessments/NIE_Climate_Change_and_National_Security.pdf. Accessed 25 July 2022

NDC partnership. ndcpartnership.org/funding-and-initiatives-navigator/pilot-auction-facility-methane-and-climate-change-mitigation-paf. Accessed 25 July 2022

NIKKEI Asia, https://asia.nikkei.com/Opinion/Will-China-use-climate-change-as-a-bargaining-chip. Accessed 25 July 2022

NPR, www.npr.org/2008/03/31/89233955/dan-ariely-takes-on-irrational-economic-impulses. Accessed 26 July 2022

Pauw WP et al (2019) Conditional Nationally determined contributions in the Paris Agreement: foothold for equity or Achilles heel? Climate Policy 20(4):468–484

Scientific American, www.scientificamerican.com/article/countries-back-away-from-pledge-to-update-climate-goals-this-year/. Accessed 25 July 2022

The New York Times, https://www.nytimes.com/2022/01/20/climate/build-back-better-climate-change.html. Accessed 25 July 2022

United Nations, www.un.org/en/climatechange/net-zero-coalition. Accessed 26 July 2022
U. N. Environment Programme www.unep.org/resources/emissions-gap-report-2021. Accessed 25 July 2022
United Nations Framework Convention on Climate Change. https://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf. Accessed 26 July 2022
Vox, https://www.vox.com/2020/2/27/20994118/carbon-offset-climate-change-net-zero-neutral-emissions. Accessed 26 July 2022
VoxEU, https://voxeu.org/article/collapse-clean-development-mechanism. Accessed 26 July 2022
World Bank, www.worldbank.org/en/topic/climatechange/brief/pilot-auction-facility-methane-climate-mitigation. Accessed 25 July 2022
WRI, www.wri.org/research/bottom-line-offsets. Accessed 26 July 2022

The Conflict Between Paper Industry and Plastic Industry and the Future Development Prospects Under the Background of China's "Plastic Ban"

Shiyi Wang

Abstract In the current world economy, plastic material has been widely used in the packaging industry, agriculture, industry, and other fields, but because the traditional waste plastic products have not been reasonably recycled, the phenomenon of "white pollution" is becoming more and more serious. Therefore, various governments around the world have issued different degrees and different methods of plastic restrictions to solve the environmental pollution caused by disposable plastics and promote the sustainable development of the green economy. China issued its first restrictions on single-use plastic bags in 2008, and in 2021 issued the strictest plastic ban to date. In the process of policy change, the paper industry and the plastics and chemical industry have put forward their alternative plastic solutions, through degradable materials to meet consumer demand for plastic products. Because the paper products made of plant fiber are similar to the products made of PLA degradable plastics in function, the market competition between the two industries is inevitable. The literature review part of this paper will analyze in detail the industry transformation and the possible opportunities and challenges brought about by the policy changes of China and other countries to limit plastic bags. Part of the text will first analyze the paper industry and plastic industry operating status quo and reflect the impact of the "plastic limit order" on the two industries and business changes. After that, the paper straw, biodegradable mulching film, and takeout packaging will be analyzed in terms of their replacement status, advantages and disadvantages, and r&d status, and the long-term and short-term prospects of plastic substitute products will be discussed.

Keywords Plastic Ban · Industrial economy · Paper industry · Plastic industry

S. Wang (✉)
College of Economics and Management, Shanghai Ocean University, Shanghai 201306, China
e-mail: 1944141@st.shou.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_127

1 Introduction

Since China introduced its first ban in 2008, the traditional plastics industry in China has faced significant policy hurdles and competition from alternative products. For the paper industry, paper also as the main packaging material because of its good degradation ability and sustainable development ability, has become the packaging market favored direction. Therefore, the competition between the plastic industry and the paper industry for similar products arises at the right moment. How to find the balance between the two industries and the opportunities and challenges they face has become an important issue to promote the green economy.

At present, there is no similar interdisciplinary macroeconomic and industry analysis for China's plastic restriction policy, but only summarized and analyzed the advantages and disadvantages of plastic industry and paper industry in the replacement of plastic products at a micro level, and there is a scientific research gap in cross-industry interdisciplinary analysis.

This paper will research two industries use situation and could replace plastic products on the market, from the macro level to explore the conflicts between the two industries, paper products under different scenarios and the advantages and disadvantages of biodegradable plastic products, and provide a papermaking industry and plastic industry in the future development and research and development of the key direction, so as to promote the further development of China's green economy.

2 Literature Review

From the invention in the 1880s to the wide application of plastic products today, five commercial plastics, mainly polypropylene, polyethylene, polyvinyl chloride, polystyrene, and polyethylene terephthalate, have brought tremendous convenience and social and economic benefits to all aspects of life and industry of human society (Andrady and Neal 2009). Plastics can be widely used in the packaging industry, textile industry, and other industrial products.

However, due to the cheap and stable chemical properties of plastic, the discharge of "white waste" seriously affects the sustainable development of the environment and endangers human health (Ritchie and Roser 2018). Take Ireland, which has the best implementation effect of the "plastic limit", as an example (Convery et al. 2007). Since March 2002, the Irish government imposed a tax of 0.15 euro on each plastic bag purchase, which reduced the amount of plastic bags discarded by 94% in Ireland. The first restriction on plastic biodegradability was the release of THE European Standard EN 13432 for Biodegradable Materials, which requires that biodegradable plastics have the following four characteristics: 1, decay, 2, biodegradability, 3, composting process without side effects, 4, set the highest standard of heavy metal content. In 2007, The General Office of the State Council issued measures Restricting the Production, Sale, and Use of Plastic Shopping Bags, aiming at guiding consumers

to purchase and use plastic bags correctly and reasonably. After nearly 10 years of initial establishment of "plastic restriction" awareness, the fifth Plenary Session of the 18th CPC Central Committee in 2015 revised and implemented a more stringent Environmental Protection Law. Among them completed part of consumer goods "plastic limit" to "plastic ban" policy change. The latest policy on plastic bags was proposed by the Chinese government at the 75th SESSION of the United Nations General Assembly on September 22, 2020: to peak carbon emissions by 2030 and achieve carbon neutrality by 2060. Plastics are an important part of the goal of carbon neutrality because they release a lot of carbon dioxide in the waste disposal process.

In response to China's increasingly stringent restrictions on plastic use, the plastics industry is fighting the onslaught by promoting new lines of environmentally friendly plastics. (Peng and Yuan 2021) From the current mainstream development of degradable plastic materials, photodegradable plastics and biodegradable plastics have a relatively ideal development prospect.

"Plastic limit" for the paper manufacturing industry, will inevitably bring a lot of good and opportunities, but also brought many challenges (Ji 2021). At present, the main "paper instead of plastic products" at home and abroad around the disposable plastic products market, such as degradable paper-based packaging bags, tapes, paper straws, mulching film, etc. Although paper can produce a substitution effect on plastic products, plastic products are irreplaceable in some industrial industries because of their better physical and chemical properties than paper-based products, such as household appliances and automobile manufacturing industries. It is impossible to achieve the "ban on plastic" in various industries. Therefore, this paper will deeply explore the conflicts between the paper manufacturing industry and the plastic industry in the future and how to achieve "carbon neutrality" by 2060.

3 Operating Conditions of Paper Making Industry and Plastic Industry

3.1 Operating Status of the Paper Industry

Paper manufacturing industry because of its packaging paper, cultural paper, and special paper products in the fast-moving goods, residential life, industrial manufacturing, agriculture and national defense, and other fields are widely used, the scale of the world's forestry and paper companies gradually expand and effectively drive the development of upstream and downstream industries. The raw material of the papermaking industry is mainly green and low-carbon biomass fiber and recyclable waste paper. It has the characteristics of environmental protection and international sustainable development and is recognized internationally as a "never-failing" industry. In the industry, newsprint, uncoated printing writing paper, coated printing paper, household paper, packaging paper, whiteboard, cardboard, corrugated base paper, and special paper as the main components. Among them, packaging paper,

corrugated paper, and special paper can realize "replacing plastic with paper" for some products. The following will analyze the response of the paper industry status quo brought by the annual changes in production and sales volume of packaging paper and corrugated base paper.

It can be observed in Fig. 1 that since 2008, when the first "plastic limit order" was issued, both the sales volume and production volume of packaging paper showed a linear and stable growth. Compared with 2008, the production volume increased by 25.89% in total and the sales volume increased by 26.19% in total in 2020. One of the factors that determine the change in production and sales is the quantity and quality of pulp (Wu and Xu 2020), is the basic raw material, pulp and paper industry The second is the change in consumer demand brought about by relevant policy changes. Since 2008, when the Chinese government officially restricted the use of plastic bags, a growing number of plastic products, such as disposable hotel toiletries and disposable plastic packaging for restaurants, have been banned. Therefore, although many Chinese paper enterprises have experienced a reduction in the import of waste pulp since 2020, they can always achieve a gross margin of 15% in 2020 and improve the profitability of the paper industry through the remedy based on the increase in the import of wood pulp (China Packaging 2014).

Figure 2 reflects the sales volume and production volume of Corrugated base paper in China from 2008 to 2020. And packing paper of the same above shows the trend of steady rise gradually, of which 2018 experienced a substantial sales and production is falling because received foreign economic situation, the influence of the economic downturn, the market demand, economic benefits drop (China Paper Association 2019). But the following years have overcome the challenges and difficulties to restore the paper industry to an overall smooth operation.

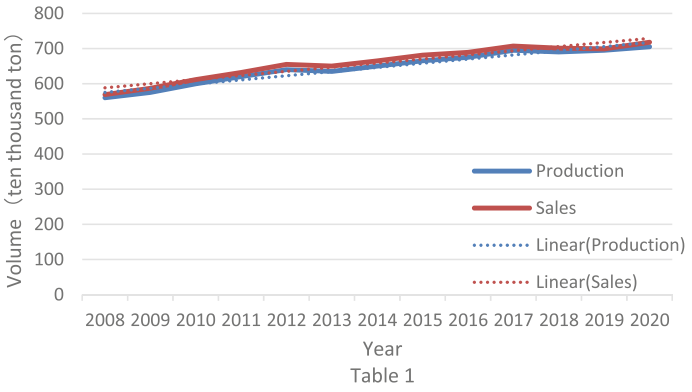


Fig. 1 2008–2020 China packaging production and sales volume

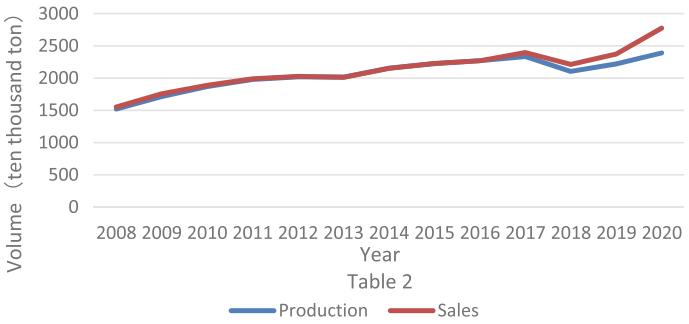


Fig. 2 2008–2020 China corrugated paper production and sales volume

The data in the table show that the sales volume and production volume of Chinese corrugated base paper increased by 57.24% and 78.87% respectively from 2008 to 2020. Such a large increase is attributed to two factors: 1. Corrugated packaging consumer products are in line with the trend of Green consumption in China. The Chinese government has shown a strong desire to achieve a green economy since before the 2008 ban on plastic bags, and even more so with a "carbon neutral plan" proposed in 2021. Therefore, as an effective "green packaging", corrugated packaging has the physical and chemical properties of being lightweight, recyclable, and easy to decompose. It can realize the advocate "replacing plastic with paper", which is in line with the needs of today's economic development. 2. Corrugated packaging industry still has huge market potential to tap. Due to several cross-industry policies in China and the healthy and rapid development of the macroeconomy, many downstream industries of the packaging industry, such as food and catering, electronic products, medicine, and daily consumer products, will have a huge reaction to the packaging industry and promote the packaging industry to generate a large number of market space.

3.2 Operating Status of the Plastic Industry

It can be found in Fig. 3 that, on the whole, the output of primary plastic in China has shown a huge increase from 2008 to now. Taking the output in 2008 as the base period, the output in 2020 has increased by 186.45% year-on-year. However, in 2009, due to changes in the international economic situation and the impact of China's "ban on plastic bags" policies, the company experienced a huge downward fluctuation, but then returned to the normal growth trend.

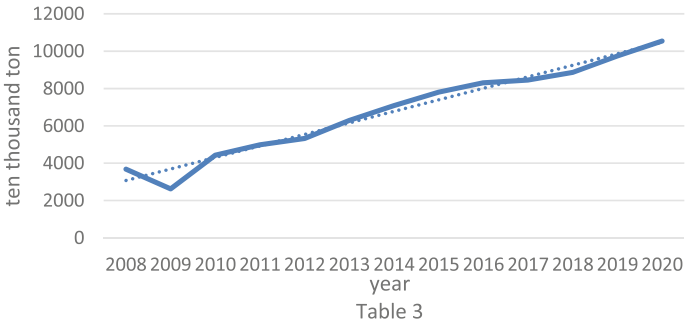


Fig. 3 Production of plastics in primary form

After the development and accumulation of China's plastic industry since the reform and opening up, its market development has formed a complete industrial chain with large scale and complete product categories. In the past five years, the annual valuation is about 10 billion yuan, which makes plastics widely used in many industries (Chen and Yuxuan 2016). The development of the traditional plastic industry has received certain impacts and challenges. Therefore, to reduce the accumulation of "white plastic" in China as a large plastic consumer, the plastic packaging in the plastic industry should gradually transform into green packaging.

However, as a major plastic producer and consumer in the world, the production reached a staggering 25% in 2019 and the consumption reached 15% of the world, but the consumption of degradable plastics was only 4.9% of the world. It can be seen that biodegradable plastics are still in their infancy in China due to the influence of scientific research and development, the high cost of biodegradable plastics, and relevant policies. However, it has a very broad development prospect under the background of the "carbon neutrality" policy (Comprehensive Utilization of Resources in China 2016).

4 Replacement Effect of Some Substitute Plastic Products

Degradable plastic has no big difference from traditional plastic in performance, but the cost is about 2 times higher, so degradable plastic packaging and paper fiber packaging with the same degradable characteristics will inevitably produce similar products competition and conflict. The paper straw, biodegradable agricultural film, and food packaging will be analyzed as follows.

4.1 The Paper Straw

At the 2018 international coffee drinks enterprise leading Starbucks began to respond to social environmental protection demand, stop using the plastic straws, worldwide by printing on plastic straw packaging with the words "to use less plastic straws greener" and at the same time the paper straw and plastic straw on the counter, guide consumers to take the initiative to choose paper straw. According to the questionnaire, 95% of Chinese consumers are willing to take the initiative to choose paper straws. (Zong et al. 2021).

It can be seen that China's ban on plastic straws has brought about a huge market demand for degradable straws, among which paper straws and PLA (polylactic acid degradable straws) are widely promoted and used, and there are certain market competition and conflict between the two. In terms of cost, the production of paper straws has a great cost advantage at present, but it still means a huge cost rise for traditional industries that give up disposable traditional straws. In 2018, a ton of traditional disposable plastic straws cost around 8000 yuan, while a ton of paper straws cost 22,000 yuan, and a ton of PLA straws cost 44,000 yuan (Zhu et al. 2022).

4.2 Degradable Mulch Film

The mulching film has been widely used in the field of agricultural product cultivation in China, which can help improve the yield of agricultural products and planting efficiency in many aspects. However, at present, the mulching film is mostly made of polymer compound plastic, resulting in increasingly serious "white pollution". The plastic film, which aims to improve the production efficiency of crops, is difficult to recover and cannot be degraded, resulting in the destruction and pollution of land organization structure and the destruction of farmland ecological environment. Therefore, In 2018, China began to promote the use of degradable agricultural film. The leading chemical enterprise Jinfa Technology Co., Ltd. took the lead in developing PLA degradable mulch film, which effectively alleviated the ecological environment of farmland and promoted the development of green agriculture.

Now the market for degradable mulching film is mainly divided into the following categories, liquid mulching film, non-woven mulching film, degradable plastic mulching film, and paper mulching film. (Chen et al. 2021) contrast biodegradable plastic film and paper film, Compared with paper mulching film, the degradable mulching film has a better replacement effect on traditional plastic mulching film because of its simple operation, convenient process, and wide applicability. Paper mulching film in the manufacturing process because of the need to plant slurry processing into paper at the same time needs to have a certain extension strength and thermal insulation function, need to add a variety of additives to complete. The addition of chemical additives is not only difficult to ensure the film's humidity

preservation and light transmission, but also causes the same environmental pollution as the traditional plastic film, while the production cost is high, so it is not suitable for commercialization.

4.3 Takeaway Packaging

In the past five years, China's takeout catering industry has developed rapidly. In 2018, the market size of the Internet catering industry increased by 112.5% year on year. The plastic takeout packaging required by the catering industry has brought many troubles to the environment. (China Packaging 2019) There are three stages in the application of takeout packaging in China: foamed plastic, PP plastic, and degradable lunch box, among which both foamed plastic and PP plastic are non-degradable plastic lunch boxes in nature. Therefore, under the dual role of China's green economic policy and consumers' enhanced awareness of environmental protection, biodegradable lunch boxes will inevitably have a huge market volume in the future.

There is a competition between PLA material meal boxes and paper meal boxes in the degradable takeaway meal box. The degradable plastic lunch boxes represented by PLA are bound to have physical properties similar to those of traditional plastic, such as hardness, waterproofness, and ductility. However, because the recycling efficiency of Chinese plastic is not high, the recycling rate of only 30% leads to the degradable PLA lunch boxes being reduced to household garbage with lower degradation efficiency. And the paper lunch box in physical nature is not as good as the plastic lunch box, such as the film paper bowl, which can not do to store high temperature or liquid food. From the consumption of environmental protection purpose, in the short term because of limited by compared with the traditional plastic boxes, biodegradable boxes of higher manufacturing costs, the degradation of paper boxes because have more friendly conditions more suitable for consumers to choose in the short term, but in the future as China plastics recycling efficiency, PLA material can be more efficient recycling, or license of degradable plastic lunch box will become mainstream.

5 Discussion

By analyzing the current operation situation of China's paper industry and plastic industry, as well as the current popularity and development prospect of substitute plastic products such as paper straws, degradable plastic film, and takeout packaging, this research analyzes the conflicts and possible future opportunities between the paper industry and plastic industry in the context of the plastic limit in China.

Through the Figs. 1, 2 and 3 related data can be concluded that China's paper industry and plastic industry at present although all at a high-speed development stage, sales and production are stable growth since 2008, but will be received because of the plastic limit policy and international economic situation changes bring a different degree of positive and negative. In this subject part of the generation of plastic products, selection of the current mainstream of three generations of plastic products on the market, among them because of the consumers for the product functional requirements and environmental protection, paper straws and take-out packaging is short for papermaking industry advantage, can put money into R&D emphatically improve product performance and expand the scale of production. Because of the inherent physical properties of paper, the degradable mulching film can provide a replacement for the traditional non-degradable plastic mulching film for the plastic chemical industry.

The conflict between the paper and plastics industries is being discussed because in China and around the world, sustainable development is being sought through a strong push for a green economy. Paper plastic replacement and degradable plastic replacement are effective ways to replace traditional plastic and reduce white waste. Compared with developed countries, China's current environmental protection industry is deficient in the low recycling efficiency of plastic, and the average garbage recycling efficiency of developed countries is between 80 and 90%, while China's is only 30%. Therefore, in the short term, the use of paper, a plant fiber material whose degradation conditions are not harsh, can better meet the needs of China's environmental protection and economy. In terms of long-term development, China needs to upgrade its industry and policies, optimize the waste recycling industry chain, improve the recycling rate of plastics, and give full play to the advantages of degradable plastics.

Due to the lack of available data, the results could not confirm the proportion of degradable plastics and paper materials to the replacement of traditional plastics with the time after the release of the plastic limit order. We can only conduct a macro analysis on the replacement of plastics through the popularity of common substitute plastics products in daily life. At the same time, this paper does not take into account the development progress of possible plasticizing materials in the future. In the future, with the development of science and technology and the evolution of products, the cost of degradable plastic and paper packaging may change greatly, which will also bring the direction of plastic replacement to the future. In the future research can be related to the industry and product statistics for plastic replacement effect of visual analysis of the process of plastic generation, so that enterprises and consumers at present the current situation of green economic development and future development trends.

References

Andrady AL, Neal MA (2009) Applications and societal benefits of plastics. Philos Trans R Soc B: Biol Sci 364(1526):1977–1984

Business analysis and future market forecast of Chinese paper industry. China Packag 1(03):20

Chen C, Ji Q, Liu Y, Wang J (2021) Hemp biodegradable film research progress. Mod Plast Process Appl (04):60–63. https://doi.org/10.19690/j.issn1004-3055.20200284

China Packaging (2019) 39(07):71–72. (in Chinese)

China Paper Industry 2018 Annual Report. China Paper Association (2019)

Comprehensive Utilization of Resources in China, 201,39(03):71

Convery F, McDonnell S, Ferreira S (2007) The most popular tax in Europe? Lessons from the Irish plastic bags levy. Environ Resource Econ 38(1):1–11

Du C, Ma Y, Wang S (2016) Modern economic information 2016(01):387. (in Chinese)

Ji X (2021) Research direction and progress of replacing plastic with paper. In: Proceedings of 2021 international paper technology conference, pp 265–282

Peng X-C, Yuan D-X (2021) Development status of degradable plastics. Qilu Petrochemical 49(04):320–324

Ritchie H, Roser M (2018) Plastic pollution. Our World Data

Wu L, Xu X (2020) Low carbon economy under the background of China's paper industry development present situation analysis. China For Econ 2020(04):35–37. https://doi.org/10.13691/j.carolcarrollnkicn23-1539/f2020.04.010

Zhao Q (2019) Comparative study on the "Plastic Ban" system between China and Europe. East China University of Political Science and Law, MA Thesis

Zhu Y, Zhang J-M, Deng J-Y, Huang J (2022) Degradable straw biomass research progress. J Pap Pap 9(01):14–20.https://doi.org/10.13472/j.PM2022.01.004

Zong X, Lang ZH, Tang YW (2021) Research report on the impact of replacing plastic straws with paper straws under the policy of "Limit Plastic Straws". Cleaning World 37(07):77–78+81

The Effectiveness Factors on Purchase Intention in the Marketing Process of Original Children's Clothing Brands

Yuran Yuan

Abstract With China's rapid economic development and cultural diversity and tolerance, the consumption habits of residents have been influenced accordingly. In terms of clothing consumption, consumers are beginning to pursue personalized and alternative designs for clothing, and China's original design clothing brands are gradually developing. As one of the original clothing brands, Jiangnanbuyi children's clothing sub-brand has been questioned and resisted by consumers due to its unique design style and concept. This study aimed to explore what factors affect purchase intention in marketing original children's clothing brands need to be noted. This paper applied Marketing Mix Theory and revied the important results of the 4Ps on consumer. Later a qualitative analysis, and SWOT analysis is used to discussed on the case of Jiangnanbuyi. The research concluded that product designs that were too innovative and ignore consumers' needs would reduce consumers' willingness to buy. Thus, when companies innovate their product design concepts and marketing programs, they need to align with consumers' perceptions and values.

Keywords Purchase intention · Original design · Marketing mix theory

1 Introduction

1.1 Research Background

In recent years, the economy of China has developed rapidly, and the level of disposable income has significantly increased; simultaneously, the society and culture tend to be diversified and inclusive. All these factors have contributed to the change in people's consumption concept. In the apparel market, consumers' demand for clothing has shown a trend of changing from mass to personalized (Wang and Wu

Y. Yuan (✉)
College of Business Administration, Huaqiao University, Quanzhou 362000, China
e-mail: yuranyuan@stu.hqu.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_128

2020). Whether in terms of clothing brand culture, design style, or fabric selection, "unique," "free," "niche," and "original" have become critical words for consumers to select and purchase clothing. This situation has created a favorable environment for developing China's local original design clothing brands. From 1995 to 2022, original design clothing brands such as JiangNanBuYi (JNBY), Rift, CABBEEN, and YES BY YESIR have emerged and set off a wave of establishing original design clothing brands in China.

Childrenswear, an essential part of the apparel industry, has undoubtedly become a market targeted by many original design brands. With the establishment of 10 emerging Chinese original design childrenswear brands such as Si Tu Veux, Wobabybasics, and JUZI STORE (http://www.bundpic.com/posts/post/55681831f032a0e68c981d55), personalized original clothing is shaping the present and future of Chinese children.

JNBY Group is an original design apparel company founded in 1994 and headquartered in Hangzhou, China, focusing on creative design, craftsmanship, and technology research and development, production, and sales of branded apparel (http://www.jnbygroup.com/).

As one of the well-known original clothing brands in China, JNBY has established jiangnanbuyi (jnby) by JNBYand POMME DE TERRE, two clothing sub-brands for children of different ages, with the design concept of "freedom, imagination, joy, authenticity" and "spontaneity, liberty, exploration" respectively, JNBY is committed to designing children's clothing with unique style, bold colors, exaggerated patterns, and high recognition (http://www.jnbygroup.com/).

According to the performance report disclosed by JNBY, in 2021, JNBY ranked first in the Chinese designer brand fashion industry in total retail sales (http://www.jnbygroup.com/). The revenue of its children's wear brand jnby by JNBY reached RMB 354,643,000, accounting for 14.3% of the brand's total revenue from June to December 2021, which played an essential part in the profitability of the whole group (http://www.jnbygroup.com/).

However, in September 2021, jnby by JNBY, a sub-brand using "originality" and "individuality" as its marketing gimmick, was caught in a storm of improper design concepts. A Chinese customer found some English phrases such as "Welcome to the hell," "Let me touch you," and strange patterns like Satan, bloody dismembered limbs of a human on her child's shirt sold by the brand (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). She expressed her doubts about the shirt's design on social media, and the post attracted widespread attention and discussion (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). Subsequently, jnby by JNBY published a letter of apology to consumers on September 23, 2021, stating that it had taken down the product line in question, provided return channels, and set up a special team to initiate a self-investigation (https://www.thepaper.cn/newsDetail_forward_14682599). However, this action did not restore consumers' favorable impression, making them wonder whether the design of the whole brand had negative cultural connotations in the deep layer.

1.2 Research Gap

Previous studies on JNBY and its sub-brands have focused on the incubation mode of operation of local Chinese designer brands, internationalization strategy, brand positioning, brand image enhancement, and Personalization marketing (Liu 2019; Jiang 2018; Wang 2016; Li 2017; Zhao 2010; Tong and Yu 2015; Chen 2021). Meanwhile, the main target of previous academic studies is the women's clothing sub-brand with the same name as the Group—JNBY, due to its high degree of popularity and recognition (Li 2017).

On the contrary, little research has been done on the marketing strategy of the group's children's apparel sub-brand—jnby by JNBY, which is in the crosshairs of public opinion. Therefore, using jnby by JNBY as an example, this research will focus on: What are the factors affecting purchase intention in the process of marketing original children's clothing brands need to be noted?

1.3 Fill the Gap

This paper will analyze the problems of the original design childrenswear brand—jnby by JNBY's marketing based on the marketing mix theory.

First, this paper will review the concept and evolution of the marketing mix theory and explore the influence of price, product, place, and promotion on customers' purchase intention. Secondly, this paper will use the method of qualitative case studies to analyze the existing marketing problems of jnby by JNBY with the help of Swot analysis tools; finally, this paper will provide marketing improvement strategies for jnby by JNBY's original design of children's clothing.

2 Literature Review

2.1 Marketing Mix Theory

Definition. Marketing mix theory is a series of tools and tactics that enterprises use to achieve marketing goals and sell their products to the targeting customers, including how to develop the products and do price fixing, where to sell the offerings, and communication and promotion progress (https://www.feedough.com/marketing-mix-4ps-7ps-of-marketing/). Marketers use these tools to implement and enhance their marketing plans to satisfy customers and reach the objectives of the organization (https://www.feedough.com/marketing-mix-4ps-7ps-of-marketing/.).

The 4Ps Mix of Marketing. In 1960, Jerome McCarthy, a professor at the University of Michigan, introduced the famous 4Ps mix in his book "Basic Marketing" (Chi

2005). The theory specifically includes the four elements of Product, Price, Place and Promotion (Chi 2005).

Taking the perspective of a company, McCarthy believes when enterprises engage in marketing activities, they should not only consider the various external environment but also make a marketing mix strategy to adapt to the changing environment, meet the needs of the target consumers, and pursue the objectives of the whole group (https://www.feedough.com/marketing-mix-4ps-7ps-of-marketing/).

From the 6Ps to 11Ps Mix. Philip Kotler, a famous American marketing scientist, added two "Ps" to the original 4Ps mix in 1986, Power and Public Relations, which is referred to as 6Ps portfolio (https://www.feedough.com/marketing-mix-4ps-7ps-of-marketing/). Subsequently, marketing theory has been refined in the practice of companies, and the 10Ps, 11Ps (Product, Price, Promotion, Place, Power, Public Relations, Probe, Partition, Priorition, Position, People) portfolio have emerged (Chi 2005).

The 4Cs Mix of Marketing. As the market competition becomes fierce, companies realize that they need to not only pay attention to the needs of customers, but also to competitors, potential competitors, suppliers and other factors (Chi 2005). At the same time, they need to analyze their own strengths and weaknesses and adopt corresponding marketing strategies (Chi 2005).

Thus, Don E. Schultz proposed the 4Rs marketing mix, which includes four elements: Relevancy, Reaction, Relation and Return (Chi 2005). Compared with the previous theories, the 4Rs mix focuses on competition and strives to obtain the maximum output with the minimum input (Chi 2005).

The 4Vs Mix of Marketing. The 4Vs marketing mix consists of four elements: Variation, Versatility, Value, and Vibration, to cultivate the core competitiveness of the company (Chi 2005).

2.2 Important Results

In this paper, the impact of each "P" on consumers' purchase intention will be analyzed based on the combination of 4Ps, widely used in marketing strategy analysis.

Product and Purchase Intention. The design and external image of products can reflect the concept and culture of a company, and a product image that meets the aesthetics of consumers can enhance product recognition and stimulate the purchase intention.

In the process of marketing by companies, a number of cases confirm this view. Cha-Yan-Yue-Se, A Chinese milk tea brand, focuses on visual design and empowers the brand through Chinese classical symbols to create an old-style brand image, forming its unique visual identity system (Zhou 2022). All of these boosts them become one of the top companies in the Chinese milk tea market (Zhou 2022). Another example, the Gu Yuan Museum of Ningxia Province, which is located in the northwest of China, integrates the elements of cultural relics into the packaging design of the culture and creative products, highlighting the characteristics of the product and attracting a number of consumers (Sun 2020). What's more, the packaging design graphics of children's toys are primarily figurative, which can increase the publicity effect at the product strategy level (Qin 2021).

Price and Purchase Intention. The discount pricing strategy can primarily attract consumers and cultivate consumption habits.

The milk tea brand Cha-Yan-Yue-Se adopts long-term single product discounts to enhance consumers' goodwill toward the brand, which can quickly form repetitive purchases (Zhou 2022). The Gu Yuan Museum attracts large number of visitors and increases the museum's cultural and creative income by offering discounts on cultural and creative products during traditional holidays (Sun 2020). Fresh food companies will offer discounts appropriately according to the storage time of ingredients, which on the one hand solves the inventory and on the other hand attracts consumers who pursue affordable prices (Lai 2020).

Place and Purchase Intention. The discount pricing strategy can primarily attract consumers and cultivate consumption habits.

When customers have many channels to purchase the products they need, the amount of helpful information they can access will become great. Meanwhile, the service quality will also improve, ultimately increasing their willingness to consume (Liu 2017). Joint marketing between online and offline channels is an excellent way to expand brand exposure and influence and increase customers' willingness to buy.

The marketing of a Chinese cell phone brand, Meitu, combines online promotion and offline store experience and has quickly formed a good reputation in the market (Zhang 2018). Moreover, the situation is quite the same in FMCG companies: ZARA has many offline stores in 77 countries, so consumers can shop offline to experience actual products and services. At the same time, customers can also choose convenient online shopping—the group has opened 22 online shopping platforms to meet the preferences of consumers who like shopping online (Ye 2021). Fresh food companies open up e-commerce channels, customers generate orders online, offline stores issue orders and staff immediately carry out sorting and distribution to meet the demand of consumers to buy fresh vegetables without leaving home (Lai 2020).

Promotion and Purchase Intention. In the context of the Internet, social media marketing can effectively build a bridge between companies and customers based on people's reliance on circle communities and herd mentality.

The Palace Museum uses a large number of fans on WeChat and Weibo (Chinese social media) platforms to create intellectual property and create hot topics to strengthen the brand awareness of the Forbidden City in the minds of consumers (Gao 2018). Cha-Yan-Yue-Se drives the consumption behavior of others through the promotion of key opinion leaders (abbreviated KOL) on social media to form a hot effect, which can constitute a virtuous purchase cycle, enhancing the promotion (Zhou 2022). Agricultural products can quickly enhance the visibility of products or enterprises through live broadcast of anchors with goods, attracting more customers and expanding market channels and increasing the share (Cai et al. 2021).

2.3 Summary

In this paper, the 4Ps marketing mix will be used to analyze the marketing strategy and problems of the original children's clothing brand jnby by JNBY.

"Product" will represent the product design concept and creativity, "Price" is the pricing strategy of jnby by JNBY, "Place" refers to its sales channels, and "Promotion" represents the marketing approach, which will be elaborated on in the paper with specific marketing events.

3 Method

3.1 Research Design

Using qualitative case studies is a well-established approach in research areas of consumer behavior. In the case of jnby by JNBY, qualitative analysis will also be used to examine what factors drive consumers—parents or other adults who need to buy children's clothing—to purchase original branded children's clothing.

Various methods are used to assess factors affecting consumers' purchase intention of original children's clothing, and each has its advantages and disadvantages. However, in this paper, SWOT analysis will be applied.

Qualitative research is a method in which the researcher uses historical review, documentary analysis, interviews, factual observations, and documentation to obtain information, analyze it by non-quantitative means, and conclude (Wang and Yang 2016). Its purpose is to make further predictions based on the description and interpretation of the natural world (Wang and Yang 2016).

SWOT analysis is a tool used to measure and evaluate the internal characteristics (strengths, weaknesses) and external environment (opportunities, threats) of a

company, and small businesses widely use it, non-profit organizations, and other types of business entities (https://asana.com/resources/swot-analysis).

SWOT analysis is systematic, emphasizing the analysis of a company's external environment and internal resources starting from the structural analysis (https://new.qq.com/omn/20200203/20200203A07HWG00.html). jnby by JNBY's problem was caused by the deviation between the design concept of the company and the perception of external consumers and society as a whole on the "elements that should be used in children's clothing design," i.e., the contradiction between the coordination of internal resources and external environment.

Many scholars have also used qualitative research and SWOT analysis in their studies of other apparel companies. SWOT analysis was used in the literature that studied the development of Chinese fast fashion brands using the Urban Revivo brand as an example (Lv and Li 2021). Qualitative research was used in the literature exploring denim garments and denim fabrics (Liu and Lin 2020).

3.2 Research Object

Brand Introduction and Development Process. jnby by JNBY is the first children's clothing brand of JNBY Group, launched in 2011. The targeting customers of the brand are children between 0 and 10 years old, and the brand's philosophy is "free imagination." With the use of contemporary art design techniques, "Freedom, Imagination, Joyful and Sincerity" is the core of the design, drawing on the interest in life, sharing art and knowledge, and conveying great values (https://www.jnbykids.com/). At the same time, it encourages parents to grow up with their children, to find a more accessible, pure, and happy communication space with parents when they are childlike, and to show children's true nature and unique talent (https://www.jnbykids.com/).

Incident Process. On September 19, 2021, a mother who was on a trip with her child found that the shirt bought for her child by other elders in the family had weird words and patterns such as "welcome to hell" and severed human limbs, which the mother thought were uncomfortable elements that should not appear on children's clothes (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). This shirt came from jnby by JNBY. The mother then posted the pictures of the clothes and tried to ask for an explanation from the brand, which also led to extensive discussion (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg).

People began searching for the brand jnby by JNBY, exploring the design philosophy behind its children's clothing (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). In the process, people found some photos on jnby by JNBY's overseas social media account; many suspected pedophilia and pornographic elements are also incorporated into the brand's clothing design: patterns of children touching their private parts, naked men and women touching and kissing each other, a child shot by millions of arrows, bleeding cartoon rabbits, and the racist words of "THE

WHOLE PLACE IS FULL OF INDIANS. I WILL TAKE THIS GUN AND BLOW THEM TO PIECES (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg)."

A few days after the incident, JNBY Group's Hong Kong share price plummeted for two consecutive days, with its market value evaporating by HK$1.9 billion (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). At the same time, China Daily, China Central Television, and other authoritative media reported the incident (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg).

On September 23, 2021, jnby by JNBY issued an official apology announcement (https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml). They claimed to have taken down all the problematic children's clothing and set up a special team to conduct a self-investigation (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). Nevertheless, at the same time, the brand also gave some explanation: jnby by JNBY upholds "free imagination" in clothing design, and as a local brand rooted in the Chinese market, it has always tried to promote the creative designs of local designers (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg). The clothes' so-called violent and bloody elements have design concepts and reference sources. For example, the text and motif of racial Indians is from a 1904 Western children's picture book, Little Nemo: Adventures in Slumberland; the motif of children touching their private parts is from a triptych by painter Hieronymus Bosch's triptych The Garden of Earthly Delights (https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg).

However, such wording did not restore consumer goodwill toward jnby by JNBY, but rather spurred condemnation of the brand from various perspectives, including business ethics, childrenswear design industry rules, and the principles and boundaries of innovative clothing design.

In addition, JNBY Group's image as a quality apparel company with "local Chinese designer original brands" has been seriously damaged by the withdrawal of the company's director from Chinese nationality and the children's clothing incident. People began to doubt JNBY Group's corporate ethics and even questioned whether its political stance was correct. As a result, JNBY Group's reputation is getting worse.

3.3 SWOT Analysis

Strength. The advantages of jnby by JNBY in Product and Place are quite obvious.

At the product level, jnby by JNBY's most significant advantage is the original clothing design. Nowadays, the phenomenon of homogeneity in the clothing industry is pronounced; different clothing brands often appear to copy the style and production of pirated brand-name clothing phenomenon. jnby by JNBY with a completely independent design system, clothing mainly rustic urban style, can be distinguished from other clothing, reflecting product differentiation.

In addition, jnby by JNBY combines online with offline stores to cover the full range of consumer purchase channels. Especially under the Corona Virus Disease 2019 (abbreviated COVID-19) epidemic, the online sales channel has played a significant role. According to the JNBY Group's interim report for 2021–2022, online channel sales increased by 12.9% in the first half of the fiscal year 2022 compared to 2021, driving the overall revenue growth of the Group (http://www.jnbygroup.com/).

Weakness. In this reputation crisis incident, Promotion is undoubtedly the biggest weakness of jnby by JNBY.

Public relations management, an essential part of Promotion, plays a vital role in jnby by JNBY's children's clothing design issues. However, the brand did not seize the critical moment of public relations management: it did not respond immediately but did not respond until the authorized media named it and asked for rectification; it is easy to see through its apology that jnby by JNBY did not understand the public's actual demand for children's clothing design, and it used "original design" as a cover and tried to change the direction of public opinion, but the result is counterproductive.

Opportunity. The transformation technology has brought to Place is an opportunity for developing for jnby by JNBY and all apparel companies.

The clothing industry gradually popularized the rapid response supply chain model to reduce costs. All clothing brands began to establish data analysis centers to collect sales data from online and offline stores and tried to set up representative pilot stores across the country (https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml).

At the same time, the apparel brands adjusted their merchandise supply model from futures ordering to a guided "futures order", "quick replenishment," and "quick response" merchandise supply model (https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml). They put the product mix into the test stores first, and if the sales response is good, they will immediately replenish the order to market, and if the sales are not good, they will stop production. It provides an excellent opportunity to develop existing apparel brands and businesses that want to enter the apparel market (https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml).

The Chinese apparel brand Li Ning is a good example. According to its disclosure, quick response merchandise accounts for about 20% of store sales, while gross margins are much higher than those for futures bulk orders, showing better control of retail discount rates (https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml).

Threaten. At the product layer, style adultization is the product design trend of children's wear in recent years (Ke 2016). Since parents make the purchase decision of children's clothing, then children's clothing brands will consciously cater to parental consumption by adding popular elements of adult clothing design, ignoring the aesthetics and preferences of children.

However, excessive adultization can cause children to lose their innocence prematurely, which is not conducive to their psychological growth. jnby by JNBY's children's clothing event is the most relevant example, whose clothing design fits the currently popular "dark style" and ignores the target group's essential characteristics.

4 Results

The advantages and disadvantages of jnby by JNBY are prominent.

Its advantages are reflected in the following points: first, the original design of the clothing is the brand's most significant advantage and the most potent gimmick for its marketing; second, combined online and offline sales channels cover a wide range of consumers groups and increase sales.

Its disadvantages are reflected in the following points: weak awareness and ability of public relations management; the bottom line of innovation of original design does not seem very clear.

5 Discussion

5.1 Factors Affecting Purchase Intention of Consumers of Jnby by JNBY

First, Price is one of the factors that influence jnby by JNBY customers' willingness to buy. The position of jnby by JNBY's offerings is in the middle to the high end of the market with relatively expensive price. At the same time, many people with extra impacts such as movie stars like to buy jnby by JNBY products for their children, making the brand's clothing synonymous with "quality" and "taste," and jnby by JNBY's brand image is enhanced by the higher pricing.

As a result, the Veblen effect occurs when jnby by JNBY's target customer base is middle to high income people—the higher the price is, the more the demand will be.

Second, as one of the most essential parts of Product, original design is the signature of jnby by JNBY and the most crucial factor that influences the brand's consumers' willingness to buy. It stimulates consumers' desire to buy by targeting their personality traits—the middle class and bourgeois parents' pursuit of quality, design, and differentiation in children's clothing—and providing uniquely designed clothes and attentive services accordingly. The jnby by JNBY has established a professional design team that belongs to its brand, and the clothing design incorporates novel ideas and unique designs that can stand out in a homogenized clothing market. Whether the brand's clothing has a sense of design and uniqueness influences the consumer's decision to buy the product or not.

At the same time, the rationality of the design concept also influences consumers' willingness to buy in the case of children's clothing with design elements considered inappropriate by children's parents (e.g., violent and gory patterns), consumers' willingness to purchase decreases significantly.

Third, Promotion plays an important role in impacting consumption willingness. The paper will discuss it from two layers: public welfare marketing and culture marketing.

Public welfare marketing refers to the marketing process of creating a quality brand image through socially responsible actions such as donations and environmental protection in order to gain consumer recognition and support (Hu 2022). It can increase the product's reputation from the psychological level and then stimulate consumers' willingness to buy so that the company can gain public support in the market competition.

In the development process, jnby by JNBY uses Public welfare marketing to win consumers' trust and influence their willingness to buy. The company is concerned about the interests of the underprivileged, and in May 2022, it held a charity event for mentally challenged children in Hangzhou, China, called "Adventure to the Stars" (http://mobile.rmzxb.com.cn/tranm/index/url/www.rmzxb.com.cn/c/2022-05-27/3125932.shtml). The brand claims it will continue to contribute to the development of children's welfare, improve the quality of life of disadvantaged children, and bring them a better childhood (http://mobile.rmzxb.com.cn/tranm/index/url/www.rmzxb.com.cn/c/2022-05-27/3125932.shtml).

Cultural marketing refers to the products produced by the company as a carrier of culture, to adapt to different environmental cultures to start marketing activities while conveying the corporate culture and philosophy (https://baike.so.com/doc/5568535-5783702.html). Through cultural marketing, companies can establish emotional bridges with consumers, attach their corporate values to original art installations, build a resonant frequency with consumers, and finally achieve a win—win situation in which consumer benefits are satisfied, and brand value is enhanced (http://science.china.com.cn/2022-03/21/content_41910968.htm).

During the Chinese New Year in 2022, JNBY Group equipped its offline stores with a series of "Grasshopper and Tiger" art installations created by traditional Chinese weaving techniques to show the public that JNBY Group is exploring and focusing on traditional Chinese culture and sustainable fashion (http://science.china.com.cn/2022-03/21/content_41910968.htm). With the nourishment of traditional culture, JNBY Group has created its unique design and then used the concept of sustainability as a link to create emotional resonance with the new generation of consumers, successfully achieving the synchronization of brand commercial value and corporate cultural value.

Fourth, Place is also a factor that should be considered when analyzing jnby by JNBY consumers' willingness to buy.

Omni-channel marketing is a way for companies to sell goods or services by integrating offline channels, e-commerce channels, and others to meet the needs of

consumers to buy at anytime, anywhere and in any way, providing customers with an undifferentiated buying experience (https://www.sohu.com/a/294691130_712775).

By enriching customer awareness of brand and product information and meeting customer demand across different channels, omnichannel marketing brings consumers closer to products. It inspires a sense of sovereignty and belonging, thereby increasing purchase intent (Wang 2022).

jnby by JNBY achieves complete contact with consumers by establishing online and offline purchasing channels. At the same time, the brand has set up pop-up shops in many first- and second-tier cities in mainland China to deliver a new concept of aesthetics that integrates art and lifestyle to the public. jnby by JNBY's omnichannel marketing allows consumers to find the products they need in any channel, bringing them the best experience and increasing their willingness to buy.

5.2 Comparison

There are differences in the case of jnby by JNBY compared with the previous studies on the factors affecting consumers' willingness to purchase.

First, price does affect consumers' purchase intention, but whether purchase intention increases or decreases when the price is increased requires consideration of the product's positioning and attributes. Unlike the milk tea and creative products mentioned above, jnby by JNBY is positioned as a mid-to-high-end original children's clothing brand. The show-off consumer psychology generates the Veblen effect—that is, when the price increases, consumer demand for jnby by JNBY products does not drop significantly, even because of the "high quality" and "status" brought by expensive clothes. "and" "status symbols" that expensive fashion brings, which increases the willingness to buy.

Secondly, the brand's marketing efforts on social media can affect people's willingness to buy, but not always positively. jnby by JNBY's case, the social media marketing and the apology letter issued to manage public relations angered consumers instead. Using social media marketing is both a risk and an opportunity.

In addition, there are similarities in the factors influencing consumers' willingness to buy. The more channels the product is available, the more practical information the consumer can receive, and the more willingness to buy will increase as the consumer's perception of the brand deepens.

5.3 Suggestion

Finding a Balance Between Design Concepts and Consumers' Cognition. One thing jnby by JNBY needs to make clear is that even if their original design of clothing is unique and novel if its design concepts conflicts with consumers' cognition and

values, they will not reap any benefits from the market. A product with a special design concept must be based on customer needs and preferences.

The design concept of the product expresses the company's attitude toward the whole society. When facing children, women's rights, and other sensitive issues, companies should empathize with consumers and deeply understand their emotional needs and expressions. At the same time, companies must integrate the cognition of consumers and design concepts to design products that inspire value recognition among target customers. If companies have and make good use of the opportunity to form emotional empathy with consumers, they have the strength to win users and facilitate the realization of successful marketing.

Improve Public Relations Management. Excessively long response time, shirking responsibility, and the measures they take did not meet the needs of customers are problems with jnby by JNBY's public relations management. The group can improve it in the following two ways:

First, enhancing cooperation with the media is a good choice for them to improve the situation.

In the technological era, the volume of information is large and fast, and the media is the most important way to spread information. By enhancing cooperation with the media, companies will be able to respond quickly when crisis communication is needed, control negative public opinion to a certain extent, and maintain the brand image.

Second, adopting a "bottom-up"—from consumers to enterprises—conversation mechanism.

Consumers' needs are the departure point of corporate activities. When the brand's reputation is damaged, enterprises should lower their posture and listen to consumers' voices to find the underlying causes of the problem, rather than standing opposite to consumers and issuing high-handed announcements and notices. Companies can establish a comprehensive consumer feedback channel, analyze the suggestions received in-depth and improve public relations management.

6 Conclusion

In the context of the rapid development of original design clothing in China, this article investigates how original clothing brands can market children's clothing in an appropriate way for the JNBY Group's children's clothing sub-brand jnby by JNBY, which emphasizes free and bold design concepts and novel marketing strategies that contradict the public's perception of children's clothing design, thus causing the brand's reputation to decline. Through the collation of the evolution of marketing mix theory and based on the traditional 4Ps marketing mix, the factors influencing consumers' willingness to purchase jnby by JNBY products are explored using qualitative analysis and SWOT analysis.

Ultimately, the paper concludes that when companies innovate their product design concepts and marketing programs, they need to align with consumers' perceptions and values. Product designs that are too innovative and ignore consumers' needs will reduce consumers' willingness to buy.

This paper analyzes the marketing mix strategy of original design children's clothing brands in China, composes the relevant literature, and verifies the practicality of the marketing mix theory in original clothing. It provides directional guidance for original apparel companies in balancing internal design, marketing concept, and external public perception. It helps them to carry out design innovation and product promotion better.

Due to the complexity of the market environment, it is impossible to extract universal influencing factors, and this paper is only based on seeking a balance between internal and external ideas in marketing, avoiding the possibility of how to convey novel or alternative ideas to the public and use marketing to make people accept them. At the same time, the suggestions for improvement made in this paper are broad and limited to other situations where conditions are relatively stable and need to be refined for direct implementation.

In the future, more cases and literature will be referred to explore marketing methods that apply to different fields of balancing internal and external corporate ideas.

References

360Baike Homepage, https://baike.so.com/doc/5568535-5783702.html. Last accessed 08 July 2022
Asana Homepage, https://asana.com/resources/swot-analysis. Last accessed 08 July 2022
Cai YL, Jiao ZZ, Jin QC (2021) Analysis of marketing strategy of Guangxi Province Mangosteen industry based on 4P theory. Mark Manage Rev 1(06):67–68
Caishang-top Homepage, https://mp.weixin.qq.com/s/8Tfg_GW6opgirFRB5pisEg. Last accessed 30 June 2022
Chen DP (2021) Research on the brand image promotion strategy of Jiangnan Buyi in the context of social media. Zhejiang Gongshang Univ. https://doi.org/10.27462/d.cnkighzhc.2021.000334
Chi GH (2005) Introduction to the development of marketing mix theory. Northern Econ Trade 3(01):45–46
Feed Homepage, https://www.feedough.com/marketing-mix-4ps-7ps-of-marketing/. Last accessed 29 June 2022
Gao Y (2018) How to integrate cultural heritage into modern life—the "Forbidden City Model" from the 4P theory. Humanity World 1(19):60–66
Hu LL (2022) The impact of public service marketing on brand development. Ind Innovation Res 1(10):78–80
JNBY Homepage, http://www.jnbygroup.com/. Last accessed 29 June 2022
Jnbykids Homepage, https://www.jnbykids.com/. Last accessed 08 July 2022
Jiang L (2018) Analysis on the internationalization strategy of JNBY brand. In: Beijing institute of fashion technology
Ke CW (2016) Analysis of the current development of China's children's clothing market. Prog Text Sci Technol 1(04):4–6
Lai LY (2020) Analysis of the marketing strategy of "Qian Da Ma" based on 4P marketing theory. Int Relat 1(02):291

Li MY (2017) Case study of International Marketing—taking Jiangnan Buyi (JNBY) as an example. Sci Technol Econ Market 1(4):195–196
Liu QH (2017) Study on the impact of integrated online and offline multi-channel service quality on customers' purchase intention. Hubei University
Liu YC (2019) Research on the incubation operation mode of Chinese local designer clothing brands——take JiangNanBuYi (JNBY) as an example. West Leather 41(8):34
Liu GM, Lin LX (2020) Qualitative analysis of the causes of broken elasticity in denim garments and denim fabrics. Dyeing Finish Technol 42(09):32–34
Lv PQ, Li R (2021) Development strategy of Chinese fast fashion apparel brands based on SWOT analysis—Take Urban Revivo as an example. Text Rep 40(02):34–35
Qin Y (2021) Optimization analysis of children's toy packaging design based on 4P marketing theory. Hunan Packag 36(03):133–135
Science China Homepage, http://science.china.com.cn/2022-03/21/content_41910968.htm. Last accessed 08 July 2022
Sina Tech Homepage, https://finance.sina.com.cn/tech/2020-09-22/doc-iivhuipp5777996.shtml. Last accessed 08 July 2022
Sohu Homepage, https://www.sohu.com/a/294691130_712775. Last accessed 08 July 2022
Sun XN (2020) Research on the marketing strategy of museum cultural and creative products based on 4P Theory—Taking Guyuan Museum as an example. Ident Appreciation Cultural Relics 2(03):140–141
Tencent News Homepage, https://new.qq.com/omn/20200203/20200203A07HWG00.html. Last accessed 08 July 2022
The Bund Homepage, http://www.bundpic.com/posts/post/55681831f032a0e68c981d55. Last accessed 29 June 2022
The Paper Homepage, https://www.thepaper.cn/newsDetail_forward_14682599. Last accessed 30 June 2022
Tong X, Yu GR (2015) Personalized marketing strategies of original clothing brands—take Jiangnan Buyi as an example. Mark Modernization 2(22):69–70
Wang S (2016) JNBY's international marketing road. Modern Econ Inf 13(19):355–356
Wang K (2022) Study on the impact of omnichannel integration on consumers' purchase intention. Pioneering Sci Technol Mon 35(02):98–100
Wang WX, Yang HJ (2016) An introduction to qualitative and quantitative research. West Leather 38(10):219
Wang K, Wu XK (2020) The power of original design and the development of China's Garment Industry. Art Obs 2(7):24–26
Xianning News Network Homepage, http://mobile.rmzxb.com.cn/tranm/index/url/www.rmzxb.com.cn/c/2022-05-27/3125932.shtml. Last accessed 08 July 2022
Ye HS (2021) Analysis of the application of 4P theory in ZARA marketing strategy. Classic Brand Mark 1(02):33–34
Zhang YF (2018) Research on the effectiveness of brand marketing based on 4P theory—take meitu cell phone as an example. J News Res 9(03):227+246
Zhao XQ (2010) Research on brand positioning and promotion strategy of Chinese clothing brand JNBY. Sun Yat-Sen University
Zhou F (2022) Analysis of the marketing strategy of Cha-Yan-Yue-Se to generation Z based on 4P theory. J Commun 3(09):12–14

Three Rounds to Ensure Japan a Smarter Vaccination Appointment System

Dongli Wang

Abstract As the initial part of the allocation, the vaccination appointment system plays a key role in the allocation of medical resources. Japan's current vaccination appointment system is based on a "first-come, first-serve" priority criterion, which is unfair to some residents, such as elderly people living alone or residents who do not know how to use the internet. The current system puts too much anxiety on people. They are always worried that the chances of getting a vaccine appointment will be taken by others who act earlier. As a result, people hoping to get vaccinated are either constantly calling or waiting for a response from their computers and smartphones. This has finally led to system congestion. This work provides a more reasonable priority criterion and redesigns a "three rounds" system that can effectively avoid the problems of the current system. The reformed system enables a more equitable and efficient distribution of vaccine appointment system.

Keywords Vaccination appointment system · Equality · Alleviating congestion · Smarter priority criteria · Flexible framework

1 Introduction

1.1 The General Background of the Market Design

Vaccine distribution is a subject in which knowledge of the market design is likely to come into play following significant advances in recent years. The matching theory is the study of finding the correct solution to problems such as "who gets what" and "who matches with whom." People who want to be vaccinated have preferences about where, when, and what type of vaccine they want to get. On the other hand, the way vaccines are distributed, the policy objectives regarding who should be prioritized

D. Wang (✉)
Department of Industrial Design, Hunan University of Technology, Hunan 412008, China
e-mail: wangdongli515@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_129

and how they should be prioritized, and how this policy objective can be achieved as much as possible within the various constraints in vaccine supply. This is what matching theory deals with. System design based on matching theory has been widely used in living kidney transplantation, the assignment of interns to hospitals, school selection, and other practical problems. Also, regarding the COVID-19 pandemic, Parag A. Pathak and his collaborators have formulated pandemic rationing of medical resources as a new application of market design (Pathak et al. 2021a).

Designing an allocation system for medical resources is not like designing any other system. It is supposed to follow several different ethical principles. These principles include equity, which is the fair distribution of benefits and burdens; utilitarianism, which is maximizing welfare; reciprocity, which is respecting contributions others have made in the past; instrumental valuation, which is respecting contributions others could make in the future; solidarity, which is fellowship with other members of society; non-discrimination, which requires that specific individual characteristics such as gender, race, and age play no role during the allocation (Pathak et al. 2021b). As part of the vaccine allocation system, the vaccine appointment system plays a crucial role in how efficiently and fairly we allocate the vaccines. Market designers must also consider the above principles when designing a vaccination appointment system.

1.2 The Current Vaccination Appointment System in Japan

Japan's current vaccination appointment system operates on a "first-come, first-serve" basis. According to the national relevant policies, the residents are divided into several age groups, and the people over 65 get vaccinated first, then the 60–64. The vaccines are allocated to a specific age group at a particular time frame, meaning in a specific time frame, there are existing residents and the residents who are left from the last period, except the first period. The "first-come, first-serve" priority criteria put too much anxiety on people. They are always worried that the chances of getting a vaccine appointment will be taken by others who act earlier. As a result, people hoping to vaccinate are constantly calling or waiting for a response from their computers and smartphones. Even after a long wait, only a limited number of residents managed to make reservations, and most of the residents either kept waiting worryingly or disappointedly gave up. If vaccines are distributed more efficiently, fairly, and smoothly, they can bring happiness to society at no cost to anyone. A more efficient and equitable appointment system is required to achieve the goals above. To further discuss the details, in the following discussion, we only focus on a single area rather than nationwide.

1.3 Main Research Question

Inefficient: the Shortcomings of the Current Vaccine Appointment System. The current vaccine appointment system is inefficient. For instance, the sudden in-flux of a substantial amount of people caused the vaccine appointment system of Yokohama City 5-h regionwide stoppages, which led to a waste of resources and inefficiency. The first-come-first-served appointment system wastes not only the residents' time but also the labor and working time of local government employees, telephone line costs, and the cost of enhancing the reservation system server. Fair-ness is an essential ethical standard for designing a medical rationing system (Persad et al. 2022). In terms of fairness, the order of precedence is also not ideal. Determine priority order on a "first come, first serve" basis, those who have family members to help them and those who have good Internet connections will be more advantageous.

With the current system, some people are more dominant than others. They are rich people, people who have a more prominent family and people with faster internet, or people who are good at using the internet (Noda 2021a). This is against one of the explicit ethical principles for rationing scarce medical resources: treating people equally regardless of their socioeconomic status (Pathak et al. 2020). Older adults without a smartphone or proficient internet skills were unfairly disadvantaged in competing for vaccination appointments. Moreover, Intensive complaints from residents who were in an inferior position urged the government to provide effective solutions.

Problematic: the Shortcomings of the Current Vaccine Appointment System. The current vaccine reservation system is on a "first-come, first-serve" basis. It is almost equivalent to telling residents that if they do not make an appointment early, the time slots will be occupied by others. Under the psychological influence, phone calls will flood in, and the website will be accessed intensively within a concise time frame as soon as the appointment channels are opened, directly resulting in a long wait or a system failure. Hotline and Internet lines will be broken down because of the overconcentration of applications. Many similar things happened in different cities in Japan during the vaccine allocation period. For instance, On May 10, 2021, the local news website "kanaloko" reported that Yokohama city was busy allocating the new Coronavirus Vaccine for the elderly. On the first day of receiving reservations, the system was paralyzed due to excessive applications, and the service was completely shut down in about 45 min. Two days later, the system started working again, but the hotline was still hard to get accessed all day (Shimbun 2021). In addition to the breakdowns caused by the congestion, another potential risk must be considered. If the appointment system continues to remain unchanged, more malicious booking agencies will emerge, and more and more agents will be hired to make the appointment for clienteles, leading to more societal issues.

A Smarter Vaccine Appointment System is Urgently Needed. The goal of the vaccination appointment system is not only just to help as many residents to get vaccinated at the time slots they prefer as possible, but also to avoid the problematic situation above and make sure every resident has no reason to com-plain about the outcome of the matching system. The system should be able to help the hospitals get as close to the target take-in number as possible (to make the most out of the resources), alleviate the current system's pressure, and avoid wasting resources. The first-come, first-served reservation system has exposed the fragility of the current reservation system, as illustrated by the abovementioned problems. The current operation rules have brought a significant burden to the appointment system, wasted resources of local governments, destroyed the fairness between vaccination volunteers, and are undesirable to society. This inefficient and unfair situation needs to be improved urgently to maintain the stable and efficient operation of society, and the problems brought by the existing system also need to be solved. The current reservation method needs to be improved on the premise of ensuring the interests of residents. We need a vaccination appointment system that is more effective in relieving the congestion of appointment booking. In other words, we need a smarter vaccine appointment system to address these issues.

1.4 A Guideline for the Rest of the Content

After the following "Literature" part, we introduce the model and describe the flow path of the reformed "three rounds" system in Sects. 1.1 and Sect. 1.2, which provide a detailed elaboration on how the "three rounds" work. In Sects. 2.1 and Sect. 2.2, we discuss how to avoid a waste of vaccines. After reflecting on the limitations of my work and visualizing the future exploration in the "Discussion" part, we finally come to an end in the "Conclusion" part.

2 Related Literature

As a notable young segment of economics, market design has grown considerably in recent years. At the same time, there has been a growing body of research on how Market Design can be applied to medical resource allocation. For example, the consensus on the rationing of medical resources is exhaustively described in papers. The literature is extensive, with the remarkable agreement that a special kind of public resource, medical resources, should be allocated according to certain ethical principles. These principles include equity, utilitarianism, reciprocity, instrumental valuation, solidarity, and non-discrimination (Pathak et al. 2021a). Guidelines for allocating medical re-sources also need to emphasize procedural values, such as accountability, reasonableness, and transparency (Dawson et al. 2020).

These ethical principles were navigated when trying to redesign the vaccine appointment system. The idea "was inspired by the wisely concept of "widening access" that the previous paper provided (Doğan and Erdil 2022). The University of Tokyo Market Design Center has been studying how to apply market design to urgent issues, such as working on finding solutions to the current problematic vaccination system (Kojima and Odahara 2021). It has also identified the shortcomings of the current vaccine appointment system at an early stage and has already tried to advise the government on it last year (Fumio and Keiichiro 2021). The rich background information and the accurate interpretation of Japan's medical allocation market are impressive. However, most of their research on the vaccine appointment system has remained a rough concept, and they have not explored and elaborated on these concepts in greater depth. For example, their study mentioned prioritizing residents by their age, lottery, etc. (Fumio and Keiichiro 2021). In their work, it is not motioned that there would be a great possibility of ties appearing. Moreover, these studies do not take a comprehensive view of the system, either focusing on changing the criteria for prioritization or not giving enough weight to some participants in the market, especially the minority groups (Noda 2021b). In contrast to previous studies, this work offers a flexible, comprehensive, and universal framework and spells out the scenario concretely. Instead of solely focusing on priority criteria, this work also considers the different participants, predominantly minority populations such as the elderly, people living alone, and people who are left from the previous round. All these make this "three-round" system brighter than the current one.

3 The Reformed "Three Rounds" System

3.1 Model

R is a finite set of residents, and T is a finite set of time slots. For each time slot t ∈ T, each time slot has q_t seats. S is a finite set of seats. for each seat s ∈ S. (i.e., each time slot t ∈ T = 30 min, and each slot has q_t seats $= \{s_{1,}s_{2,}s_{3,}s_{4,}s_{5,}s_6\} \in S$). q_t denotes the time slot capacity, which means the maximum number of residents that can be placed in a time slot.

There is no obvious heterogeneity between the seats in the same time slot. Residents report their preferences to the hospital in which they are appointed. H is a finite set of hospitals. A given time frame D a finite set of hospital H. Within the given time frame of hospital $h \in H$, ($D_h = \{\mathrm{d}_1, \mathrm{d}_2, \mathrm{d}_3\mathrm{d}_4, \ldots \mathrm{d}_\mathrm{d}\}$), the capacity of hospital h is q_h. We assume the working hours of the hospital are fixed; therefore, the daily capacity q_d is fixed. For all d ∈ D, we assume the intake target per day t_d is the same and fixed. Hence the number of available seats per day s_d is the same and fixed.

The daily intake target t_d is at most equal to the daily capacity q_d of the hospital. Within the given time frame D, the sum of all days' intake target equals the hospital capacity. That is, $\sum_{d \in D_h} t_d \leq q_h$, $\sum_{d \in D_h} q_d = q_h$.

To simplify the model, we will assume that all residents are acceptable to all the time slots in the hospital appointed, and hospitals prefer to fill their unoccupied seats to meet their capacity rather than leave the seats empty. A matching μ is an assignment of residents to time slots. Here each resident can be assigned to only one time slot. No hospital or time slot is assigned more residents than its capacity.

Formally, μ is a function μ: R $\cup$ T $\rightarrow$ R $\cup$ T such that μ(r) $\in$ T $\cup\{i\}$ for all r $\in$ R; $\mu(r) \in$ T; for all r $\in$ R, r $\in \mu(t)$ if and only if $\mu(r) =$ c; for all t $\in$ T, $|\mu(t)| \leq q_t$. Hence, $\mu(t)$ denotes the set of residents who are assigned to time slot t. Although $\mu(h)$ is not in the range of the function μ, we use it to denote the set of residents who are initially assigned to hospital h by the government, $\mu(h) = q_h$, for all $h \in$ H. The assignment for resident r is denoted by $\mu(r)$; we say $\mu(r) =$ r when r remains unmatched in any time slot. Each resident r $\in$ R has a strict preference ranking $\succeq_r$ over T $\cup \{r\}$. A time slot is acceptable to r if t $\succ_r r$. Each time slot ranks its applicants from the most preferred to the least based on their date of birth. Here we denote the preference ranking by $\succ_t$.

q_t denotes the time slot capacity. If r is ranked in the top q_t, we say r gets matched with time slot t in μ. The applicants who did not get matched go to their next preferred time slot (if there is any) and compete with other applicants. If not, either she/ he chooses to go into the "walk-in" round or automatically enter the next period (The special access and walk-in" round will both be available for them).

3.2 The "Three Rounds" Vaccination Appointment System

Although the specific procedures might slightly vary from district to district, we can illustrate a general flow path of the reformed vaccination appointment system.

Main Round. When the local government asks people to report their preferences before the vaccine allocation starts, the residents report their preferred time slots from the most to the least, given their criteria (There is no limitation to the number of preferences). In the first (primary) round, participants who apply for the same time slot are ordered based on their date of birth. For all slot t $\in$ T, all r $\in$ R. The preferences of reporter r_1, r_2, r_3, r_4, r_5, r_6, r_7 are as shown in Table 1.

The hospitals collect the residents' preferences before they start rationing the time slots for vaccination. The date of birth of the reporters r_1, r_2, r_3, r_4, r_5, r_6, r_7 are (see Table 2).

Table 1 The preferences of the reporters

r_1	r_2	r_3	r_4	r_5	r_6	r_7
t_1	t_1	t_1	t_1	t_1	t_1	t_1
t_2	t_2	t_3	t_2	t_3	t_3	t_2
t_3	t_3	t_2	t_3	t_2	t_2	t_3

Table 2 The date of birth of the reporters

r_1	r_2	r_3	r_4	r_5	r_6	r_7
December 12 1950	December 13 1950	November 12 1950	October 9 1949	May 10 1949	May 10 1948	October 9 1951

r_1 = December 12, 1950, r_2 = December 13, 1950, r_3 = November 12, 1950, r_4 = October 9, 1949, r_5 = May 10, 1949, r_6 = May 10, 1948, r_7 = October 9, 1951, then we rank $r_6 > r_5 > r_4 > r_3 > r_1 > r_2 > r_7$.

For each time slot t ∈ T, has $q_t = 6$ seats.

All residents are acceptable if r ≤ q_t,

$$\mu(t_1) = r_1, r_2, r_3, r_4, r_5, r_6 \tag{1}$$

r_7 go to the next preferred time slot and compete with other applicants. The capacity of time slot t is q_t, and the participants who get matched with t go automatically into the "got in" round. If the residents did not get matched with any of the acceptable time slots after all (either r_7 ranked lower than the top 6 or t is not acceptable for r_7), they could choose either going to the "walk-in" round or entering the following time frame if they are still willing to participate.

"Got In" Round. In the "got in" round, the order of getting vaccinated among the residents in the same time slots will be determined by the order in which they turn the sheet in. For instance, the order of the decision-making would be r_1,r_2,r_4, r_6, r_3, r_5 if the order of them turning the sheet in is $r_1 > r_2 > r_4 > r_6 > r_3 > r_5$. That is how we break the potential ties. This actually can also avoid time waste (for instance, r1, r2, and r3 belong to the 12:00–12:30 pm time slot, all of them are supposed to arrive 5 min before 11:00 am filling out the sheet or waiting to turn in the sheet. All of them arrived on time except r3. In this case, r3 could still have the chance to get vaccinated if he/she arrives before 12:25. If not, he/she is automatically assigned to the walk-in round unless he/she chooses to participate in the next time frame). Instead of adopting the original priory orders, reranking the residents in the "got in" round allows some room for people who are late for the appointment and creates more potential acceptable matching results. For hospitals, it saves the time they spend waiting for the belated residents; therefore, an efficiency improvement is expected. The residents who missed the appointment still get to choose to go to the "walk-in" round or enter the following time frame. The residents who choose walk-in rounds can walk to the hospitals that have vacancies without a previous appointment.

"Walk In" Round. After the main round, some left residents (low ranking, did not get matched with any of their preferred time slots in the main round) who later found unscheduled spare time to go to the hospital. The residents who are left from the last period and the "newcomers"—residents who suddenly changed their minds and decided to get vaccinated. If there are any vacancies q_v, if she/he is among the highest-ranked q_v acceptable residents among those "walk-in" residents, then she

gets the seat. The priority order is determined by the number of cards they take when they arrive at the hospital (first come, first serve). In this round, the initial residents always ranked higher than the walk-in residents. Sometimes, vacancy also appears when the initial residents are absent from the time slot. In this case, the seat will be assigned to the "newcomers", and the initial resident still gets to choose to go into the walk-in round later. This is to divide the total resource into several categories and consider rationing for these smaller numbers of units separately (Pathak et al. 2020).

3.3 How to Avoid the Waste of Vaccines

One often mentioned concern is the waste of vaccines caused by immature systems that lack careful observation of the specific markets. For example, even if markets are all facing the problem of congestion, there is a tremendous possibility that the cause and the final solution for the problematic markets are entirely different since they have their unique market background and distinct market environment. To provide novel, practical solutions to the markets' problems. Market designers must dive into the target market and try to comprehend the distinctions that make the diverse kinds of markets function properly or poorly (Roth 2007). Since vaccines do not work im-mediately after vaccination, it is crucial to consider the possibility that vaccination may lead to an over-concentration of people who are at risk of becoming severe. In addition, some COVID-19 vaccines are stored in a frozen state and need to be dis-solved before vaccination, so the number of vaccines must be estimated beforehand and prepared according to the number of patients. Therefore, a proper appointment system must be established to avoid vaccine waste and carry out the whole vaccine rationing process effectively. For vaccines for COVID-19, there are several companies offering vaccines made in different ways. As shown in Table 3, Japan has been using four different vaccines supplied by different manufacturers. The four vaccines vary from each other in unit size and storage condition (see Table 3).

A Unified Appointment System to Deliver the Information Promptly. A higher injection rate can be expected if empty time slots are filling up quickly. On the other hand, if the detailed information about the vacancy is not delivered to the public promptly, efficiency will be reduced. Whether it is easy for residents to spot vacancies depends on how the reservation system is designed. In general, individual vaccinations are managed independently by individual medical institutions. In this way, even if you call medical institution A, you can only confirm the availability of medical institution A, but not of medical institution B. If this situation is over-looked, there is a considerable risk that the vaccination rate will decrease due to the lack of information on vacancies and that the time spent finding vacancies will in-crease. For medical institutions, telephone contact with citizens has increased, resulting in system congestion and higher labor costs. The best way to increase the efficiency of information dissemination is to have a unified reservation management system.

Table 3 The unit sizes and storage conditions of the four vaccines used in Japan (Noda 2021c)

	Pfizer	AstraZeneca	Moderna/Takeda
Storage temperature	− 75 ± 15 °C	2–8 °C	− 20 ± 5 °C
Unit of 1 vial	5 doses/vial	10 doses/vial	10 doses/vial
Minimum distribution unit (Minimum quantity delivered to vaccination sites at one time)	195 vials (For 975 inoculations)	10 vials (for 100 inoculations) Initial supply of 3 million vials	2 vials (for 20 inoculations) Remaining 9 million vials 10 vials (10 vials (for 100 inoculations)
Storage conditions after opening the vials	(Thaw at room temperature and dilute with saline solution prior to inoculation) 6 h at room temperature after dilution (once needle inserted and thereafter) 6 h at room temperature	48 h at 2–8 °C No dilution required (after once the needle is inserted)	6 h at 2–25 °C (No refreezing after thawing) No dilution required

With a unified system to manage appointments, there is no need to make multiple phone calls. For example, a unified booking website can be used instead of calling hospitals to see where places are available.

A Prior Information Gathering to Better Predict Vaccine Demand. By collecting citizens' preferences before opening vaccination lanes, we can better match residents with their favorite times based on specific criteria and better predict vaccine demand because the citizens who are not willing to participate in the vaccine at this time will not submit their preferences.

The "Walk-In" Round to Widen Access for Alternates. With Round 2, this work is widening access for potential alternates and providing them an easier way to partici-pate in vaccinations. Those spaces left open in Round 1 will be filled by these alter-nates, which means that medical resources, such as vaccines will be fully utilized.

The Special Access for the Residents from the Last Time Frame. Residents who are left from the previous time frame will be given the right to get vaccinated through special access. Prioritizing these residents is not only to improve the vaccination rate and avoid a waste of vaccines but also is in line with our principle of giving priority to the elderly.

4 Discussion

In the work, we emphatically discussed how to through the new system to solve some problems before the system and make it more fair, reasonable, and efficient. In designing the system's rules, the work also considers prioritizing and how to give priority to the vulnerable elderly and the residents who are left behind. However, there is still a minority group that further research needs to pay attention to pregnant women. Due to the exceptionally physical condition of pregnant women, we must consider the potential problems and provide them extraordinary care. On some points as the physical condition examination before the injection, the length of the post-observation time, and observation standard after injection, pregnant women need to be taken differently from non-pregnant. More importantly, be prepared to deal with adverse reactions in pregnant women after vaccination. In reality, every hospital only has a limited capacity and limited medical facilities, especially for particular patients. In other words, not every hospital is capable of vaccinating pregnant women. In addition, future studies should pay close attention to scientific re-search related to pregnant women vaccination and update our knowledge base at any time.

5 Conclusion

Prior work has documented how we can make the current vaccine appointment system more equitable, efficient, and reasonable. For example, prioritizing the residents based on their date of birth alleviates congestion and avoids other problems the current system brings about. The "three rounds" contributes several desirable traits. Firstly, it satisfies fairness; instead of problematic sort criteria, we provide priority criteria not affected by wealth, social status, etc., which effectively avoids problems like system congestion and the potential illegal agency problem. Secondly, it is strategy-proof, it assigns residents their most preferred result based on a fair priority criterion, and there is no incentive for residents to act any strategic manipulation. Last but not least, it satisfies efficiency. Moreover, the "three rounds" describe a universal framework for the medical resource allocation problems, which can be used in various applications. With this basic framework and a sure grasp of the de-tails of the specific markets, a smarter system can be achieved undoubtedly.

References

Dawson A, Emanuel EJ, Parker M, Smith MJ, Voo TC (2020) Key ethical concepts and their application to COVID-19 research. Public Health Ethics 13(2):127–132

Doğan B, Erdil A (2022) Widening access and managing recruitment with smart targets. https://ssrn.com/abstract=4045704

Fumio O, Keiichiro K (2021) Urgent proposal for dramatic improvement of vaccination reservation. https://toyokeizai.net/articles/-/429226

Kojima F, Odahara H (2021) Toward market design in practice: a progress report. Jpn Econ Rev 73:467–480

Noda S (2021a) Desirable vaccine distribution based on matching theory (special feature creating a social mechanism with economics). Nihon Hyoronsha (The Keizai Seminar) 720:31–35

Noda S (2021b) Vaccine reservation in Japan is defective. Common points with buying up the toilet paper.https://www.asahi.com/articles/ASP5D55G9P5DULBJ00J.html

Noda S (2021c) COVID-19 Vaccine allocation plan and matching market design.https://www.mdc.e.u-tokyo.ac.jp/overview/disaster-relief/covid-19-vaccine/

Pathak PA, Sönmez T, Ünver MU (2021b) Reserve systems for allocation of scarce medical resources during the COVID-19 pandemic: the path from April 2020 to April 2021. Chest 160(4):1572–1575

Pathak PA, Sönmez T, Ünver MU, Yenmez MB (2020) Triage protocol design for ventilator rationing in a pandemic: integrating multiple ethical values through reserves. https://www.nber.org/papers/w26951

Pathak PA, Sönmez T, Ünver MU, Yenmez MB (2021a) Fair allocation of vaccines, ventilators and antiviral treatments: leaving no ethical value behind in health care rationing. In: Proceedings of the 22nd ACM conference on economics and computation. Budapest Hungary, pp 785–786

Persad G, Pathak PA, Sönmez T, Ünver MU (2022) Fair access to scarce medical capacity for non-covid-19 patients: a role for reserves. BMJ 376:o276

Roth AE (2007) The art of designing markets. Harv Bus Rev 85(10):118

Shimbun K (2021) Vaccine reservation confusion in Yokohama: Indignant elderly people, people without smartphones are refugees. https://www.kanaloco.jp/news/government/article-496290.html.

Tourism Prediction in Canada and the US Based on a Modified GM (1, 1) Model Considering COVID-19 Effect

Dongting Yang and Jinjin Yang

Abstract Widespread COVID-19 has brought obvious loss for tourism. Accurate tour-ism forecasting is necessary for future tourism planning. It is tested that grey theory based technique is suitable to describe the uncertain systems. Therefore, the GM (1, 1) model whose background parameters are optimized through the Harmony Search theory is adopted to predict tourism for Canada and the US. The obvious advantage of GM (1, 1) is the ability to handle a small sample with less information. For the original GM (1, 1), the back-ground parameter value is usually chosen a fixed value 0.5, the presented model in our work prefers the adaptive vector α with the aim to improve the forecasting accuracy. And the presented HS optimization GM (1, 1) model is applied for the tourism prediction for Canada and the US. The experimental results are satisfactory, which could also indicate the effect of COVID-19 on tourism to a certain degree.

Keywords Tourism prediction · Grey theory · GM (1, 1) · Harmony search algorithm

1 Introduction

According to the reports, COVID-19 has significantly affected the global economy and human life. While many industries such as the delivery industry and online shopping are enjoying the opportunity brought by the pandemic, some of the other, for example, the tourism industry, are suffering a heavy blow. In order to minimize the influence and eliminate the wide spread of varus, most countries or regions all over the world have established rigid travelling restrictions and many scenic spots have already closed.

D. Yang (✉)
University of Toronto, Mississauga, ON L5L 1C6, Canada
e-mail: dongting.yang@mail.utoronto.ca

J. Yang
University of Toronto, Scarborough, ON M1C 1A4, Canada

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_130

As the major tourist countries in North America, the United States and Canada have been affected by the epidemic. According to the data of the International Air Transport Association, the revenue of the global aviation industry in 2020 will be 55% lower than that in 2019. According to Oxford Economics, the U.S. tourism industry alone will lose $519 billion due to the restrictions and limitations. At the same time, a recent analysis by the Toronto Tourism Bureau of Canada said that the tourism industry in Toronto lost 8 billion 350 million Canadian dollars in 2020, due to the reduction of tourists and the cancellation of a large number of international conferences in COVID-19. Furthermore, the loss due to the restriction will increase to more than $14 billion if the Great Toronto Area is included. As a result, it is necessary to predict the tourism demand to make a reasonable suggestion for national or local government.

As one of the indexes to evaluate the tourism demand, the tourists' interest level is fundamental to analyzing the composition of the tourism economy, to make tourist destinations, and it is a benefit for countries or regions to better know tourism demand and changes in the tourism market. Therefore, in our work, the tourism interest level in Canada and the US is chosen as research objects to predict the tourism future trend and to evaluate the possible effect of COVID-19 on the tourism industry.

2 Methodologies

2.1 GM (1, 1) Model

Grey theory is the basis of the grey prediction technique, which is established by Professor Deng (1989). Grey prediction models which belong to statistical methods have been widely used in many fields of engineering, energy system, economic system, social science, etc. (Zhang et al. 2019; Akay and Atak 2007; Wang and Le 2019; Jin et al. 2012). The GM (1, 1) model has been frequently used for prediction with the advantage of dealing with small samples and uncertainty (Deng 1982).

The main concept of GM (1, 1) is changing the original data series with random trends into first-order accumulated addiction series, which could show an exponential growth trend. Suppose the original data series $x^{(0)} = \left\{x^{(0)}(1), x^{(0)}(2), x^{(0)}(3), \ldots, x^{(0)}(n)\right\}$ with irregular distribution. Based on $x^{(0)}$ the first-order accumulated generating operation (AGO) sequence can $x^{(1)}$ be generated. Shown as Eq. (1):

$$x^{(1)} = \left\{x^{(1)}(1), x^{(1)}(2), x^{(1)}(3), \ldots, x^{(1)}(n)\right\} \tag{1}$$

where $x^{(1)}(i) = \sum_{k=1}^{i} x^{(0)}(k), i = 1, 2, \ldots n$

As $x^{(1)}$ introduced above, GM (1, 1) first-order differential (FOD) equation is shown as below:

$$\frac{dx^{(1)}}{dt} + ax^{(1)} = b \tag{2}$$

In the above equation, instead of remaining the same, the background parameter $x^{(1)}$ is now replaced by the equal weight moving average of $x^{(1)}$ for the adjacent two-time points. The new $x^{(1)}$ is calculated as Eq. (3).

$$x^{(1)} = \left(x^{(1)}(k+1) + x^{(1)}(k)\right)/2 \tag{3}$$

The coefficients a and b in Eq. (2) are the interim parameters which can be calculated through OLS algorithm, which is written as Eq. (4).

$$\hat{a} = \begin{bmatrix} a \\ b \end{bmatrix} = \left(B^T B\right)^{-1} B^T Y \tag{4}$$

where $Y = \begin{bmatrix} x^{(0)}(2) \\ x^{(0)}(3) \\ \vdots \\ x^{(0)}(n) \end{bmatrix}$, $B = \begin{bmatrix} -\frac{1}{2}\left[x^{(1)}(1) + x^{(1)}(2)\right] & 1 \\ -\frac{1}{2}\left[x^{(1)}(2) + x^{(1)}(3)\right] & 1 \\ \vdots & \vdots \\ -\frac{1}{2}\left[x^{(1)}(n-1) + x^{(1)}(n)\right] & 1 \end{bmatrix}$

Equation (5) represents the time response whitening function (Eq. (2)):

$$\hat{x}^{(1)}(k) = \left(x^{(0)}(1) - \frac{b}{a}\right)e^{-a(k-1)} + \frac{b}{a} \tag{5}$$

Finally, in order to obtain the grey theory-based predicting model for the original sequence $x^{(0)}$, the inverse-AGO (IAGO) process is employed. Shown as Eq. (6).

$$\hat{x}^{(0)}(k) = \hat{x}^{(1)}(k) - \hat{x}^{(1)}(k-1) = \left(1 - e^{a)}\right)\left(x^{(0)}(1) - \frac{b}{a}\right)e^{-a(k-1)} \tag{6}$$

2.2 *Optimized GM (1, 1) Model*

In this section, the proposed optimized GM (1, 1) model is described in detail. In our work, the GM (1, 1) is combined with HS optimization technique in order to build the HS-based GM (1, 1) forecasting model. HS belongs to meta-heuristic optimization, pioneered by Geem et al. (2001). The meta-heuristic optimization imitates the music players' improvisation to pursue the perfect status of harmony and is amazingly effective with multiple-optimization problems.

Before moving to the next step, it is necessary to modify the background value in the traditional GM (1, 1) model. To make the model more reliable, instead of simply dividing the value in half (Like Eq. (2)) and getting the average, the parameter α is added in order to make the calculation more accurate. The modified formula for the background value $x^{(1)}$ should be written as Eq. (7).

$$x^{(1)} = \alpha x^{(1)}(k) + (1-\alpha)x^{(1)}(k+1) \tag{7}$$

where $\alpha = 1/\beta - 1/(e^{\beta}-1)$. When $\beta \to 0, \alpha \to 0.5$ As $|\beta|$ becomes smaller, α gets closer to 0.5; As $|\beta|$ increases in its value, α deviates from 0.5. Since the value of α is fluctuated as the value of $\beta \to 0$ changes, it is not suitable to take α as a constant value of 0.5. As a result, the background value vector $\alpha = (\alpha_2, \alpha_3, \cdots, \alpha_k, \cdots, \alpha_n)$ is introduced to represent an adaptive value instead of 0.5. Then matrix B is written as Eq. (8):

$$B = \begin{bmatrix} -\alpha_2 x^{(1)}(k) + (1-\alpha_2)x^{(1)}(k+1) & 1 \\ \alpha_3 x^{(1)}(k) + (1-\alpha_3)x^{(1)}(k+1) & 1 \\ \vdots & \vdots \\ \alpha_n x^{(1)}(k) + (1-\alpha_n)x^{(1)}(k+1) & 1 \end{bmatrix} \tag{8}$$

The purpose of optimization GM (1, 1) is how to determine vector $\alpha = (\alpha_2, \alpha_3, \cdots, \alpha_k, \cdots, \alpha_n)$ s. Through the Harmony Search optimization technique, the adaptive α vector can be determined. The concrete procedures are as follows.

First, to initialize the optimized issue and algorithm parameters.

$$\begin{aligned} &\text{Minimize } f(x) \\ &s.t.\ x_i \in X_i \quad i = 1, 2, \ldots, N \end{aligned}$$

where $f(x)$ is the objective function, and the x is the set of variable (x_i). X_i is the range of the possible value boundary of (x_i) and i represents the number of (x_i) which ends with N.

The second step is to initialize the Harmony Memory (HM). HM matrix contains a certain amount of solution vectors that are randomly generated. These solution vectors have the same amount as the harmony memory size (HMS) and are sorted by the values of $f(x)$.

The third step is to generate the novel harmony and the HM could be updated with the suitable one. The novel harmony vector (HV) can be improvised through three rules: pitch adjustment, memory consideration and a random selection. The newly generated HV will be compared to the worst HV in terms of the objective function. Once the new-generated HV is determined to exceed the existing worst HV, it will then expel the existing worst harmony. This step will repeat until the termination criterion is met.

3 Data

In this section, the HS-GM (1, 1) model is used to forecast the tourism interest level in Canada and the U.S. to test the possible influence of epidemic disease on the tourism industry. The original data of tourism interest levels for Canada and the US were collected from a web of Google Trends (https://trends.google.com/trends/?geo=CA), shown in Tables 1 and 2.

Figures 1 and 2 show the main trends of tourism interest levels in Canada and the U.S., which shows an obvious fluctuating feature in recent two years. To test whether

Table 1 Original data of tourism interest level in Canada

	2016	2017	2018	2019	2020	2021
Jan	100.00	147.55	166.08	211.40	202.70	98.95
Feb	110.46	129.18	175.84	192.25	212.38	82.92
Mar	99.54	160.60	169.24	163.64	110.27	108.37
Apr	99.93	136.15	179.52	177.23	41.29	119.62
May	101.24	141.69	172.48	182.92	67.07	89.29
Jun	119.80	143.09	209.05	194.02	127.03	152.90
Jul	137.31	195.99	243.67	258.03	190.23	231.93
Aug	133.60	214.81	266.82	279.57	161.85	220.31
Sep	114.64	146.89	182.46	213.61	105.29	112.43
Oct	102.99	136.79	166.46	161.16	74.11	105.41
Nov	90.29	126.48	143.26	161.72	64.08	82.10
Dec	86.15	105.55	145.70	125.48	61.58	66.07

Table 2 Original data of tourism interest level in the U.S.

	2016	2017	2018	2019	2020	2021
Jan	100.00	128.01	153.84	186.42	200.66	157.51
Feb	113.58	129.39	168.46	201.35	207.23	172.34
Mar	115.24	161.12	189.06	210.73	145.96	209.28
Apr	110.41	157.58	169.27	192.06	76.12	203.51
May	135.18	160.95	189.54	199.84	139.82	214.83
Jun	156.87	174.08	213.14	241.80	187.15	245.80
Jul	142.18	188.32	218.33	238.30	182.26	230.76
Aug	126.20	179.49	206.19	211.63	164.53	187.75
Sep	116.94	143.35	179.93	174.51	142.98	176.03
Oct	107.18	126.51	152.64	159.34	133.09	134.80
Nov	94.57	119.69	149.24	146.58	100.06	120.11
Dec	102.13	117.27	138.26	154.32	126.06	131.79

it is suitable to apply the GM (1, 1) model, 1-AGO of data series should be calculated first, which shows exponent increasing trend.

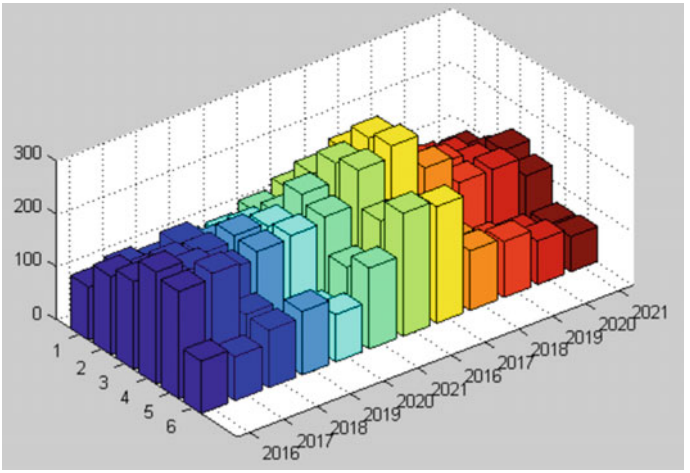


Fig. 1 Data trend of tourism interest level in Canada

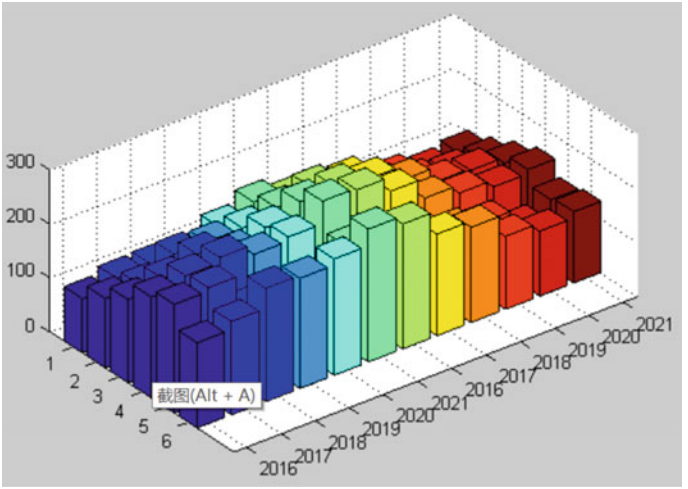


Fig. 2 Data trend of tourism interest level in the U.S.

4 Simulation and Predicted Results

The parameters of HS algorithm are set: HMS (harmony memory size) = 5, PAR (pitch adjusting rate) = 0.6, HMCR (harmony memory considering rate) = 0.99, Max (maximum iteration number) = 700, lw = 0, uw = 1. The population variance (bandwidth) is fixed without considering the various phases of the algorithm, so it is not necessary to have different bandwidth values for a more satisfactory searching performance. In order to take advantage of the HV information and make parameters initialization reduction, the novel HV is joined to calculate the bandwidth value as according to Eq. (9).

$$\begin{aligned} x'_{ijnew} &= x_{ijnew} + \left(UB_j - x_{ijnew}\right) \times Rand(0,1) \quad Rand(0,1) > 0.618 \\ x'_{ijnew} &= x_{ijnew} - \left(x_{ijnew} - LB_j\right) \times Rand(0,1) \quad Rand(0,1) \leq 0.618 \end{aligned} \tag{9}$$

where x'_{ijnew} is the novel HV after pitch adjusting, x_{ijnew} is the HV before adjusting, UB_j is the upper bound of x_{ij}, LB_j is the corresponding lower value, i is the number of harmony in HM, and j is the number of variables. Equation (9) shows x'_{ijnew} considering pitch adjusting technique is limited in the possible extent of x_{ij}, then sloping overestimation is resolved.

Tables 3 and 4 represent the predicted data of Canada and the U.S. respectively.

Figure 3 shows the monthly predicted tourism interest level for Canada and the U.S. in 2022, which could indicate the situation tourism industry will face due to COVID-19. In a short period, the tourism interest needs more time to recover.

To ensure the result is more reliable, the posterior-variance test (PVT) and small error probability test (SEPT) were also adopted for the presented model. The PVT was transplanted from the probability prediction method, which is a statistical state

Table 3 The predicted data of Canada

	2016	2017	2018	2019	2020	2021	2022
Jan	100.00	175.97	168.76	161.85	155.21	148.85	142.75
Feb	110.46	180.98	167.2	154.46	142.7	131.83	121.79
Mar	99.54	168.54	150.92	135.15	121.02	108.37	97.04
Apr	99.93	160.17	139.59	121.66	106.03	92.41	80.54
May	101.24	164.9	141.46	121.34	104.09	89.29	76.59
Jun	119.8	174.04	168.49	163.12	157.92	152.88	148.01
Jul	137.31	212	216.81	221.74	226.78	231.93	237.2
Aug	133.6	235.8	231.83	227.92	224.08	220.31	216.6
Sep	114.64	185.04	163.37	144.24	127.35	112.44	99.27
Oct	102.99	149.61	137.07	125.58	115.05	105.41	96.57
Nov	90.29	142.11	123.9	108.02	94.17	82.1	71.58
Dec	86.15	131.53	110.73	93.22	78.48	66.07	55.62

Table 4 The predicted data of U.S.

	2016	2017	2018	2019	2020	2021	2022
Jan	100.00	142.96	153.83	165.53	178.13	191.68	206.26
Feb	113.58	157.14	168.46	180.59	193.59	207.54	222.48
Mar	115.24	161.12	170.81	181.08	191.98	203.52	215.76
Apr	110.41	157.59	158.48	159.38	160.28	161.18	162.09
May	135.18	160.94	170.17	179.92	190.23	201.13	212.66
Jun	156.87	174.08	189.76	206.86	225.49	245.8	267.94
Jul	142.18	188.95	198.63	208.81	219.51	230.76	242.58
Aug	126.2	191.53	190.58	189.63	188.69	187.75	186.82
Sep	116.94	149.16	155.4	161.9	168.67	175.73	183.08
Oct	107.18	145.66	143.04	140.47	137.95	135.47	133.04
Nov	94.57	132.61	129.37	126.21	123.12	120.11	117.17
Dec	102.13	134.89	134.15	133.41	132.68	131.94	131.22

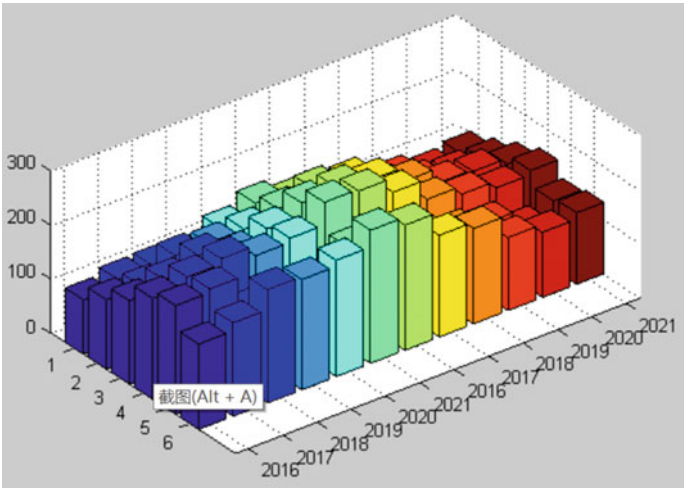


Fig. 3 The monthly predicted tourism interest level for Canada and U.S. in 2022

assessment technique between actual data and forecasting results (Deng 1982). The posterior-variance test divides the root mean square (RMS) of the variance for residuals by RMS of actual data's variance so as to calculate ratio between forecasting data and original data. The equation is shown as Eq. (10).

$$C = \frac{S_2}{S_1} = \frac{\sqrt{\frac{1}{m}\sum_{k=1}^{m}(\varepsilon(k)-\bar{\varepsilon})^2}}{\sqrt{\frac{1}{n}\sum_{k=1}^{n}\left(x^{(0)}(k)-\bar{x}\right)^2}} \tag{10}$$

where S_1 is RMSV for actual data and S_2 is RMSV for residuals.$\varepsilon(k)$ is the difference for the period k. $\overline{\varepsilon}$ is the mean of the residuals. $x^{(0)}(k)$ is original data for the kth period. $\overline{x}$ is the mean of original sequence.

The Eq. (11) below presents the smaller value probability error:

$$P = P\{|\varepsilon(k) - \overline{\varepsilon}|\} < 0.6745S_1 \tag{11}$$

Based on Eq. (10), the proposed Harmony Search optimization GM (1, 1) model belongs to the "Good" level.

5 Conclusion

To test the possible influence of COVID-19 on the tourism industry in Canada and U.S., the HS optimization based GM (1, 1) prediction model is adopted in this paper. The HS optimization algorithm is used to optimize the background parameter through optimizing the MAPE function. Using the monthly data from 2016 to 2021 for Canada and U.S., the predicted data of monthly tourism interest level are obtained, which demonstrated that the epidemic effect would affect the tourism industry at a certain time.

References

Akay D, Atak M (2007) Grey prediction with rolling mechanism for electricity demand forecasting of Turkey. Energy 32(9):1670–1675

Deng J (1982) Control problems of grey system. Syst Control Lett 1:288–294

Deng JL (1982) Control problems of grey system. Syst Control Lett 1(5):288–294

Deng JL (1989) Introduction to grey system theory. J Grey Syst 1(1):1–24

Farmaki A, Miguel C, Drotarova MH, AleksiÃ A, Casni AC, Efthymiadou F (2020) Impacts of Covid-19 on peer-to-peer accommodation platforms: host perceptions and responses. Int J Hosp Manag 91:102663

Geem ZW, Kim JH, Loganathan GV (2001) A new heuristic optimization algorithm: harmony search. Simulation 76:60–68

Google Trends. https://trends.google.com/trends/?geo=CA

International Air Transport Association. https://www.iata.org/

Jin QH, Zhang BB, Lv XJ (2012) Population projections on the base of model GM(1,1). J Sichuan Univ Arts Sci 5:7–9

Toronto Tourism Bureau of Canada. https://cbc.radio-canada.ca/

Wang C-N, Le AP (2019) Application of multi-criteria decision-making model and gm (1, 1) theory for evaluating efficiency of FDI on economic growth: a case study in developing countries. Sustainability 11(8):2389

Zhang P, Ma X, She K (2019) Forecasting Japan's Solar energy consumption using a novel incomplete gamma grey model. Sustainability 11(21):5921

Using Beneish M-Score and F-Score to Detect Financial Fraud

Baiyi Hou, Ruisi Lin, Xinyu Li, Zhetong Liu, and Jingwen Zheng

Abstract The purpose of this study was to determine whether the f-score and the Beneish M-model could detect financial fraud and corporate failure in US-listed companies. Financial information on the selected companies was collected from the SEC database for five consecutive years. Based on the analysis, the researcher concluded that the Beneish M-model was largely able to detect irregularities in the financial statements, but the f-score was not as effective as M-score.

Keywords Beneish M-Score · F-Score · Fraud · Financial statement

1 Introduction

The condition of a public company's financial statements is a key factor in shareholders' decisions to make equity investments. By making up financial statements, corporations could mislead investors into believing that their business is more lucrative than it is to obtain more money. Such action is known as financial fraud. Following Enron's bankruptcy in 2001, Congress passed the Sarbanes–Oxley Act of 2002, which

B. Hou (✉)
Qingdao No.2 Middle School, Qingdao 266061, China
e-mail: houbaiyi2004@163.com

R. Lin
School of Economics and Management, Xiamen University Malaysia, 43900 Sepang, Malaysia
e-mail: cst1809215@xmu.edu.my

X. Li
Department of Accounting and Business Law, Baylor University, Waco 76798, USA
e-mail: Xinyu_Li1@alumni.baylor.edu

Z. Liu
Justin Siena High School, Napa 94558, USA

J. Zheng
Nanjing Foreign Language School Xianlin Campus, Nanjing 210023, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_131

tightened reporting standards for all publicly traded firms in the United States. To date, there are still many companies that have falsified their financial statements. One of the biggest financial fraud scandals of these years was disclosed in 2020. The SEC's alleged that in its publicly reported financial statements for 2019, Luckin Coffee purposefully exaggerated the reported revenues and expenses while substantially understating the net loss. Its share price plummeted after the financial fraud was revealed, causing huge losses to investors.

Because of the information gap between the public and listed companies, it is difficult for investors to recognize the truthfulness of the financial statements disclosed by companies. While there are indicators such as revenue growth without a commensurate increase in cash flow, continued marketing growth while rival companies struggle, and a considerable spike in a company's results in the final financial quarter of the fiscal year, these can all point to untrustworthy financial statements. Timely detection of financial statement fraud can enable a large percentage of investors to avoid losses. Therefore, there is an urgent need to make sure data that can identify fraud in financial statements more accurately.

The Beneish model (M-score) is a financial fraud detection tool. Asset quality, depreciation, gross margin, and leverage are among the eight criteria examined in financial statements to establish the risk of earnings manipulation. The model was proven to be effective in detecting 76% of profits manipulating corporations submitted to US Securities and Exchange Commission accounting enforcement actions.

The F-score stems from a project funded by the Big Four Research Advisory Board to learn more about 'earnings quality and the conspiracy of fraudulent accounting. It assesses a corporation in five categories: accrual quality, business results, non-financial measurements, off-balance-sheet activities, and market-based motivations, and generates a value to suggest whether additional research is warranted. Historically, F-Score has accurately identified over 60% of companies investigated by the SEC for misrepresentation during the study period.

We will use these two models to calculate the scores of each of the five companies with confirmed financial fraud and compare these values with other companies without financial fraud to verify the validity of the model to detect their reliability.

2 Importance of Detecting Financial Fraud

The financial statements contain information about a company's financial status, profitability, and growth potential. Financial statements allow investors to gain insight into a company's overall performance to assess the value and growth prospects of a stock. Financial statements can also send red flags about financial instability or accounting misconduct. It is because of the importance of financial statements that some public companies will go to great lengths to manipulate financial statement numbers to make false disclosures. Each year, fraud causes significant losses to the target company's shareholders and creditors, thereby impeding the proper functioning of the capital markets.

Corporate fraud and misconduct pose a persistent threat to public trust in capital markets. Fraud is defined as a premeditated act intended to secure an unfair or illegal gain or advantage for the offender (KPMG 2006), which frequently results in the victim's investment being lost. Financial statement fraud is the most costly type of fraud, generating a median loss of $1 million (Association of Certified Fraud Examiners 2014). It can harm capital markets and cause irreparable damage to a company's reputation due to a loss of investor confidence. Other major impacts include delisting from the stock exchange due to an abnormal fall in share price and the sale of significant assets when fraud is detected, resulting in a significant loss of share-holder value (COSO 2010).

3 Literature Review

3.1 Earnings Manipulation

Earnings manipulation is described as management breaking accounting regulations to improve a company's financial performance through an illegal earnings management technique (Beneish 1999). Between 1998 and 2007, the Committee of Sponsoring Organizations of the Treadway Commission (COSO) conducted a study that looked at US public corporations that were determined to have participated in misleading financial reporting practices. A COSO-sponsored study conducted in 2010 discovered that misrepresentations in revenue recognition were responsible for 61% of corporate fraudulent reporting scandals. Another study, published in 2013, by the US Government Accountability Office, looked at financial restatement data for exempt and non-exempt companies in the US that were required to conduct internal auditor attestations. According to this study, from 2005 to 2011, Misstatements of charges and faulty recognition of revenue accounted for over half of all restatement cases in the United States among exempt and non-exempt corporations. As a result of the preceding study, we can generalize that the majority of financial statement fraud is caused by companies' earnings manipulation practices.

3.2 The Overview of M-Score

Utilizing financial statement variables, the Beneish model is designed to separate earnings manipulators who breach accounting standards from non-manipulators. The model used eight measures to represent either financial statement distortions caused by earnings manipulation or the proclivity to engage in earnings manipulation, as shown below.

$$M-Score = -4.84 + 0.92DSRI + 0.528GMI + 0.404AQI + 0.892SGI + 0.115DEPI - 0.172SGAI + 4.679TATA - 0.327LVGI$$

The number of DSRI is used to detect if the receivables and income made a balance in two years. GMI(Grass margin Index) refers to that if the ratio of GMI is larger than 1 means the ratio is reduced. SGI(Sales Growth Index) is the ratio of sales to the current year and the former year. Almost most companies try to hide the fact that their growth is slowing down because this shows the depression and is possible to lead to the losses in stock price. DEPI(Depreciation Index) is the ratio of the currency depreciation and the previous year. If the depreciation index is greater than 1 means that the company rate of depreciation asset. SGAI refers to the ratio of sales and expenses in the current year and the previous year. LVGI(Leverage Index) refers to the total liabilities to total assets in the current year and previous year. TATA(Total Accruals to Total assets) represents the expenses that measure the changes in other parts of the working capital account except for the difference be-tween cash and depreciation. For M-Score, − 2.22 is the threshold. If the data is greater than − 2.22 means that indicates that there may be a manipulator. − 1.78 can be another threshold for detecting fraud if the number is larger than − 1.78, then it would be very likely to be a fraud.

3.3 The Overview of F-Score

Some researchers have integrated different fraudulent accounting warning signs into a composite measure called the "F-Score" (Predicting Material Accounting Misstatements 2010). The F-Score evaluates a company on five dimensions—accrual quality, financial performance, non-financial metrics, off-balance-sheet activity, and market-based incentives—and assigns a numerical value to indicate whether the presence or absence is cause for further investigation. The average company score is 1, and the higher the number, the higher the likelihood of accounting misstatement occurring.

$$Predicted\ value = -7.893 + 0.790 * rsst_acc + 2.518 * ch_rec + 1.191 * ch_inv + 1.979 * soft_assets + 0.171 * ch_cs - 0.932 * ch_roa + 1.029 * issue$$

Convert predicted value to probability of manipulation
using logistic function = epredicted value/(1 + epredicted value)
where e = 2.71828183,
Compute F - Score by dividing by unconditionalprobability
of manipulation (0.0037).

F-score analyzes seven variables that may suggest the motive of fraud: non-cash net operating assets (rsst_acc), accounts receivable (ch_rec), inventory (ch_inv), soft assets (soft_assets), sales change (ch_cs), return on assets (ch_roa) and debt or equi-ty issue (Issue). According to the standard from CDC "Score greater than 1.0 indi-cates that the risk is higher than the normal level (73%), a score greater than 1.85 indicates higher risk (86%), and a score greater than 2.45 indicates an extremely high risk of accounting manipulation (92%)."(www.cdc.gov) This shows how to use the F-score to determine the risk of fraud.

3.4 T-Test

The final statistical tool we use for analyzing differences between two presumably unrelated means is the T-test. The samples for the testing are drawn at random from the two categories or groups. It is a statistical procedure in which samples are picked at random and no perfect normal distribution exists. (Wallstreetmojo Editorial Team Reviewed by Vaidya et al. 2022).

To test the significance of the two scores in detecting financial statement falsification. Three crucial data variables are the mean difference (the difference between the means of each data set), the standard deviation of each group, and the number of data values in each group.

4 Sample Selection

We wanted to investigate whether the Beneish model values could significantly detect financial fraud. So we selected data from five companies accused of financial fraud over five years and there were five competitors who did not commit financial fraud during the same period. And then we employ two contrast methods to integrate the data: horizontal contrast and vertical contrast. The horizontal comparison approach compares ratings from firms without fraud to scores from companies with fraud that are the same size as the phone companies in the same year. The difference between the same company's score in the year of fraud and the year without fraud is compared using the vertical comparison approach.

4.1 RINO International Corp.

RINO is the holding company for a subsidiary in China that manufactures, installs, and services steel industry equipment. According to the SEC, RINO's CEO and Chairman of the Board of Directors inflated the company's revenues and used proceeds from a securities offering for personal use under circumstances that were

dis-closed to investors. In the SEC's complaint, RINO's periodic filings from 2008 to 2010 contained false and misleading statements and omissions about the company's revenues and operations.

4.2 Manitex International, Inc.

Manitex International, Inc. is a manufacturer and distributor of cranes, forklifts, and heavy equipment in Bridgeview, Illinois. The SEC alleged that two accounting fraud schemes by three of the company's former senior executives resulted in the issuance of materially misstated financial statements. Manitex improperly accounted for nonexistent inventory and misled its outside auditors. In 2014, the company's former chief operating officer created false inventory lists and shipping documents and provided falsified documents to its outside auditors, thereby materially inflating its 2014 operating income and pre-tax income.

4.3 Sleep Number Corp.

Sleep Number Corp. is an American manufacturer of beds, as well as foundation and bedding accessories. According to recently filed allegations, Sleep Number and its senior management misrepresented and failed to disclose the company's true financial condition. As its foam supply chain was severely damaged by the winter storm, many customers did not receive goods as contracted. And, contrary to its financial statement representations, the company did not have the necessary supply chain flexibility and redundancy to offset unexpected disruptions.

4.4 Luckin Coffee Inc.

Luckin Coffee Inc. is a coffee manufacturer and café chain in China. The corporation owns and operates coffee shops, retailers, and food kiosks. The SEC charged Luckin Coffee Inc. with misleading investors by manipulating the company's revenues, expenditures, and income statement in order to fraudulently appear to achieve rapid growth and enhanced profitability while meeting earnings projections. According to the SEC's lawsuit, Luckin Coffee used linked parties through three separate purchasing schemes from at least April 2019 through January 2020. According to the SEC's complaint, Luckin Coffee used related parties to create dishonest sales transactions, intentionally fabricated more than $300 million in retail sales, created false operating databases, and altered accounting and bank records to reflect fraudulent sales to conceal the fraud from at least April 2019 to January 2020.

4.5 CELADON GROUP Inc.

The Securities and Exchange Commission has charged two former executives of CELADON GROUP Inc. in Indiana with accounting fraud for misrepresenting the company's revenue and earnings per share. According to the lawsuit, as a result of transactions with third-party distributors, Celadon grossly misrepresented its pre-tax in-come, net earnings, and earnings per share in its financial report for the fiscal year ended June 30, 2016, as well as following public disclosures. What's more, executives lied to their auditors and investors in an attempt to conceal millions of dollars' worth of overstated truck values.

5 Data Analysis

Based on the Beneish model and F-score model, the M-score and F-score of selected samples were figured. The statistic values are computed in five years as far as possible, but inevitably, there are exceptions caused by the restricted amount of accessible data. Therefore, the calculation of statistic value from RINO International CORP, the Sleep Number Corp. Luckin Coffee Inc. and those of the selected corresponding company are conducted in a four-year period, two-year period, and one-year period respectively. The tables enumerated both tests' numerical results would be attached at the end of each comparison part.

We calculated the M-score and F-score of the five companies separately for the years in which the financial statements were manipulated and for the years in which the financial statements were not. The vertical analysis in our research compares the data in different years of companies that have committed fraud, and the focus was to figure out whether the two models are efficient enough in reflecting the potential manipulation of the financial statements.

Subsequently, making sure that there are numerical value differences between companies that were not proven to commit fraud and companies that manipulated their financial reports, we computed the M-scores and F-scores of similarly scale companies in the same industry which did not falsify their financial statements, and measured the statistical difference horizontally.

In general, through horizontal and vertical comparisons, we look forward to roughly assessing the M-score and F-score's validity in predicting financial fraud based on accounting disclosure.

5.1 Vertical Comparison

CELADON GROUP Inc. is a transport company located in Indiana. According to SEC, it manipulated its financial statement in 2016. Typically, the M-test and F-test

benchmarks that indicate potential manipulation are − 2.22 and 1. The larger both values, the greater possibility of the intentional operation of the financial statements. The numerical statistics turn out that in 2012 and 2013, the existence of purposely manipulation is possible, in 2014 and 2015, the values are − 3.3148 and − 2.7070, which fall within a reasonable standard, while in 2016, the M-statistic of − 1.0135 indicates a higher risk of intentional manipulation. Celadon's F-scores from 2012 to 2016 are all approximately 1, which fit in the manipulation criterion of the F-test.

RINO International CORP, a U.S.-listed Chinese company, committed fraud from 2008 to 2010. Its M-scores from 2007 to 2010, which are 2.76, − 0.61, − 1.70, and − 0.63 respectively, exceed − 2.22. The rounded values of F-statistics settle at 1.01 in this five-year period. Both of the test outcomes are evidence of potential manipulation.

Sleep Number Corp. is an American company that makes beds and bedding accessories. The U.S. Securities and Exchange Commission charged Sleep Number with financial fraud in 2021. From their annual report, the M-scores in 2020 and 2021 are − 4.6855 and − 3.9613, and the F-scores are 1.1400 and 1.0152. The M-statistics denote that the manipulation possibility in both years is low. In contrast, the F-scores we obtained are above the normal risk.

Manitex International, Inc. is a machinery industry company and the U.S. Securities and Exchange Commission fined Manitex International and its three former senior executives for committing accounting fraud. They fabricated inventory orders and made up fake transactions with another company in 2014. The M-values we obtained from its disclosed financial statements from 2010 to 2014 are − 2.0621, − 2.1025, − 2.2182, − 2.0121 and − 2.0052. Only the M-score in 2012 indicates the potential manipulation in its financial statements. After rounding up to two decimal places, Manitex's F-values stay stable at 1.02 (Figs. 1, 2, 3, 4, 5, 6, 7 and 8).

Celadon						
		2012	2013	2014	2015	2016
Variable	Coefficient	Value	Value	Value	Value	Value
M-score		-2.1438	-2.0257	-3.3148	-2.7070	-1.0435
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	1.2952	1.2056	0.6543	1.0412	0.8693
GMI	0.5280	0.6940	0.9843	1.5272	0.7111	1.4904
AQI	0.4040	-0.0699	0.9025	-2.3481	-0.5991	3.2388
SGI	0.8920	1.0540	1.0245	1.2374	1.1863	1.1827
DEPI	0.1150	1.3283	1.2556	0.8969	1.3279	0.7875
SAI	-0.1720	0.9747	0.9986	1.0297	0.9777	1.0259
LVGI	-0.3270	0.5798	1.2944	1.5440	0.7274	1.0904
TATA	4.6790	0.0921	0.0764	0.1155	0.0506	0.0617

Fig. 1 CELADON GROUP Inc. 2012–2016 M-scores

Celadon						
		2012	2013	2014	2015	2016
Variable	Coefficient	Value	Value	Value	Value	Value
F-score		1.0074	1.0077	1.0077	1.0088	1.0078
Predicted Value		-5.2086	-5.4293	-5.3475	-5.0459	-5.4644
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.1149	0.2002	0.0374	0.3349	-0.1627
ch_rec	2.5180	0.0056	0.0156	0.0410	0.0213	0.0033
ch_inv	1.1910	0.0152	0.0031	-0.0098	0.0012	-0.0296
soft_assets	1.9790	0.2239	0.2386	0.2641	0.3041	0.4147
ch_cs	0.1710	1.3124	1.0127	1.2109	1.1982	1.2122
ch_roa	-0.9320	0.0124	-0.0065	0.0019	-0.0126	-0.0093
issue	1.0290	1.0000	1.0000	1.0000	1.0000	1.0000

Fig. 2 CELADON GROUP Inc. 2012–2016 F-scores

RINO					
		2007	2008	2009	2010
Variable	Coefficient	Value	Value	Value	Value
M-score		2.7647	-0.8546	-1.7576	-0.6273
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	0.5781	1.2232	0.8119	1.8208
GMI	0.5280	1.0426	1.2374	1.0388	1.1112
AQI	0.4040	1.3829	0.6993	0.4843	2.1604
SGI	0.8920	5.9144	2.1904	1.3825	0.8615
DEPI	0.1150	0.5298	1.0329	0.8246	2.5650
SAI	-0.1720	2.3238	0.9926	0.3418	2.8280
LVGI	-0.3270	0.3563	1.0203	0.2565	3.4609
TATA	4.6790	0.2444	0.1290	0.0983	0.3489

Fig. 3 RINO International Corp. 2007–2010 M-scores

5.2 Horizontal Comparison

Luckin Coffee Inc. is a U.S.-listed Chinese corporation that was reported for financial fraud by SEC in 2019. STARBUCKS CORP, which is a famous U.S. coffee company, was chosen as its counterpart. From their annual reports in 2019, Luckin and Starbucks exhibit 1.132 and − 6.58 as M-score, and 1.1075 and 1.0237 as F-scores.

RINO					
		2007	2008	2009	2010
Variable	Coefficient	Value	Value	Value	Value
F-score		1.0128	1.0170	1.0052	1.0150
Predicted Value		-3.5469	0.7706	-3.6085	-3.2325
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.9742	0.5219	0.3690	0.6843
ch_rec	2.5180	0.3258	0.3571	0.0334	0.1114
ch_inv	1.1910	0.0016	0.0113	0.0223	0.0005
soft_assets	1.9790	1.0445	0.9749	0.5948	0.8490
ch_cs	0.1710	1.0000	5.9144	2.1904	1.3825
ch_roa	-0.9320	1.0000	0.8840	1.0746	0.6328
issue	1.0290	0.0000	0.0000	0.0000	1.0000

Fig. 4 RINO International Corp. 2007–2010 F-scores

Sleep Number					
		2020		2021	
Variable	Coefficient	Variable	Value	Variable	Value
M-score			-4.6855		-3.9613
	-4.8400		-4.8400		-4.8400
DSRI	0.9200	0.0015	0.0014	0.0060	0.0055
GMI	0.5280	0.0915	0.0483	0.0508	0.2682
AQI	0.4040	0.4680	0.1891	0.5630	0.2274
SGI	0.8920	1.0056	0.8970	1.1740	1.0472
DEPI	0.1150	0.2590	0.2980	0.2360	0.0271
SAI	-0.1720	1.2590	-0.2165	1.2420	-0.2136
LVGI	-0.3270	0.8190	-0.2678	0.9860	-0.3224
TATA	4.6790	0.0916	0.4286	-0.2570	-1.2025

Fig. 5 Sleep Number Corp. 2020–2021 M-scores

According to Manitex International Inc.'s Business scope, we adopted TEREX CORP, another manufacturing company, as the comparator. TEREX's M-statistics are − 4.8787, − 1.4871, − 4.1160, − 2.0269 and − 2.5603, and its F-values are 1.0112, 1.0128, 1.0097, 1.0104 and 1.0113. The M-statistics of both companies from 2010 to 2014 show a value difference between companies that have committed fraud and the company that did not. However, there is no such clear difference in the F-values of both companies.

Sleep Number					
		2020		2021	
Variable	Coefficient	Variable	Value	Variable	Value
F-score			1.1400		1.0152
Predicted Value			-3.1751		-4.6954
	-7.8930		-7.8930		-7.8930
rsst_acc	0.7900	0.2900	0.2291	0.2436	0.1924
ch_rec	2.5180	0.0070	-0.0176	0.0280	0.0705
ch_inv	1.1910	0.1560	0.1858	0.1149	0.1368
soft_assets	1.9790	1.5680	3.1031	0.7878	1.5591
ch_cs	0.1710	1.9800	0.3386	1.1898	0.2035
ch_roa	-0.9320	0.1610	-0.1501	-0.0068	0.0063
issue	1.0290	1.0000	1.0290	1.0000	1.0290

Fig. 6 Sleep Number Corp. 2020–2021 F-scores

Manitex						
		2010	2011	2012	2013	2014
Variable	Coefficient	Value	Value	Value	Value	Value
M-score		-2.0621	-2.1025	-2.2182	-2.0121	-2.0052
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	0.8538	0.6910	0.6760	0.8589	1.4138
GMI	0.5280	0.8203	1.1840	1.0427	1.0396	-0.0005
AQI	0.4040	0.8432	0.8507	0.7427	1.1277	0.9489
SGI	0.8920	1.7155	1.4841	1.4425	1.1940	1.0776
DEPI	0.1150	0.5319	0.9331	0.7218	1.6418	1.9111
SAI	-0.1720	1.3278	0.8575	0.7960	0.9320	1.0190
LVGI	-0.3270	1.0294	1.0428	0.9868	0.8811	1.1126
TATA	4.6790	0.0411	0.0407	0.0511	0.0487	0.1088

Fig. 7 Manitex International, Inc. 2010–2014 M-scores

RINO International CORP's data from 2007 to 2010 was compared to another high-tech company, Nordson Corporation (NDSN). For Nordson, the M-score from 2007 to 2010 are − 1.6089, − 2.4946, -4.2200, and − 1.7326, which are mostly lower than − 2.22. As mentioned above, RINO's score in 2007–2010 is greater than − 2.22 which stands for the high risk of manipulation in its financial statements.

Manitex						
		2010	2011	2012	2013	2014
Variable	Coefficient	Value	Value	Value	Value	Value
F-score		1.0155	1.016	1.0186	1.0146	1.015
Predicted Value		-4.4434	-4.1850	-4.1363	-4.5537	-4.9494
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.1417	0.1506	0.2325	0.1617	-0.0264
ch_rec	2.5180	0.0858	0.0384	0.0899	0.0119	0.0910
ch_inv	1.1910	0.0341	0.1023	0.1390	0.0685	0.0980
soft_assets	1.9790	0.8004	0.8337	0.8658	0.8351	0.8219
ch_cs	0.1710	1.4061	1.5802	1.3990	1.2597	0.9930
ch_roa	-0.9320	-0.0184	0.0029	0.0304	0.0024	-0.0340
issue	1.0290	1.0000	1.0000	1.0000	1.0000	1.0000

Fig. 8 Manitex International, Inc. 2010–2014 F-scores

For CELADON GROUP Inc., the similar company that mainly engaged in freight transportation, FEDEX CORP, is selected as the comparison object. The computed M-values of 2012–2016 are -2.2469, − 2.2856, − 2.3986, − 2.2383 and − 1.9495, which overall below the normal risk. The F-values from 2012 to 2016 according to FEDEX's disclosed financial reports are 1.0077, 1.0077, 1.0077, 1.0041, and 1.009, which approximately fall within the normal risk standards of the F-test (Figs. 9, 10, 11, 12, 13, 14, 15 and 16).

		Luckin Coffee		Starbucks	
		2019		2019	
Variable	Coefficient	Variable	Value	Variable	Value
M-score			1.1320		-6.5800
	-4.8400		-4.8400		-4.8400
DSRI	0.9200	0.8173	0.7519	4.2100	3.8732
GMI	0.5280	0.7966	0.4206	1.0030	0.5269
AQI	0.4040	2.1365	0.8631	1.1000	0.4444
SGI	0.8920	0.2793	0.2491	1.0750	0.9589
DEPI	0.1150	1.1909	0.1370	0.9550	0.1098
SAI	-0.1720	0.5469	-0.0941	0.9950	-0.1711
LVGI	-0.3270	3.0366	-0.9930	1.4740	-0.4820
TATA	4.6790	0.2440	1.1417	1.3160	6.1576
				Luckin Coffee	Starbucks

Fig. 9 Luckin Coffee Inc. & STARBUCKS Corp. 2019 M-scores

		Luckin Coffee 2019		Starbucks 2019	
Variable	Coefficient	Variable	Value	Variable	Value
F-score			1.1075		1.0237
Predicted Value			-4.5344		-4.0063
	-7.8930		-7.8930		-7.8930
rsst_acc	0.7900	0.1293	0.1021	0.2327	0.1838
ch_rec	2.5180	0.3274	0.8244	0.0086	0.0217
ch_inv	1.1910	0.0356	0.0424	0.0059	0.0070
soft_assets	1.9790	0.5226	1.0342	0.8488	1.6798
ch_cs	0.1710	1.7686	0.3024	1.1524	0.1971
ch_roa	-0.9320	-0.0258	0.0240	-0.8244	0.7683
issue	1.0290	1.0000	1.0290	1.0000	1.0290
				Luckin Coffee	Starbucks

Fig. 10 Luckin Coffee Inc. & STARBUCKS Corp. 2019 F-scores

		Manitex & TEREX									
		2010		2011		2012		2013		2014	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
M-score		-2.0621	-4.8787	-2.1025	-1.4871	-2.2182	-4.1160	-2.0121	-2.0269	-2.0052	-2.5603
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	0.8538	0.7682	0.6910	0.7833	0.6760	0.7694	0.8589	1.1298	1.4138	0.8948
GMI	0.5280	0.8203	0.5245	1.1840	1.0033	1.0427	1.0298	1.0396	1.0271	-0.0005	0.9976
AQI	0.4040	0.8432	0.8295	0.8507	1.7708	0.7427	1.0285	1.1277	1.0156	0.9489	0.9842
SGI	0.8920	1.7155	1.1343	1.4841	1.4634	1.4425	1.1338	1.1940	1.0146	1.0776	1.0317
DEPI	0.1150	0.5319	0.8593	0.9331	1.2418	0.7218	0.8764	1.6418	0.9416	1.9111	0.8465
SAI	-0.1720	1.3278	13.2476	0.8575	-0.0254	0.7960	11.3567	0.9320	0.6356	1.0190	2.1117
LVGI	-0.3270	1.0294	1.0523	1.0428	0.8753	0.9868	0.9985	0.8811	0.9771	1.1126	1.0454
TATA	4.6790	0.0411	0.0330	0.0407	0.0472	0.0511	0.0480	0.0487	0.0506	0.1088	0.0469
									Manitex		TEREX

Fig. 11 Manitex International, Inc. & TEREX Corp. 2007–2010 M-scores

5.3 T-Test

To use a statistical method to evaluate this research deduction's accuracy of the efficiency of the M-test and F-test, we adopted the T-test.

The data were divided into two groups, one for companies found to have committed financial fraud and the other for companies that have not committed financial fraud. Since the sample sizes of the two groups are different, and they do not have the same variances, the unequal variance t-test method is used for our calculation. The null hypothesis is there is no statistical difference between companies that have commit-ted fraud and those that do not.

Manitex & TEREX											
		2012		2013		2014		2015		2016	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
F-score		1.0155	1.0112	1.016	1.0128	1.0186	1.0097	1.0146	1.0104	1.015	1.0113
Predicted Value		-4.4434	-4.9119	-4.1850	-4.8447	-4.1363	-5.3649	-4.5537	-5.5343	-4.9494	-5.0985
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.1417	0.0160	0.1506	-0.2201	0.2325	-0.4591	0.1617	-0.4272	-0.0264	-0.0567
ch_rec	2.5180	0.0858	0.0336	0.0384	0.0630	0.0899	-0.0145	0.0119	0.0226	0.0910	-0.0145
ch_inv	1.1910	0.0341	0.0187	0.1023	0.0492	0.1390	-0.0062	0.0685	-0.0029	0.0980	-0.0244
soft_asset	1.9790	0.8004	0.7339	0.8337	0.7717	0.8658	0.7789	0.8351	0.8168	0.8219	0.8029
ch_cs	0.1710	1.4061	1.0437	1.5802	1.4444	1.3990	1.2193	1.2597	0.9309	0.9930	1.0671
ch_roa	-0.9320	-0.0184	0.1352	0.0029	-0.0599	0.0304	0.0096	0.0024	0.0184	-0.0340	0.0201
issue	1.0290	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
										Manitex	TEREX

Fig. 12 Manitex International, Inc. & TEREX Corp. 2007–2010 F-scores

RINO & NDSN									
		2007		2008		2009		2010	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value
M-score		2.7647	-1.6089	-0.8546	-2.4946	-1.7576	-4.2200	-0.6273	-1.7326
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	0.5781	1.0843	1.2232	0.8635	0.8119	1.4891	1.8208	0.6168
GMI	0.5280	1.0426	1.0304	1.2374	0.9945	1.0388	0.9791	1.1112	0.9592
AQI	0.4040	1.3829	1.2272	0.6993	1.0069	0.4843	0.8599	2.1604	0.8886
SGI	0.8920	5.9144	1.1137	2.1904	1.1320	1.3825	0.7183	0.8615	1.2715
DEPI	0.1150	0.5298	7.9261	1.0329	0.0761	0.8246	0.3311	2.5650	7.1051
SAI	-0.1720	2.3238	0.9971	0.9926	0.7626	0.3418	1.6119	2.8280	0.7761
LVGI	-0.3270	0.3563	1.2541	1.0203	0.8628	0.2565	0.9137	3.4609	0.8422
TATA	4.6790	0.2444	-0.0277	0.1290	0.0030	0.0983	-0.3691	0.3489	0.0282
								RINO	NDSN

Fig. 13 RINO International CORP & Nordson Corporation 2007–2010 M-scores

For M-score, the t-value of the test is 13.376. Since the formula definition requires rounding to the least possible integer, the initial number of degrees of freedom, 29.86, is reduced to 29. A degree of freedom of 29 and a significance level of 10% generate a value of 1.699 in the t-value distribution table. When this value is com-pared to the calculated value of 13.376 it is clear that the calculated t-value is greater than the value in the table at the 10% significance level. The null hypothesis is thus rejected. The numerical difference of the M-score from the manipulated financial reports can be proven to exist, and The M-score can be used effectively to verify whether a company has manipulated the data in its financial statements.

RINO & NDSN									
		2007		2008		2009		2010	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value
F-score		1.0128	1.0123	1.0170	1.0103	1.0186	1.03199	1.0146	1.03834
Predicted Value		-3.5469	-3.3010	0.7706	-3.2524	-4.1363	-6.3142	-4.5537	-5.8632
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.9742	0.4914	0.5219	0.4729	0.2325	0.3414	0.1617	0.4931
ch_rec	2.5180	0.3258	0.0353	0.3571	0.0884	0.0899	-0.0327	0.0119	0.0560
ch_inv	1.1910	0.0016	0.0353	0.0113	-0.0014	0.1390	-0.0198	0.0685	0.0214
soft_asset	1.9790	1.0445	1.0299	0.9749	0.8586	0.8658	0.7326	0.8351	0.8819
ch_cs	0.1710	1.0000	1.0000	5.9144	1.1137	1.3990	1.1320	1.2597	0.7283
ch_roa	-0.9320	1.0000	1.0000	0.8840	1.1084	0.0304	-1.5748	0.0024	-1.1508
issue	1.0290	0.0000	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
								RINO	NDSN

Fig. 14 RINO International CORP & Nordson Corporation 2007–2010 F-scores

Celadon & FEDEX											
		2012		2013		2014		2015		2016	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
M-score		-2.1438	-2.2469	-2.0257	-2.2856	-3.3148	-2.3986	-2.7070	-2.2383	-1.0435	-1.9495
	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400	-4.8400
DSRI	0.9200	1.2952	0.9969	1.2056	1.0094	0.6543	0.9279	1.0412	1.0058	0.8693	1.1947
GMI	0.5280	0.6940	1.0119	0.9843	0.9900	1.5272	0.9920	0.7111	0.9765	1.4904	0.9677
AQI	0.4040	-0.0699	0.9266	0.9025	0.9428	-2.3481	1.0225	-0.5991	1.2213	3.2388	1.4999
SGI	0.8920	1.0540	1.0859	1.0245	1.0377	1.2374	1.0289	1.1863	1.0414	1.1827	1.0614
DEPI	0.1150	1.3283	1.0321	1.2556	0.9546	0.8969	0.9783	1.3279	1.0512	0.7875	1.1373
SAI	-0.1720	0.9747	0.9849	0.9986	1.0184	1.0297	0.9723	0.9777	1.0484	1.0259	0.9774
LVGI	-0.3270	0.5798	1.2426	1.2944	1.1417	1.5440	1.2014	0.7274	1.1725	1.0904	1.3312
TATA	4.6790	0.0921	0.0547	0.0764	0.0503	0.1155	0.0386	0.0506	0.0387	0.0617	0.0428
									Celadon		FEDEX

Fig. 15 CELADON GROUP Inc. & FEDEX Corp. 2012–2016 M-scores

For F-score, the t-value of the test is 0.296. The degree of freedom is rounded down to 29 for the reason mentioned in the context. Looking at the t-value distribution table, a degree of freedom of 29 and a significance level of 10% give a value of 1.699. Comparing this value with the calculated value of 13.376 indicates that the calculated t-value is less than the value in the table at the 10% significance level. Consequently, the null hypothesis that the F-score does not affect detecting financial statement fraud cannot be rejected, that is, the F-score cannot be proven to be efficient enough in predicting the potential manipulation of companies' financial statements.

Celadon & FEDEX											
		2012		2013		2014		2015		2016	
Variable	Coefficient	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
F-score		1.0074	1.0077	1.0077	1.0077	1.0077	1.0077	1.0088	1.0041	1.0078	1.009
Predicted Value		-5.2086	-5.4302	-5.4293	-5.5248	-5.3475	-5.4846	-5.0459	-6.2646	-5.4644	-5.2871
	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930	-7.8930
rsst_acc	0.7900	0.1149	0.0330	0.2002	0.0434	0.0374	0.0312	0.3349	0.0664	-0.1627	0.1667
ch_rec	2.5180	0.0056	0.0039	0.0156	0.0102	0.0410	0.0119	0.0213	0.0063	0.0033	0.0324
ch_inv	1.1910	0.0152	0.0001	0.0031	0.0005	-0.0098	0.0002	0.0012	0.0008	-0.0296	0.0000
soft_assets	1.9790	0.2239	0.3281	0.2386	0.3029	0.2641	0.3209	0.3041	-0.4904	0.4147	0.3961
ch_cs	0.1710	1.3124	1.0828	1.0127	1.0327	1.2109	1.0274	1.1982	1.0452	1.2122	1.0347
ch_roa	-0.9320	0.0124	0.0149	-0.0065	-0.0214	0.0019	0.0169	-0.0126	0.0001	-0.0093	-0.0240
issue	1.0290	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
									Celadon	FEDEX	

Fig. 16 CELADON GROUP Inc. & FEDEX Corp. 2012–2016 F-scores

5.4 Similarities and Differences

By analyzing the financial statements of the ten companies mentioned above, we find that most of them do commit financial fraud by inflating their net profits or earnings. A larger net profit makes it appear that they performed better in business during the year and thus attracts more investors.

But each of these companies used different means to increase their operating income. We noted that three companies increased their sales by creating a large number of fake transactions. Another one hid its poor business situation (the storm disrupted the chain and could not deliver the goods on time) and included the payment for unfinished transactions in its operating income.

6 Prevention of Financial Statement Fraud

When investors decide to put money into a company, they will most likely look at the company's financial statements to make sure that the company can generate profits for them. For most large public companies, their financial statements are audited by auditors. Due to changes in the business environment, non-audit engagements make up a major portion of an accounting firm's revenue. This undermines the stability and objectivity of the audit. Companies may pay high audit fees leading to auditors' involvement in accounting fraud. Therefore, the SEC should require companies to change their auditors every five years. Also, it is important to establish an environment that supports the integrity of the financial reporting process. The audit department of the accounting firm should also be independent, and an audit governance committee should be established to focus on improving the quality of the audit. At the time of the auditors' involvement in the audit, they can verify the transaction from both

sides of companies. It is better than only trusting one company's record. In addition, accounting firms should set up compensation to incentivize auditors who expose financial fraud.

Sometimes, executives or employees may commit financial fraud without the knowledge of shareholders and managers. As a result, managers can take steps to prevent fraud by company insiders, the most effective of which is internal control. For example, when their companies store the goods or move their products from the warehouse to other departments, they should require scanning the barcode of each batch of goods. In this way, every product can be recorded in the system. It is more accurate to track the inventories and know where they go. "It is important to configure the system to restrict the ability to create, delete, and ship to 'one-time' customers to prevent employees from using that technique to conceal the theft of inventory" (Romney et al. 2021). Besides, they should segregate duties. One employee cannot be in charge of custody, recording, and authorization at the same time. In addition, the company's information department needs to restrict access to master data to prevent people from modifying it.

Conflicts of interest between managers and company owners may lead them to manipulate financial statements to meet requirements. The owners elect a board of directors to serve them and determine the company's strategy and direction. "Many boards, however, do not serve shareholders. Board members may be motivated to accept corporate practices that benefit the company's management or themselves but rather the shareholders. As a result, they may be inclined to overlook misleading accounting techniques." (Madura 2004). Executive compensation is an effective way to resolve conflicts of interest between managers and owners. Companies usually motivate managers through salary, bonuses, and long-term incentives like stock awards and options. Because wage rates vary by region of the world, it is especially difficult for corporations executing the multinational strategy to successfully employ CEO remuneration as a governance instrument.

7 Conclusion

By calculating and comparing the M-scores of these ten companies, we found that the M-score is very helpful in helping to identify financial fraud, and we can easily distinguish the companies with financial fraud from the values. However, the F-scores of these companies have few differences, which makes it difficult to distinguish effectively between companies that have engaged in fraud and those that have not.

Because we only choose 10 US-listed companies as our sample, and some of these companies withdrew from sec due to the revelation of financial fraud we cannot obtain data for a longer period. Our conclusion is still limited to determining whether the M-score applies to all listed companies.

References

Association of Certified Fraud Examiners (2014) 2014 Global fraud study: Report to the nations on occupational fraud and abuse. Retrieved from http://www.acfe.com/rttn/docs/2014-report-to-nations.pdf

Amiram D, Bozanic Z, Cox JD, Dupont Q, Karpoff JM, Sloan RG (2017) Financial reporting fraud and other forms of misconduct: A multidisciplinary review of the literature. SSRN. Retrieved 21 Apr 2022, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3021055

Beneish MD (1999) The detection of earnings manipulation. Financ Anal J 55(5):24–36

COSO (2010). Fraudulent financial reporting: 1998–2007: an analysis of U.S. public companies. Retrieved 21 Apr 2022, from http://www.coso.org/documents/cosofraudstudy2010_001.pdf

KPMG (2006) Fraud risk management: developing a strategy for prevention, detection and response. Retrieved 21 Apr 2022, from http://www.us.kpmg.com

Madura J (2004) What every investor needs to know about accounting fraud. McGraw-Hill

Romney MB, Steinbart PJ, Summers SL Wood DA (2021) Accounting information systems. Pearson Education Limited

The detection of earnings manipulation—calctopia. (n.d.). Retrieved 21 Apr 2022, from https://www.calctopia.com/papers/beneish1999.pdf

What Are the Value-Creating Ramifications of the Recycling Textile Model Within Africa, Compared with the Conventional Model?

Ziheng Lei, Yiheng Huang, Zhewen Yan, Yulong Ou, and Yumei Cui

Abstract As the society develops and the economy thrives, there are inevitably some consequences behind the pulchritude of a gorgeous figure—environmental stress. Consumers are embracing the economic modality of linear consumption model and value mindsets of consumerism that neglect the capability for a good to be recycled, either durable or non-durable, especially within relatively impoverished regions such as the African continent where education regarding environmental protection is lacking. Currently, Africa is overflowing with clothing due to consumption or charity, and for most of the clothes, they end up in the landfills, leaving a voluminous carbon footprint behind. Thus, people are endeavoring to make a difference by transforming the conventional linear textile economic modality into a circular textile industry. This essay aims to investigate, inform, and evaluate the value creation process of circular textile industries in Africa and the premises in achieving this goal.

Keywords Circular economy · Textile industry · Reuse and recycling · Sustainability

Z. Lei (✉) · Y. Ou
Shanghai World Foreign Language Academy, Shanghai 200233, China
e-mail: jeremylei.sh@gmail.com

Y. Huang
Yew Chung International School of Shanghai (Puxi), Shanghai 201103, China

Z. Yan
Shanghai American School, Shanghai 201106, China

Y. Cui
Hangzhou Wickham International School, Hangzhou 310000, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_132

1 Introduction

Since industrialization, the linear consumption model has been the dominant economic modality for the world economy. As a model that follows the "Take-make-dispose" principle, all value generated during the creation process of a product would be entirely lost once it is disposed of. This was not a significant problem in the early stages of industrialization. However, as the economy continues to expand at a rapid pace, and as the use of material is projected to double from 2015 to 2050 according to a report by Langsdorf (Langsdorf 2022), this model is starting to pose substantial environmental problems as it accelerates the depletion of resources, exacerbates pollution, and aggregates climate change. These problems associated with the current linear model are visible in the existing textile model in African countries. Besides those potential issues, there are also other consequences that are specific to the contemporary textile model in African countries: the current cotton-to-textile value chain is highly susceptible to black swan events that lead to recessions because it is highly reliant on the production of cotton. For instance, because of COVID-19, around 70% of the cotton produced by the four major cotton-producing countries in Africa was stuck in mills and deteriorated due to adverse weather Moea (Moea and Meliadò 2021), which posed substantial economic costs for both the cotton industry and the textile industry.

However, here is a solution that would mitigate the aforementioned issues—adopting the circular economy. It may restore lost values in the current linear model to drive economic growth and help African countries achieve their macroeconomic objectives for the benefit of their people. The future of a circular textile model is promising especially in Africa for a few reasons. The first reason regards the size of the African textile industry. According to a report by the Ellen MacArthur Foundation (Circular Economy in Africa: Fashion and Textiles. 2022), even though China and India are still the largest players in the textile industry to date, the African textile industry is also gaining attention as clothing brands like H&M are switching their production to African countries due to lower wages. Furthermore, the African textile industry is expected to deteriorate its scale by more than 4% from 2021 to 2026 Mordor Intelligence (Industry Textile Industry 2022). Therefore, the circular textile model could have an impact on a large scale. Aside from the size of the industry, Africa also has plentiful untapped resources. For example, there is a great amount of unexploited labor and natural resources.

Various organizations including but not limited to the Ellen MacArthur Foundation have initiated various programs promoting the transition to a more economically and environmentally sustainable modality: circular economy, which enables the circulation and generation of value by extracting value from waste materials (Circular Economy in Africa: Fashion and Textiles 2022). Waste and resource use could be reduced, enabling the decoupling of economic growth and resource use. Furthermore, according to McKinsey (Bové and Swartz 2019), the transition to a circular economy "could boost Europe's resource productivity by 3% by 2030, generating cost savings of €600 billion a year and €1.8 trillion more in other economic benefits".

All in all, due to the combination of the growing size of the textile industry, the existence of untapped resources, and the various drawbacks of the current linear model that is highly dependent on cotton production, the value derived from switching to a recycled (more circular) textile industry would be quite substantial.

Therefore, the aim of this paper is to examine the value-creating ramifications that would be derived from switching to a recycling textile model within Africa compared to the current model. There could be a deeper understanding to unleash the potential of a circular economy in the African textile industry and to prompt further research on circular economy to accelerate the materialization of this modality so that the African economy can achieve higher economic growth, achieve economic development, and hopefully, escape the poverty trap to make life more enjoyable.

1.1 Problem Identification

The textile industry plays a key role in the multitude's every-day life. Currently, the global textile industry is valued at roughly $933.6B in 2021 (Global Textile Market Size and Share Report 2022), and, according to a study of Ellen MacArthur Foundation (Circular Economy in Africa: Fashion and Textiles 2022), the African industry is estimated to be $31B. With such a great market scale, the textile industry is posing threats on the environment so that recycling has altered from an alternative to a must—it takes 20,000 L of water to produce 1 kg of textile, while only 1% of the textile is recycled every year, regardless of the fact that 95% of which can be recycled (Fashion Industry Environmental, Waste, and Recycle Statistics 2022). Besides a gigantic consumption of water resources, dumping the used clothes into landfills or incineration would emit toxic substances, involved during its production, into the groundwater and atmospheric system (Stone et al. 2020). Technically, the mechanism of recycling textiles is complex and costly—including anaerobic digestion, fermentation, composting, fiber regeneration, and thermal recovery (Juanga-Labayen et al. 2022). Nevertheless, technology is not the primary impeding factor of implementing recycling, the societal factor would instead be more of an obstacle.

To begin with, from the economic dimension, the cotton industry, with a CAGR of 3.1% is a crucial source of foreign exchange and a vigorous GDP driving force for the African economy (Africa Textile Industry 2022): it is not only a significant raw material source but also a critical income source for the large amounts of local cotton farmers. Currently, there are more than 20 million cotton farmers employed in Africa, which occupies approximately 4% of the entire 453 million workforces (Moea and Meliadò 2021). Therefore, the local authorities might be concerned regarding the structural unemployment issues that people are unemployed due to technological change.

In addition, on the sociological dimension, there are copious barricades to transforming domestic consumers' attitudes towards recycled textiles derived from second-handed recycled clothes not only culturally but also economically. On the one hand, according to Joseph Rwagatare (Joseph Rwagatare 2018), 'no one goes around

proudly showing off someone else's discards. Thus, some Africans and governments regard second-handed-recycled clothes (SHRCs) and recycled textiles as undignified so that they might avert the SHRCs, slowing down the development of the recycled textile industry due to low demand. On the other hand, some African legislators have either banned the SHRCs or imposed tariffs on them (Protectionist Ban on Imported Used Clothing 2018), due to the fact that they would compete with local textile industries in light of their lower prices. Currently, an estimated 70% of the donated clothes by westerners end up in Africa (Baraka 2021), resulting in an excess supply that drags down the market price. As a result, governments are taking measures to halt SHRCs from entering. For instance, Uganda has levied 15%-20% on the used clothes, and Rwanda has hiked its tax to $5 per kg in 2018, compared to $0.5 per kg in 2016.

Thus, a combination of consumer attitudes and governmental considerations has made the recycled textile industry and its deriving circular economy struggles to flourish.

2 Value Creation

Despite the obstacles mentioned, the recycled textile industry is so innovative and essential that it would derive value ramifications within separate parties and stakeholders, including the multinational companies producing the recycled textile, the positive influences on other aspects of technological development, a greater overall potential in Africa's economic development, and a mitigated environmental threat.

To begin with, regardless of the fact that domestic cultures and consumers are less inclined to recycled textiles, exporting the products into the global market would be an efficacious alternative because of a trend of environmental protectionism and reduced global consumerism. Because 95% of the used clothes, i.e. the raw material for recycling MSMEs (Ministry of Micro, Small and Medium Enterprises), could be recycled (Fashion Industry Environmental, Waste, and Recycle Statistics 2022), and there is a lot of push back from SHRCs in the local market, the additional value could be created by such MSMEs through either upcycling (refining the textile into yarns and acting as the foundation of clothes) or downgrading (transforming into the acoustic/thermal insulating materials filled between cavities) and eventually re-exporting the clothes back to the western world including but not limited to the United States and Europe. At the embryo stages, the African countries could employ firms already in the field. For instance, the 'Suave Kenya' that upcycled clothes into bags (Our Story—Suave Kenya 2022). In the long term, subsidies could be implemented so as to promote a structural change of the entire industry from conventional to 'green'.

In addition, the recycled textile industry would create millions of job opportunities for Africans, especially for women, and further solve the gender disparities. The entire chain would be provoked in the circular economy model: from the rudimentary logistics to highly-selective research and development, and from the essential

production lines to radiating fashion industry, there will be an utter structural revolution taking place within the African continent, even influencing the globe through the outsourcing and product exports. Nevertheless, a structural change derived from a novel technology trend represents contemporary labor being tossed into the abyss: the elder, the young, and women having deficiencies in education and knowledge (Gender Equality 2022) might not be able to overcome this barrier and become exacerbated, and the education disparities between parties would take generations to mitigate.

Lastly, the recycled textile industry reduces great environmental issues due to the fact that conventional production tools are not eco-friendly—it takes 3781 L of water to produce a pair of jeans, equivalent to 33.4 kg of carbon emission (World Bank Group 2019). Hence, benefits are yielded from avoiding the production of new materials of raw textile fibers. Nevertheless, benefits might fail to arise in some cases when there is a low replacing rate as well as a more cleaned production tool being utilized. Besides, the environmental costs count not merely on its reduced emission, but rather the lifetime carbon footprint, including the transportation environment impact ramifications: escorting commodities or allocating factors of production. Since the environmental stress is alleviated due to a decreased production of virgin cotton, the impact on the original raw cotton economic model needs to be scrutinized.

2.1 Prerequisites for the Novel Circular Cotton Model

To begin with, every recycling starts with someone, i.e. consumers, voluntarily disposing of the discarded textiles and clothes in a certain location. The used garment collections require a significant amount of effort because it is trivial in the number of clothes per capita, but in the meantime voluminous in the to-be-collected individuals. This business model could barely be achieved without citizens' efforts to intentionally recycle their disposed garments. In other words, an awareness of recycling should be emphasized within the region through both short-term and long-term approaches. Societally, conducting education would be the most efficacious method to assist the next generation to garner their awareness. Nevertheless, this might be a tedious and time-consuming trek. Therefore, the short-term stimulus must be implemented apropos of recycling. For instance, using fiscal compensation in return for each clothes to consumers who contributed, or a large-scale bruit via social media and mass media through either advertisements or campaigns. Recycling firms could also take the advantage of traffic within a crowd-densed area or design a vibrant recycling bin with much visual appeal.

Subsequently, the collection sorting process is essential—once collected, the garnered clothing is classified into three categories: reuse, rags, and fibers (The Process of Recovering and Recycling Old Clothing 2019). This process is typically conducted through manual labor, which requires expertise after professional training, and investment from firms. Mechanical systems such as conveyor belts and bins could be used to improve classifying efficiency.

Last but not least, is the processing stage. Usually, textiles are composed of distinct materials such as wool, cotton, and nylon, to name a few, and this could affect the methodologies of recycling. Still, the mechanism of recycling textiles could be generalized into the following steps: anaerobic digestion, fermentation, composting, fiber regeneration, and thermal recovery (Juanga-Labayen et al. 2022), which are technically complex and costly. In addition, there might be technological barriers to recycling due to a lack of production lines or a deficiency in the core technology. After all, Africa is currently undergoing a severe brain drain that nearly 70,000 of skilled professionals are leaving the continent (Brain Drain 2018). The government might subsidize the related industry and workers to alleviate the issue.

2.2 Current Status Apropos of the Circular Textile/Cotton Model

As mentioned in an earlier section, only 1% of the world's textile produced is recycled, and due to the copious barriers and prerequisites, the African textile industry is still predominantly linear. According to Oduah (2020), African producers and brands in the textile industry are still of the most resourceful and sustainable in terms of their business practices, and there are still companies at the forefront of the adoption of the circular textile model. In fact, according to a report by The Insight Partners (Middle East and Africa Recycled Textile Market to Grow at a CAGR 2021), the combined value of the recycled textile industry in the Middle East and Africa is $403.85 M, and this value is expected to grow at a CAGR of 5.4% from 2020 to 2027.

A part of a circular economy is about recycling, and, according to a report by Leblanc (LeBlanc 2020), there are two sources for textiles to be potentially recycled: "Post-consumer" and "Pre-consumer" which include by-products from the production of fabric and by-products from upstream industries. In terms of "post-consumer" recycling, a lot more work must be done as the recycling rate is substantially lower than the percentage of textiles that could be recycled as aforementioned. In terms of "pre-consumer" recycling, African cotton producers also have yet to unlock the value-creating potential of by-products as currently the major value of cotton production is derived from cotton's lint or fiber. However, there are other parts of cotton that could be exploited, such as "stalks, husks, cottonseed, and short-staple fibers" (Meliado et al. 2019).

According to a report by the Ellen MacArthur Foundation (Circular Economy in Africa: Fashion and Textiles 2022), there are still companies that are driving circular practices in the textile industry. The first company that will be discussed is named Demco, a textile manufacturer based in Tunisia. Although it does not recycle "post-consumer textile", it practices "Pre-consumer" recycling as it utilizes recycled raw materials to manufacture its Jeanswear, sportswear and knitwear. In fact, 50% of the

water used in production is recycled or reused water; 30% of energy stems from energy generated by solar panels. They also collect and sell all waste materials from the production of textiles to certified companies to be recycled. What is even more encouraging is that, according to Demco (Circular Economy in Africa: Examples and Opportunities—Fashion and Textiles: Shared by IGC 2021), the demand for recycled textiles increased by 400%.

Also, a social enterprise formed by the two brands named Woogui and Karingana Wa Karingana is also focusing on developing more sustainable and circular practices in the textile industry. Instead of synthetic dyes, the enterprise utilizes more environmentally friendly dyes that come from "cotton fabrics, banana leaf textiles, and recycled plastic." Although not all materials used come from circular practices when dealing with the waste generated from the textile industry, the use of other recycled materials also promotes circularity in other industries (Circular Economy in Africa: Examples and Opportunities—Fashion and Textiles: Shared by IGC 2021).

2.3 Competition and Mitigation of Current Raw Cotton Export Model

Since raw cotton is one of the most important export products of many countries in Africa, the raw cotton export industry is crucial to the livelihoods of millions of farmers and their families. However, as the novel circular model would recycle used products and re-export these, the total demand for raw cotton would decrease, which would threaten the jobs and income of these millions of African families. Nevertheless, this impact can be mitigated depending on the situation. For instance, as is already the case for many smallholders in Africa, they always ensure that they will be able to provide for the family (Brink et al. 2021). This means that in the past when cotton prices were low, they often resorted to growing something else to sell. Though cotton isn't a locally sold product, in regions such as West Africa, there is always demand for food in the regional market, which ensures that the other crops grown can be sold (Pais et al. 2021). Due to the growing population in Africa and the expanding food security issues, this switch of crops can be the solution to the decrease in cotton demand caused by the transition from the current raw cotton export model to the new circular model.

However, this transition from growing cotton to other plants on such a large scale can require a massive amount of money and resources, since the inputs needed, such as fertilizers and growing conditions, can vary drastically across different crops. This would mean that government subsidies may be needed in order for the transition to be sustainable, but due to the aforementioned consumer and government attitudes towards circular textile products, this would be especially hard to accomplish. Therefore, there needs to be a solution that requires minimal change, and therefore resources, that could make this transition smooth.

Currently, in Africa, cotton is mainly grown for its fiber or lint, which is used in the textile industry. Nonetheless, as the textile industry will need less output in these products after transforming to the new model, this cotton can be used to produce other products, like soap (Moea and Meliadò 2021). Though fiber and lint have less demand, other parts of the cotton-like the stalks, husks, cottonseed, and short-staple fibers can be utilized to make cotton by-products. Furthermore, not only is this method a good solution to the potential unemployment caused by the new model, but it will also benefit local businesses by adding domestic value. Whereas 90% of the raw cotton lint produced by sub-Saharan countries is exported, products like soap do have a local market in Africa and will boost local businesses (Moea and Meliadò 2021).

3 Evaluation of the Novel Circular Model

3.1 Pros

Firstly, the recycled textile industry reduces great environmental issues since conventional production tools are not eco-friendly. Hence, benefits are yielded from reducing the production using raw textile fibers through reduced carbon footprint due to less incineration and landfill dumping and preserved scarce natural resources.

Secondly, due to the presence of large foreign markets, Africa can reap many benefits by exporting its products to global markets. In the long run, subsidies can be implemented to facilitate a structural shift from traditional to "green" across the industry. And also because the industry is labor-intensive, it can create millions of jobs for Africans, which provides job opportunities for many African citizens, especially women. Therefore, increasing the potential for the African economy.

Third, in Africa, cotton belongs to the textile industry. In the past, when cotton prices were lower, they often chose to grow other crops to sell. While cotton is not a locally marketed product, in regions such as West Africa, there is always a demand for food in regional markets, which ensures that other crops grown can be sold. A shift in this crop could address the declining demand for cotton caused by the shift from the current export pattern of raw cotton to a new circular pattern due to population growth and food security concerns in Africa. After the textile industry transforms into a new model, there will be less demand for these products, and cotton can be used to make other products. Other parts of cotton, such as stems, hulls, cotton seeds, and short fibers, can be utilized to make cotton by-products. Therefore, this approach can be a good solution to the potential unemployment problem brought about by the new model.

3.2 Cons

To begin with, as aforementioned, from the sociological standpoint, there are copious barricades to transforming domestic consumers' attitudes towards recycled textiles due to factors like their culture. Thus, some Africans and governments have an aversion to these recycled clothing, which reduces the demand for recycled clothing, and this lack of demand could potentially jeopardize the profitability of the circular textile industry and reduce the potential scale of the industry. In fact, according to an OR, a firm that investigates the African market for imported second-hand clothing, around 40% of clothes are dumped into landfills due to a lack of demand. Hence, the potential to scale up the market and the industry could be jeopardized if this detestation to recycled clothing remains (Baraka 2021).

Furthermore, some African legislators have imposed protectionist policies on these SHRCs due to their price competitiveness which will cut the domestic producers' market share of the textile market. Therefore, the implementation of the model would be limited due to these policies. However, from the standpoint of African countries, if the domestic circular textile industry can reduce its costs of production, it could sell these second-hand clothes at a price that is competitive enough to drive out foreign competition, and hence promote the African textile industry and aid its transition to a circular textile model.

In addition, a lot of the African countries have a tight fiscal budget and their citizens, including businesses, might not have sufficient savings to invest in capital and labor that would enable the successful adoption of the circular textile model. This means that this policy would be time-consuming, especially without any foreign direct investments, since the research and development required for the textile recycling technology require substantial capital expenditure. Therefore, this circular model could be limited by implementation lag and affect lag.

Last but not least, although the adoption of the circular textile model would create job opportunities, the working conditions of these new jobs remain questionable. Albeit, it is still a step in the right direction as more job opportunities mean potentially more income and higher real output as more resources are being utilized.

4 Conclusion

To sum up, the aspirational transformation from the conventional linear economy into a ground-breaking circular flow textile model would confront several challenges in the aspects of both society and the market, including the technological barrier, consumers' avert attitudes along with impactful structural changes to be conducted. Nevertheless, this transformation is turning from an option into an urgent call, for the sake of the environment and of our offspring, given the exacerbating global warming issue. With the circular textile model, not only could Africa garner carbon neutrality more rapidly, but also could yield a great amount of market value

towards domestic recycling firms, garment manufacturers, and even the global textile industry, meanwhile creating latent positions of jobs. Circular economic modalities are prerequisites for long-term development—after all, a devastated environment overshadows our lavish skyscrapers and makes our previous efforts in vain.

References

Africa Textile Industry | 2022–27 | Industry Share, Size, Growth—Mordor Intelligence. (n.d.). https://www.mordorintelligence.com/industry-reports/africa-textile-industry---growth-trends-and-forecast-2019---2024. Retrieved 7 May 2022

Baraka C (2021) Secondhand fashion: is it really good for Africa?" Vogue Business, 25 Nov 2021. www.voguebusiness.com/sustainability/secondhand-fashion-is-it-really-good-for-africa

Brink H et al (2021) Potential effects of circular economy strategies on low and middle income countries. Pbl 18 Nov 2021. www.pbl.nl/sites/default/files/downloads/pbl-2021_potential-effects-of-circular-economy-strategies-on-low-and-middle-income-countries_4457_0.pdf

Bové A-T, Swartz S (2019) Mapping the benefits of a circular economy. McKinsey & Company, McKinsey & Company, 14 Mar 2019. https://www.mckinsey.com/business-functions/sustainability/our-insights/mapping-the-benefits-of-a-circular-economy#:~:text=In%20recent%20years,%20McKinsey%20research%20has%20shown%20that,products-is%20at%20least%20part%20of%20the%20answer.%201

Brain Drain: A Bane to Africa's Potential (2018) Mo Ibrahim Foundation, 9 Aug. 2018, mo.ibrahim.foundation/news/2018/brain-drain-bane-africas-potential

Circular economy in africa: examples and opportunities—fashion and textiles: shared by IGC (2021) Circular economy in africa: examples and opportunities—fashion and textiles | Shared by IGC, Aug 2021. https://emf.thirdlight.com/link/uitrjv2osbts-hg5uvq/@/preview/1

Circular Economy in Africa: Fashion and Textiles (2022) Ellen MacArthur Foundation, ellenmacarthurfoundation.org/circular-economy-in-africa-fashion-and-textiles. https://ellenmacarthurfoundation.org/circular-economy-in-africa-fashion-and-textiles. Accessed 26 Apr 2022

Fashion Industry Environmental, Waste, and Recycle Statistics (2022) EDGE 28 Jan 2022, edgexpo.com/fashion-industry-waste-statistics. https://edgexpo.com/fashion-industry-waste-statistics/

Gender Equality (2022) UNICEF Eastern and Southern Africa. www.unicef.org/esa/gender-equality. Accessed 26 Apr 2022

Global Textile Market Size and Share Report, 2022–2030 (2022) Grand View Research www.grandviewresearch.com/industry-analysis/textile-market. Accessed 26 Apr 2022

Juanga-Labayen JP, Labayen IV, Yuan Q (2022) A review on textile recycling practices and challenges. Textiles 2022 2, 174–188. https://www.mdpi.com/2673-7248/2/1/10

Langsdorf S, Duin L (2022) The circular economy and its impact on developing and emerging countriesurens duin. Ecologic. https://www.ecologic.eu/sites/default/files/publication/2022/50068-Circular-Economy-and-Developing-Countries-final.pdf

LeBlanc R (2020) The basics of clothing and textile recycling. The balance small business, the balance small business, 30 Dec 2020. https://www.thebalancesmb.com/the-basics-of-recycling-clothing-and-other-textiles-2877780

Meliado F et al (2019) Unlocking the hidden value of cotton by-products in African least developed countries. UNCTAD, 1 Oct 2019. https://unctad.org/news/unlocking-hidden-value-cotton-products-african-least-developed-countries#:~:text=Cotton%20is%20a%20predominant%20cash%20crop%20for%20many,for%20over%201.5%20million%20metric%20tonnes%20of%20lint. (Duplicated with one in 2.4)

Middle East and Africa Recycled Textile Market to Grow at a CAGR of 5.4% to Reach US$ 608.73 Million from 2020 to 2027 (2021) The Insight Partners 8 Jan 2021. https://www.theinsightpartners.com/reports/middle-east-and-africa-recycled-textile-market/#:~:text=The%20recycled%20textile%20market%20in%20Middle%20East%20and,the%20major%20economies%20in%20Middle%20East%20and%20Africa

Moea TJ, Meliadò F (2021) Covid has disrupted Africa's cotton production. Here's how soap could provide a solution. World Economic Forum. https://www.weforum.org/agenda/2021/05/cotton-byproducts-africa-economics-business-covid-coronavirus/

Oduah C (2020) Africa's fashion business is using new and traditional methods to drive sustainability Quartz. https://qz.com/africa/1909386/african-fashion-tries-its-hand-at-old-priority-sustainability/

Our Story—Suave Kenya (2022) Suave Kenya, global.suavekenya.com/our-story/?v=518f4a738816. Accessed 1 May 2022

Pais G et al (2021) Safeguarding Africa's food systems through and beyond the crisis. McKinsey & Company, 31 Aug 2021. www.mckinsey.com/featured-insights/middle-east-and-africa/safeguarding-africas-food-systems-through-and-beyond-the-crisis

Protectionist Ban on Imported Used Clothing (2018) Africa Renewal, 4 June 2018. www.un.org/africarenewal/magazine/december-2017-march-2018/protectionist-ban-imported-used-clothing

Rwagatare J (2018) The New Times | Rwanda, 4 April 2018. www.newtimes.co.rw/profile/joseph-rwagatare

Stone C et al (2020) Natural or synthetic—how global trends in textile usage threaten freshwater environments. Sci Total Environ vol 718, p 134689. Crossref. https://doi.org/10.1016/j.scitotenv.2019.134689. https://pubmed.ncbi.nlm.nih.gov/31843315/

The Process of Recovering and Recycling Old Clothing (2019) The Balance Small Business, 27 Feb 2019. www.thebalancesmb.com/how-garment-recycling-works-2877992

World Bank Group. "How Much Do Our Wardrobes Cost to the Environment?" World Bank, 8 Oct 2019. www.worldbank.org/en/news/feature/2019/09/23/costo-moda-medio-ambiente

What Can Chinese Universities Learn from American Universities About Endowment Management

Jingxi Shi

Abstract This paper firstly reveals the importance of endowment in the development of universities and higher education, and then through comparing the endowment of Chinese universities with American universities in terms of the size, investment return rate, spending and so on concludes that the performance of endowment management in Chinese universities is comparable with US public universities but both of them are worse than US private ones. Consequently, this paper analyses the reasons behind the phenomenon and lastly make advice on the development of Chinese universities so that they can enjoy more endowment resources and adopt wiser investment strategy for the construction of university and for the development of higher education.

Keywords Endowment management · University · Investment strategy

1 Introduction

University endowment has long been an integral part of the American university system. Prestigious universities are known for having sizable endowments that help support scholarships for students, attract high-quality researchers and educators, fund valuable research projects and so on. Just as we see from Harvard, the endowment is the largest financial asset of Harvard and plays an indispensable role for the university development. The endowment not only remains the largest source of revenue supporting the university budget but also supports nearly every aspect of university operations. Besides, there are lots of academic programs in the university and these programs weave a vibrant tapestry of scholarship and research, from cutting-edge technology to the arts and humanities. One of the most important threads that holds this tapestry together is the endowment. So the stronger the endowment, the brighter and more ambitious university's tapestry can be.

J. Shi (✉)
Nanjing Audit University, Nanjing 211815, China
e-mail: 970711399@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_133

As China strives to enhance its university education, several Chinese universities have started to incorporate the establishment and utilization of university endowment funds to assist in the process. Compared with the world-class university, Chinese universities have long relied on the government grant and tuition revenue. What's more, Chinese universities lack the ability to gather social resources—such as corporate donations and alumni donations—to diversify the investment and have not establish the system to support higher education from all sectors of society. Accordingly, the endowment size in China is relatively small and this has become a shortcoming that restricts the development of higher education. But fortunately, since it is at the early stage in the development of the Chinese university endowment, it gives China the opportunity to learn from their American peers.

This paper evaluates the characteristics and performance of Chinese university endowments and compare them to their American peers. So through such comparison, we can recognize the difference between the Chinese and American universities and more importantly, we can learn the endowment management model in American university and transform the management strategy in China. In detail, I selected top five Chinese universities: Beijing University, Tsinghua University, Zhejiang University, Nanjing University, Fudan University, top three American private universities: Harvard, Stanford, MIT and top three American public universities: University of California, Los Angeles; University of California, San Diego; University of Michigan.

Through comparing the endowment between Chinese and American universities, I found that contrary to general belief, Chinese universities in fact enjoy comparable resources to major U.S. academic institutions, except for top private U.S. universities which enjoy far superior endowment size, new endowment each year and so on, but Chinese universities need to adjust their investment strategies to take more risks to remain competitive in the management of sizable endowment. Specifically, I found the followings. First, while top U.S. private universities have significantly larger endowment—in terms of both the aggregate amount and per student amount—than other universities, Chinese and American public universities are more comparable in terms of the aggregate and the per student amount. Second, their large endowments give U.S. private universities the ability to spend more per their student, while Chinese and U.S. public universities are also comparable on this metric. Third, in terms of investment performance, the performance of U.S. university endowment funds—both private and public—generally track the U.S. equity performance, but they are slightly lower average return and more volatility. Fourth, investment performance of Chinese university endowments, on the other hand, tend to be relatively stable, yielding approximately 5% per year between 2015–2020.

After above analysis, I concluded that in order for Chinese universities to achieve greater performance, they should try their best to obtain more money through diversified financing channels. What's more, Chinese universities should also take more risky investment strategies such as invest more in the equity. Besides, Chinese government should bear their responsibility to help universities further development.

1.1 Literature Review

The paper contributes to the literature on the drivers of university endowment success in America. For example, Lerner, Schoar and Wang argue that large endowments and schools with high average SAT scores managed to generate similar and above overall average returns (Lerner and Wang 2008). Corroborating evidence is in Barber and Wang who provide a mean performance (from 1991 to 2010) of 11.49% for Ivy League schools, 10.23% for the top-30 schools by SAT scores and 8.17% for other institutions (Barber and Wang: Do (Some) 2013). Additionally, Cejnek, Franz, Randl and Stoughton conclude that endowment management is a fertile area for application of the advanced state of development of modern financial theory and empirical analysis. So universities should pay attention to the four area: asset allocation, performance, spending policy, and governance for the management of endowment (Cejnek 2014).

Literature by Chinese scholars on university endowment has been more limited, with most focusing on evaluating endowment performance of top U.S. universities. For instance, Lijie evaluates the endowment performance of Harvard University and conclude that the strong support from donators, solid investment management and stable spending strategy contribute to the sustainable development of Harvard. Similarly, Zhanghui, Yulan study the performance of Stanford Endowment Fund and suggest that optimized foundation structure, professional investment team and effective investment operation are all the key to the success of endowment development (Lijie 2015; Zhanghui 2019). While such observations offer interesting insights on how top U.S. university endowment manage their funds, these papers stop short of offering specific lessons for Chinese universities, especially on how to adapt the lessons in the Chinese context, given differences in economic environment. Furthermore, studies on Chinese endowment funds have been limited in quantity, so this gives fewer insights for Chinese universities.

2 Data and Methodology

In order for my paper representative, I selected top five Chinese university: Beijing University, Tsinghua University, Zhejiang University, Nanjing University, Fudan University. I found the data: endowment size, spending and investment income of five universities from 2015 to 2020 in the website: China Foundation Center, which is a website provides information and news about university foundation all around China. Besides, I also download the annual report of five foundations where I use relative information to calculate the investment return rate and new endowment.

For the American university, I selected top three American private universities: Harvard, Stanford, MIT and top three American public universities: University of California, Los Angeles; University of California, San Diego; University of Michigan. I used the website: NACUBO (The National Association of College and

University Business Officers) to collect the investment return rate of average US university in each year from 2015 to 2020. For the individual university, I searched the official website of each university where I also download the annual report to find the endowment size, spending and so on.

In order for the data comparable among each university, I calculated spending per student, new endowment per student, so this can exclude the impact of student number.

3 Key Findings

In more detail, I concluded the findings into five points.

American Universities Have Accumulated Sizable Endowments, Especially Top Private American Universities. As we can seen from the chart (Fig. 1), in 2020, private universities of America have a sizable endowment than other types of university. All of the three top private universities have an endowment size over 18 billion. While on average, public universities only own an endowment size about 10 billion or even less and Chinese universities just have about 1 billion endowment. Besides, Harvard has the largest endowment size among the 11 universities, which is about 40 times larger than Beijing University (152 million).

For the Chinese and US public universities, although some public universities (UMICH) seem to have a larger endowment than Chinese universities, when ruling out the particular ones, we can see the endowment of these two types of universities have a relative comparable size, fluctuating around 1 billion. And these trend can be seen from year to year.

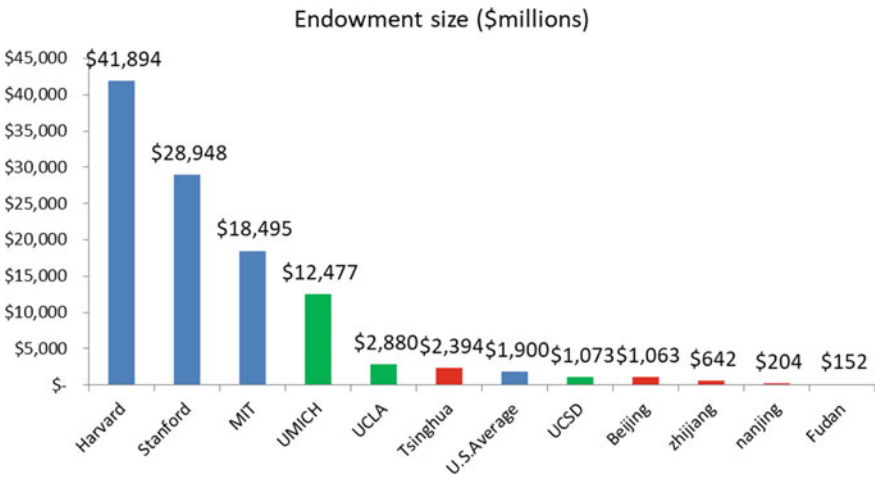


Fig. 1 Endowment size among Chinese and American universities

When we look up past five year data, we can see that the endowment size gap between US private universities and public as well as Chinese universities have exited. In 2016, Harvard embraced over 35,000 millions endowment size whereas UCLA and Beijing university only have about 1800 and 900 millions size. Form 2016 to 2020, it's also glad to see that endowment size constantly increase among different universities.

Spending Follows Endowment: A University with Larger Endowment Spends More Per Student. From the bar chart (Fig. 2), we can see clearly that following the trend of endowment size, the top private universities in America have spent far more endowment per student than private and Chinese universities, with an average of 75.48 thousands per student in 2020. For the same year, we can see that Chinese universities and public universities have spent 1.99 thousands and 3.33 thousands per student respectively, so the spending per student in these two types of universities is close and is also in line with the change of the endowment size.

Distributions from endowment provide a critical source of funding for the University around world. The main categories of funds cover faculty salaries and scholarship as well as manufacture construction. For US universities, spending practice has to balance two competing goals: the need to fund the operating budget with a stable and predictable distribution, and the obligation to maintain the long-term value of endowment assets after accounting for inflation. So in order to reduce the effects of inflation and the higher cost of education, most of institutions use an averaging mechanism to compute spending which help ensure the amounts are not widely fluctuating, and most likely are slightly increasing each year. The equal-weighted average spending rate of all institutions in the NACUBO Study was approximately 4.4% of the average fund value.

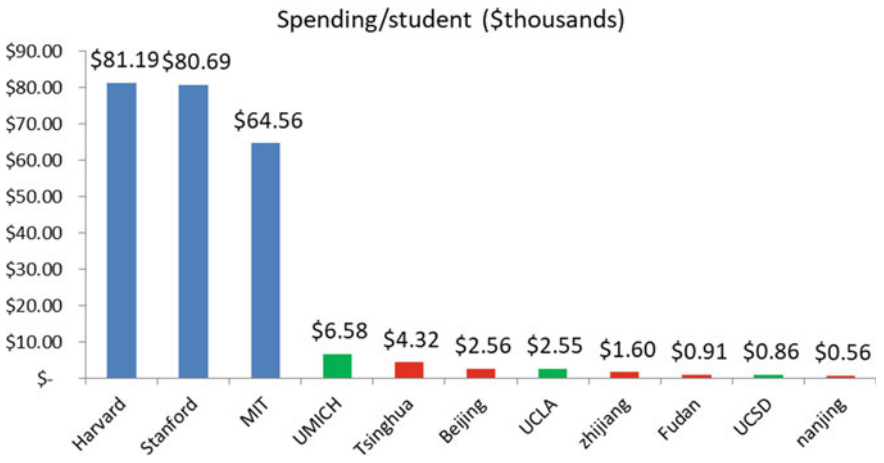


Fig. 2 Spending per student among Chinese and American universities

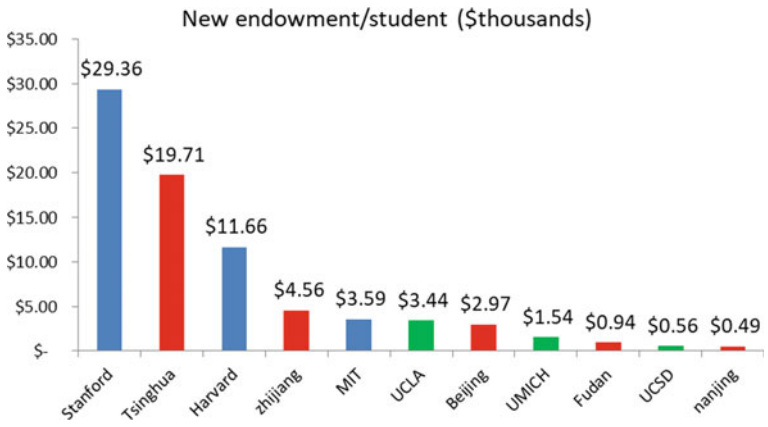


Fig. 3 New endowment per student among Chinese and American universities

New Endowment Per Student Follows Endowment: A University with Larger Endowment Receives More New Endowment Per Student. The bar chart (Fig. 3) shows the average new endowment per student in Chinese and American universities from 2017 to 2020. As we can see again, the private universities in America receives far more new endowment in the five years, where Stanford has the largest new endowment per student (28.75 thousands). This also follows the trend of endowment size. When looking at the Chinese and public universities in America, though the new endowment per student fluctuates in different schools, we can see that on average this two types of universities receive the new endowment per student below 5 thousands.

In general, there are two ways to earn new endowment, one is government grant and the other is social donations. Among US universities, social donations play a core role in the enlargement of endowment. Just as Harvard, the endowment is made up of more than 14,000 funds in 2021 and most of them come from corporate and alumni donations. In China, though more and more wealthy people are donating their money for Chinese universities, the channels to obtain non-government donations are relatively single. Compared with US universities, Chinese universities gain much fewer social donations and have a lower proportion in the university revenue. For example, Beijing university, which tops the list of alumni donations in China, has accumulated 2.017 billion RMB in alumni donations in the past 25 years, which is less than Harvard's individual donation (also alumni donation) in 2015, indicating a significant gap.

Endowment Performance is Generally Below the Overall Equity Benchmark. As we can see from the chart (Fig. 4), when comparing the investment return rate of US and Chinese universities with the benchmark: S&P 500, we can see that generally both endowment performance are below the benchmark except in some year, where it is close to the benchmark.

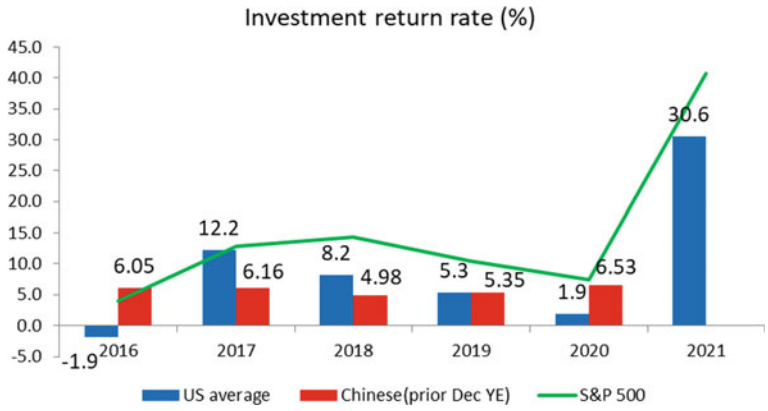


Fig. 4 Average investment return rate among Chinese and American universities

US Endowment—Both Public and Private Universities—Have Generally Tracked the Equity Benchmark Better Than Chinese, Chinese Endowment Returns Have Been Low But Relatively Stable. For the detail, we can see from the chart (Fig. 4) that the the change of the investment return rate in public and private university in America are in line with the change of benchmark, so the fluctuations of the return rate are relatively large, which means the investment strategy of American university are risky. And we can also see that the university return rate are close to the benchmark and sometimes below it (Table 1).

However, for the Chinese university, the investment return rate is stable from 2016 to 2020 and this is not consistent with the benchmark, where in 2020 there is a sudden rise of return rate. Besides, except in 2016, the investment return rate of Chinese universities are all far below the benchmark.

In terms of asset allocation, US universities enjoy a diversified portfolio. Just as we seen from chart (Fig. 5), all of US universities described have invested money in public equity, private equity, hedge funds, real estate such risky assets and in bonds, natural resources such safety assets. What's more, they invested more in the risky assets and thus enjoyed higher investment return rate. For example, UCSD, MIT invested 92%, 85% money into public equity, private equity, hedge funds and real estate respectively and then achieved 8.5 and 9.1% 5 year investment return, while UCLA invested 77% money into risky assets and obtained 5.3% 5 year investment return. For Chinese universities, they tend to invest their money into bonds and equity, so have a single investment way.

When we look at asset allocation among Chinese universities (Table 2), we can see that generally Chinese universities invest nearly half of their money into short-term investment, which is safer but less profitable than long-term investment. On the contrary, US universities allocate about 90% money into the long-term investment, and thus enjoy higher investment return rate.

Table 1 Investment returns of endowment funds

Investment return (%)	2016	2017	2018	2019	2020	5 year Avg
U.S. Private Universities						
Harvard	− 2.0	8.1	10.0	6.5	7.3	6.0
MIT	0.5	14.3	13.5	8.8	8.3	9.1
Stanford	− 0.4	13.1	11.3	6.5	5.6	7.2
Average	*− 0.6*	*11.8*	*11.6*	*7.3*	*7.1*	*7.4*
U.S. Public Universities						
UCLA	− 4.1	15.8	10.5	3.7	0.5	5.3
UCSD	–	13.9	7.6	7.1	5.0	8.4
UMICH	4.8	7.0	7.0	7.0	6.5	6.5
Average	*0.3*	*12.2*	*8.4*	*5.9*	*4.0*	*6.2*
Chinese Universities						
Tsinghua	7.4	8.1	6.0	7.4	11.4	8.0
Fudan	–	5.9	4.2	3.7	2.7	4.1
Beijing	2.8	4.2	4.0	7.1	7.1	5.0
Zhejiang	6.3	7.3	4.6	1.9	6.7	5.3
Nanjing	7.8	5.3	6.2	6.8	4.9	6.2
Average	*6.0*	*6.2*	*5.0*	*5.4*	*6.5*	*5.8*
Benchmark return						
S&P 500	4.0	12.9	14.4	10.4	7.5	9.8
Russell 3000	2.1	15.8	14.8	9.0	6.5	9.6

4 Analysis

4.1 The Larger Foundations Are, the Riskier Assets They Will Invest

As we can seen from chart (Fig. 6), with the increase of endowment size, the foundation will invest more many into equity and real assets, which are riskier assets. The foundation with endowment size over 1 billion invest nearly 90% into risky assets while those with endowment size under 25 million only allocate about 70% to such categories. To be more specific, when looking more detail into equity allocation, we can see that large foundations tend to invest in private equity and marketable alternative such riskier equity while small foundations choose to invest global equity such safe one.

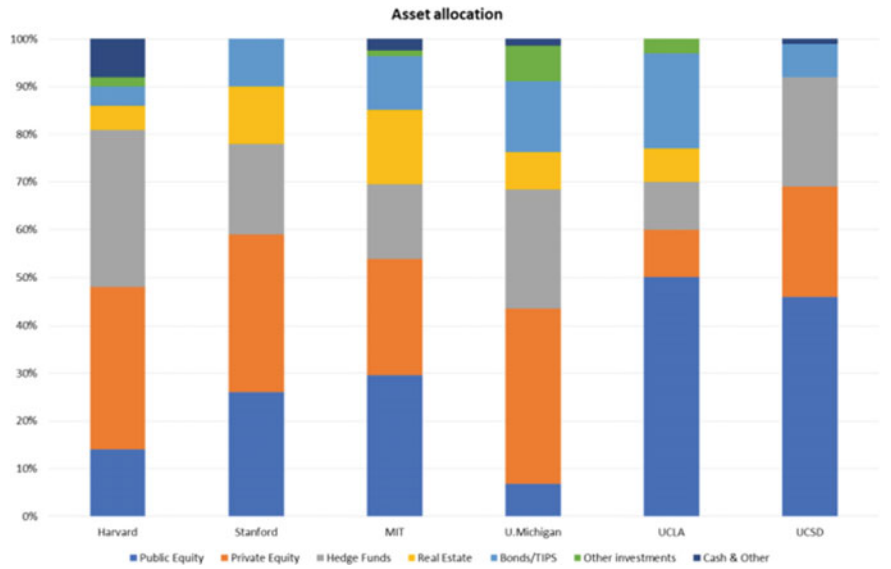


Fig. 5 Asset allocation among American universities

Table 2 Asset allocation among Chinese universities

	Tsinghua (%)	Fudan (%)	Beijing (%)	Zhejiang (%)	Nanjing (%)
Cash	2.07	40.38	2.54	14.39	26.58
Short-term investment	43.47	0.00	37.88	20.36	0.03
Long-term investment	54.45	59.62	59.59	65.25	73.38

4.2 Investment Performance Varies Slightly: With Funds Over $1 Billion Doing Very Well, Funds Below $25 m Doing Poorly, and Others in the Middle Do Average

Table 3 shows the relationship between endowment size and 10 year average return. For example, when foundations over $1 billion invest $1 now, they can obtain $214 ten years later. So we can conclude that funds over $1 billion doing very well, funds below $25 million doing poorly, and others in the middle do average. The reasons for the investment performance variations are as follows. Because of the sizable endowment, large endowments have more choice to allocate assets. Besides, PE and VC are more willing to obtain large institutions investment. So since the high return of private equity, large foundations will invest more in such sphere and thus achieve good investment performance.

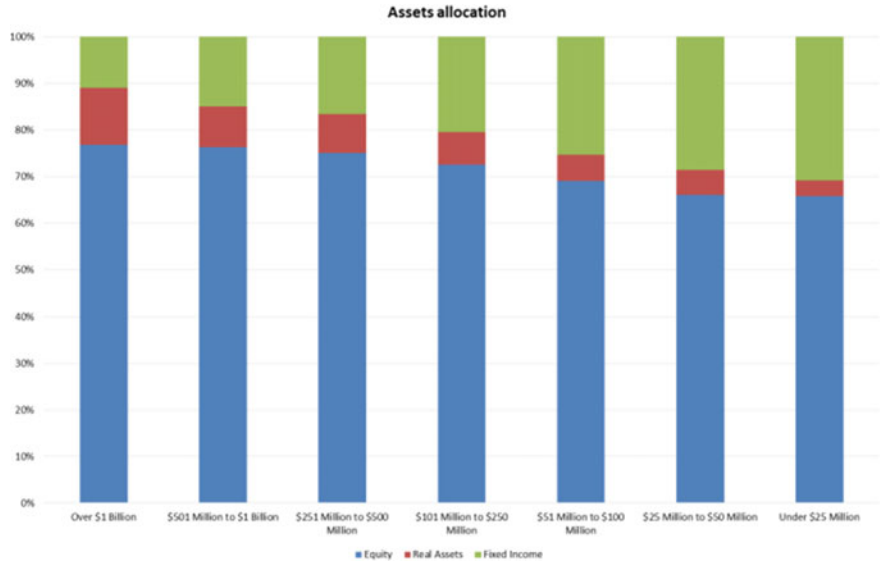


Fig. 6 Asset allocation among American universities in terms of endowment size

Table 3 Relationship between endowment size and 10-year average return

Endowment size	10-year average return
Over $1 Billion	2.14
$501 Million to $1 Billion	2.04
$251 Million to $500 Million	2.08
$101 Million to $250 Million	2.06
$51 Million to $100 Million	1.97
$25 Million to $50 Million	2.06
Under $25 Million	1.68

4.3 US Public and Private Universities Follow Similar Assets Allocation Model: Invest More in Equity

As we can see from chart (chart 7), both US public university and private one follow similar assets allocation model, they tend to invest more in the equity and real assets such risky assets (about 90%), and invest only 10% in the fixed income. This is also confirmed in the above discussion. US top public and private universities all achieve great performance which are close to the benchmark. So it is the relatively sizable endowment and assets allocation model help them achieve this (Fig. 7).

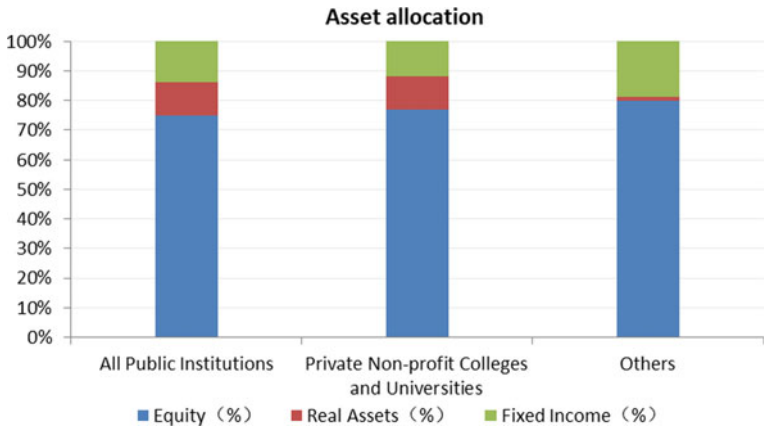


Fig. 7 Asset allocation among American universities

5 Recommendations

After above analysis, we can see that although Chinese universities are comparable with US public universities, in order to make competitive in the world, they should catch up with the development of US private universities and there are many aspects they can improve.

5.1 Get More New Endowments

As we can see from data, the new endowment Chinese universities got is much lower than US private universities. However, new endowment is one of the key point in the university development. The sustainable and sufficient financial resources can not only contribute to higher education construction, but also help universities achieve comprehensive development. I think new endowment come from two ways. One is society donation and the other is investment management. Nowadays, although Chinese universities are transforming, their financing channels are single, relying too much on the fiscal appropriation and tuition. Limited outside fund support conflicts with the increasing capital needs. The unique value of endowment lies in increasing resources supply and satisfying capital needs. So the management of university should realize the diversity of financing can trigger university vigor, promote competitive advantages and more importantly, form stamina of sustainable development. Universities should try their best to gather funds from all over the society, such as corporate and alumni.

5.2 Chinese University Need to Take More Risk

After gathering sizable endowment, one of important parts is the management of endowment, making money become more money. However, the investment strategy of Chinese universities are conservative. Although this can ensure they get stable money from year to year, they lose the chance to gain much money. I think there are many reasons that Chinese universities choose this strategy. First, because the relatively low amount of endowment and the urge to use money, Chinese universities have no choice to adopt low risk strategy to ensure it can earn constant income. Unlike US private universities, using annual new endowment to appreciate, Chinese universities use their principal to development. If the risky investment strategy does not achieve ideal results, it may greatly impact the survival of universities. Second, The management of endowment attaches to the financial authority, the decision model relies on the university administrative decision, so the investment cannot adjust to the investment environment quickly.

5.3 The Role of Chinese Government

In order to improve the endowment management, government should bear their responsibility. First, government should cultivate donation culture, encouraging every person, every alumni to try their best to help alma mater better development. Second, government can encourage universities to try risky investment strategy by compensating universities if they are short of money because of investment loss and taking back the compensation if they make investment gain in the next year. So universities don't need to worry about current cash flow and can pay much attention for long-term development. Third, government can try their best to make equity market more efficient and healthier, so more and more universities are willing to invest in the equity.

6 Conclusion

This paper firstly reveals the importance of endowment in the development of universities, then through comparing US universities with Chinese universities concludes that Chinese universities in fact enjoy comparable resources to major U.S. academic institutions, except for top private U.S. universities which enjoy far superior endowment size, new endowment each year. Then I analyze the reason behind this: larger universities tend to adopt risky investment strategy and achieve higher investment return rate. Finally, I make advice on the development of Chinese universities: they

should attract more endowment and take more risk investment. I believe as Chinese universities and government pay more attention to the higher education, Chinese universities are bound to perform well in the near future.

References

Lerner S, Wang (2008) Secrets of the academy: the drivers of University endowment success. J Econ Perspect, pp 207–222

Barber, Wang (2013) Do (Some) University Endowments Earn Alpha?

Cejnek F, Randl, Stoughton (2014) A survey of university endowment management research. J Investment Manage

Lijie (2015) Research and enlightenment on endowment fund management strategy of Stanford, Contemporary education administration, pp 124–128

Zhanghui Y (2019) The investment risk management of Harvard endowment fund and its enlightenment to first-class universities in China, global perspective, pp 65–68

What Types of Policy Convergence Have Been Created During Global Financial Crisis in 2008?

Ruiying Li

Abstract The affiliation damage brought by 2008 global financial crisis influences un-countable people's life, which could be attributed into the conflict between neoliberalism and financialization development. It is valuable to consider about which types of policy convergence were created during the crisis to provide guidance for future human beings. Therefore, this paper discussed about the policy convergences created by different countries as well as glob-ally during 2008 financial crisis, from the perspectives of worldwide, global north and global south. Globally, the majority of countries pursued tax re-duction policy. Specifically, global north countries preferred expansionary monetary polies while global south countries preferred to pursue policies for developing geopolitics and expand domestic demand.

Keywords Policy convergence · 2008 global financial crisis · Tax reduction policy · Expansionary monetary policy · Geopolitics development

1 Introduction

The 2008 financial collapse is the greatest global economic crisis since the Great Depression of 1930 (Stockhammer 2015). It is attributable to the implementation of the ideologies of neoliberalism and financialization (Becker and Jäger 2010), which are expressed in the operation of the depoliticized free market led by the United States and the United Kingdom (Burnham 2014). In addition, the Minsky cycle reveals endogenous development in the liberal markets and the presence of the time of bubble bust (Boyer 2012). To avert depression following a Minsky moment similar to 1930, the majority of the world's governments responded aggressively and enacted a series of initiatives. According to Marx's premise, capitalism society will experience periodic financial crises (Zwan 2014). In light of this, it is beneficial to analyze policy convergences in order to assess the effectiveness of the actions taken by authorities

R. Li (✉)
School of WMG, University of Warwick, Coventry CV4 7AL, UK
e-mail: ruiying.li129@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_134

to combat a recession. The phrase 'policy convergences' refers to the propensity of governments throughout the globe to enact similar policies (Bennett 1991). On the basis of a comparison and contrast between the global north and south, four sorts of arrangements (expansionary monetary policy, tax reduction, rising domestic demand, and emerging geopolitics) may be identified as typical policy convergences that emerged throughout the crisis. Thus, this article will be separated into three sections in order to explain the causes of the aforementioned policy convergences and assess the various results of comparable policies.

2 Worldwide—Tax Reduction Policy

After rescuing failing banks (Bieling 2013), the majority of international countries pursued expansionary policies (Callinicos 2012), particularly tax reduction measures. Since the financial cri-sis caused distrust of the neoliberal economy (Bieling et al. 2016), people started to believe in the market economy (capitalism's alternative), and Keynesian economic thought was supported once again (Bieling 2014). In other aspects, Keynesian ideology recommends expansionary fiscal measures, which are exemplified by tax cuts, to stabilize the market and boost the economy (Bieling 2013). The strategy was hastened from the worldwide south to the north due to varying regional circumstances. Specifically, in order to stabilize the market as rapidly as feasible, the advanced countries often spent more money on tax cuts. In 2008, the US government implemented a 168 multi—billion—dollar tax cut scheme (Mai 2014). On November 24, 2018, the British government enacted a pro-gramme to reduce taxes by 200 billion pounds as part of an economic recovery plan centered on tax cuts (Riches and Palmowski 2016). In contrast, governments in the third world, such as India and Brazil, decreased import levies on just a few items (Kaltenbrunner and Painceira 2015).

In addition, macroeconomists acknowledge that the dynamics leading up to each crisis were unique (Boyer 2012). Consequently, the examination of the effectiveness of the tax decrease should take into account the diverse state circumstances. Specifically, the strategy has a higher favorable impact in the United Kingdom than those in the U.S. After the less successful response to the 117 billion pounds cash bailout in the United Kingdom (Bell and Hindmoor 2014), tax cut was sought as the focal point of the economic stimulus plan and a positive response was produced. It mostly represented the increase in Christmastime consumerism (Kolb 2010). In contrast to the way in the United Kingdom, people in the United States lacked faith in the US market (Kolb 2010). To be more specific, all financialized nations are part of the credit-led development (Zwan 2014), hence the primary purpose of the system is to originate and distribute credit (Bieling 2013).

However, despite the fact that financial innovation in the United States helped Schumpeterian entrepreneurs amass great wealth and also introduced a number of derivatives trading to the credit supply (Boyer 2013), the credit crash was precipitated by mortgage-backed equities in the private credit-driven speculative boom

(Boyer 2012). The widespread skepticism of the credit system is a damaging blow to the economic system. According to Berkmen's (2009) research, the low support percentage for the program is due to the perception among US residents that the policy sought to lessen the burden on companies rather than citizens. Consequently, in order to re-store long-term public trust, the agreement should be linked to the society's 17 sustainable development objectives (Nilsson et al. 2016). Boyer (2013) said that the twenty-first century is an unequal and unstable one. Governments should investigate the concerns of corporate masculinities (Connell and Wood 2005) and climatic anomalies (Sayer 2009; Gills 2010) in the context of the capitalist economic crisis. The attainment of sustainable development objectives may also result in wealth accumulation. To explain it from a gender perspective, Motgomerie and Young (2011) demonstrated that women's economic power is substantially correlated with their family's wealth increase. In other words, if a nation wishes to expedite capital accumulation, its leadership must eliminate cultural prejudices against women and elevate women's social position via legislation (Elias 2005). Next an appraisal of tax cuts, the following two paragraphs will examine policy convergences in the global north, respectively.

3 Global North—Expansionary Monetary Policy

Due to the convergence impact of the world's dominating economic, the global north drastically shifted its expansionary fiscal policy, which mostly depended on the reduction of interest rates and quantitative easing. This measure proclaimed that governments from the north worldwide sought market capital injections to prevent economic stagnation (Mollah 2010). First, in terms of interest reduction, the United States, the United Kingdom, and the European Union all decreased their rates to about 1% (Credit and Production 2017). By December 2018, the Federal Reserve (FED) declared that the Federal Funds Rate will remain between 0 and 0.25% for the foreseeable future (Goddard and Wilson 2016). In addition, developed economies used quantitative easing in succession. For example, European Central Bank acquired 60 billion Eurobonds to finance it (Mollah 2010). To assure market liquidity, the U.S. government continues to issue new financial derivatives such as Term Auction Facility (TAF), the Primary Dealer Credit Facility (PDCF), and others (Credit and Production 2017). Up until March 2009, the FED injected 371.5 billion dollars into the financial market in an effort to increase its flexibility (Goddard and Wilson 2016).

Generally speaking, the expansionary fiscal policy is having an immediate impact. Nonetheless, this move has some remaining flaws. Initially, it might cause the currency to experience inflation. According to Bieling's (Bieling 2013) assertion, which is also referenced in Marxist theory, the boom-bust cycle is a characteristic of financialization in capitalist societies. The accumulation of the vast amount of fictional money created by the government has a high likelihood of causing another bubble (Bieling 2013). In contrast, experts from the Keynesian strain said that, compared to the financial crises of 2008 and 2009, governments removed a more

severe recession by direct funding (Callinicos 2012). Consequently, quantitative easing is required in the global north. Under these conditions, the group urged authorities to increase oversight of the financial sector. Although Wall Street lobbyists sought to thwart market intervention (Boyer 2013), that was difficult to advocate on such contentious matters in the United States (Mahoney 2007).

As a consequence, the US government passed the Dodd-Frank Act in 2010 to strengthen the government's oversight of the financial sector (Christophers 2016). This method might mitigate the incidence of the inflation issue and restore market trust among the populace. The second deficiency of expansionary fiscal policy is the accumulation of enormous government indebtedness. From 2007 to 2011, the Eurozone's public debt level rose from 66.3 to 91.8% (Bieling 2013). However, the situation deteriorated when the Eurozone adopted Keynesianism and compelled all its member-ship to combine quantitative stimulus and austerity to boost the markets (Grauwe and Ji 2012). Critically speaking, the irrational aspect of Keynesian austerity is its disregard for the uniqueness of each state. Using Sweden and Finland as examples, currency devaluation boosted exports and alleviated the issue of declining domestic demand; thus, austerity was inappropriate for their circumstances (Boyer 2012). In addition, the Greek national debt crisis demonstrated the inadequacy of the approach (Boyer 2012). Indeed, the Greek crisis prompted the examination of the Maastricht treaty's inherent flaws (Caporaso and Kim 2012). Bieling et al. (2016) showed the application of the regulatory method to enhance the theory of European integration and solve the aforementioned deficiencies. In conclusion, while the expansionary monetary practices of the global north are beneficial, each state should pursue its own circumstances. The subsequent one will examine the convergence of policies in the developing world.

4 Global South—Developing Geopolitics and Expanding Domestic Demand

The bulk of the policy trend for export-driven strategically economies in the developing world (Bieling et al. 2016) is to increase domestic demand and build geopolitics. Due to the fact that developing nations used global commerce and vertically Foreign Direct Investment (FDI) to overcome the problem of inadequate growth (Boyer 2013), the crisis has mostly affected their actual economies. Therefore, despite the fact that the afore-mentioned fiscal and monetary policies would generate a more favorable response on the financial markets of these nations (Gills 2010), they continued to implement measures to safeguard the actual economy.

Initially, governments inside the global south routinely increased domestic demand by boosting government spending. It drastically affected the economic climate in emerging regions. For instance, the Brazilian government stressed the family allowance programs and minimum salary rules (Choi 2000). Consequently, Brazil's GDP expanded in the second half of 2009 (Kawai et al. 2012). Due to

China's expansive domestic economy, the Chinese GDP maintained growing during the recession (Choi 2000). Consequently, this nation could be seen as the most persuasive illustration of the success of this approach and was portrayed as the dominant power in East Asia (Beeson 2009). Secondly, the formation of the BRICS nations (Ban and Blyth 2013) and the regional integration push in Asian Countries (Beeson 2009) indicated the appeal of geopolitical in the global south.

Specifically, the BRICS emerged as global investors during the financial crisis and supported the nations worst hit by the crisis (Ban and Blyth 2013). Particularly China, which said at the Group of 20 Finance Ministers and Central Bank conference that it would use $40 billion to finance global market development (Beeson 2009). Due to the above actions, China has the highest foreign exchange reserve at now (Beeson 2009). In contrast, the integration strategies of East Asia assist emerging nations in avoiding competitive marketing interactions in a capitalist market (Boyer 2013), hence fostering a more diverse export industry and worldwide value chain. In conclusion, the preceding helped nations in the developing world and expanded their growth space.

5 Conclusion

It may be claimed that reduction in taxes was among the most widespread responses to the 2008 financial crisis. In addition, the disparate environments of the global northern and southern draw distinct policy convergences. The northern region predominantly enacted an expansionary monetary policy, whilst the southern region mostly enacted measures aimed at increasing consumers' consumption demand and advancing geopolitics. In the first place, it is important to evaluate the current system of a variety of nations, as well as the measures that may successfully shield the nation from the effects of capitalism's cyclical financial crises.

References

Ban C, Blyth M (2013) The BRICs and the Washington consensus: an introduction. Rev Int Polit Econ 20(2):241–255. https://doi.org/10.1080/09692290.2013.779374

Becker J, Jäger J (2010) Development trajectories in the crisis in Europe. Debatte 18(1):5–27

Beeson M (2009) Geopolitics and the making of regions: the fall and rise of East Asia. Polit Stud 57(3):498–516

Bell S, Hindmoor A (2014) The ideational shaping of state power and capacity: winning battles but losing the war over bank reform in the US and UK. Gov Oppos 49(3):342–368

Bennett CJ (1991) 'What Is Policy Convergence and What Causes It?' British J Political Sci 21(2):215. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsjsr&AN=edsjsr.193876&site=eds-live&scope=site. Accessed 10 May 2019

Berkmen P (2009) Global financial crisis. Explaining cross-country differences in the output impact. International Monetary Fund (IMF working paper: WP/09/280). Available

at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b2366657&site=eds-live&scope=site. Accessed: 10 May 2019
Bieling HJ (2013) European financial capitalism and the politics of (De-) financialization. Compet Chang 17(3):283–298
Bieling HJ (2014) Shattered expectations: The defeat of European ambitions of global financial reform. J Eur Publ Policy 21(3):346–366
Bieling HJ, Jager J, Ryner M (2016) Regulation theory and the political economy of the European union. J Common Market Stud 1:53
Boyer R (2012) The four fallacies of contemporary austerity policies: the lost Keynesian legacy. Camb J Econ 36(1):283–312
Boyer, R. (2013) 'The present crisis. A trump for a renewed political economy', review of political economy, p 1. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsbl&AN=RN326353405&site=eds-live&scope=site. Accessed: 10 May 2019
Burnham P (2014) Depoliticisation: economic crisis and political management. Policy Polit 42(2):189–206
Callinicos A (2012) Contradictions of austerity, Cambridge J Econ, p 65. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsbl&AN=RN305481500&site=eds-live&scope=site. Accessed 10 May 2019
Caporaso JA, Kim M-H (2012) The Maastricht treaty at twenty: a Greco-European tragedy? J Eur Integr 34(7):769–789
Choi JJ (2000) Asian financial crisis. financial, structural and international dimensions. JAI (International finance review: 1). Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b4323033&site=eds-live&scope=site. Accessed 10 May 2019
Christophers B (2016) Geographies of finance III: regulation and "after-crisis" financial futures. Prog Hum Geogr 40(1):138–148. https://doi.org/10.1177/0309132514564046
Connell RW, Wood J (2005) Globalization and business masculinities. Men Masculinities 7(4):347–364. https://doi.org/10.1177/1097184X03260969
Elias J (2005) The gendered political economy of control and resistance on the shop floor of the multinational firm: a case-study from Malaysia. New Political Economy 10(2):203–222. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=bas&AN=BAS206984&site=eds-live&scope=site. Accessed: 10 May 2019
Gills B (2010) Going south: capitalist crisis, systemic crisis, civilisational crisis. Third World Quarterly 31(2):169
Goddard J, Wilson JOS (2016) The global financial crisis and the Eurozone sovereign debt crisis. Oxford University Press (Very Short Introductions). https://doi.org/10.1093/actrade/9780199688920.003.0007
Grauwe PD, Ji Y (2012) Mispricing of Sovereign Risk and Macroeconomic Stability in the Eurozone*. J Common Market Stud (6):866. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsggo&AN=edsgcl.305490813&site=eds-live&scope=site. Accessed 10 May 2019
Kaltenbrunner A, Painceira JP (2015) 'Developing countries' changing nature of financial integration and new forms of external vulnerability: the Brazilian experience'. Cambridge J Econ 39(5):1281–1306
Kawai M, Lamberte MB Pak Y (2012) The global financial crisis and Asia. Implications and challenges. Oxford University Press (Online access with subscription: University Press scholarship online (Oxford scholarship online)). Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b2660180&site=eds-live&scope=site. Accessed 10 May 2019
Kolb RW (2010) Lessons from the financial crisis. causes, consequences, and our economic future. Wiley (The Robert W. Kolb series in finance), Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b2592195&site=eds-live&scope=site. Accessed 10 May 2019

Mahoney C (2007) Lobbying success in the United States and the European Union. J Public Policy (1):35. Available at: https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsggo&AN=edsgcl.162179271&site=eds-live&scope=site. Accessed 10 May 2019

Mai VM (2014) 'Capacity of welfare regimes to absorb macro-economic shocks. National differences in the development of unemployment, poverty and the distribution of income in the aftermath of the financial crisis 2008', Anchor Academic Publishing (Compact). Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b3622671&site=eds-live&scope=site. Accessed 10 May 2019

Mollah S (2010) Financial crisis. is there a need for paradigm shift? Emerald (Studies in economics and finance: v. 27, no. 2). Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=cat00003a&AN=lvp.b3673751&site=eds-live&scope=site. Accessed 10 May 2019

Montgomerie J, Young B (2011) Home is where the hardship is. Gender and wealth (Dis) accumulation in the subprime boom. CRESC Working Paper, p 79

Nilsson M, Griggs D, Visbeck M (2016) Map the interactions between sustainable development goals: Mans Nilsson, Dave Griggs and Martin Visbeck present a simple way of rating relationships between the targets to highlight priorities for integrated policy. Nature (7607), p 320. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsggo&AN=edsgcl.455613251&site=eds-live&scope=site. Accessed 10 May 2019

Riches C, Palmowski J (2016) global financial crisis (2008) [global financial crisis]. A Dictionary of Contemporary World History

Rochon L-P, Rossi S eds (2017) Post-Keynesian Economics. Volume I. Issues in Methodology. Volume II. Credit, Money and Production. Volume III. Employment, Distribution, Growth, Development, Asset Bubbles and Financial Crises. Elgar Research Collection. International library of critical writings in economics, vol 332. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=ecn&AN=1676971&site=eds-live&scope=site. Accessed 10 May 2019

Sayer A (2009) Geography and global warming: can capitalism be greened? Area (3):350. Available at https://search-ebscohost-com.liverpool.idm.oclc.org/login.aspx?direct=true&db=edsgao&AN=edsgcl.205523380&site=eds-live&scope=site. Accessed: 10 May 2019

Stockhammer E (2015) Rising inequality as a cause of the present crisis. Camb J Econ 39(3):935–958

Van Der Zwan N (2014) Making sense of financialization. Soc Econ Rev 12(1):99–129

Influences of Human Activities on Coral Reef Ecosystems in Sanya, China

Xinyu Lin

Abstract As one of the most ecologically significant and human-related ecosystems, the coral reef ecosystem faces disturbances from human activities. As a consequence of social, economic, and technological development, those disturbances are extraordinarily obvious and impactful to the coral reefs in Sanya, China. The impacts of the four most influential human activities, leisure, land-based pollution, fishery, and industrialization, on the coral reef ecosystem in Sanya are analyzed in this paper. The human activities have either direct or indirect influences on the corals and other marine organisms by damaging the corals' structures or hinder their physiological functions. This paper can be used as a reference to analyze impacts of human activities on corals in other areas and restrain people's behaviors to protect and recover the coral reef ecosystem.

Keywords Human activities · Coral reef ecosystems · Sanya · Disturbance · Degradation

1 Introduction

Covering around 70% of the Earth, oceans undertake enormous responsibilities in maintaining high biodiversity and ecological balance. The coral reef ecosystem covers around 0.1% of the oceans' surface area and sustains thousands of organisms. As the "rainforests of the sea," coral reefs have many functions: maintaining the diversity of marine ecosystems, breeding marine organisms, enlightening scientists to produce drugs to cure diseases such as cancer, arthritis, supporting commercial development, protecting shorelines, etc. However, this diverse and indispensable ecosystem is facing unprecedented challenges. Coral reefs around the world are deteriorating with similar trajectories (Pandolfi et al. 2003). Human activities are one of

X. Lin (✉)
Scripps Institution of Oceanography, UC San Diego, La Jolla, CA 92093, USA
e-mail: x7lin@ucsd.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_135

the most significant causes of the decline, with nearly half of coral reefs having a high impact score (Halpern et al. 2008).

As one of the few coral reef gathering places in mainland China, the coral reef ecosystem in Sanya not only plays an ecological role, but also has significant economic value. Sanya, located in the southernmost part of Hainan Island (18°09′34′N ~ 18°37′27′ N, 108°56′30′ E ~ 109°48′28′E), has the only national coral reef reserve of mainland China (Fig. 1). The Sanya Reserve has a total area of 56 km^2 with three coastal regions: Luhuitou Bay, Dongmaozhou Island and Ximaozhou Island section (in Sanya Bay), and Yalong Bay section (Qiaomin 2011). Although there are some coral reef regulations about conserving and managing in Sanya Reserve, the coral reefs in Sanya are still facing challenges. The coverage of coral reefs has experienced a severe decline in recent decades (Qi et al. 2010). The coral coverage in Sanya declined from around 40% in 2000 to about 10% in 2004 (Lirong and Huanting 2006). Currently, both decreasing in number of coral reef fishes and the coral coverage and increasing in the number of macrobenthos that obstructs the growth of coral reefs indicate the threats faced by coral reef ecosystems in Sanya (Youfang et al. 2018). The previous study illustrates that the direct and indirect impacts from human activities are one of the main causations of coral reefs' deterioration in Sanya (Qi et al. 2010).

In that case, how human activities influence the coral reef ecosystem in Sanya, China is worth analyzing. The impacts of a few most impactful human activities on the coral reefs and related marine organisms in Sanya will be discussed in this paper. Also, the causation of increasing in frequency and intensity of those activities will be analyzed. Therefore, this research can become a tool for future researchers to better understand the influences of human activities on coral reefs in Sanya. The disturbances of human activities on the coral reef ecosystem in other places may also use this research for reference. Depending on the severity of the damage to coral

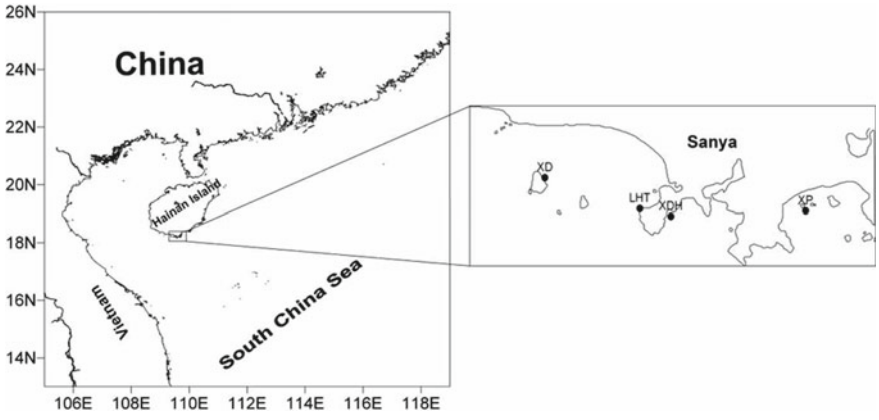


Fig. 1 Map of Sanya National Coral Reef Nature Reserve. (XDH: Xiaodonghai Bay; LHT: Luhuitou Bay; XD: Ximao Island; XP: Xipai Island) (Huang et al. 2013)

reefs caused by human activities, people can take action accordingly to protect and recover the coral reef ecosystem.

2 Global Situation

2.1 General Global Situation of Coral Reefs

The coral reef ecosystem is degrading globally. Using the principal components analysis (PCA), scientists analyze the trajectories of changes of coral reefs in terms of the ecological status of seven general categories of biota of reef inhabitants (large herbivores, large carnivores, small herbivores, small carnivores, corals, suspension feeders, seagrass). Globally, the average ecological status declined over time for all seven biotas (Pandolfi et al. 2003). The coral reefs in some areas are nearly close to rare or even ecologically extinct states such as Jamaica, Western Panama, etc. (Fig. 2). Moreover, reefs are degrading in a linear trend across all cultural periods (Fig. 3). If this trend is continuing, there will be few coral reefs in a few decades.

2.2 Causation of the Situation

The situations of coral reefs are largely caused by human activities. Although coral reefs appeared about 240 million years ago and survived many extinctions, they are currently facing challenges due to the development of human society. Many degradations of coral reefs are caused by human activities such as chemical pollution, overfishing, construction and sedimentation, tourism, etc., which results in the loss of biodiversity, basic food supplies and reef economic revenue (El-Naggar 2021). The circumstance that human activities lead to destructions of coral reefs worldwide also appears in Sanya, China. Different from what people usually regards, climate change has a much smaller impact on the coral reefs in China than human activities do such as coastal development, pollution, overfishing, etc. (Hughes et al. 2013). Around 80% of the coral reefs in the South China Sea and around Hainan Island are destroyed by human activities since 1980 (Hughes et al. 2013).

2.3 Human Impacts on Coral Reefs

Land-Based Pollution and Leisure Activities Influence Corals in Great Barrier Reef (GBR), Australia. In the Great Barrier Reef (GBR), increasing in terrestrial inputs of nutrients and sediments is the leading cause of coral reefs' deterioration (McCook 1999). When the number of herbivores and competitions are high, nutrient

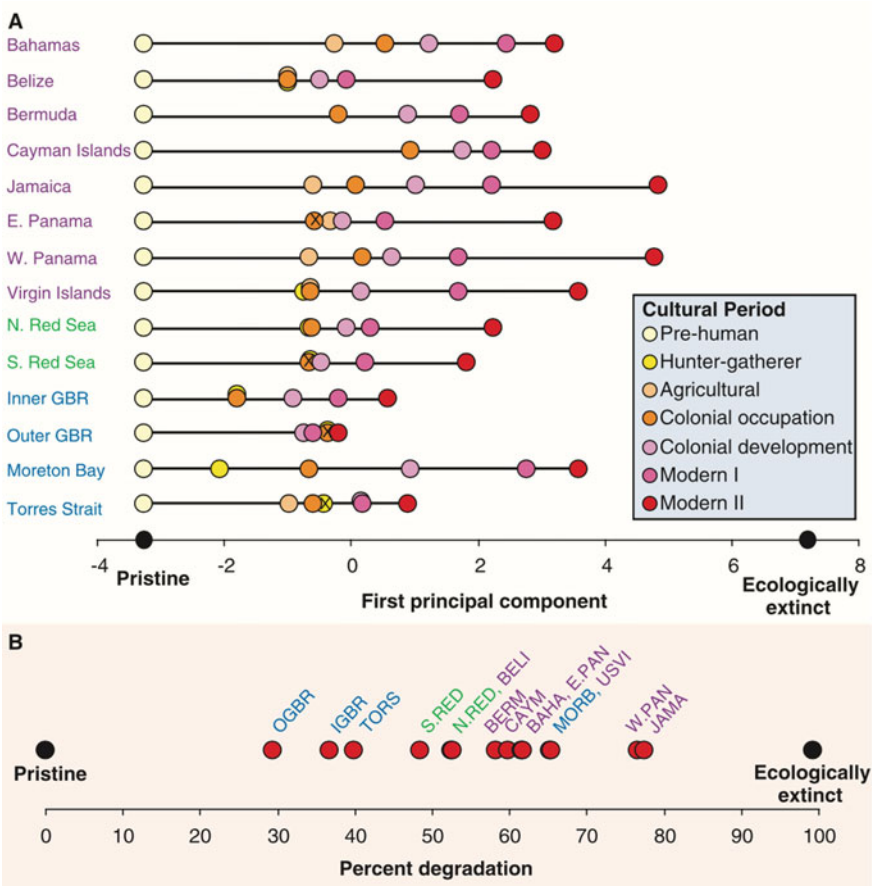


Fig. 2 Degradation of coral reefs (Pandolfi et al. 2003). **a** The ecological states of coral reefs in seven cultural periods. **b** Present coral reefs condition of the 14 reef regions. (OGBR, outer Great Barrier Reef; IGBR, inner Great Barrier Reef; TORS, Torres Strait Islands; S.RED, southern Red Sea; N.RED, northern Red Sea; BELI, Belize; BERM, Bermuda; CAYM, Cayman Islands; BAHA, Bahamas; E.PAN, eastern Panama; MORB, Moreton Bay; USVI, U.S. Virgin Islands; W.PAN, western Panama; JAMA, Jamaica)

enhancement and sediments will not definitely lead to algal overgrowth of corals (McCook 1999). However, with human impacts, eutrophication and sediments are likely to cause algal overgrowth, leading to reef degradation (McCook 1999). Sediments from human activities will decrease the coverage of most reefs of the GBR (Wolanski et al. 2004). Additionally, we cannot underestimate the potential disturbances of leisure activities on marine protected areas in Eastern Australia. Divers can contribute to environmental damage in marine protected areas, and with growing numbers of visitors, this kind of damage can become severe and irreversible (Harriott et al. 1997). However, compared with scuba diving, boat anchoring brings much

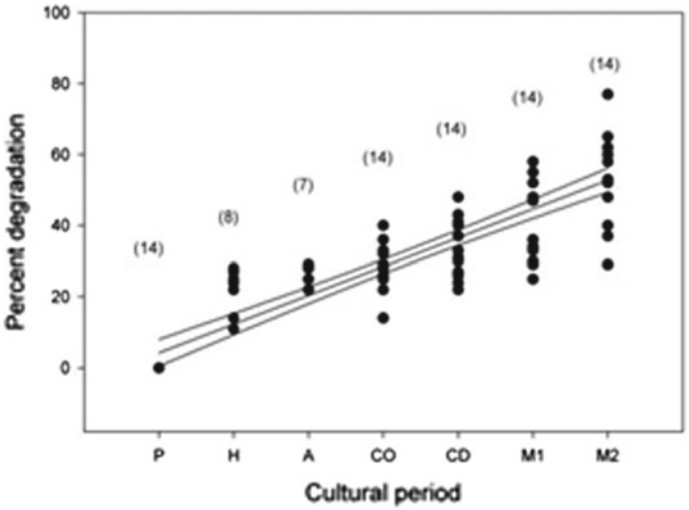


Fig. 3 Percent degradation of 14 reef regions over time (Pandolfi et al. 2003). Each point represents percent degradation at that time. Numbers above the points are the numbers of reef regions recorded at a particular cultural period. Cultural periods are same as that in Fig. 2

more damage to Australia's coral reefs (Harriott et al. 1997). In that case, limiting the number of tourists to 20,000 divers per site per year is necessary to protect Australia's coral reef ecosystems (Harriott et al. 1997).

Sewage Discharge, Overfishing, Recreational Activities and Industrialization Influence Corals in Taiwan, China. The coral reefs in Kenting National Park (KNP) in Taiwan were subjected to human influence such as sewage discharge, overfishing, habitat destruction, etc., which decelerate the living coral coverage in KNP (Keshavmurthy et al. 2019). The increasing in phosphate, nitrite, and ammonia concentration in the seawater of KNP leads to the overgrowth of macroalgae, which competes with coral reefs and causes coral coverage decreases (Liu et al. 2012). Additionally, recreational activities are also consistent with the degradation of shallow-water corals (Liu et al. 2012). There is a negative correlation between KNP coral cover and numbers of skin divers ($r_2 = 0.62$, $n = 24$, $p < 0.01$) and a positive relationship between numbers of tourists and algal coverage (Liu et al. 2012). Recreational activities such as skin diving, scuba diving, jet boating, surfing, etc., have negative impacts on the coverage of shallow-water corals and positive influences on the overgrowth of algae. Lastly, the global warming caused by industrialization increases the frequencies or intensities of tropical storms, which plays a significant role in driving the degradation of coral reefs in KNP (Keshavmurthy et al. 2019).

Eutrophication, Tourism, and Destructive Fishing Practices Influence Corals in Indonesia. Human activities also disturb the coral reefs in Indonesia. Located in the "coral triangle", Jakarta Bay (JB) currently only preserves less than 5% coral coverage for nearshore and less than 20% coverage for offshore (Baum et al. 2015).

Localized human activities are the primary causation of the degradation of coral reefs there (Baum et al. 2015). Among all human impacts, eutrophication caused by sewage runoff, agriculture and aquaculture lead to high turbidity levels, which reduce the ability of photosynthesis and calcification rates (Baum et al. 2015). In that case, the hard coral coverage reduces to around 2% and fish abundance decreases by around 80% (Baum et al. 2015). Fortunately, those negative impacts mainly concentrate in nearshore areas rather than the open ocean (Damar 2006). Moreover, tourism and destructive fishing practices also brought considerable damages to the corals in Indonesia. In the Bunaken Marine Park, destructive fishing and the negative consequence of tourism such as boat striking and anchoring lead to a decreasing in the hard coral coverage (Fava et al. 2009).

3 Human Impacts in Sanya

3.1 Most Impactful Activities

According to Chinese Industry and Economy, in the Spring Festival holiday in 2019, 997,000 tourists visited Sanya, with a year-on-year growth of 3.1% (Sanya's tourism economy grows in the first quarter 2019). Learning from the experience of the Great Barrier Reef, Taiwan, and Indonesia, the disturbance of tourists on coral reefs in Sanya cannot be ignored. Similar to what happened in Taiwan, due to the industrial development in China, global warming and ocean acidification may also have negative impacts on the coral reef ecosystem in Sanya. Moreover, using the index of human impact, scholars quantify human activity impacts on coral reefs in Sanya, revealing the changing trend of human activities on coral reefs in the past 40 years. The human activities that influence the coral reef ecosystem in Sanya shift from destructive fishing practices to land-based pollution and tourism from the twentieth century to the twenty-first century (Qi et al. 2010). However, overfishing still exists until now. Therefore, the coral reefs in Sanya are facing a similar problem as that in GBR, Taiwan, and Indonesia. The methods used to analyze the human impacts on coral reefs in those three areas can also be used in analyzing the human disturbance on the coral reef ecosystem in Sanya. This paper will analyze the influences of leisure activities, land-based pollution, fishery and industrialization on coral reefs and related marine organisms in detail.

3.2 Leisure Activities

Water sport is a kind of leisure activity that the whole process or the main process happens underwater or on the surface of water, including rowing, water skiing, canoeing, diving, and so on. Due to the development of economy in China, a growing number of people spend money on travelling, especially to Sanya, which caused an over-developed tourist industry. This Over-developed tourist industry brings both direct and indirect impacts on the coral reef ecosystem and other marine organisms. Fortunately, tourism constrains the development of illegal fishing, which may protect some coral reef fish in a short term.

Current Situation and Causation. A majority of tourist attractions in Sanya are ocean-based, such as Wuzhizhou Island, Fenjiezhou Island, West Island, etc. According to a report from China Tourism Academy, 70% of areas for water sports are located in Sanya, which makes Sanya the most popular tourist destination (Yuanjun 2021). For example, in 2017, around 300 thousand people dived in Wuzhizhou Island (Huang et al. 2020). The development of economy in China is the main reason for the increase in tourists' number. In 2018, 63% of Chinese people spent more than 10,000 RMB per year on traveling and 56% of Chinese people spend more than 20% of the total living expense (Global travel spending report 2019). From 2013 to 2019, the number of tourists traveling to Sanya shows an exponential growth (Fig. 4). Different from Australia, most people in Sanya are doing discovery scuba diving, meaning that they dive into the ocean with oxygen tanks and other equipment while being held and guided by an instructor, so diving licenses are not required. In that case, people's activities will influence the ocean and the coral reef ecosystem.

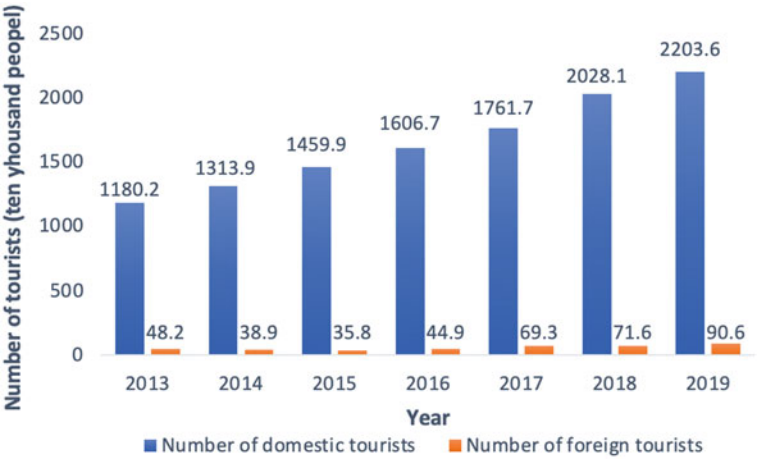


Fig. 4 Number of tourists in Sanya from 2013–2019. *Data from* www.chyxx.com

Impacts on Corals. Some recreational activities or their derived activities will disturb the coral reef ecosystem in Sanya directly. Anchoring brings direct damage to coral reefs by directly deconstructing them (Zhongjie et al. 2011). Unlike the Great Barrier Reef (GBR) situation, most scuba diving negatively influences corals in Sanya. Since a vast number of visitors dive in Sanya have no diving licenses, they do not have enough skills to maintain balance and control themselves underwater, and thus they may collide, touch, kick the benthic creatures such as coral reefs, which causes corals to secrete more mucus than they normal do. Mucus plays significant roles by assisting corals to defense, calcify, reproduce, feed, and resist desiccation, sediment shedding, burn, harmful oxygen radicals, etc. (Brown and Bythell 2005). Therefore, the abnormal secretion of mucus will affect the growth and health of corals. Visitors may also kick up sediments, disturbing the typical living environment of corals and other marine organisms (Zhongjie et al. 2012). Reducing in water clarity will hinder the photosynthesis of corals, which diminishes their nutrients production. The fixed diving platform or other observation decks also blocks sunlight and inhibit corals' photosynthesis (Zhongjie and Chunhua 2011).

Tourism also impacts the corals in Sanya indirectly. Sightseeing boats, motorboats, speedboats and snorkeling have relatively small impacts on coral (Zhongjie et al. 2011). However, those boats may cause noise pollution, oil spill, or collide coral reefs (Zhongjie et al. 2012). Free-swimming coral larvae have a behavioral response to reef noise, so noise pollution can influence the orientation of coral larvae (Vermeij et al. 2010). Oil pollution is also one of the threatens to coral reefs but the exact effects of oils depending on the types of corals and oils, oil concentration, exposure times, environmental conditions (Haapkylä et al. 2007). For example, exposing to oil negatively influences the growth rate of corals by decreasing the deposition rate of calcium (Haapkylä et al. 2007). Additionally, due to the circumstance that many visitors wear sunscreen when they participate in water sports, the chemical substances in the sunscreen such as microplastics will go into the ocean and influence the corals in Sanya. Sunscreens can kill zooxanthellae, a symbiotic microalga in corals, inducing corals bleaching (Sánchez-Quiles and Tovar-Sánchez 2015). In general, both surface water sports and diving disturb the coral reefs in Sanya.

Impacts on Other Species. Tourism also has indirect impacts on other marine organisms. On the one hand, tourism takes the place of other human activities such as destructive fishing, illegally transacting coral reefs, etc., so the amount of coral reef fishes increases in a particular tourist attraction in Sanya. From 2004 to 2008, in Wuzhizhou Island, the coral reef fish density increased by 55 fish/m^2 (Zhongjie et al. 2012). Also, the number of giant clams and sea cucumbers recoverd (Zhongjie et al. 2012). On the other hand, noise pollution negatively influences some marine organisms. Noise from boats affect the physiology of fish from their embryonic stage on, which may influence their fitness (Ferrier-Pagès et al. 2021). For instance, the embryos of coral reef damselfishes' heart rates (*Amblyglyphidodon curacao, Amphiprion melanopus* and *Acanthochromis polyacanthus*) increases by ~ 10% for the last two species when subject to the noises from 2-stroke engines (Ferrier-Pagès

et al. 2021). The noise also raises embryonic mortality of sea hares and predation rates of Ambon damselfish (Dinh et al. 2018).

3.3 Land-Based Pollution

Land-based pollution refers to pollutants from land going into the sea, causing or potentially causing damage to the marine environment. The contaminants may have the characteristics of diffusion, bioaccumulation, biodegradability, etc. It is another indispensable factor that disturbs the growth and health condition of corals in Sanya. This kind of pollution is mainly caused by sewage discharge and littering.

Current Situation and Causation. Nutrients in sewage discharge and plastics mainly consists of land-based pollution. Wastewater contains many nutrients such as nitrogen and phosphorus. The highest dissolved inorganic nitrogen (DIN) and PO_{43}- value were detected at the estuary of Sanya River, illustrating that human activities in Sanya caused more nutrient inputs into the ocean (Jing et al. 2017). Therefore, terrigenous inputs are the main point source of nutrients that may cause eutrophication. According to a report from Sanya Municipal Bureau of Ecology and Environment, the costal water in most areas meets the seawater quality standard, but a few areas contain exceeded phosphate, inorganic nitrogen, etc. Those nutrients mainly come from agriculture, industrialization, and sanitary sewage.

Plastic, including micro-plastic and macro-plastic, is another significant component of land-based pollution. Macro-plastics refer to relatively large pieces of plastics and micro-plastics are plastics with a length less than 5 mm. According to a report from the Ministry of Ecology and environment of the People's Republic of China, in 2020, there are 2000 pieces of medium and small pieces of floating garbage on Sanya's sea surface per km^2, among which plastic products account for 85.7% (Bulletin of Marine Ecology and Environment Status of China 2020). There are 239,901 pieces of garbage per square kilometer on beaches in Sanya, and plastic garbage accounts for 84.6% of the total (Bulletin of Marine Ecology and Environment Status of China 2020). 4800 pieces of garbage per square kilometer on the ocean floor, among which 83.1% of the total is plactic (Bulletin of Marine Ecology and Environment Status of China in 2020). Additionally, the sedimentation in LuHuiTou Bay in Sanya has a micro-plastic amount 50 ± 3 to 530 ± 7 items/kg (Huang et al. 2021). The release of plastic pollution is mainly caused by tourism, fishery, and shipping (Bulletin of Marine Ecology and Environment Status of China 2020).

Impacts on Corals. Due to the circumstance that corals can survive in a broad range of nutrient concentrations, there are both negative and positive impacts of nutrient runoff on corals in Sanya (Distribution and in Coral Reef Degraded Areas within Sanya Bay 2017). Many researches indicate that eutrophication can negatively influence corals' calcification rates, reproductive success, skeletal density, etc. For instance, a high phosphate level made coral have a fragile skeleton and more DIN and PO_{43}^{-} reducing hermatypic coral's growth rate (Guo et al. 2017). On the contrary,

elevated nutrients can also positively assist coral growth or prevent corals from bleaching to some extent (Guo et al. 2017). In general, researchers did not discover a strong correlation between the number of nutrients in sewage discharge and a declining coverage of coral reef in Luhuitou Bay, Sanya (Guo et al. 2017).

Comparing with macro-plastics, micro-plastics have much more influences on coral reefs in Sanya. After ingesting micro-plastic, corals' intestines can be blocked, impairing corals' feeding performance since micro-plastic can offer a false sense of "fullness", which then inhibit them to consume other foods (Huang et al. 2021). Also, micro-plastic can attach to the surface of corals, which can cause coral bleaching, tissue necrosis, increasing the susceptibility to coral disease (Huang et al. 2021). It can also alter the photosynthetic capacities of zooxanthellae, decrease growth rate and calcification rate, enhance stress response, suppress immune performance, etc. (Huang et al. 2021). Nevertheless, all of the influences of micro-plastic are limited since some scientists also discovered that some species are unsusceptible to the disturbance of micro-plastic. For example, exposing to PE microbeads did not affect the prey capture ability and growth rates of coral *Madrepora oculata* (Huang et al. 2021). Therefore, the exact impacts of micro-plastics on coral depend on various factors such as coral species, the concentration of micro-plastic, type of micro-plastic, exposing time, etc.

Impacts on Other Species. Eutrophication can assist the growth of algae and potentially cause the occurrence of red tide or even dead zone, which can change the population structure of marine ecosystems. For instance, the population of crustaceans will increase with the growing biomass of macroalgae (Grall and Chauvaud 2002). Due to the situation that the carbon fixed by algae can be transferred faster through the trophic web, the benthos community may shift from macrophytes to opportunistic species (Grall and Chauvaud 2002). With the rising concentration of nutrients, the productivity of zoobenthos will decrease and the dominant species will shift from K reproductive strategy into r reproductive strategy (Grall and Chauvaud 2002).

Macro-plastics have more obvious influences on other marine organisms. Plastic has been found in the stomachs of many marine species, including sea turtles, sea birds, whales, etc. Those plastics can paralyze their gastrointestinal tract and inhibit the digestive system from working (Vegter et al. 2014). Sea turtles regard floating plastics as jellyfish, so after ingesting plastics, they can inhibit sea turtles' ability to regurgitate (Vegter et al. 2014). Also, many seabirds not only directly consume plastics, but also feed their chicks with plastics (Vegter et al. 2014). Consuming relatively hard plastic can lead to peritonitis, chronic infection, septicemia, etc. (Vegter et al. 2014). In general, plastic may disturb animals' gut perforation, dietary dilution, toxin introduction, interfere development, etc.

3.4 Fishery

Destructive fishing practices include blast fishing, bottom trawling, cyanide fishing, Muro-ami, which can easily result in irreversible damage to the marine ecosystem especially the coral reef ecosystem. People use this practice since they can get a large number of fishes efficiently during a short period of time. Although there are fewer destructive fishing practices in Sanya than a few decades ago, mariculture still thrives until today. Being regarded as one of impactful human activities on the marine ecosystem, fishery not only disturbs coral reefs in Sanya, but also influence other marine species.

Current Situation and Causation. In 2013, Sanya had around 70,295 tons of marine catch and 6008 tons of mariculture, which are continuously increasing in the following years (Zhongyin et al. 2015; Geng and Xizhe 2019). With the increasing number of fishing vessels and developing technology, fishery resources in Sanya are exploited. In the coastal coral reef areas in Sanya, even within the national coral reef reserves, explosive fishing and illegal fishing still exist (Meixia et al. 2011). Under this circumstance, various problems appear including the low density of fishery resources, high developmental costs, increasing environmental damages, etc. (Zhongyin et al. 2015). The accelerator of this situation is the development of transportation, cryopreservation techniques, and increasing demands of marine products (Meixia et al. 2011). People gradually change their food structure by consuming more protein and less fat.

Impacts on Corals. Destructive fishing practices can directly damage coral reefs in Sanya by breaking down the branches of coral reefs or even destructing the structure of reefs. At the same time, the industry of catching or rearing marine species will indirectly affect corals. The expansion of fishery, which can be illustrated using MTI (marine trophic index) and RMTI (Region-based marine trophic index) (Fig. 5) and the increase of ecological pressure are correlated to the bleaching of coral reefs in Sanya (Geng 2019). An expansion in fishery means an increase in the number of voyages and fishing vessels, which in turn increases the extend of human interference, and the activities of fishing vessels can significantly affect the water quality of seawater (Geng 2019). Corals mainly live in a marine environment with good water quality, so the expansion of fishery becomes a factor that accelerates coral reef bleaching in the South China Sea.

Additionally, the remaining cables and fishing nets of cultivating pearl oysters and Eucheuma hinder the growth of corals (Meixia et al. 2011). The sewage from mariculture, such as farming shrimp and abalone, is usually directly discharged into the sea, which causes extra ammonia, nitrogen and sulfide to pollute the seawater and endanger the coral reef ecosystem (Meixia et al. 2011). Lastly, mariculture also influence the survival rate of juvenile corals, since no juvenile reef-building species

Fig. 5 Change of MTI in the South China sea from 1960 to 2000 (Geng 2019). The marine trophic index measures the change in mean trophic level of fisheries landings by region and globally, which can be used to accurately assess the changes in trophic levels of marine ecosystems in the South China Sea over a certain period of time, and thus indirectly revealing the changes and expansion of fisheries in the South China Sea. From 1960 to 2000, the MTI is continuously decreasing, revealing that the fishery resources in the South China Sea is continuously decreasing

Pocillopora damicornis survived at the aquiculture site after 81 days (Villanueva et al. 2006).

Fishery also indirectly disturbs coral reefs in Sanya. Many commercially significant marine fish species live around coral reefs depending for food or protection. Grouper and snapper, two of the popular commercially important marine fish species in Sanya, are both carnivores, meaning that they mainly feed on other fish or crustaceans. They are indispensable for the coral reef ecosystem since they can controll population sizes of lower trophic level fishes. Decreasing in the number of grouper and snapper by targeted catching leads to an increase in lower trophic level fishes, which will break the balance of the coral reef ecosystem in Sanya. Additionally, as strong predators in the coral reef ecosystem, grouper and snapper can defend against the invasion of some foreign species. According to a study of The University of Queensland (UQ), grouper can limit the invasion of lionfish, an invasive species that eat herbivores with nearly no predators, since researchers discovered lionfish in the stomachs of groupers (Study reveals grouper can help control lionfish invasion 2021). Also, with the decrease in herbivores, the coverage of algae may go up, which can compete with coral reefs.

Impacts on Other Species. Overfishing of specific species leads to significant changes in species composition and their distribution (Meixia et al. 2011). In that case, the food source, trophic structure, or physiology of higher trophic levels may change accordingly. For instance, due to the intensive fishing, anchovy, large yellow

croaker, small yellow croaker, and hairtail tend to have simpler population structures by showing a declining trend in body length, weight, and ages of sexual maturity, and increase in individual fertility rates and mortality (Zhao et al. 2015). Also, many fishing practices, such as longline, gillnet, purse seine net, and trawl have high bycatch, indirectly disturbing other un-target species. For example, the spring bycatch rate in Hainan island is around 38.4%, accelerating the decline in dolphins (Liu et al. 2016). Especially for small dolphins, they are easily entangled in fishing gears (Liu et al. 2016).

3.5 Industrialization

According to a report from The People's Government of Sanya city, from 2018 to 2019, the industrial production in Sanya grew 11.237 billion yuan, which has an increase of 3% over the previous year (Bulletin of National Economic and Social Development of Sanya 2019). This growth is the combination effect of population growth, which creates extra labor force, technology development, and social development, which requires economic and resource support. Under such a rapid development, the byproducts from industrialization such as greenhouse gas (GHG) may lead to unexpected disturbances on the coral reef ecosystem in Sanya.

Current Situation and Causation. According to a communique of Sanya Municipal Bureau of Ecology and Environment, the total amount of industrial waste gas discharged in Sanya in 2019 was 887.2488 million m^3 (Bulletin of National Economic and Social Development of Sanya 2019). Industrial waste gas refers to pollution-containing gases released into the air in the process of fuel combustion or production, which includes carbon dioxide, nitrous oxide, methane, freon, etc. Similar as the situation in Taiwan, many of those industrial waste gases are greenhouse gases (GHG), which can rise seawater temperature and cause acidification (Keshavmurthy et al. 2019). The pH value of seawater in Sanya Bay decrease from 8.3 to 8.07 from 2001 on (Dingtian et al. 2013). However, different from Taiwan, warming may not directly increase the frequencies or intensities of tropical storms in Sanya. In the past half-century, the frequency and intensity of typhoons have fluctuated without apparent increase or decrease trends in Hainan island (Fuzhen 2007). In that case, the influences of industrialization on tropical storms in Sanya are not significant until now, meaning that industrialization has no noticeable disturbance on corals in Sanya by affecting tropical storms.

Impacts on Corals. Warming and acidification accelerated by industry disturb the normal function of coral reefs in Sanya by increasing the carbon dioxide level in the ocean and decreasing the pH of seawater. Acidification interferes with corals' calcification rate to slow down the growth rate of coral. The response of acidification of corals depends on their species. The calcification rate of *Favites complanata* (massive coral), *Montipora digitate* (branching coral), and *Acropora hyacinthus* (branching coral) were significantly reduced when exposing to the environment with elevated

CO_2, while *Pavona decussata* (leaf coral), *Porites nigrescens* (massive coral), and Acropora Formosa (branching coral) were not significantly affected (Yuan et al. 2019). As the pH of seawater increases from 7 to 8, the content of dissolved inorganic carbon (DIC) decrease from 12 to 1 mg/L, which means the pH value of seawater is negatively correlated with the content of DIC, indicating that acidification has substantial negative impacts on the carbon sequestration of corals in Sanya (Dingtian et al. 2013). However, a species may not resist both high carbon dioxide levels and high temperatures at the same time. Warming forces corals to expel the symbiotic zooxanthellae, since exposing to a high temperature will cause zooxanthellae to produce reduced oxygen intermediates, which can cause lipids, proteins, and DNA damage. Depending on the intensity and duration of warming, it can lead to different extent of coral bleaching. Although *Pocillopora damicornis* (reef coral) from Luhuitou Bay can survive under a high level of CO_2 by having high autotrophic capacity, it may not survive under 33 °C seawater for a long time (Xiangcheng et al. 2019; Lei 2020). In general, branching corals in Sanya have a relatively low resistance to high temperature, which causes them to bleach easily, but massive corals and leaf corals have high resistance to warming (Shu et al. 2008). The ability to resist high temperature is positively correlated to the density of zooxanthellae (Shu et al. 2008).

Impacts on Other Species. Warming and acidification caused by industrialization will also disturb other marine organisms. Both the earlier bloom of phytoplankton and the change of the dominant phytoplankton bloom are associated with ocean acidification (Jinfeng 2015). Acidification can also increase the growth of a few species of molluscs, but has no or negative effects on most molluscs by reducing their calcification rate (Jinfeng 2015). Diminished calcification rate may decrease the competitiveness of marine organisms, reduce their mature age, change the buoyancy of the seawater, or even alter their gene expression (Jinfeng 2015). Acidification and warming also influence marine vertebrates. For instance, under the temperature of 20 °C and the CO_2 condition of 1100 μatm, the mineralization in the skeleton of embryos of the little skate (*Leucoraja erinacea*) changes accordingly. High CO_2 level increased the mineralization of the cartilage of crura and jaws, but the high temperature caused mineralization in their pectoral fins decreased (Santo and Valentina 1894). Moreover, most fishes are thermo-conformers, which are sensitive to ambient temperature, and thus change in sea temperature or salinity impacts their respiration and metabolism (Zhaokun and Honghui 2013). Higher temperature forces many fishes to move northward or southward, which changes their distribution and structure of the marine ecosystem (Baohong et al. 2009).

4 Conclusion

In general, activities, land-based pollution, fishery, and industrialization are indispensable human activities that have either positive or negative influences on the coral

reef ecosystem in Sanya. Those activities may directly damage the structure of coral reefs or hinder the normal physiological functions of corals by slowing down their growth rate, calcification rate, metabolic rate, irritability, etc. However, there are still some species can survive in a highly human-disturbed environment. Due to the fact that the coral reef ecosystem is correlated with other marine ecosystems, those activities also have direct and/or indirect impacts on other marine organisms.

Fortunately, the disturbances brought by human beings can be slowed down or even eliminated, which brings benefits to the coral recovery in Sanya. The possibility and feasibility of recovering the coral reefs in Sanya depend on many factors. For the corals that live in a relatively good natural marine environment with minor degradation, the natural recovery potential is high, which may take five to ten years to recover (Yuanchao et al. 2014). Nevertheless, for the corals living in the environment with high human disturbances such as pollution and fishery, active restoration is necessary (Yuanchao et al. 2014). Although corals in Sanya may recover in the following few decades, we have to decrease human disturbances to meet the prerequisite of coral restoration.

However, more researches should be done to further understand the effect of human activities on coral reefs in Sanya. Firstly, researchers discovered that fishery and ecological pressures are correlated to coral bleaching in Sanya, but the mechanisms under this situation are still unclear. More efforts can be input to study how fishery and coral bleaching are correlated in future research. Moreover, the impacts of oil pollution on corals in Sanya are highly species-specific and environment-depended, so understanding how different type of oil pollutions disturb different types of corals under vary oil concentration, exposure times, and environmental conditions is necessary for protecting and recovering corals in Sanya. In general, the mechanisms for corals to cope with human disturbances are complicated, so comprehending how a certain species of corals in Sanya deals with a certain human disturbance under a given condition is time and energy consuming and full of challenge.

References

Baohong C, Qiulin Z, Shengyun Y (2009) Impacts of climate change on marine biodiversity. J Oceanogr Taiwan Strait 28(3):437–444

Baum G, Januar HI, Ferse SC, Kunzmann A (2015) Local and regional impacts of pollution on coral reefs along the thousand islands North of the Megacity Jakarta, Indonesia. PLOS ONE 10(9)

Brown BE, Bythell JC (2005) Perspectives on mucus secretion in reef corals. Mar Ecol Prog Ser 296,pp 291–309

Bulletin of Marine Ecology and Environment Status of China in 2020, https://www.mee.gov.cn/hjzl/, last accessed 2021/10/21.

Bulletin of National Economic and Social Development of Sanya in 2019. http://www.sanya.gov.cn/tjjsite/tjgb/202002/71d3af6d424b457db2481d8f9b3e9557.shtml. Last accessed 07 Nov 2021

Bulletin of National Economic and Social Development of Sanya in 2019. http://hbj.sanya.gov.cn/sthjsite/tzgg/202006/10ff196e4e884549a564e4475e9f9963.shtmlla. Last accessed 07 Nov 2021

Christine, F-P Leal MC, Calado R, Schmid DW, Bertucci F, Lecchini D, Allemand D (2021) Noise pollution on coral reefs?—a yet underestimated threat to coral reef communities. Mar Pollut Bull 165, 112–129

Damar A (2006) Effects of enrichment on nutrient dynamics, phytoplankton dynamics and productivity in Indonesian tropical waters: a comparison between Jakarta Bay, Lampung Bay and Semangka Bay

Dingtian YA, Xiujuan SH, Sumin LI, Haibin YE, Chaoyu YA, Chao XU, Junde DO (2013) Spatial and temporal distribution of pH in Sanya Bay in recent 10 years and its effects on coral reef. South China Fish Sci 9(1):1–7. (In Chinese with an English abstract)

Dinh JP, Suca JJ, Lillis A, Apprill A, Llopiz JK, Mooney TA (2018) Multiscale spatio-temporal patterns of boat noise on U.S. Virgin Island coral reefs. Mar Pollut Bull 136:282–290

El-Naggar H (2021) Human impacts on coral reef ecosystem. In: Rhodes ER, Naser H (eds) Natural resources management and biological sciences, IntechOpen

Federica F, Ponti M, Scinto A, Calcinai B, Cerrano C (2009) Possible effects of human impacts on epibenthic communities and coral rubble features in the marine park of Bunaken (Indonesia). Estuar Coast Shelf Sci 85(1):151–56

Geng W, Xizhe W (2019) Association between fishery expansion and coral reef bleaching—take one of coral reef of the South China sea for example. J Liaoning Normal Univ (Natural Science edition) 4, 518–524. (In Chinese with an English abstract)

Global travel spending report (2019) http://www.mafengwo.cn/gonglve/zt-944.html. Last accessed 21 Oct 2021. (In Chinese)

Grall J, Chauvaud L (2022) Marine eutrophication and benthos: the need for new approaches and concepts. Global Change Biol 8(9):813–830

Guo J, Yu K, Wang Y, Xu D, Huang X, Zhao M, Yang H, Zhang R (2017) Nutrient distribution in coral reef degraded areas within Sanya Bay, South China Sea. J Coast Res 33(5):1148–1160

Haapkylä J, Ramade F, Salvat B (2007) Oil pollution on coral reefs: a review of the state of knowledge and management needs. Vie et Milieu/Life and Environment, Observatoire Océanologique—Laboratoire Arago, pp 91–107

Halpern BS, Walbridge S, Selkoe KA, Kappel CV, Micheli F, D'Agrosa C, Bruno JF, Casey KS, Ebert C, Fox HE, Fujita R, Heinemann D, Lenihan HS, Madin EMP, Perry MT, Selig ER, Spalding M, Steneck R, Watson R (2008) A global map of human impact on marine ecosystems. Science 319(5865):948–952

Harriott VJ, Davis D, Banks SA (1997) Recreational diving and its impact in marine protected areas in Eastern Australia. Ambio 26(3):173–79

Huang H, Zhou G, Yang J, Liu S, You F, Lei X (2013) Diversity of free-living and symbiotic symbiodiniumin the coral reefs of Sanya, South China Sea. Marine Biol Res 9(2):117–28

Huang J, Wang F, Zhao H, Xu H, Liu S, Xu Q, Wang A, Li X (2020) Reef benthic composition and coral communities at the Wuzhizhou island in the South China sea: the impacts of anthropogenic distuance. Estuar Coast Shelf Sci 243:106863

Huang W, Chen M, Song B, Deng J, Shen M, Chen Q, Zeng G, Liang J (2021) Microplastics in the coral reefs and their potential impacts on corals: a mini-review. Sci Total Environ 762:143112

Hughes TP, Huang H, Young MA (2013) The wicked problem of China's disappearing coral reefs. Conserv Biol 27:261–269

Jiang L, Guo M, Zhang F, Zhang Y, Zhou G, Lei X, Yuan X et al (2020) Impacts of elevated temperature and PCO2 on the brooded larvae of Pocillopora Damicornis from Luhuitou Reef, China: evidence for local acclimatization. Coral Reefs 39(2):331–344

Jinfeng Z, Xuelu G, Fengxia Z, Peimiao L, Wen Z (2015) Responses of marine organisms and ecosystems to ocean acidification. Mar Environ Sci 34(4):630–640. (In Chinese with an English abstract)

Keshavmurthy S, Kuo CY, Huang YY, Carballo-Bolaños R, Meng PJ, Wang JT, Chen CA (2019) Coral reef resilience in Taiwan: lessons from long-term ecological research on the coral reefs of Kenting National Park (Taiwan). J Mar Sci Eng 7(11):388

Lirong W, Huanting Z, Chaojing S (2006) Impacts of human activities on the coral reef ecosystem in Xuwen. Ocean 23.001(2006):81–85. (In Chinese)
Liu P-J, Meng P-J, Liu L-L, Wang J-T, Leu M-Y (2012) Impacts of human activities on coral reef ecosystems of Southern Taiwan: a long-term study. Mar Pollut Bull 64(6):1129–1135
Liu M, Lin M, Turvey S, Li S (2016) Fishers' knowledge as an information source to investigate bycatch of marine mammals in the South China sea. Anim Conserv 20(2):182–192
Meixia Z, Kefu Y, Qiaomin Z, Qi S (2011) Evaluating the sustainability of coral reefs in Santa of Hainan Island using marine ecological footprint. J Trop Oceanogr 30(2):74–80. (In Chinese with an English abstract)
McCook LJ (1999) Macroalgae, nutrients and phase shifts on coral reefs: scientific issues and management consequences for the great barrier reef. Coral Reefs 18(4):357–367
Pandolfi JM, Bradbury RH, Sala E, Hughes TP, Bjorndal KA, Cooke RG, McArdle D, McClenachan L, Newman MJH, Paredes G, Warner RR, Jackson JBC (2003) Global trajectories of the long-term decline of coral reef ecosystems. Science 301(5635):955–958
Qi S, Meixia Z, Lingying H, Hongqiang Y, Huiling Z (2010) Human activities and impacts on coral reef at the Luhuitou Fringing Reef, Sanya. Tropical Geography 1001-522(12010)05-0486-06, pp 486–509. (In Chinese with an English abstract)
Qiaomin Z (2011) Coral reef conservation and management in China. Econ Valuation Policy Priorities Sustain Manage Coral Reefs, pp 198–202
Sánchez-Quiles D, Tovar-Sánchez A (2015) Are sunscreens a new environmental risk associated with coastal tourism? Environ Int 83:158–170
Shu L, Kefu Y, Qi S, Tianran C, Meixia Z, Hongqiang Y (2008) Experimental study of stony coral response to the high temperature in Luhuitou of Hainan Island. Trop Geogr 28(006):534–539. (In Chinese with an English abstract)
Di Santo V (2019) Ocean acidification and warming affect skeletal mineralization in a marine fish. In: Proceedings of the royal society B: biological sciences 286(1894):20182187
Sanya's tourism economy grows in the first quarter (2019) Chinese industry and economy. 4:90–91. (In Chinese)
Study reveals grouper can help control lionfish invasion. https://phys.org/news/2011-07-reveals-grouper-lionfish-invasion.html. Last accessed 07 Nov 2021
Vegter AC, Barletta M, Beck C, Borrero J, Burton H, Campbell ML, Costa MF et al (2014) Global research priorities to mitigate plastic pollution impacts on marine wildlife. Endangered Species Res 25(3):225–247
Vermeij MJ, Marhaver KL, Huijbers CM, Nagelkerken I, Simpson SD (2010) Coral Larvae Move toward Reef Sounds. PLoS ONE 5(5)
Villanueva RD, Yap HT, Montano MN (2006) Intensive fish farming in the Philippines is detrimental to the reef-building coral Pocillopora Damicornis. Mar Ecol Prog Ser 316:165–74
Wolanski E, Richmond RH, McCook L (2004) A model of the effects of land-based, human activities on the health of coral reefs in the great barrier reef and in Fouha Bay, Guam Micronesia. J Mar Syst 46(1–4):133–144
Yang FZ, Wu SA (2007) Changes of extreme weather events in Hainan Island for last 39 years. Meteorol Monthly 3:107–113
Youfang S, Xinming L, Jiansheng L, Jianhui Y, Yingying W, Hui H (2018) Ecosystem status and health assessment of Sanya Coral Reef National Nature Reserve. Biodivers Sci 26:258–265. (In Chinese with an English abstract)
Yuan X, Guo Y, Cai WJ, Huang H, Zhou W, Liu S (2019) Coral responses to ocean warming and acidification: implications for future distribution of coral reefs in the South China Sea. Mar Pollut Bull 138:241–248
Yuanchao L, Yilin L, Jieying H, Daoru W (2014) Feasibility of coral reef Ecosystem restoration in Xisha Islands. Ocean Dev Manage 1: 101–103. (In Chinese)
Yuanjun H (2021) Report on data of sports tourism consumption in China. China Tourism Academy. (In Chinese)

Zhaokun D, Honghui L, Youqing X (2013) Effect of ocean acidification on respiratory metabolism of marine living things. Feed Industry 33(20):15–17. (In Chinese with an English abstract)
Zhongjie W, Daoru W, Cuixin Y, Yuanchao L, Min C, Chunhua C (2012) Variation tendency and analysis of cause of coral in Sanya. Mar Environ Sci, 1007–6336, 05-0682-04, 682–685 (2012). (In Chinese with an English abstract)
Zhongyin C, Yan C, Jun M, Youming L, Zilong W (2015) Current situation and countermeasures of fishery resources protection in Sanya coastal basin. Fujian Agric (05):40–42. (In Chinese)
Zhao S, Lü B, Li R, Zhu A, Wu C (2015) A preliminary analysis of fishery resource exhaustion in the context of biodiversity decline. Sci China Earth Sci 59(2):223–235
Zhongjie W, Chunhua C, Xiangyu D (2011) Impacts of tourism activities on coral reefs in Sanya Wuzhizhou island. Ocean Dev Manage 03, 57–60

Co-modeling and Optimal Control of a Solar Power Integrated with Variable Load Energy Management System and Battery Energy Storage System

Xuanhe Zhang

Abstract With the development of social economy and the continuous expansion of power grid, renewable energy generation has gradually attracted people's attention because of its unique characteristics. How to integrate renewable energy into the traditional power grid and make use of it has become a key development direction. This study takes photovoltaic power generation as the starting point and combines with battery energy storage system to optimize the power distribution of the grid. This study brings new possibilities for the integration of photovoltaic energy storage power generation system into the traditional power grid, which is of great significance to the entire power grid structure and environment. In this paper, Matlab is used as a simulation tool, method of linear programming is used to simulate and analyze the power grid connected to photovoltaic energy storage system, and the power grid management strategy is optimized from the perspective of power grid price. This study provides a new way to optimize photovoltaic energy storage system, which is of certain significance to the future development direction of using new energy.

Keywords New energy power generation · Photovoltaic · Battery energy storage · Grid electricity price · Optimization

1 The Introduction

1.1 The Concept and Current Situation of New Energy Generation

In all kinds of human production and life, energy is an irreplaceable special product. After three important energy revolutions, today's energy structure is dominated by fossil energy and supplemented by renewable energy (Ford and Abdulla 2021).

X. Zhang (✉)
North China University of Technology, Beijing 100144, China
e-mail: Xiaomengnan119@126.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_136

Although the efficiency and stability of fossil energy bring convenience to human beings, but its non-renewability and greenhouse effect bring unprecedented threats to human living environment. Therefore, to give full play to the alternative role of new energy, improve the utilization rate of new energy, innovative design of green and sustainable energy system, to serve the production and life of human beings to the greatest extent, is the main development direction of new energy in the current world.

According to the World Energy Statistical Yearbook 2020, oil consumption accounted for 31.2%, coal for 27.2% and natural gas for 24.7% in 2020. Although the global fossil energy consumption decreased in 2020 due to the Novel Coronavirus effect, it still accounts for the majority of total energy consumption, up to 80%. This shows that the energy crisis is still very serious (Shahzad 2020).

The consumption of fossil energy has brought serious environmental problems to the whole world. Carbon emissions grew by 2% in 2018, the highest in nearly five years. In 2019, emissions grew by 0.5%, a modest increase but still higher than the sum of the previous six years or so (Ershun et al. 2016). As the most widely distributed and abundant resource, solar power generation has gradually become a new energy generation mode with the greatest development potential and the fastest growth. Due to the gradual popularization of photovoltaic power generation technology, it can effectively reduce the consumption of fossil energy, so it plays a significant role in promoting the adjustment of energy structure, reducing carbon emissions, achieving carbon neutrality and protecting the environment.

According to the Statistics of the International Renewable Energy Agency, at the end of 2019, photovoltaic power generation accounted for about 23% of the global installed renewable energy power generation, with a scale of 586 GW, compared with the same type of new energy power generation installed by 20% (Wang et al. 2021). In the long run, photovoltaic power generation is of great significance to the sustainable development of power system, the realization of new energy development strategy and the construction of an eco-friendly society (Onifade et al. 2021).

Table 1 Advantages and disadvantages of photovoltaic power generation

	Advantages	Disadvantages
Concentrated large photovoltaic power stations on the ground	Suitable for desert and other vast areas and large power	(1) Insufficient power generation efficiency, solar energy conversion efficiency is only about 30%
Distributed power station	It is suitable to be built near the electricity site to meet the needs of specific users	(2) Obviously affected by climate, the output power has a certain randomness and volatility

1.2 Advantages and Disadvantages of Photovoltaic Power Generation

See (Table 1).

1.3 Trends of Photovoltaic Power Generation

Photovoltaic power generation, as an indispensable part of new energy generation, will become the most important energy source in the future. At present, photovoltaic power generation technology presents a variety of development trends: the first is the MPPT solar tracking technology, which calculates the output power of photovoltaic array by detecting the dc voltage and output current of the main loop, and then realizes the tracking of the maximum power point. Therefore, it can effectively improve the utilization efficiency of photovoltaic (Villegas-Mier et al. 2021). Finally, the integrated photovoltaic energy storage system: photovoltaic power generation system will appear power fluctuations and other phenomena, resulting in unbalanced fluctuations of the overall power connected to the grid. The battery energy storage system can effectively alleviate this kind of situation. As a temporary energy storage device, it can release or absorb the electric energy in the photovoltaic power generation system flexibly, so as to ensure the smoothness of the output power of the grid.

1.4 Literature Review

At present, there are a lot of literature on the analysis and research of photovoltaic power generation and battery energy storage system. Literature (Sheeja and Kalpana 2021) proposed a new power flow analysis algorithm of four-port converter, which can be used for solar photovoltaic and battery-powered telecom coincidence grid-connection under low voltage, providing a new idea for solving photovoltaic volatility. With OpenDSS as the research background, literature (Jangurn and Bhumkittipich 2020) conducts simulation analysis on how photovoltaic and energy storage systems can be improved when used together. Literature (Li Yaze and Jingxian 2020) carried out a relatively comprehensive optimization design for the whole service cycle of the battery-assisted photovoltaic system, and accurately modeled the impact of solar panels and battery aging. Literature (Dhaked and Birla 2022) designed a solar plate-Stirling system and a battery energy storage system, which realized the power management of the battery in different states of light intensity, and carried out relevant simulation with MATLAB. Literature (Li and Zhao 2021) proposed a new self-generated energy saving system based on PV, ESS and EHP. Literature (Yichao et al. 2022) proposed an active power regulation scheme

considering the output power limit of energy storage and a reactive power regulation scheme involving photovoltaic energy storage. Reference (Yijie et al. 2021) proposed a capacity design method of distributed PHOTOVOLTAIC energy storage system for household photovoltaic energy storage system, considering the maximum photovoltaic self-sufficiency rate and other factors. Literature (Xiao-hu et al. 2022) takes Shandong, China as an example to establish a cost–benefit economic model of photovoltaic energy storage system. Literature (Shrivastava et al. 2021) introduces the control of photovoltaic cell series system in grid-connected mode, and proves that PQ control can maintain the load level and the battery system can work effectively simultaneously under variable light intensity. Reference (Karmakar and Singh 2020) aimed at the smoothing problem of photovoltaic power generation process, the randomness caused by short-term power fluctuation of photovoltaic power station was realized by using the battery energy storage power regulation system integrated with photovoltaic power station and power grid and BES algorithm, and simulation experiments were carried out.

2 Research on Solar Photovoltaic Modeling Method

2.1 Load

In residential communities and most commercial cases, the load is basically the electrical appliances used in the building. Among them, air conditioning system is usually the biggest power consumption component in a particular season. The extra load is mainly reflected in household lamps and small electrical appliances (Enongene et al. 2020).

2.2 Photovoltaic System

Photovoltaic Power Generation System Structure. A photovoltaic system has several components. It includes photovoltaic arrays, inverters, transformers, inverter control systems and other grid-connected and grid components. Among them, a plurality of photovoltaic cells form a photovoltaic array through series and parallel connection, and the electricity generated by the photovoltaic array will be transmitted to the power grid through the inverter, filter and boost transformer, so as to meet the normal demand of the user side.

Mathematical Model and Working Principle of Photovoltaic Battery. The internal structure of photovoltaic batteries is diverse and complex, and its general structure can be simplified to the circuit structure equivalent to a current source,

diode, parallel resistor and series resistor. The resistance value of the parallel resistance R mainly depends on the material of the photovoltaic cell, and its resistance value is infinite under ideal conditions. The resistance value of the equivalent resistance R in series mainly depends on the impurity concentration of the photovoltaic cell, and its resistance value is zero under ideal conditions (Fig. 1).

Through Kirchhoff's current law, the output current can be obtained as follows:

$$I_{pv} = I_{ph} - I_{sat} - I_{sh} \tag{1}$$

Therefore, the illumination current generated by illumination can be written:

$$I_{ph} = \left[I_{sc} + \frac{K_{si}}{1000}(T - 25)\right]\frac{S}{1000} \tag{2}$$

I_{sc} is the photovoltaic cell short-circuit current. K_{si} Is the temperature coefficient of photovoltaic cell output current. T is the ambient temperature, S is the light intensity.

Diode reverse saturation current is:

$$I_{sat} = I_{rs}\left[e^{\frac{q}{AKT}(I_{pv}R_s + U_{pv})} - 1\right] \tag{3}$$

I_{rs} is diode reverse saturation current. **A** is the coefficient related to the characteristics of the diode. **Q** is the amount of charge. **K** is Boltzmann's constant.

The current through the parallel resistor is:

$$I_{sh} = \frac{I_{pv}R_s + U_{pv}}{R_{sh}} \tag{4}$$

Through the above formula, the volt-ampere characteristics of photovoltaic cells can be obtained and used as a physical model of photovoltaic cells.

In addition, photovoltaic output power is subject to a variety of natural influences. Among them, light intensity has a decisive influence on photovoltaic output power,

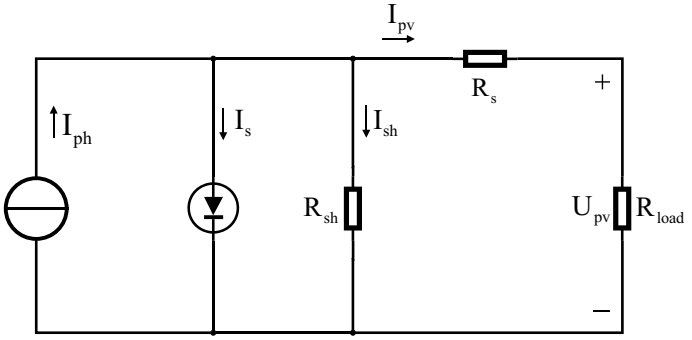


Fig. 1 Structure of photovoltaic batteries

and its conversion efficiency is affected by temperature. Therefore, the formula of light intensity and unit output power of photovoltaic system is as follows:

$$P_s = \mu S I_r [1 - 0.005(t_0 + 25)] \tag{5}$$

μ is photoelectric conversion efficiency; S is photovoltaic illumination area; I_r is light intensity; t_0 is the ambient temperature.

Influence of Photovoltaic System on Power Grid

1. Influence on grid voltage: Photovoltaic power generation itself is affected by natural factors such as half day and night, so its power supply for the grid has a certain degree of discontinuous and volatility (Jianlin et al. 2022).
2. Influence on power grid: The output power of the photovoltaic system changes with sunshine intensity. For example, when the light intensity changes, the photovoltaic system will have problems such as too low power and too large output harmonics (Lin et al. 2017). Thus, the stability of the power grid will be impacted and the stable operation of the power system will be affected.

2.3 Photovoltaic Energy Storage System

Battery Energy Storage. So far, the energy storage methods that can be applied in the photovoltaic power generation system include physical energy storage, electromagnetic energy storage, chemical energy storage and other principles.

Chemical energy storage has been widely used in large-scale grid-connected generation of new energy. Chemical energy storage can be divided into lithium ion battery, lead acid battery and sodium-sulfur battery according to the reaction principle and battery structure. Lead-acid battery technology is mature and has certain applications in power plants, substations and other fields. It plays an important role in maintaining stable and reliable operation of power grid. Lithium ion batteries are also widely used in new energy power generation, peak cutting and valley filling. Its safety is high and discharge voltage is stable. In addition, lithium-ion batteries are affordable. Lead-acid battery has low cost, wide optional capacity of monomer and can be recycled, which is conducive to the sustainable development of the environment. Therefore, this paper chooses lead-acid battery as the simulation object.

Mathematical Model of Battery. As the most important part of energy storage system such as distributed power grid, battery is suitable for different working environment. Due to the characteristics of mature technology, wide application and low cost, batteries are often used to stabilize bus voltage and balance power fluctuation in grid (Upasani and Patil 2018). Therefore, batteries are selected as energy storage devices in this paper.

The internal parameters of the battery are mostly nonlinear, so the mathematical model can better analyze its working characteristics. Battery models mainly include

mathematical model, electrochemical model and electrical model. Among them, the electrical model mainly uses DC voltage source, resistance capacitor and other devices to simulate the dynamic characteristics of the battery, so it is more suitable for simulation and optimization, and has higher accuracy. Therefore, this paper uses electrical model to model the battery.

At present, Rint model and Thevenin model are more common.

Rint model. Rint model is the battery as an ideal voltage source and internal resistance series. As shown in Fig. 2.

The formula is expressed as follows:

$$U_b = E - IR \tag{6}$$

The ideal voltage source and the equivalent internal resistance of the battery change in real time.

The Rint model is the most common battery model. Its parameter setting and simulation modeling are easy and universal. Its disadvantage is that the accuracy is not high, the storage battery in the transition state of charge and discharge is not quite obvious.

Thevenin model. Thevenin model is to add a set of RC circuit on the basis of Rint model, so that it can simulate the long time parameters of battery dynamic response. As shown in Fig. 3.

The formula is expressed as follows:

$$\mathrm{U}_b = \mathrm{E} - IR_b - U_s$$
$$I = C_s \cdot \frac{dU_b}{dt} + \frac{U_d}{R_b}$$

In the circuit, U_b is the voltage at both ends of RC network; R_s is the electrochemical polarization resistance, C_s is the equivalent electrochemical polarization

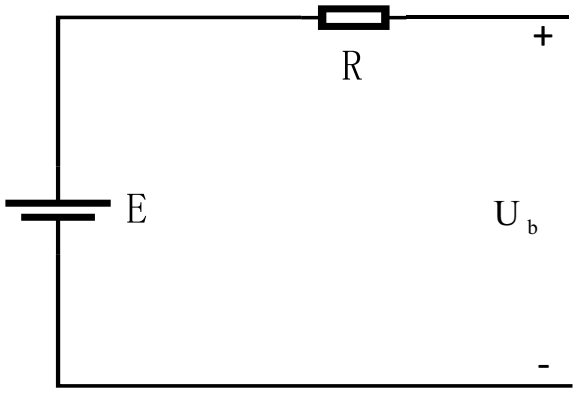


Fig. 2 Diagram of rint model

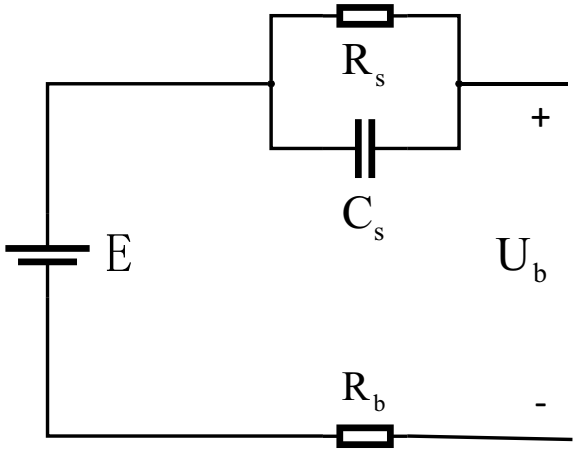


Fig. 3 Diagram of Thevenin model

capacitance. E is the ideal voltage source, and R_b is the ohm resistance inside the circuit.

The Thevenin model can take into account steady-state and transient characteristics of battery well. However, the influence of battery charge and discharge phenomenon on the battery is not considered comprehensively.

Photovoltaic Energy Storage System Structure. As shown in the figure, the micro-network topology of the combination of photovoltaic energy storage systems is shown below (Fig. 4).

The photovoltaic energy storage power generation system mainly includes a plurality of photovoltaic power generation units, battery energy storage units, photovoltaic inverters, energy storage inverters and bus (Lee and Choi 2019), which reach the power grid through transformers to meet users' electricity demand. Therefore, this paper will conduct simulation analysis for photovoltaic energy storage system.

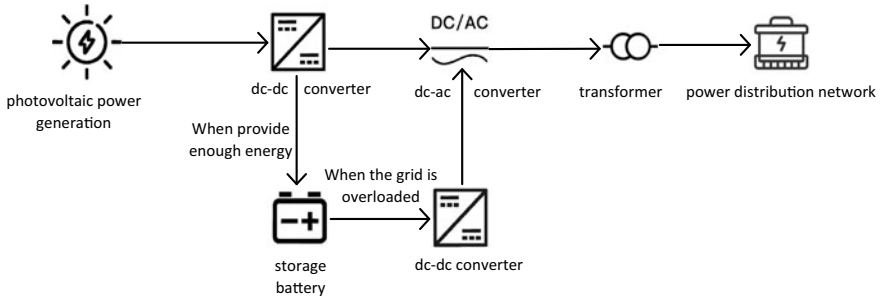


Fig. 4 Structure of photovoltaic energy storage system

3 Optimization and Simulation of Photovoltaic Battery System

3.1 Energy Management Strategies for Photovoltaic Battery Systems

The management control of photovoltaic cell energy storage system proposed in this study is based on whether the photovoltaic power generation system can store surplus electricity into the battery and further reduce the burden of the power grid when there is a lot of burden on the power grid after meeting the power demand of users. Among them, the burden of power grid is reflected by power grid price. When grid prices are high, photovoltaic energy storage systems provide electricity to the grid. When the grid price is low, the photovoltaic energy storage system will store the electricity generated by photovoltaic generation into the energy storage system. Thus, the negative impact of photovoltaic power generation volatility and uncertainty on power supply can be reduced.

3.2 Optimal Control

The optimization control of this simulation is to optimize the corresponding target by changing the value of the decision variable under the condition of satisfying the constraint conditions, and then make the corresponding target reach its minimum value.

The formula is as follows:

$$\min \sum_{j} f_j(x, u) \tag{7}$$

In the formula, **x** is the optimization target, **u** is the constraint condition.

3.3 The Optimization Goal

Simulation is designed to minimize the total operating cost of the grid, which includes many different components. The most common one is the cost of purchasing power for the grid, so this simulation optimizes the minimum power price of the grid.

Power grid electricity price calculation equation is:

$$C_{tot} = \sum_{k=0}^{N} C_{grid}(k) \cdot E_{grid}(k) \tag{8}$$

C_{tot} is the total electricity price of the grid, C_{grid} is the electricity price of the grid in time period K, E_{grid} is the electric energy consumed by the grid in time period K.

3.4 The Decision Variables

Therefore, this simulation takes this as the starting point to optimize the power grid, battery and battery storage respectively.

$$x = \left[P_{grid}(k)\, P_{batt}(k)\, E_{batt}(k)\right] \tag{9}$$

P_{grid} is grid electricity, P_{batt} is battery electricity, and E_{batt} is battery storage electricity.

3.5 The Constraint

In power grid optimization, most of the constraints come from physical limitations. For example, once the battery in the simulation reaches saturation, it can no longer store the extra light provided by pv. Conversely, once the battery runs out, it does not relieve the grid of any additional burden. In addition, the energy consumed by the user must be equal to the electricity provided by the grid plus the electricity provided by photovoltaic power generation, so the overall power generation must comply with the constraint equation of heat balance.

The battery power balance equation is:

$$E_{batt}(k) = E_{batt}(k-1) + P_{batt}(k) \cdot \Delta T \tag{10}$$

E_{batt} is battery energy storage, P_{batt} is battery energy.

The constraint equation of heat balance is:

$$P_{load}(k) = P_{grid}(k) + P_{batt}(k) + P_{pv}(k) \tag{11}$$

P_{load} is the load power, P_{grid} is the grid power, P_{pv} is the photovoltaic power, P_{batt} is the battery power.

3.6 Linear Programming

The simulation design adopts linear programming method, which minimizes the decision variables within a set of linear constraints. It is easy to express and easy to

solve. The simulation software MATLAB used this time has this function. However, it still has some disadvantages, that is, it is limited to constraint conditions and cost equation, which leads to the linear final result of its decision variables. Therefore, it can clearly analyze the trend of power grid electricity price after the intervention and optimization of photovoltaic energy storage, but it cannot analyze the trend of power grid electricity price affected by other external conditions.

4 Results and Analysis of Photovoltaic Cell Simulation

4.1 Simulation Background Description and Results

According to the above mentioned management strategy, using MATLAB programming design of the whole framework. The simulation takes one day as a period, during the peak period of power consumption, namely 18:00 to 22:00, the simulation draws the curve of power grid price, photoelectric energy, battery energy and load change. The simulation curve is as follows (Fig. 5).

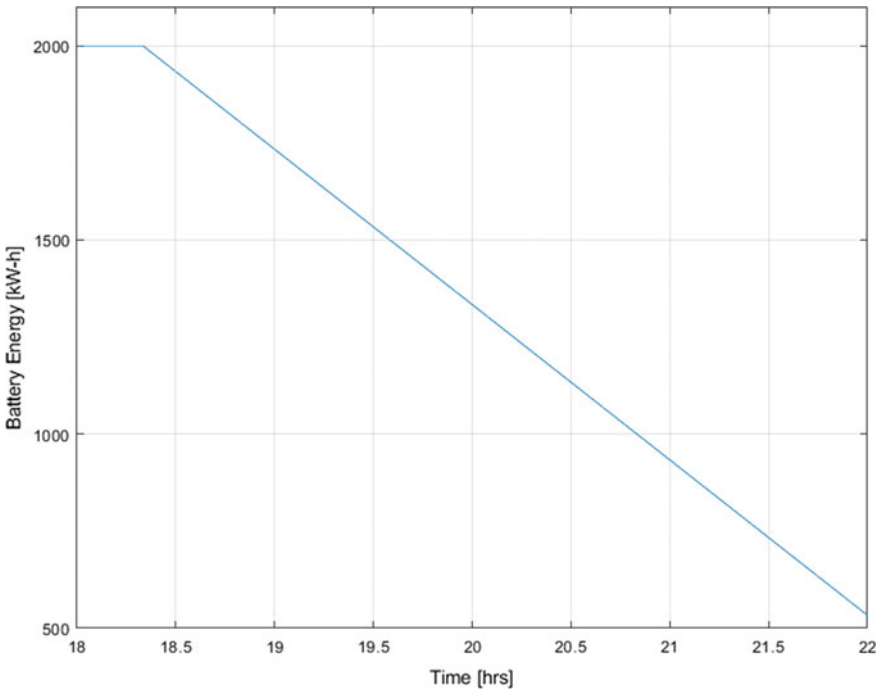


Fig. 5 The curve of battery energy

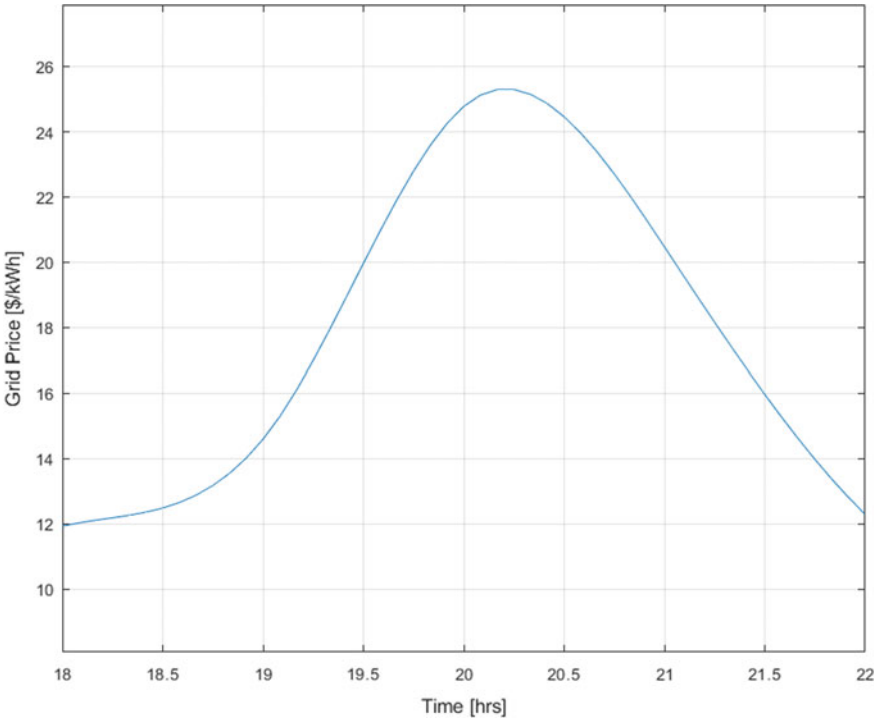


Fig. 6 The curve of grid price

The output energy of the battery drops significantly from 2000KW/H to 510KW/H from 18:00 to 22:00 in the evening, indicating that the power grid is in the peak period of power consumption at this time, and the energy storage battery provides power supply for the power grid (Fig. 6).

The grid price rises from 18:00, with an initial price of $12 /KWh. At about 20:15, the grid price reaches its peak, which is about 25 $/KWh. During 20:15–22:00, the price of power grid begins to drop to the initial price at 18:00, which is about 12.5 $/KWh (Fig. 7).

The curve of electric energy provided by pv is shown in the figure. Due to the influence of sunset, the pv was gradually reduced from 180KW at 18:00 to 0KW at 20:00 (Fig. 8).

The curve shown in the figure provides the electric energy curve for the grid. At around 18:30, the initial 475 kW drops to around 100 kW due to the energy provided by the storage battery. However, due to the peak power consumption, the power of the grid continues to rise to 225 kW from 18:30 to 19:00. Later, as the peak period has passed, the grid power gradually decreased to 100 kW (Fig. 9).

The curve shown in the figure is the power consumption curve of the user side load. It can be clearly seen that the average electric energy used by the load is 620 kW from 18:00 to 20:00 during the peak period of power consumption. When the peak

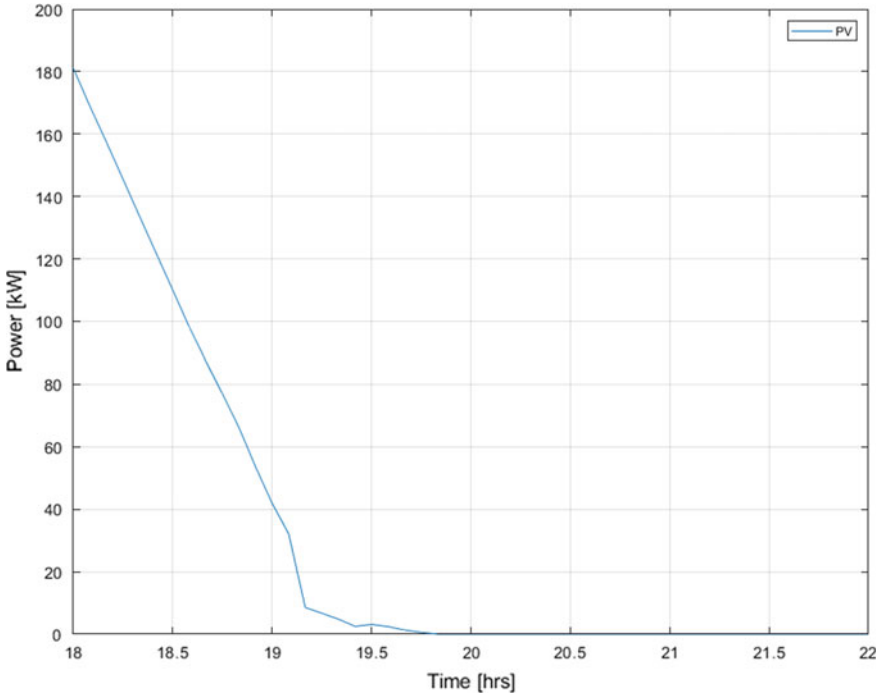


Fig. 7 The curve of photovoltaic power

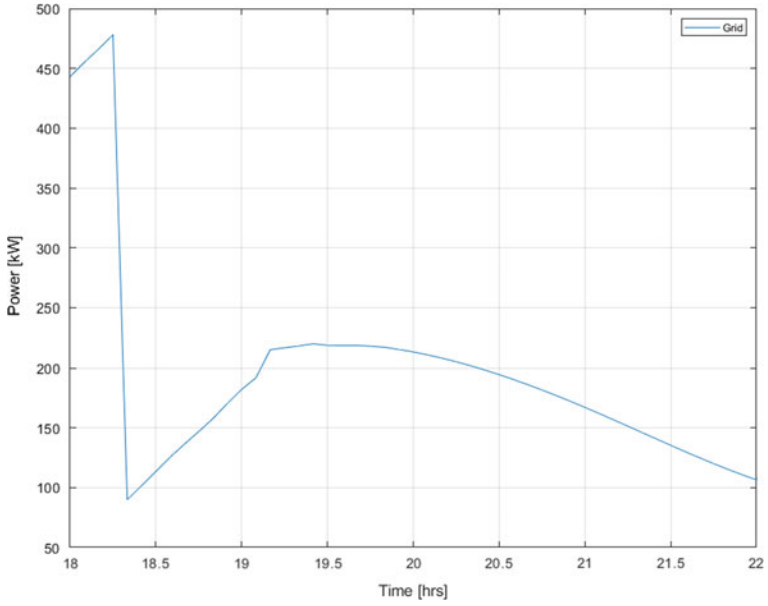


Fig. 8 The curve of grid power

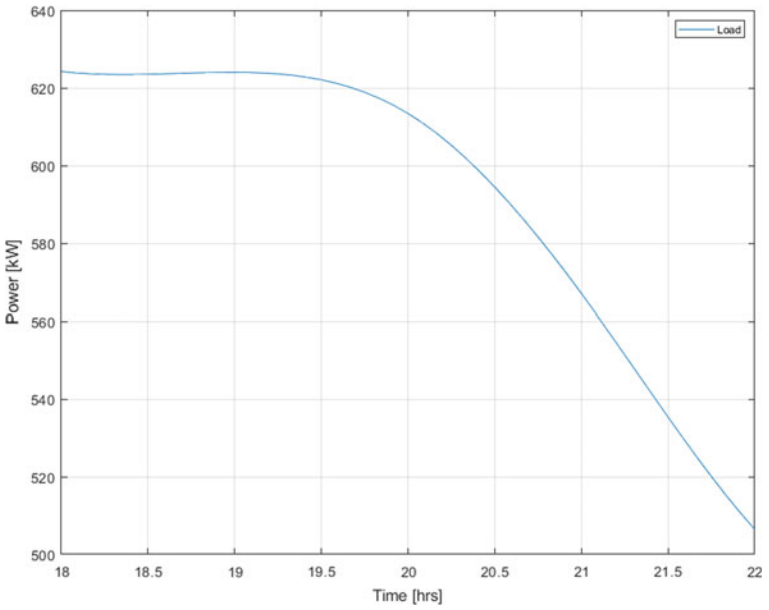


Fig. 9 The curve of grid power consumption

power consumption has passed, that is, from 20:00 to 22:00, the user load power consumption gradually decreases from 600 to 500 kW.

5 Conclusion

With the rapid development of photovoltaic system and policy support, photovoltaic power generation has entered the development stage of large-scale construction, and there will be more and more families with their own photovoltaic power generation system in the future. This paper combines photovoltaic power generation system and battery energy storage system, and provides the excess electricity provided by photovoltaic to the power grid, effectively helping the power grid to reduce the cost of power generation and improve the user's own income. In this paper, matlab software is used to conduct simulation analysis on the changes of power grid electricity price of photovoltaic energy storage system, which can effectively help the household photovoltaic power generation users to obtain the optimal scheduling strategy and optimize the user's electricity consumption structure. For the power grid, the model plays a certain role of peak clipping and valley filling, which is beneficial to the safe operation of the power grid.

References

Du E, Zhang N, Kang C, Miao M (2016).Reviews and prospects of the operation and planning optimization for grid integrated concentrating solar power. In: Proceedings of the CSEE (21), 5765–5775+6019

Dhaked DK, Birla D (2022) Modeling and control of a solar-thermal dish-stirling coupled PMDC generator and battery based DC microgrid in the framework of the ENERGY NEXUS

Enongene KE, Abanda FH, Otene I, Obi SI, Okafor C (2020) Data on the daily electricity load profile and solar photovoltaic (PV) system components for residential buildings in Lagos Nigeria. Data Brief 30:105531

Ford MJ, Abdulla A (2021) New methods for evaluating energy infrastructure development risks. Risk Anal Official Publ Soc Risk Anal. https://doi.org/10.1111/risa.13727.Advanceonlinepublication

Jan-ngurn C, Bhumkittipich K (2020) Analysis of power grid system with solar power sources and energy storage system integrations using OpenDSS. In: 2020 59th annual conference of the society of instrument and control engineers of Japan (SICE), pp 1868–1872

Jianlin L, Zhijin F, Yuliang T, Zhixin Q, Mingxuan C (2022) Application prospect analysis of electrochemical energy storage technology in county-wide rooftop photovoltaic system. Acta Energiae Solaris Sinica

Karmakar S, Singh B (2021) Battery energy storage (BES) for mitigation of short-term power fluctuations in large-scale solar PV plant due to cloud movement. In: 2020 3rd international conference on energy, power and environment: towards clean energy technologies, pp 1–6

Lee S, Choi DH (2019) Reinforcement learning-based energy management of smart home with rooftop solar photovoltaic system, energy storage system, and home appliances. Sensors (Basel, Switzerland) 19(18):3937

Li J, Zhao H (2021) Multi-objective optimization and performance assessments of an integrated energy system based on fuel, wind and solar energies. Entropy (basel, Switzerland) 23(4):431

Lin Z, Tao H, Yinghua D, Yabo Y, Yulong X (2017) Reliability evaluation of PV station based on time varying factors. Electric Power

Onifade ST, Erdoğan S, Alagöz M, Bekun FV (2021) Renewables as a pathway to environmental sustainability targets in the era of trade liberalization: empirical evidence from Turkey and the Caspian countries. Environ Sci Pollut Res Int 28(31):41663–41674

Shahzad U (2020) Environmental taxes, energy consumption, and environmental quality: Theoretical survey with policy implications. Environ Sci Pollut Res Int 27(20):24848–24862

Shrivastava A, Rohit SS, Gupta N, Paliwal P (2021) Control of Solar-battery storage based Microgrid. In: 2021 innovations in energy management and renewable resources (52042), pp 1–6

Sheeja V, Kalpana R (2021) Power flow management of a solar PV and battery powered telecom load with bidirectional grid power exchange. In: 2021 IEEE 4th international conference on computing, power and communication technologies (GUCON), pp 1–6

Upasani M, Patil S (2018) Grid connected solar photovoltaic system with battery storage for energy management. In: 2018 2nd international conference on inventive systems and control (ICISC), pp 438–443

Villegas-Mier CG, Rodriguez-Resendiz J, Álvarez-Alvarado JM, Rodriguez-Resendiz H, Herrera-Navarro AM, Rodríguez-Abreo O (2021) Artificial neural networks in MPPT algorithms for optimization of photovoltaic power systems: a review. Micromachines 12(10):1260

Wang M, Yao M, Wang S, Qian H, Zhang P, Wang Y, Sun Y, Wei W (2021) Study of the emissions and spatial distributions of various power-generation technologies in China. J Environ Manage 278(Pt 1):111401

Xiao-hu W, Chun-li C, Zhi C, Chun-liang C, Mei-tin J (2022) Empirical analysis of cost-CO2-energy benefits of distributed photovoltaic-battery storage system-taking (PV-BSS) in a case study in rural Jiaozhou Shandong. China Environ Sci (01):402–414

Yaze L, Jingxian W (2020) Optimum integration of solar energy with battery energy storage systems. IEEE Trans Eng Manage

Yichao W, Xiangqi L, Zhongwei C, Haotian L, Yefan W (2022) A virtual synchronous generator control method based on independent grid-connected structure of photovoltaic system and energy storage system. Acta Energiae Solaris Sinica (01):249–255
Yijie Z, Xing L, Zhenwu C, Xiaochun Z, Yong Z (2021) Sizing method and operating characteristics of distributed photovoltaic battery system. CIESC J (S1):503–511

The Relationship Between the Evolution of Buildings and the Environment in China

Yitong Dai

Abstract The increasing concerns about the building industry's impacts on the environment have necessitated the need to examine the relationship between the evolution of buildings and the environment. The article is based on secondary data that answers two research questions informing the proposed research topic: (a) stages and historical evolution of buildings and related technologies for sustainable buildings in China, and (b) how can buildings be constructed to be more environmentally friendly to support the current demand and trend for sustainable buildings? Through the research findings, different stakeholders in the building industry will understand ways to accomplish environmental sustainability goals. The research revealed that the advancement of buildings and related technologies since the ancient era has led to significant development in the building and construction industry. Consequently, this has led to the over-consumption of natural resources (clearing land and harvesting natural resources) for building purposes, increasing environmental problems. Particularly, in China, the modernism and post-modernism architectural eras have witnessed unprecedented growth in the building industry, posing increased environmental problems. However, the current and future focus of the Chinese building industry is on the evolution of building towards innovative and technological advancements that promote environmental sustainability practices.

Keywords Evolution · Buildings · Environment · Sustainability · Technology · Natural resources · Cost · Efficiency

1 Introduction

The evolution of buildings and the environment are two closely connected concepts. Thus, the importance of developing buildings that support environmental sustainability cannot be overlooked. Architects should develop buildings that consider the

Y. Dai (✉)
Contemporary Arts and Visual Arts, Simon Fraser University, Vancouver, Canada
e-mail: Yda47@sfu.ca

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_137

relationship with the environment and natural systems (Archibuilt 2017). As part of environmentally friendly building practices, architects should develop buildings that advocate better resource use. However, to understand how to fulfill changing demands and expectations in the building and construction industry, players should understand the evolution of building technologies. This will prepare them for future expectations as the industry continues to evolve. Wu et al. (2019) noted that in the past, building technologies were based on particular geographical environments (Wu et al. 2019). Today, rapid innovations and technological advancements have eliminated the geographical aspects of space and time, leading to the convergence of architecture and more advanced practices in building construction. Consequently, architects should understand the connection between the evolution of buildings and the environment to adopt the best practices to ensure sustainability. Hyde insists that the approach will ensure that potential challenges with changing environmental conditions are addressed while developing buildings (Hyde 2018).

Two research questions guided the article: (a) the stages and historical evolution of buildings and related technologies for sustainable buildings in China; and (b) how can buildings be constructed to be more environmentally friendly to support the current demand and trend for sustainable buildings? The answers to the questions were obtained through comprehensive secondary data from different credible online sources. Responses to the research questions revealed the significant relationship between the evolution of buildings and the environment. The article is important because it offers information among stakeholders in the Chinese building industry and the environment to collaborate toward environmental protection and sustainability, protecting current and future generations.

2 Stages and Historical Evolution of Sustainable Buildings in China

The evolution of buildings and related technologies in China has happened for decades, where the evolution is aimed at enhancing how buildings fulfill users' needs and adapt to environmental standards and expectations. Wu et al. explained that as part of building technologies, the main element is the building structure that traces historical aspects of building technologies (Wu et al. 2019). The building structure relates to the materials used for building construction purposes, such as wood and bricks. The building structure existed before the start of human civilization but has been influenced by aspects such as culture, science and technology, politics, and the economy over the centuries. This has, over the years, led to different forms of building structures worldwide across different civilizations. Figure 1 shows the evolution of building technologies and structures across different times in China, from the nest structure (over 1.7 million years old) to the modern new structural form (introduced in 2000) (Wu et al. 2019). From the diagram, the periods can be classified into three: the ancient, modernism, and post-modernism eras.

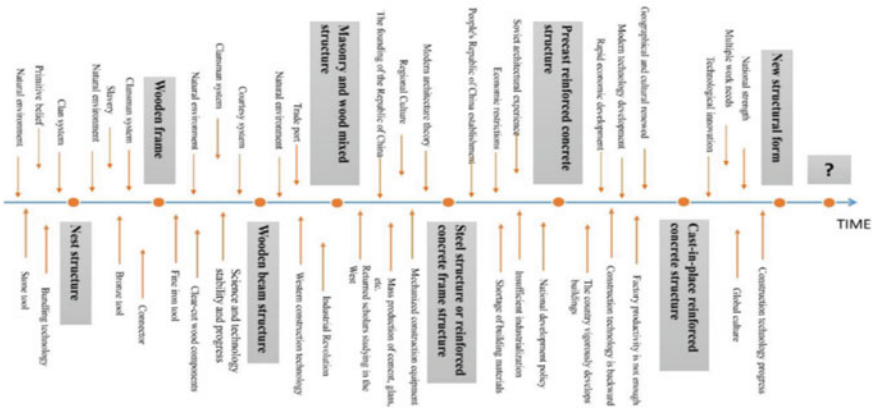


Fig. 1 Timeline for the development of building technology and structures (Wu et al. 2019)

2.1 Ancient Architectural Era

From Fig. 1, it can be seen that the ancient architectural era relates to prehistoric times, which includes the nest structure, wooden frame structure, wooden beam structure, and masonry and wood mixed structure. The different building eras lasted from over 1.7 million years ago to the Opium War period in the 1840s. As observed through the different stages in the evolution of buildings, threats of buildings to environmental sustainability increased as humans became more civilized. For instance, ground buildings started emerging during the nest structure, and there was an increased demand for solid-wood structures. This meant that whereas the natural environment needed to be cleared to develop the buildings, natural resources would also be used. Besides, during the wooden frame period (twenty first Century BC to second Century BC), advanced tools such as bronze tools enhanced the construction of wooden frame structures. The periods that followed the invention of the tool witnessed technological advancement and increased usage of wood to build more complex and advanced structures, as shown in Figs. 2 and 3. Further developments in the building industry during the wooden beam structure (second century BC-eighteenth century) and masonry and mixed era (the 1840s) led to significant developments in building technologies and techniques (Wu et al. 2019). The advanced construction tools allowed people to use environmental resources to develop buildings extensively. This threatened environmental sustainability based on the increased use of natural resources to develop the building industry. Pan reiterates that technological advancement experienced during the Industrial Revolution resulted in significant ecological and environmental destruction (Pan 2021).

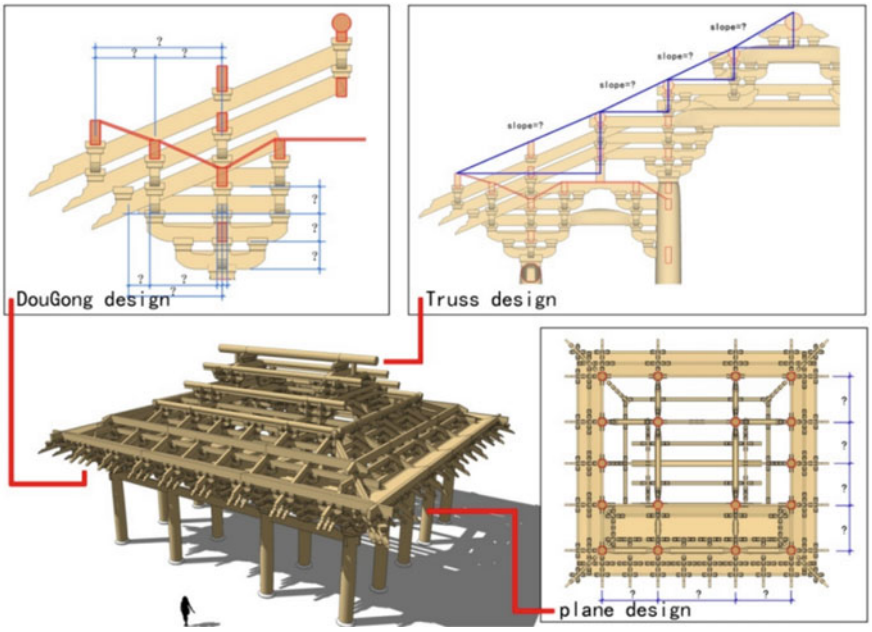


Fig. 2 Designs for wooden buildings in ancient China (Chuang 2018)

Fig. 3 Ancient Chinese wooden building (Ningning 2017)

2.2 Modernism Architectural Era

The modernist architectural era in China spans from the late nineteenth century to the 1960s (History 2018). The period was characterized by a dramatic advancement in building technologies and materials advocating minimalism (Fraser 2000). Two building structures developed during the era are reinforced concrete (1912–1949)

Fig. 4 A historic brick building in China (1912–1949) (Lyme 2016)

and precast reinforced concrete (1949). Between 1912 and 1949, the architectural field proliferated through architects from the West and China (Hu 2009). The period saw increased production of alternative materials for building, such as glass, cement, steel, and other materials reducing wooden structures. Precast reinforced concrete structures emerged in 1949 and were common alongside brick-concrete structures (Fig. 4) (Wu et al. 2019). The advanced building materials resulted in increased waste from construction sites, creating more environmental problems. Kabirifar et al. observed that in the construction industry, construction and demolition waste result in environmental problems (Kabirifar et al. 2020). 35% of these wastes are disposed of in landfills, causing detrimental impacts on the environment (Kabirifar et al. 2020).

2.3 Post-modernism Architectural Era

The post-modernism architectural era started in the 1960s, resulting in unprecedented changes in the building industry (7). According to Ionescu et al., laborious historical processes have facilitated the advancement of building techniques and technologies for today's energy-efficient buildings (Fig. 5) (Ionescu et al. 2015). This has been a common trend during the post-modernism building era. For instance, cast-in-place structures were introduced in the Chinese building industry in the late 1970s, increasing construction speed while optimizing safety. Equally, new structural forms since the 2000s have significantly been influenced by technological innovations supporting high-rise and large-scale building construction (Wu et al. 2019). This has necessitated a focus on sustainable buildings that reduce the building industry's

environmental problems. Alawneh et al. observed that today, building construction focuses on energy and water efficiency issues to fulfill UN Sustainable Development Goals (SDGs) (Alawneh et al. 2018).

Overall, in the evolution of buildings, environmental issues remain vital based on the use of resources and building designs. However, this happens at an extra cost considering that people supporting green initiatives are expected to pay a premium price, as shown in Figs. 6 and 7 (The Constructor Organization 2021).

Fig. 5 A sustainable building in China (Liu 2015)

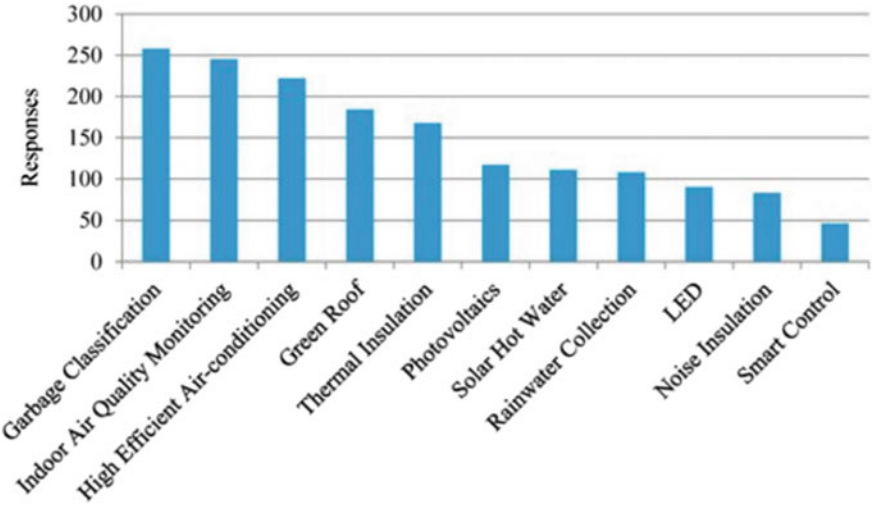


Fig. 6 Customers' willingness to pay for sustainable technologies (Xie et al. 2017)

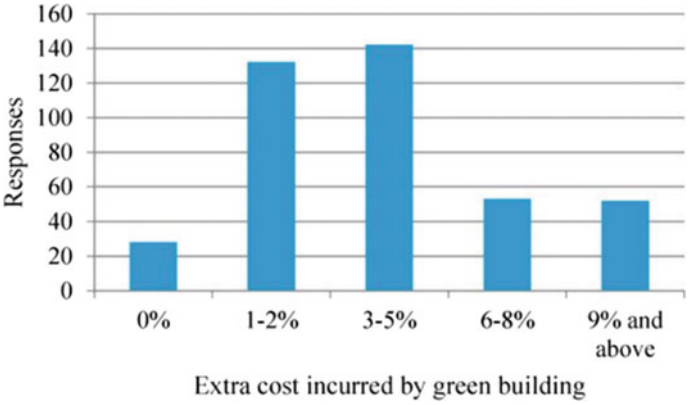


Fig. 7 Extra costs for green building (Xie et al. 2017)

3 Constructing Sustainable Buildings

Today, stakeholders are prioritizing the building of environmentally friendly buildings. Various considerations are necessary to ensure that buildings are environmentally friendly. Akadiri et al. noted that the building industry is a critical component of the economy and has significant environmental impacts (Akadiri et al. 2012). The environmental effects are felt considering that the industry comprises the largest users of material resources, energy, and water, making the sector a formidable polluter. Consequently, with the increasing concerns about the impacts the building industry has on the environment, there is increased attention and focus on actions and strategies advocating for sustainable building practices and activities (Akadiri et al. 2012). Figure 8 shows a framework guiding strategies and actions for sustainable building practice: resource conservation, cost efficiency, and design for human adaptation (Akadiri et al. 2012).

Fig. 8 Framework for sustainable buildings (Akadiri et al. 2012)

The resource conservation aspect suggests that when thinking of sustainable building, the focus is to optimize the usage of natural resources to fulfill needs among the current generations while maintaining the usefulness of these resources for future generations (Akadiri et al. 2012; Simão and Lisboa 2017). For instance, during construction, resource conservation will be achieved through methods that minimize wastage of construction materials, such as reducing consumption of the materials, reuse, and recycling. Also, in homes, using solar panels that trap renewable energy is critical for resource conservation (Akadiri et al. 2012). However, building quality should not be compromised as developers seek to save construction costs and fulfill sustainability targets. Necessary standards to be pursued to ensure that building quality is maintained with a focus on environmental sustainability.

The cost-effective component of sustainable building advocates for minimizing project costs while assuring that buildings will have long-term economic benefits. The cost aspect is a crucial consideration in constructing sustainable buildings considering that players in public and private sectors make investment decisions based on the anticipated costs and expected economic returns (Akadiri et al. 2012). The higher the expected returns, the more willing such investors will be to support the industry's continued growth and sustainability. Also, the design for the human adaptation component prioritizes sustainable building for comfortable and healthy environments for human activities. Such buildings should fulfill the following basic requirements, not harm the environment, support healthy living among people, and advocate for efficient resource use (Akadiri et al. 2012). Thus, while focusing on environmental sustainability, strategies and actions ought to target a balance between human needs (social), the environment, and economic issues. Verma and Asafo-Adjei emphasized that sustainable building approaches should be considered throughout the building's life cycle (Verma and Asafo-Adjei 2021). The buildings' design, construction, and maintenance should adopt sustainable practices and solutions.

Additionally, innovations and technologies have promising results towards realizing environmental sustainability goals. New innovations and technologies should be consistently developed and leveraged to support sustainability in the building industry and the environment. According to Verma and Asafo-Adjei, recent technological advancements have introduced new green and sustainable building practices that reduce human and environmental health problems (Verma and Asafo-Adjei 2021). This is evident through reduced waste, efficient water and energy use, reduced pollution, and reduced environmental degradation challenges (Verma and Asafo-Adjei 2021). Parashar and Parashar observed that green roof technologies are being adopted to accomplish goals for environmental sustainability in the building and construction industry (Parashar and Parashar 2012). Green roof technology involves growing vegetation on roofs, a solution that has been noted to have tremendous environmental benefits to occupants and the environment (Parashar and Parashar 2012). The International Communication Union noted that many real-world technologies are used to accomplish environmental sustainability goals in the building industry (International Communication Union (2012)). For instance, a UNEP building in Nairobi is constructed to incorporate green building features that further reveal the link between

evolving buildings and the environment. The building is designed using modern technologies to achieve environmental sustainability goals. The building's data centers are utilizing advanced technologies that use water and air for cooling, solar panels provide energy needs, green vegetation is planted around the building for a clean and healthy environment; and energy-efficient computers are being utilized (International Communication Union (2012). Figure 9 portrays the design of a sustainable building with Fig. 10 showing Micro Emission Sun-Moon Mansion, Dezhou, China (a sustainable building) (Cobalt Consulting 2022). Across China, Shen and Faure noted that despite an increasing trend for sustainable buildings, environmental problems persist and more solutions should be adopted (Shen and Faure 2021).

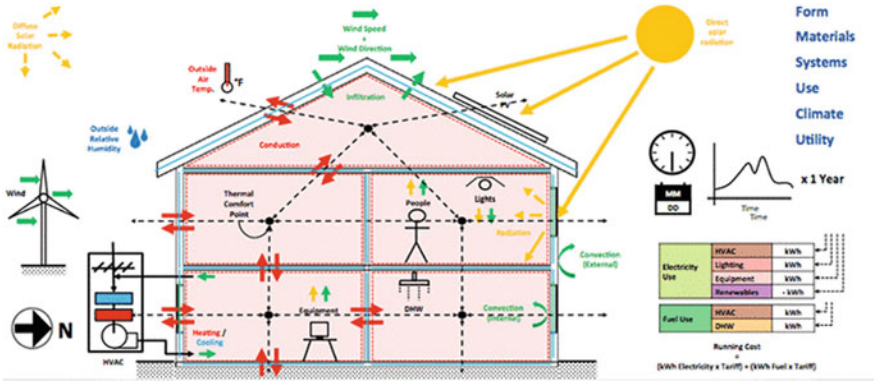


Fig. 9 Modern design of green buildings (The Constructor Organization 2021)

Fig. 10 Micro emission Sun-Moon Mansion, Dezhou, China (Consulting and (UK) 2022)

Furthermore, Industry 4.0 technologies are revolutionizing how the building industry contributes to the accomplishment of environmental sustainability goals. As demonstrated in Fig. 11 below, some of the Industry 4.0 technologies adopted across different building and construction industries in China and globally include the digital simulation model, block chain, additive manufacturing, 3D printing, cloud computing, internet of things, artificial intelligence, premanufactured building technologies, and analytics. Different technologies support building and construction through innovative technological and sustainable solutions (de Almeida Barbosa Franco et al. 2022). Liao et al. insist that modern technological advancements support eco-architecture to enhance the relationship between buildings and connected factors such as the environment (Liao et al. 2022). Figures 12 and 13 demonstrate 3D printing technology for buildings.

Finally, as suggested by The Constructor Organization, the need to pay extra costs (Figs. 2 and 3) for environmentally friendly buildings is a potentially significant challenge affecting the realization of environmentally sustainable goals in the building industry (The Constructor Organization 2021). Consequently, different stakeholders in different industries should work together to offer financial and other necessary support to cut the extra costs while pursuing environmental sustainability goals. This will encourage more people in the building industry to commit to the pursuance of environmental sustainability goals. Nevertheless, as revealed above, the exploitation

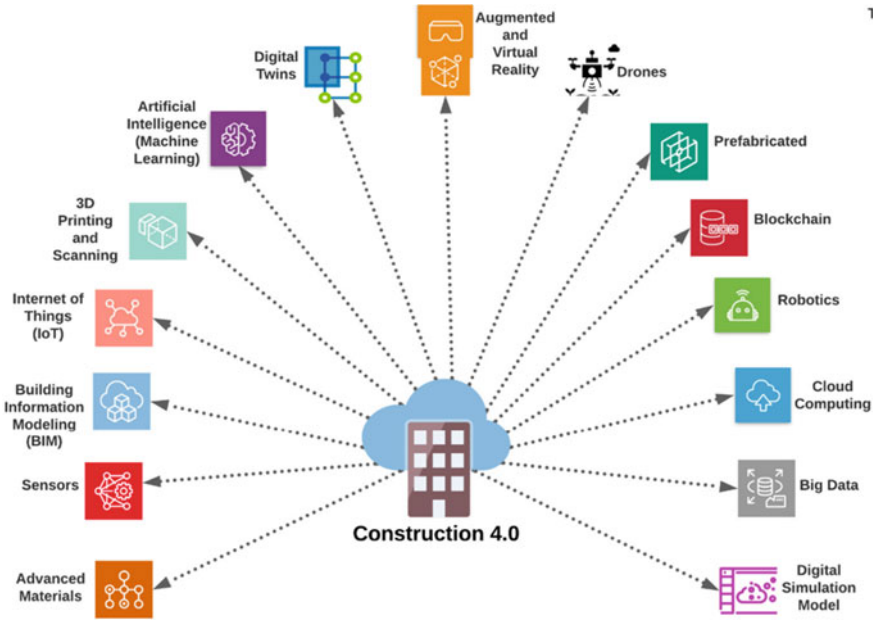


Fig. 11 Technologies accomplishing sustainability in the building and construction industry (de Almeida Barbosa Franco et al. 2022)

Fig. 12 3D printing technology (Frearson 2014)

Fig. 13 3D Printed building (Frearson 2014)

of innovative technologies in the building industry will contribute to cost efficiency, as reflected through an enhanced ability to develop sustainable buildings.

4 Conclusion

This paper sought to evaluate the relationship between the evolution of buildings and the environment in China. The findings emphasized that there is a strong connection between the evolution of buildings and the environment. In particular, the research has revealed that as the Chinese building industry developed in the past because of technological advancement and changes in users' needs, this contributed to an increase in the use of natural resources such as wood and increased waste that posed significant threats to the environment. Today, the resulting environmental problems from the rapid expansion of the building and construction industry since the Industrial Revolution have led to an increased focus on sustainable building practices. Consequently, there is increased attention to pursuing strategies and actions for environmental sustainability through sustainable building practices. The framework for sustainable building practices that support the realization of environmentally-friendly goals targets cost efficiency, design for human adaptation, and focus on

resource conservation. The three aspects are connected because they emphasize the fulfillment of environmental, economic, and social goals that advocate for enhanced human and environmental health. As different stakeholders work towards realizing environmental sustainability goals in the building and construction industry, leveraging technologies and innovations that support green building is paramount. This will contribute towards shifting the relationship between the evolution of buildings and the environment from a negative one to a positive one that has mutual benefits. Commitment and focus towards accomplishing sustainable environmental practices in the building industry are continuous, suggesting the need to constantly encourage creativity and innovation for new sustainable strategies and actions.

References

Akadiri PO, Chinyio EA, Olomolaiye PO (2012) Design of a sustainable building: a conceptual framework for implementing sustainability in the building sector. Buildings 2(2):126–152

Alawneh R, Ghazali FEM, Ali H, Asif M (2018) Assessing the contribution of water and energy efficiency in green buildings to achieve united nations sustainable development goals in Jordan. Build Environ 146:119–132

Archibuilt (2017) The relationship between architecture and environment. Online https://archibuiltnigeria.com.ng/2017/09/09/the-relationship-between-architecture-and-environment/

Chuang SUN (2018) Measurement and analysis of the ancient Chinese timber-frame building. Online https://www.cipaheritagedocumentation.org/wp-content/uploads/2018/12/Sun-Measurement-and-analysis-of-the-ancient-Chinese-wooden-architecture.pdf

Cobalt Consulting (UK) (2022) Clean energy giants: the world's five most sustainable buildings. Online https://www.cobaltrecruitment.co.uk/blog/2018/09/clean-energy-giants-the-worlds-five-most-sustainable-buildings?source=google.com

de Almeida Barbosa Franco J, Domingues AM, de Almeida Africano N, Deus RM, Battistelle RAG (2022) Sustainability in the civil construction sector supported by industry 4.0 technologies: challenges and opportunities. Infrastructures 7(3):43

Fraser V (2000) Building the new world: studies in the modern architecture of Latin America 1930–1960. Verso

Frearson A (2014) Chinese company 3D prints 10 buildings in a day using construction waste. Online https://www.dezeen.com/2014/04/24/chinese-company-3d-prints-buildings-construction-waste/

History (2018) Modernism and post-modernism history. Online https://www.history.com/topics/art-history/history-of-modernism-and-post-modernism

Hu X (2009) Reorienting the profession: Chinese architectural transformation between 1949 and 1959. The University of Nebraska-Lincoln

Hyde R (2018) The evolution of buildings and cities. Adapting to changing environmental conditions from urbanization. Architectural Sci Rev 61(1–2):1–3

International Communication Union (2012) International Communication Union. Online https://www.itu.int/dms_pub/itu-t/oth/4B/04/T4B0400000B0012PDFE.pdf

Ionescu C, Baracu T, Vlad GE, Necula H, Badea A (2015) The historical evolution of energy-efficient buildings. Renew Sustain Energy Rev 49:243–253

Kabirifar K, Mojtahedi M, Wang C, Tam VW (2020) Construction and demolition waste management contributing factors coupled with reduce, reuse, and recycle strategies for effective waste management: a review. J Clean Prod 263:121265

Liao CW, Lin JH, Chen TW (2022) Research on a framework for sustainable campus eco-architecture selection: taking a Taiwan high school as an example. Sustainability 14(10):6265

Liu C (2015) British and Chinese partner on green buildings research. Online https://www.chinadaily.com.cn/world/2015xivisituk/2015-10/22/content_22259026.htm.
Lyme C (2016) Let's roll! Chinese workers set to save the historic building by sliding it on rails for 300 feet after it is earmarked for demolition. Online https://www.dailymail.co.uk/news/peoplesdaily/article-3486117/Let-s-roll-Chinese-workers-set-save-historic-building-sliding-rails-300-feet-earmarked-demolition.html
Ningning Z (2017) Private garden houses ancient wooden architecture. Online https://archive.shine.cn/district/songjiang/Private-garden-houses-ancient-wooden-architecture/shdaily.shtml
Pan J (2021) Scientific understanding and theoretical system of a new era of ecological civilization. In: China's global vision for ecological civilization, pp 1–23. Springer, Singapore
Parashar AK, Parashar R (2012) Construction of an eco-friendly building using green building approach. Int J Sci Eng Res 3(6):1–7
Shen Y, Faure M (2021) Green building in China. Int Environ Agreements Polit Law Econ 21(2):183–199
Simão L, Lisboa A (2017) Green marketing and green brand–the Toyota case. Procedia Manufacturing 12:183–194
The Constructor Organization (2021) Elements or components of green building-material, water, energy health. Online https://theconstructor.org/building/elements-of-green-building/5375/
Verma M, Asafo-Adjei D (2021) Construction of environmentally friendly buildings: a review. J Emerg Technol Innov Res 8(1):354–360
Wu J, Wei H, Peng L (2019) Research on the evolution of building technology-based on regional revitalization. Buildings 9(7):165
Xie X, Lu Y, Gou Z (2017) Green building pro-environment behaviors are green users also green buyers? Sustainability 9(10):1703

The Impact of Data Analytic on Marketing Models in the Digital Economy—The Case of Online Education Institutions

Yilin Dai

Abstract Data-based marketing has become the direction of enterprise transformation and development, and many companies regard data-based transformation as their long-term strategic goal. In this context, the traditional education industry has also begun to develop in the direction of online education, and data-based reforms are being carried out in both teaching methods and marketing methods. This paper analyzes the relationship between data analysis and marketing through the method of literature research, and takes online education as an example to analyze the way of data marketing, so as to provide a new development direction for education.

Keywords Data analysis · Marketing management · Digital economy · Online education · Marketing

1 Introduction

With the global digitalisation process booming, the scale of growth and development planning of enterprises can rely on data for statistics and analysis, thus providing more scientific strategies to support business operations. In the era of "Internet + ", the digital marketing model, with its deep integration of marketing and data, has brought greater revenue generation to many industries. Data-based marketing is now more and more traditional enterprises put forward the direction of transformation and development, many enterprises have data-based marketing transformation as next year or even the future of long-term corporate strategy. At the same time, in the context of the normalisation of the epidemic, in addition to the Internet industry paying extra attention to data-based marketing, the traditional education industry has also started to develop towards online education and has bred many new ways of

Y. Dai (✉)
Alibaba Business School, Hangzhou Normal University, Hangzhou 311100, Zhejiang, China
e-mail: 1243485842@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_138

data marketing. Through the literature research method, this paper studies the path of optimising marketing strategies through data analytics by analysing the relationship between data analytics and marketing, and provides some new ideas for the crowd in this industry by taking online education as an example.

2 The Relationship Between Data Analysis and Marketing

In the digital age, the way people live and think has changed, and likewise people's perceptions of consumption have changed. Consumers have been given a broader perspective and a heightened sense of autonomy. The internet has made much information publicly available and consumers are not only aware of specific information about products, but can also search for reviews of their use. In this context, if companies and manufacturers ignore the changes that have taken place in the consumer world and continue to "bombard" them with information, they will lose a lot of attention.

At the same time, Big Data's ability to capture and summarise information has made it an indispensable information base for government and corporate decision-making, social management, healthcare, business marketing, product development and more. In particular, its application in the field of marketing management and innovation has greatly improved the precision of enterprises in tapping into customer needs and maximised marketing effectiveness (Chong et al. 2019). Big data analytics therefore presents opportunities for marketing.

2.1 Targeted Optimisation of Consumer Service Content

In today's society, the penetration of mobile phones and the internet into life has led to a tendency for shopping and consumption to become electronic. And because online consumption saves time in shopping malls and increases the efficiency of consumers' shopping, the number of online consumers is on the rise. Consumers use the search function to find the products they need in their daily consumption, and companies can analyse data from search records to understand consumers' consumption preferences. Based on the results of the analysis, companies can also determine the consumer's daily consumption level and consumption habits, predict the consumer's consumption behaviour and offer relevant products in advance to induce consumers to adopt consumption behaviour.

The summary of consumer information allows companies to think more objectively from the consumer's point of view and to analyse consumer psychology, so that they can provide more personalised and exclusive services to consumers, including age groups, regions, consumption motives and consumption habits. While satisfying the consumer's desire to consume, consumer satisfaction is significantly increased.

This increases the likelihood of consumer behaviour and, to a certain extent, allows for increased business efficiency.

2.2 Contributing to Cross-Selling in Corporate Marketing

Cross-selling is an emerging marketing technique in which a company identifies the diverse needs of its customers and, at the same time, satisfies them through the rational optimisation and sale of the company's related services or products. For example, when a customer buys a dress, a matching top or shoes are recommended for her. This requires the company to focus not only on the customer's current consumption but also on the customer's potential consumption in the marketing process, thus further expanding the customer's consumer market.

2.3 Help to Build and Maintain Good Customer Relationships

The core of marketing work is to establish a good relationship with customers (Chenyuan 2022). Only by establishing a good corporate image can a company establish a good relationship with its customers by ensuring smooth communication. This makes it possible for enterprises to increase their market share and competitiveness. In the information age, communication between enterprises and customers has become easier and faster with the progress of the Internet, and the needs of customers can be better grasped by enterprises, which can provide more customised services for customers through the analysis of market data. In addition, based on the amount of information available through big data, companies can provide more comprehensive, in-depth and personalised services to their customers. At the same time, based on the results of data analysis, enterprises can actively develop marketing tools that are more beneficial to both the enterprise and the customer, creating a win–win situation and laying the foundation for deeper cooperation and more potential customers, such as experiential marketing, which breaks through the traditional assumption of "rational consumers" and takes into account both the emotional and rational aspects of consumers. It is easier to win the loyalty of customers and maintain the long-term development of the company.

2.4 Helps Optimise Follow-Up Marketing

It is vital for marketing that companies and customers provide real-time feedback, trust each other, and communicate in a timely manner. The traditional approach to

one-way marketing is to conduct market research before a product is designed and ready to be put on the market, and at which point no further changes are made to better suit the actual market.

However, the fierce market competition keeps the market environment in a state of constant change. Enterprises cannot obtain effective market information at the first time, thus, they can only adjust and develop new products according to the market reflections completed in the current period after they are launched. At the same time, based on the inefficiency of data collection and analysis, the company's R&D will enter an endless cycle of development. This is a serious waste of time, human and financial resources, and the product sales and profits do not meet the company's expectations.

With the evolution of the marketing model in the age of data analytics, companies will be the first to grasp market trends and refer to them in new product development projects. The company will also be able to grasp and adopt the effective feedback from the consumer market and consumers in a short time after the new products have been launched, so that the research and development of product design can also keep pace with the market (Cuicui 2019).

3 Online Education Marketing

Since the marketing of educational institutions is mainly through traditional marketing methods, offline or online advertising, The impact of this kind of marketing method is that the accuracy of user information is not high and the marketing cost is high, which makes it more difficult for education companies to acquire customers. At the same time, although this marketing method of casting a wide net can indeed obtain some accurate users, the efficiency of customer acquisition is very low.

Therefore, the education industry has two main issues in traditional marketing, difficulty in customer acquisition and low efficiency. To compare with the traditional marketing model, online education has many advantages (Dongping 2020).

3.1 Cross-Territoriality

One of the advantages of online promotion is that it can be marketed across geographies. The demand of parents and students in the K12 education market is to achieve better results in the Academic Test for the Junior High School Students and the National University Entrance Examination in China. In China, there two examinations are regional, with candidates from the same province or city competing against each other. Therefore, K12 online education products using national teacher resources for marketing will not achieve the expected results. Instead, products with the pass rate of students in specific provinces and cities are more attractive to local parents

and students. Similar products are promoted on a geographical basis, which will be more precise and effective.

Skills education does not have strict geographical requirements, such as adult piano-related courses. Customers do not care about the background of teachers or the advantages of awards, as long as the quality of the courses is good and the price is right, they will be willing to buy related courses. Therefore, the correlation between products and regions is weak. Moreover, the market demand for adult skills education is not as large as that for K12. From the perspective of market segments, this type of education market faces problems such as narrowing of the user base and insufficient conversion, which in turn leads to revenue pressure for companies. Therefore, this kind of education company is more suitable for national promotion, as far as possible to broaden the promotion channels and user sources.

3.2 The Impact of Channels and Traffic on Marketing

The most important part of current marketing is the choice of channels, as channels determine the quality and quantity of traffic.

The core of promotion channel development is to identify the target users of the product and to infer the appropriate channels according to user habits. In order to assist enterprises to verify and optimize the data obtained from different channels in the subsequent promotion process, from the formulation of new product promotion strategies.

Educational products require relatively long-term and high-frequency usage practices to give feedback, so user retention is critical to the education industry. Based on the popularity of the Internet, WeChat public, small programs, and APPs have become the best choices for channel options. At the same time, strong products also need to maintain higher stickiness and retention with customers through APPs. While selecting channels, more in-depth operational solutions are also required, such as corresponding push messages to supplement the problem of untimely information updates in applications (Peng 2022).

However, in the Adult Skills Education category, the target group of clients is people from moderate family backgrounds who are ly curious and curious. Such intellectual users may be more easily accessed on Zhihu, so they can increase the channels for Zhihu, and at the same time, they can promote products through Q&A and comments on the Zhihu platform.

In addition, according to the number of promotional resources, product promotion also needs the support of search engine SEO/SEM. However, the extent of promotion depends on resource requirements. At present, the technology of SEO and SEM still needs many attempts, feedback, and optimization. At present, platforms with relatively high natural traffic in China include Headline, Weibo, Jane's Book, etc. Enterprises can try to promote through these platforms according to the characteristics of their own products.

3.3 Other Promotion Methods

From the perspective of channels, promotion methods are mainly divided into paid and free. From the content point of view, it can be divided into soft copy and hard copy. It is important to note that all promotions require marketing-based content. Therefore, the creation and output of content are the first in the market channel.

The soft copy is more important to reflect the tone and strength of the brand. In traditional marketing theory, it is usually understood as increasing the popularity and reputation of a product. On the other hand, hard copy is mainly used for sales, and the conversion of sales needs to be considered.

In addition, the content of the promotion needs to be closely related to the carrier. If the product is not just in demand, soft advertising can enhance the consumer or customer's demand for the product to a certain extent. For example, Instagram has a lot of recommended products to buy. Most of these recommended products are not rigid. If it is promoted through hard advertising, the overall publicity effect will be very poor, because hard advertising mainly describes the advantages of the product. This makes it difficult to communicate a must-buy message to consumers. On the other hand, adverts can be used to increase consumer motivation through vehicles such as Vloggers and Instagram recommendations to increase sales of non-essential products.

For products with urgent needs, such as K12 education, the content of publicity and promotion only needs to emphasize that the product is "better" to achieve the desired effect. Therefore, for such products, should we pay more attention to the more professional official number in publicity channels, such as CPC advertisements, infomercials, banner advertisements, news advertisements, etc.(Zhou Ying and Jiaqian 2022).

4 Research on Optimising Online Education Marketing Strategies Through Data Analysis

The benefits of marketing data can improve the accuracy of personalized marketing and enhance every aspect of business operations (Yanrong and Kongyu 2021). However, if the data source is not real, or the data is not complete enough, it will affect the correctness of the decision. As misleading information recommends the same product to the user, it also irritates the user, resulting in a poor user experience.

Therefore, in practice, one cannot blindly rely on the information provided by the data. Companies need to process and filter the information they collect, including data sources, to maximize its value in marketing decisions.

4.1 Data Sources

The first step in data-based marketing is the data source. One of the common marketing methods for online education platforms is KOL marketing, including article placement, mass texting, and live streaming. One of the most mainstream methods is article placement, which is to complete an article containing a soft article on a social platform and then pushes it to fans who follow the social platform. Mass texting means that KOLs on WeChat public number push small texts to their followers along with a link to download the app. This approach created the H5 game industry, which is now emulated by many online education apps.

As high-quality KOLs in the education field are invited to be promoted by different online education apps in turn, the effect of article or text promotion will gradually weaken. In addition, the live broadcast implantation method is not very popular at present, but its development trend is still very clear. Therefore, in the future, live background data will also become one of the main data sources for online educational institutions. In addition to KOL marketing, other data sources for online education include bidding, information flow, cross-industry cooperation, etc.

4.2 Data Processing

After confirming the source of data, the data needs to be processed and filtered, and the useful data needs to be selected and applied to the formulation of the marketing strategy of the enterprise. Previously, three scholars such as Xue Ruijie conducted a study on the children's programming market based on questionnaire data analysis. The following will use the study as a case study to summarise the process and path of data analysis to optimise the marketing model.

Sales Volume. Enterprises need to analyze and investigate the reasons for the decline in sales and turnover through different dimensions, one of the most important dimensions is the purchasing behavior of consumers.

Since consumers' buying behavior is grouped through different segments, it needs to be segmented. Then, companies need to analyze different market segments separately to find out the factors that affect the purchasing behavior of consumers in each segment. Increase overall sales by optimizing each segment.

The consumption behavior of online education providers can be subdivided according to the composition of turnover, which can be divided into traffic, conversion, unit price, repurchase, and communication.

By comparing and analyzing the data of various market segments, it can be determined that the problem that affects the decline in turnover is the problem of customer unit price or repurchase. In addition, the user behavior path can also be used as a benchmark for disassembling consumer behavior. User behavior can be divided into pre-consultation, in-consultation, purchase, and departure perspectives.

Taking the children's programming market as an example, scholars found based on data that word of mouth and credibility are the most important aspects for parents when choosing training institutions, that is, prior consultation (Ruijie et al. 2020). Therefore, online education providers selling programming courses for children need to recalibrate their branding strategies before consulting in order to optimize customer outreach and brand reputation. The content of consumer services needs to be optimized in a targeted manner to increase overall sales.

After the unbundling analysis, if the factors that affect sales exist in the consultation stage, educational institutions can start to optimize the consultation process, including cross-selling using data and marketing. Children's programming education institutions can regularly conduct statistics and analyses of sales data to help sales staff fully understand the needs and habits of customers in the sales process. This will help salespeople effectively recommend a series of related products or package combinations to customers, maximizing the company's interests while meeting consumer needs. For example, when parents inquire about Python courses, data analysis can be used to recommend other programming courses that customers who have successfully purchased Python courses tend to buy to parents. Sales staff can sell bundles to customers based on existing referrals to increase sales of other courses. In the era of big data, businesses can trade this cross-selling online for greater gains (Zhihua 2017).

In short, each aspect of the consumer's purchasing behaviour can be translated into each piece of data to be considered in a comprehensive manner, so that the essence of the problem can be better identified and targeted solutions proposed.

Customer Relationship Management. After the customer completes the purchase behavior, this is only half the process in the marketing link. The subsequent focus is on the management of after-sales customer relationships. At this time, data analysis will help to establish and maintain good customer relationships and optimize the characteristics of follow-up marketing.

In the era of big data analysis, enterprises can predict the consumption scope of future consumers based on consumer behavior and daily consumption habits, such as purchase history and information on the commodities consumed. It also makes it extremely convenient for businesses to plan their marketing campaigns in advance, enabling them to offer unique high-quality services and tailor-made products that are best suited to consumers (Hexian 2020).

Children's programming agencies can create customer profiles based on each customer's basic information and their consumption behavior, in order to provide customers with personalized marketing plans and improve the consumption experience.

Personalized marketing doesn't work for all industries or brands, as personalization means higher costs for businesses. However, as technology evolves and the consumer landscape changes, there will be more and more ways to personalize marketing. "Mass Personalization" will become easier and cheaper. Overall this helps to improve the user experience and reduce inventory costs and waste. The company will plan productivity according to market demand, and factories can also produce

personalized products on demand. This marketing approach of mass personalizing business models based on actual data and needs generated by consumers will also transform from product-centric to truly user-centric.

5 Conclusion

This paper combines data analysis with marketing, studies the path of optimizing marketing strategy through data analysis, and takes online education as an example to provide some feasible ideas. At the same time, as this paper is mainly based on research literature and lacks the support of real data, it cannot show more intuitively the help of data analysis in optimising marketing strategies, and will further improve this research by combining theory and practice through empirical analysis and other research methods.

References

Chenyuan M (2022) Research on the impact of big data analysis on enterprise marketin. Enterp Reform Manage 02:117–119. https://doi.org/10.13768/j.cnki.cn11-3793/f.2022.0082

Chong P, Hua C, Ting G (2019) Refinement marketing of telecom enterprises based on data analysis. Inf Comput (theory Edition) 11:155–156

Cuicui C (2019) Research on the influence of the era of big data analysis on marketing. Chinese Commerce 06:22–23. https://doi.org/10.19699/j.cnki.issn2096-0298.2019.06.022

Dongping H (2020) Marketing strategy analysis of online education industry under "Internet +." Modern Bus 20:20–21. https://doi.org/10.14097/j.cnki.5392/2020.20.007

Hexian L (2020) The impact of the era of big data analysis on marketing. Mark Manage Rev 02:62–63. https://doi.org/10.19932/j.cnki.22-1256/f.2020.02.035

Peng L (2022) The innovation path of online education enterprise business model in the digital economy era——Based on the grounded research of "Gaotu Group." Mod Mark (Manage Edition) 02:46–49. https://doi.org/10.19921/j.cnki.1009-2994.2022-02-0046-016

Ruijie X, Jie X, Caiyun L (2020) The market situation of children's programming based on data analysis——taking Jingzhou as an example. Comput Knowl Technol 05:21–23. https://doi.org/10.14004/j.cnki.ckt.2020.0504

Yanrong W, Kongyu Y (2021) Mobile marketing effect influence mechanism and optimization strategy——based on douyin platform data analysis. Office Autom 02:16–19

Ying Z, Jiaqian O (2022) Exploration of marketing strategy of online education and training institutions under the background of digital economy——taking "Spark Education" as an example. Jiangsu Business Theory (02), 131–134+141. https://doi.org/10.13395/j.cnki.issn.1009-0061.2022.02.034

Zhihua Z (2017) Optimization of marketing model in the era of big data. Mod Indus Econ Inf 24:49–50, 54. https://doi.org/10.16525/j.cnki.14-1362/n.2017.24.19

A Study on the Impact of Food Prices on Tobacco and Alcohol Consumption: A Case Study of CHNS Data in China

Linghao Lou

Abstract According to the recommendations of the World Health Organization (WHO), many countries use price as a policy tool to discourage the consumption of alcohol and tobacco products. Since food prices may have crowding-out and substitution effects on tobacco and alcohol consumption, the impact of food price changes on tobacco and alcohol consumption is unpredictable. The purpose of this paper is to use China Health and Nutrition Survey (CHNS) data to accurately estimate the key factors in tobacco and alcohol product consumption decisions and consumption levels. In addition to the prices of eight major categories of food, this paper identifies several social demographic and economic factors associated with the overuse of these products in the country The OLS regression results in this paper show that the impact of different food prices on residents' tobacco and alcohol consumption is inconsistent. Among them, the food price has the greatest influence on beer consumption and the least influence on liquor consumption. This may be because alcohol has the strongest social attributes and beer the weakest. In addition, the effects of the same food on tobacco and alcohol are also inconsistent. This paper concludes that this may be related to the geographical distribution of people's research preferences.

Keywords Food prices · Public health · Smoking · Tobacco consumption · Alcohol consumption · CHNS

1 Introduction

Cardiovascular disease and cancer are two major diseases leading to premature death. According to medical studies, smoking and alcohol consumption significantly increases the risk of people suffering from these two diseases. Therefore, research on tobacco and alcohol consumption is of great significance for improving people's health. The proportion of tobacco and alcohol consumption in China is at a high

L. Lou (✉)
The High School Affiliated to Renmin University of China, Beijing, China
e-mail: rdfzloulinghao@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_139

level compared with other major economies. Taking tobacco as an example, there are more than 1.1 billion smokers worldwide, which is about one in seven of the world's population. According to a report by China's National Bureau of Statistics, there are more than 300 million smokers in China, accounting for 1/3 of the world's smokers and about 1/5 of China's population, higher than the global average. Smoking kills more than one million people in China each year. China also has the highest number of alcohol-related deaths in the world, with more than 709,000 deaths a year. More worryingly, among Chinese adolescents, 28 to 43% of males and 1 to 11% of females smoke, and the average age of smokers in China is declining rapidly (Unger et al. 2002). Smoking prevention targeted at adolescents is considered an important effort to reduce the burden of tobacco-related morbidity and mortality in China in the future.

This paper uses the China Health and Nutrition Survey (CHNS) to estimate the impact of local food prices on tobacco and alcohol consumption. The author introduces some background information in the first part. Then the second part explains the data and variables used in this paper and the model. The third part reports the results of the empirical analysis. The fourth part makes an in-depth analysis of the empirical results and gives the conclusion. The findings could inform policy deliberations to curb the use of alcohol and tobacco products.

2 Background Information

Tobacco and alcohol consumption in China is closely related to China's rapid economic development in the past 40 years. Since the reform and opening up, the problem of food and clothing for the Chinese people has been solved, and the proportion of tobacco and alcohol consumption in residents' living consumption expenditure has gradually increased. We can see how this trend is changing in the data. As shown in Fig. 1, in 1978, China's per capita disposable income was 343 yuan. Urban residents spent 152 yuan on food, of which only 8.2 yuan was spent on tobacco, wine, and tea. After the reform and opening up, food consumption gradually changed to "non-staple food" with relatively complete nutrition. In 2021, China's per capita disposable income was 35,128 yuan, and the per capita consumption of food, tobacco, and alcohol was 7178 yuan, of which tobacco and alcohol consumption accounted for about one-third or about 2400 yuan. It can be seen that with the rapid development of China's economy and the improvement of residents' income, the proportion of food consumption in residents' consumption expenditure is gradually decreasing, which is consistent with the Engel's theory. The increase in the proportion of tobacco and alcohol consumption shows that the focus of residents' consumption is gradually shifting from solving the problem of food and clothing to the pursuit of entertainment.

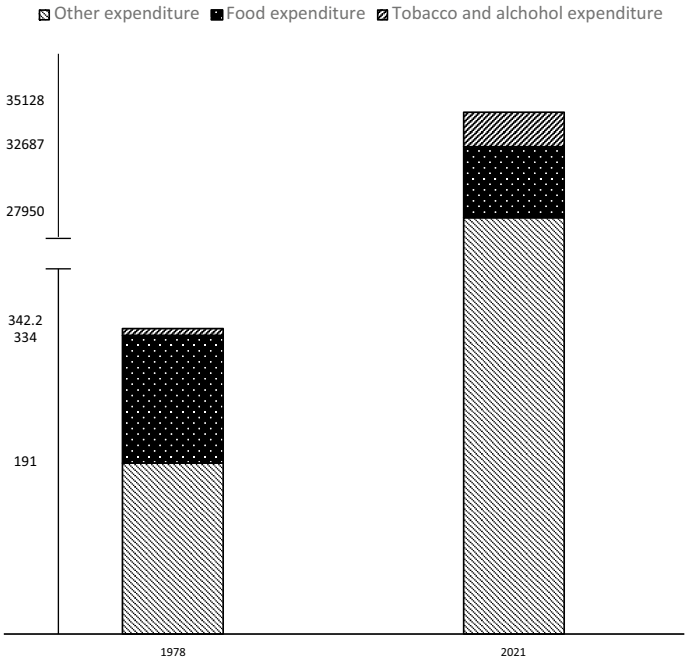


Fig. 1 Residents' living expenditure in 1978 and 2021

As the total amount of household wealth is limited, a decrease in the proportion of food consumption in household expenditure will lead to an increase in the proportion of other consumption, including tobacco and alcohol consumption, which is referred to as the crowding-out effect in economics. A substantial amount of research has studied the relationship or correlation between food consumption and tobacco and alcohol consumption in different countries and regions. For example, Husain et al. studied the crowding-out effect of tobacco expenditure on household spending patterns by using the data from Bangladesh. Their results showed that households with at least one smoker spent 4.48% more on food, 0.56% less on clothing, and 2.63% less on housing than households without smokers (Husain et al. 2018). Moreover, studies have shown that the crowding-out effects of tobacco and alcohol may be different. In Taiwan, for example, household spending squeezed out by tobacco consumption is different from that squeezed out by alcohol consumption (Pu et al. 2008). However, tobacco and alcohol consumption crowds out similar expenditures in India (Jumrani and Birthal 2017).

The methods applied to estimate the crowding-out effects of tobacco and alcohol consumption are constantly improving. Most of the original studies only compared the household expenditures on food and other basic items. However, they fail to consider the potential differences in household structure and socioeconomic status

between smoking families and non-smoking families (Efroymson et al. 2001). Subsequent studies have developed the literature by incorporating family characteristics (Busch et al. 2004) (Fig. 1).

3 Methods

3.1 Data and Variables

China Health and Nutrition Survey (CHNS) is used for data collection in this paper, and the datasets are mainly from four different years, 2004, 2006, 2009, and 2011, respectively. CHNS is supported by the Carolina Population Center at the University of North Carolina at Chapel Hill, the National Institute of Nutrition and Nutrition Food Safety, and the Chinese Center for Disease Control and Prevention. The areas under investigation include nine provinces, namely Liaoning, Heilongjiang, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi and Guizhou.

According to the hypothesis of microeconomics, ordinary consumers, as market participants, can only passively accept commodity prices, and the market behavior of a single consumer does not affect commodity prices. In other words, the consumer is merely the price-taker of the market, and the local food price is exogenous to the consumer. Therefore, using food prices as an explanatory variable can avoid the above problems.

CHNS's community survey included eight categories of food prices in local free markets and supermarkets, specifically. In this paper, the food price is defined as its price in the local free market, just as the previous study of (Wang et al. 2006). Finally, as shown in Table 1, the author calculated the mean and standard deviation of the prices of 8 food categories. Compared with the previous study (Wang et al. 2006), the food prices used in this paper are not special. Another point to mention is that the CHNS community data only provides prices for these 35 common foods and does not cover all food categories, so this can lead to some errors.

CHNS contains a lot of missing data on food prices and household food consumption. The percentage of households with food consumption data missing was 5.4%, so the households with this data were simply deleted. The absence of food price data will invalidate all samples in this area. So, for those communities where food prices were missing, the missing data was replaced with those of the nearest neighborhood.

In this paper, 35 foods for daily consumption are divided into 8 categories, Grains are Food, Cooking Oil and Sugar, Vegetables and Fruits, Meat and Poultry, Fresh Milk, and Preserved Milk Products, Fish, and Bean Curd. The price of each food group is determined by the average price of that food group. For example, meat includes pork, beef, chicken, and lamb, so the average price of meat is the average price of these four kinds of meat. Finally, descriptive statistics of variables used in the empirical analysis are shown in Table 1.

Table 1 Descriptive statistics

Variables	Obs	Mean	S.E	Min	Max
Food price					
Food grains	126,408	1.85	0.51	0.84	3.44
Cooking oil and sugar	126,408	4.68	0.96	2.76	9.10
Vegetables and fruits	126,408	1.18	0.27	0.42	2.18
Meat and poultry	126,408	9.57	2.58	3.85	17.33
Fresh milk	126,408	1.68	0.74	0.10	5.60
Preserved milk Products fish	126,408	15.27	4.78	7.16	32.25
Bean curd	126,408	1.95	0.69	0.09	5.05
Consumption of tabacco and alchohol (logrithm)					
Tabacco	126,408	0.01	0.15	0.00	3.43
Beer	125,184	0.14	0.44	0.00	4.61
Wine	125,908	0.04	0.31	0.00	4.61
Individual characteristics					
Male	126,408	0.51	0.50	0	1
Han Nationality	126,408	0.86	0.34	0	1
Age	126,394	38.14	21.11	0	91
Urban	126,404	0.67	0.47	0	1
High school	126,408	0.30	0.46	0	1

3.2 The Model Construction

In order to figure out how household expenditure on tobacco impact that on other goods and services under the control of other household characteristics, the standard methods such as ordinary least squares (OLS) can be used. Based on the above analysis, this paper established a logarithmic econometric model with tobacco, beer, and wine consumption as the explained variable, 8 types of food expenditure as the explained variable, and personal characteristics as the control variable as follows:

$$\ln(Y) = \beta_0 + \beta_1 FP + \beta_2 X' + \varepsilon \tag{1}$$

where, Y respectively represents the consumption of cigarettes, beer, and liquor, FP represents the price of food in 8 categories, and X' represents a series of control variables, including whether they are male, age, Han nationality, whether they live in urban areas, and whether they have a high school education or above.

4 Result and Discussion

This part discusses the results obtained from logarithmic econometric models of various food prices. Table 2 shows marginal trends in food price categories associated with tobacco and alcohol consumption. Due to the large sample size, a coefficient is classified to be statistically significant only when the significance level is below 5%.

As seen from the column (1) of Table 2, tobacco consumption is significantly correlated with food prices in 6 out of 8 categories. There is a significant negative correlation between the prices of Food Grains, Meat and Poultry, and Preserved Milk Products and tobacco consumption, that is, when the prices of these three kinds of food increase, tobacco consumption will decrease significantly. The prices of Cooking Oil and Sugar, Fresh Milk, and Fish are positively correlated with the consumption of tobacco. When the prices of these three foods rise, the consumption of tobacco will also increase significantly.

As seen from the column (2) of Table 2, beer consumption is significantly correlated with the prices of 7 of the 8 food categories. Among them, the prices of Cooking Oil, Sugar, Fresh Milk, and Fish are significantly negatively correlated with beer consumption, that is, when the prices of these three kinds of food rise, beer consumption will significantly decrease. And the prices of Food Grains, Meat and

Table 2 Result: food price on the consumption of tobacco and alcohol

	(1) ln (Tabacco)	(2) ln (Beer)	(3) ln (Wine)
Food price	− 0.9485*** (0.183)	3.2437*** (0.58)	− 0.7267* (0.4)
Food grains	0.3818*** (0.063)	− 2.8903*** (0.21)	− 1.5969*** (0.15)
Vegetables and fruits	0.1019 (0.207)	− 0.4394 (0.72)	− 0.8429 (0.53)
Meat and poultry	− 0.0838*** (0.037)	1.0897*** (0.11)	0.5725*** (0.09)
Fresh milk	0.3093*** (0.077)	− 0.7445*** (0.21)	0.1801 (0.13)
Preserved milk products	− 0.0558*** (0.007)	0.2598*** (0.03)	0.0381*** (0.02)
Fish	0.4484*** (0.053)	− 1.6085*** (0.1)	− 0.0121*** (0.08)
Bean curd	− 0.0902 (0.081)	1.8055*** (0.24)	1.2867*** (0.21)
Individual characteristics			
Male	− 0.0175*** (0.001)	− 0.2226*** (0)	− 0.0537*** (0)
Han nationality	− 0.0124*** (0.002)	0.0167*** (0)	0.0128*** (0)
Age	0.0004*** (0)	0.0017*** (0)	0.0011*** (0)
Urban	0.0055*** (0.001)	− 0.0349*** (0)	− 0.0394*** (0)
High school	− 0.0061*** (0.001)	0.0428*** (0)	0.0196*** (0)
Obs	126,383	125,159	125,883
Adjusted R-squared	0.0138	0.084	0.0215

Poultry, Preserved Milk Products, and Bean Curd are positively correlated with beer consumption. When the prices of these four kinds of food increase, beer consumption will increase significantly.

As seen from the column (3) of Table 2, wine consumption is significantly correlated with food prices in 4 out of 8 categories. There is a significant negative correlation between the price of Cooking Oil and Sugar and the consumption of wine, that is, when the price of such food rises, the consumption of wine will decrease significantly. While the price of Meat and Poultry, Preserved Milk Products, and Bean Curd is positively correlated with wine consumption, when the price of these three kinds of food rises, wine consumption will increase significantly. In addition, the price of Food Grains is negatively correlated with the consumption of wine, but only at the significance level of 10%.

The consumption of Tobacco, Beer, and Wine is significantly influenced by the individual characteristics of consumers. First, men consume more alcohol and tobacco than women. Han Chinese, who make up 90% of the population, consume more alcohol and fewer cigarettes than other ethnic groups. There is a positive correlation between age and tobacco and alcohol consumption, and the consumption of tobacco and alcohol increases significantly with age. There are also significant differences in tobacco and alcohol consumption between urban and rural residents. Urban residents consume more cigarettes than rural residents, but rural residents consume more alcohol. Finally, the more educated the residents, the fewer cigarettes they consume, but the more alcohol they consume.

5 Conclusion

This study used the microdata from the Household Health and Nutrition Survey (CHNS) to determine the role of food prices and personal economic characteristics in spending on tobacco and alcohol products. In this paper, regional food price was used as the explanatory variable. As personal consumption was not enough to cause regional food price variation, this method had good Exo-CAVALIers.

The author has observed that the price changes of different kinds of food have not a unique impact on tobacco and alcohol consumption. The rise of some food prices has a crowding-out effect on tobacco and alcohol consumption, while the consumption of tobacco and alcohol has a substitution effect on the rise of other food prices. For tobacco consumption, Food Grains, Meat and Poultry, and Preserved Milk Products have a crowding-out effect on tobacco consumption, which may due to the low consumption elasticity of these three commodities, and the rise in food prices will lead to the increase in total food expenditure. On the other hand, the prices of Cooking Oil and Sugar, Fresh Milk, and Fish are positively correlated with tobacco consumption. The increase in the price of Cooking Oil and Sugar may cause people to cook less at home and eat out instead, and the increase in tobacco consumption may be driven by this pathway. Fresh Milk and Fish may be related to regions, with prices higher in inland China than in coastal and grassland areas, and tobacco consumption may have

similar geographical distribution characteristics, thus leading to a positive correlation between them. The impact of food prices on alcohol consumption is different from that of tobacco consumption. Among them, food prices have the greatest impact on beer consumption. The price of 7 out of 8 food categories will affect residents' beer consumption. The prices of Cooking Oil and Sugar, Fresh Milk, and Fish are significantly negatively correlated with beer consumption, which is opposite to the impact on tobacco consumption. This possibly indicates that people in coastal areas prefer to consume beer. The price of Food Grains, Meat and Poultry, Preserved Milk Products, Bean Curd and beer consumption are positively correlated, indicating that these kinds of Food may have a crowding-out effect on beer consumption.

The consumption of Wine is slightly different from the above two commodities. Baijiu is a product with strong social attributes in China. For example, the famous Maotai liquor is one of them, and baijiu is often given to each other or collected as gifts. Therefore, food prices have the least impact on liquor consumption, and only the price of four types of food have a significant impact on liquor consumption. In addition, the regression results of this paper show that individual socioeconomic attributes have a significant impact on tobacco and alcohol consumption, which is consistent with people's daily life experience.

The limitation of this article is that the data used in this article does not cover all food categories, nor does it include the information about people eating out. Considering the externality of the model, this paper uses the food price rather than food expenditure as the explanatory variable, so the conclusion of this paper cannot directly infer the crowding-out effect. However, the conclusion of this paper is still of great significance to some extent. For example, the government can carefully adjust the food consumption price of residents according to the research conclusion of this paper, so as to avoid the drastic increase of tobacco and alcohol consumption of residents caused by the change of food price, which will increase the medical burden or have a negative impact on residents' health.

References

Busch S, Jofre-Bonet M, Falba TA, Sindelar JL (2004) Tobacco spending and its crowd-out of other goods

Efroymson D, Ahmed S, Townsend J, Alam SM, Dey AR, Saha R, Dhar B, Sujon AI, Ahmed KU, Rahman O (2001) Hungry for tobacco: an analysis of the economic impact of tobacco consumption on the poor in Bangladesh. Tob Control 10(3):212–217

Husain MJ, Datta BK, Virk-Baker MK, Parascandola M, Khondker BH (2018) The crowding-out effect of tobacco expenditure on household spending patterns in Bangladesh. PloS one 13(10):e0205120

Jumrani J, Birthal PS (2017) Does consumption of tobacco and alcohol affect household food security? Evidence from rural India. Food Secur 9(2):255–279

Pu CY, Lan V, Chou YJ, Lan CF (2008) The crowding-out effects of tobacco and alcohol where expenditure shares are low: analyzing expenditure data for Taiwan. Soc Sci Med 66(9):1979–1989

Unger JB, Yan L, Shakib S, Rohrbach LA, Chen X, Qian G, Chou CP, Jianguo S, Azen S, Zheng H, Johnson CA (2002) Peer influences and access to cigarettes as correlates of adolescent smoking: a cross-cultural comparison of Wuhan, China, and California. Prev Med 34(4):476–484

Wang H, Sindelar JL, Busch SH (2006) The impact of tobacco expenditure on household consumption patterns in rural China. Soc Sci Med 62(6):1414–1426

Analysis of Challenges and Opportunities in Today's Global Talent Management Development

Haoxuan Wang

Abstract With the development of the global economy, more and more multinational companies appear, creating a complex and substantial global talent market for the global market. Although the increased scope and diversity of the talent market have boosted the company's growth potential, due to geographic and cultural differences and today's ambiguity in talent management, there are still many dilemmas in the talent management aspect of companies that need to be resolved. This paper mainly analyzes global talent management's opportunities and challenges in these environmental changes. Through this exploration, it can be concluded that most of the changes are both opportunities and challenges for talent management. For example, personnel mobility brings more choices to recruiting but is a threat to talent retention. The benefits of expatriate business for talent development also improve employee satisfaction to a certain extent and reduce employee satisfaction promotion space.

Keywords Globalization · Talent management · Recruitment · Multinational corporations · Talent development · Talent retention

1 Introduction

With the globalization of the world economy, more and more enterprises and organizations have expanded the scale of foreign business and increased overseas investment (Schuler et al. 2011). With the frequent occurrence of this phenomenon, the importance of global talent management is gradually being valued by managers. Because as the organization develops into more diverse regions, diverse human resources are also the key points managers need to consider. At the same time, with the changes in global influence, there have also been changes in talent management, such as recruitment processes, that cannot be ignored. This essay mainly analyzes international organizations' situation in human resource management today. Through

H. Wang (✉)
Management School, Lancaster University, Bailrigg, Lancaster LA1 4YX, UK
e-mail: Lucy88136@126.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_140

the definition and changes of globalization and talent management and this paper explores in detail the current status of the labour market by analyzing four parts: The importance of global talent management, talent recruitment, talent development and talent retention. This study also attempts to explore the opportunities and challenges facing global talent management. This research provides insights into the future talent management of multinational enterprises.

2 Introduction to the Concept of Talent Management

In human resources, talent management is a relatively new concept, so there is not enough time to scrutinise and unify its definition. There are currently three mainstream talent management concepts. The first is to treat talent management as a typical human resource management activity (Kim and McLean 2012). This research generally focuses on specific human resource practices such as recruitment, development, and succession planning (Kim and McLean 2012). The second point of view emphasises the importance of the talent pool. By building a talent pool to retain and develop the company's internal talent, this view makes talent management and human resource management have distinct differences but focuses on succession planning. The third point of view has a different understanding of talent identification. Supporters believe that employees should be evaluated based on their performance. A-level employees are recognised as talents, and businesses strive to retain more A-level employees while eliminating C- and D-level employees (Kim and McLean 2012).

On the other hand, this view is limited because it is neither practical nor desirable to fill all positions within a company with the best performers. In addition to the above three points of view, David G. Collings and Kamel Mellahi put forward a fourth point. This new perspective focuses on the importance of critical positions, thereby selecting people with high potential or ability to fill strategic positions of particular value and thereby creating more advantages for the organisation's development (Collings and Mellahi 2009). Identifying and appointing these key positions becomes part of talent management activities. By generalising these four perspectives on talent management, it is not difficult to see that the definition of talent management is diverse today. This diversity also means the ambiguity of the definition to another extent. That is to say, there is no exact, detailed and unified definition of talent management today, and most organisations have some differences in their understanding of talent management. In addition to the late emergence of related concepts of talent management, the different experiences of talent in different cultural backgrounds are also one of the reasons for its vague definition. In some exceptional cases, organisations in other regions have conflicting perceptions of talent (Lewis and Heckman 2006). This diversity of understanding of talent management brings many opportunities for organisations, especially multinational companies, but its ambiguity also inevitably brings specific challenges. This paper only focuses on the importance of global talent management, recruitment, talent development and talent retention.

3 The Importance of Global Talent Management

With the development of the global economy, a more dynamic and complex business environment has been created (Tarique 2010). This change has made most organizational environments complex and unstable, leading to today's highly competitive situation among companies. Driven by multinational corporations, labour markets worldwide are becoming more extensive and more diverse, and the mobility of people is rapidly increasing (Tarique 2010). Therefore, to cope with this change and give companies as much advantage as possible in today's environment, global talent management has become an essential part of most human resource management.

Moreover, in a globalized environment, the details of the high level of competition among companies underscore the importance of talent management. First, the expansion of labour markets around the world today allows more and more potential talent to emerge (Schuler et al. 2011). Companies need to understand and compare the talent market in different regions and cultural backgrounds and reduce costs while maintaining high quality. For example, the difference in wages between countries, although wages in China and India have increased, employees in developed countries still receive higher wages than those in other developing countries (Schuler et al. 2011). This is one of the reasons why many multinational companies decide to set up factories in developing countries because it can significantly reduce costs. Secondly, after the demand for more talents, quality has also become essential in enhancing the company's competitiveness. High global competition forces more companies to improve quality, efficiency and strive to innovate (Schuler et al. 2011). High-quality and high-potential talents have a more significant advantage in efficiency and innovation. Therefore, improving and developing employees' capabilities are also critical factors for most multinational companies after acquiring talents. These factors form the basis of today's global talent management.

4 Talent Recruitment

Before discussing talent recruitment, development and retention in detail, an important concept needs to be emphasized: these three components are interdependent and not independent of each other. For example, a company's decisions regarding talent development can significantly impact recruitment and retention, both positively and negatively.

Regarding talent recruitment, how to attract talent is a problem that most multinational companies need to face because companies have higher and higher requirements for their quality (Oswald 2008). Managers will find that even in the enormous global labour market, it is difficult to find the right employees with the right abilities and salaries, this is the current status quo where there is a surplus of labour and a shortage of talent at the same time. Therefore, companies need to improve their attractiveness and uniqueness in recruitment. For example, as a retailer in the UK,

Tesco has classified different potential groups on the recruitment page and established different recruitment channels according to these categories (Schuler et al. 2011). On Tesco's web page, they have classified some groups. For Apprenticeships and Graduate, cohorts are mainly divided into Apprenticeships, Graduates and Internships these three categories (Fig. 1). In these different categories, there are various targeted items (Fig. 2). This approach undoubtedly simplifies the recruitment process for the company's human resource management, allowing managers to make decisions more quickly and accurately. For job seekers, this categorization can make them feel unique about their value, while also making the hiring process fairer.

In addition to changes in the recruiting process to improve the attractiveness, different regional cultures and perspectives on multinational companies can also be opportunities for talent acquisition. Research shows that in some developing countries, such as China, many people are more interested in multinational companies than local companies (Newburry et al. 2014). This research proves that people's attitudes and perceptions of multinational companies are different in different environments. In regions more interested in multinational companies, the talent market is undoubtedly more prosperous and active. This situation brings good advantages and opportunities for the company's talent recruitment. In contrast, in other regions that are not enthusiastic about multinational companies, such as the United States, some multinational companies with subsidiaries or factories in the United States are more prone to labour lawsuits than local companies (Newburry et al. 2014). How to maintain the talent advantage in such an environment is a challenge that the company needs to face.

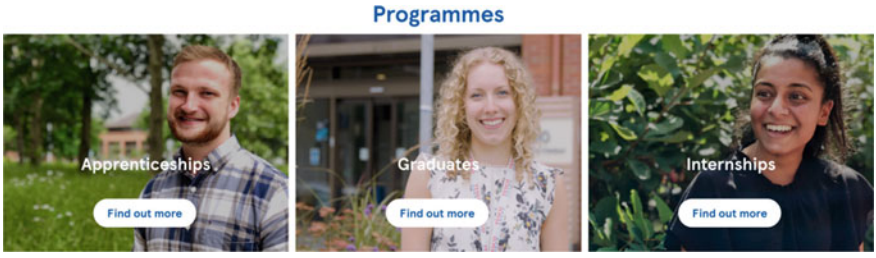


Fig. 1 Three different recruitment channels

Apprenticeships	Graduates	Internships	Tesco Ireland	Find out more
Business Management	Business	Business Diversity	Stores Graduate Programme	FAQs
Finance	Finance	Finance	Business Graduate Programme	Terms and conditions
	Retail	Technology Product	Finance Internship Programme	Privacy policy and cookies
	Technology Cyber Security	Technology Programme	Business Diversity Internship Programme	Accessibility
	Technology Product	Technology Software Engineering		Sitemap
	Technology Programme			Tesco Careers
	Technology Software Engineering			

Fig. 2 Different projects in different recruitment channels

On the other hand, there will be some marginalized groups in the cultural background of different regions, which is also an advantage for multinational companies because it means more diverse talent choices compared to local companies (Newburry et al. 2014). Groups such as women, the elderly or ethnic minorities are not valued in some regions, and some regions even marginalize these groups (Newburry et al. 2014). So, if multinational companies pay attention to these groups in these human resource markets and create fair job opportunities, it will significantly increase potential high-potential employees (Newburry et al. 2014). Because this choice will make multinational companies more attractive and, at the same time, obtain a more extensive range of talent choices, which brings more opportunities and positive development for these multinational companies. However, along with opportunities come challenges, as taking HR choices that differ from the local area can impact the company's competitiveness. Because choosing a different human resource base also means changing the way of its talent development to improve the potential of talents with higher quality, this kind of instability will become one of the fundamental challenges faced by multinational companies.

5 Talent Development

Talent development is arguably a crucial part of talent management as there is an increasing emphasis on new technologies and innovation capabilities due to the diversification of today's global market. Therefore, knowledge transfer and efficient learning ability have become the characteristics that managers value (McDonnell et al. 2010). When a company recruits high-potential talents, how to realize these potentials and improve the ability to the level required by the company is the central role of talent development (Schuler et al. 2011). At the same time, decisions related to talent development can also directly affect the company's talent retention. That is to say, some decisions positively impact talent development, but at the same time, they will pose risks to talent retention. First, some multinational companies will unconsciously have ethnocentrism when dealing with talent management issues (Kim and McLean 2012). That is, they think that other groups are inferior to their groups (Kim and McLean 2012). This belief means that some HR managers are unaware that their decisions and methods do not apply to other countries and cultures and believe that the methods they recognize are more effective. One of the examples of the concept of "talent" illustrates this problem. Boussebaa and Morgan (2008) found that British and French companies have different understandings of "talent". "Talent" is perceived by British companies as people with potential, while French companies perceive talent as people who have demonstrated their abilities (Kim and McLean 2012). This cognitive bias is a challenge for MNCs in two countries because this difference can lead to the failure of talent development in a completely different cultural environment. After all, managers do not accurately distinguish between different talents in the environment and make the wrong talent development decisions.

However, in an increasingly complex global market environment, the evaluation criteria for high-potential and capable employees are also changing, which means that these high-potential talents can quickly lose their edge (Sonnenberg et al. 2014). Because this environment often changes faster than people realize, providing employees with avenues for learning and development is necessary to ensure talent advantage (Sonnenberg et al. 2014). For example, Microsoft provides Chinese employees with a plan to study and develop in the United States (Schuler et al. 2011). The primary purpose of this plan is to allow employees to gain more experience in different environments, facilitate knowledge transfer, and make employees' thinking more "globalized", adding more opportunities and advantages for the development of multinational companies.

6 Talent Retention

Today's global mobility can be said to be a concern for talent retention (Schuler et al. 2011). After all, after the company spends much money to cultivate high-quality talents, some talents do not show their love for the company, which means that these employees may be quit because the company could not live up to their expectations (Bonneton et al. 2022). This is a severe loss for the company, so personnel retention can be more difficult but essential. First of all, career development is a factor that most employees pay attention to Bonneton et al. (2022), and it is also an essential factor that can directly affect personnel retention. When some employees are rewarded accordingly after being defined as a talent, they are unsure whether they will still be defined as a talent at another company. Then the willingness to leave is relatively low (Bonneton et al. 2022). Nevertheless, this relationship somehow creates the opposite result. When talent is paid more, the willingness to leave is also higher. Because higher pay means less room for talent to improve and develop within the company, this status quo will stimulate these employees to seek other opportunities more conducive to self-realization (Bonneton et al. 2022). This phenomenon is common among today's generation Y employees, who pay more attention to their career development opportunities and job mobility than previous generations (Festing and Schäfer 2014), so it is more difficult for them to improve their satisfaction with the company. The company's commitment also has higher requirements, which is also a problem faced by multinational companies.

Therefore, most companies will motivate employees and improve their satisfaction through compensation and development opportunities. This method is more common among multinational companies because most multinational companies require expatriate employees to perform tasks like international business travel and permanent transfer, to meet business needs (Collings 2014). Some multinational corporations will choose self-initiated expatriates among the candidates for these expatriates rather than the traditionally designated expatriates because self-initiated expatriates have more ex-pat motives, including personal development, career development, and an interest in other cultures (Farndale et al. 2014). The company's

choice not only fulfils the business but also meets the personal needs of these talents and achieves a mutually beneficial relationship. This method improves employee satisfaction and deepens the commitment between the company and its employees, thereby reducing employee turnover. However, the risk posed by expatriation is also point managers cannot ignore. That is, providing employees with more opportunities for self-improvement also means providing them with more choices. This choice can be divided into two categories. The first category is that when employees see more opportunities for development in other companies or want to try a different environment during ex-pat assignments, they are more likely to leave. Another category is when expatriates are already familiar with the environment in their area, and they may refuse when there is a strategic position that suits them in the headquarters. These are also risks that managers need to take while assigning assignments.

7 Conclusion

This paper mainly analyzes the opportunities and challenges encountered by multinational companies in talent management through the four aspects of the importance of global talent management, talent recruitment, talent development and talent retention. When human resource managers set up management methods and projects for talent management, opportunities and risks always coexist. The focus on talent in the recruiting process can significantly increase the number of talent in a company, but due to vague concepts, some wrong choices can turn this advantage into a risk. In terms of talent development, the development projects provided by the company can enable employees to acquire the capabilities and experience that the company needs. Still, more choices and other development opportunities will affect the company's talent retention. Therefore, balancing opportunities and risks is a problem most managers must consider. However, in the analysis process, there are few case studies for specific companies, which limits the accuracy of the conclusions.

References

Bonneton D et al. (2022) Do global talent management programs help to retain talent? A career-related framework. Int J Hum Resour Manag 33(2):203–238. Taylor & Francis Group. https://doi.org/10.1080/09585192.2019.1683048

Collings DG (2014) Integrating global mobility and global talent management: exploring the challenges and strategic opportunities. J World Bus 49(2):253–261. https://doi.org/10.1016/j.jwb.2013.11.009.ScienceDirect

Collings DG, Mellahi K (2009) Strategic talent management: a review and research agenda. Hum Resour Manag Rev 19(4):304–313. https://doi.org/10.1016/j.hrmr.2009.04.001

Farndale E et al. (2014) Balancing individual and organizational goals in global talent management: a mutual-benefits perspective. J World Bus 49(2):204–214. ScienceDirect. https://doi.org/10.1016/j.jwb.2013.11.004

Festing M, Schäfer L (2014) Generational challenges to talent management: a framework for talent retention based on the psychological-contract perspective. J World Bus JWB 49(2):262–271. https://doi.org/10.1016/j.jwb.2013.11.010

Kim S, McLean GN (2012) Global talent management: necessity, challenges, and the roles of HRD. Adv Dev Hum Resour 14(4):566–585. SAGE Publications. https://doi.org/10.1177/1523422312455610

Lewis E, Heckman J (2006) Talent management: a critical review. Hum Resour Manag Rev 16(2):139–154. https://doi.org/10.1016/j.jwb.2009.09.019

McDonnell A et al. (2010) Developing tomorrow's leaders—evidence of global talent management in multinational enterprises. J World Bus JWB 45(2):150–160. ScienceDirect. https://doi.org/10.1016/j.jwb.2009.09.015

Newburry W, Gardberg N, Sanchez J (2014) Employer attractiveness in Latin America: the association among foreignness, internationalization and talent recruitment. J Int Manag 20(3):327–344. https://doi.org/10.1016/j.intman.2014.01.001

Oswald FL (2008) Global personality norms: multicultural, multinational, and managerial. Int J Test 8(4):400–408. Taylor & Francis Group, LLC. https://doi.org/10.1080/15305050802435201

Schuler RS et al. (2011) Global talent management and global talent challenges: strategic opportunities for IHRM. J World Bus 46(4):506–516. ScienceDirect.https://doi.org/10.1016/j.jwb.2010.10.011

Sonnenberg M, van Zijderveld V, Brinks M (2014) The role of talent-perception incongruence in effective talent management. J World Bus JWB 49(2):272–280. https://doi.org/10.1016/j.jwb.2013.11.011

Tarique I (2010) Global talent management: literature review, integrative framework, and suggestions for further research. J World Bus JWB 45(2):122–133. ScienceDirect. https://doi.org/10.1016/j.jwb.2009.09.019

Analysis on the Difficulty of Controlling Repugnant Markets

Fulin Jiang

Abstract There are quite a few people consider it morally unacceptable to put enslaved people or human organs such as kidneys and wombs on the open market. These are all examples of repugnant transactions that a third party wants to prevent regarding the concept of moral economy. Most governments have taken some actions to deal with this repulsion. This paper illustrates the normative nature of a repugnant market and its possible implications from the perspectives of governments and the public by listing different examples in the real world. The factors affecting citizens' acceptance of the repugnant market can be concluded as governments' attitudes, cultural environment, and individual income. Moreover, there are some trade-offs between the unintended consequences resulting from the law and the reduction of the market size.

Keywords Repugnancy · Repugnant market · Government interventions · Public attitudes

1 Introduction

Although the concept of a repugnant market has not been popularised, discussions about these abhorrent transactions often occur in our lives. To make the public better understand the repugnant market and its related government policies, there is a need to define it first. Leider and Roth (2010) provide a helpful definition: "we use repugnant in its economic sense—in a repugnant transaction, the participants are willing to transact, but third parties disapprove and wish to prevent the transaction (rather than in its psychological sense of eliciting disgust among potential participants). Hence repugnant transactions are often illegal" (Julio and Elias 2017). Some people will not make these transactions even though they can obtain commercial gains, while others might still choose to do it since they do not take morality so seriously. Governments

F. Jiang (✉)
London School of Economics and Politics, London, UK
e-mail: jiangfulin0321@gmail.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_141

usually put huge taxes or even wholly ban these trades to better regulate this market. This could be effective as it can reduce negative externalities, thus increasing society's total utility. However, it could also result in unintended consequences that are even worse for the community. It is hard for the government to make decisions as the attitudes towards these repugnant markets could change over time due to an ever-changing tide of technology and ideas.

Consequently, it is crucial to investigate the possible reasons affecting the acceptance of these markets. This paper analyses the difficulty in achieving an unified identification of different repugnant markets and the reason why the government cannot control these markets perfectly. This paper can help people better understand the nature of some repugnant markets and why the public attitudes to these transactions are changing over time. It also reminds us to think if legislation is needed to prevent repugnant transactions.

2 Government Interventions on Repugnant Markets and Its Consequences

Repugnance usually relates to the concepts of negative externalities and concerns about harmful behaviours (Roth 2007). In the repugnant market, the insiders are willing to make a transaction when considering the trade-offs of their benefits, while most outside consumers disagree with them because of immorality (Leider 2010). Furthermore, people may refuse to participate in these repulsive transactions as these transactions incorporate considerations combining negative externalities and repugnance in social relations, known as the idea of taboo trade-off aversion (Tetlock 2000). Consequently, governments usually impose some policies to put a constraint on a repugnant market. This policy can discourage trades in these markets, increasing social welfare. However, it may, at the same time, cause some unintended consequences, as these regulations need enough social support. Most governments believe that these actions are repulsive enough to be tightly controlled or could lead to largely hidden markets (Alvin and Roth 2020). Two examples are listed below for further explanation.

2.1 Tobacco Industry

The tobacco market might not be a typical example of a repugnant market. However, cigarette transactions can also be considered immoral because of the obvious negative externalities and the emphasis of scholars and the media on the dangers of smoking. After the publication of two governmental reports from the UK and US revealing the relationship between tobacco and health condition, tobacco is more heavily taxed than other goods in many countries (Nagy and Petit 2016).

The reduction in the profits of tobacco firms encouraged them to make some innovations, hence, electronic cigarettes were introduced and first patented in 2003. E-cigarettes remove one of the main harmful ingredients from traditional cigarettes and the nicotine dosage is controlled to reduce the risk of nicotine overdose (Darcy and Allen 2021). The advent of e-cigarettes could be seen as a result of the positive effect of government intervention, since it generates more socially beneficial ways of consuming tobacco. The smokers can feel less guilty for vaping as the most harmful ingredients from the cigarettes have been removed. It is also an excellent way to help smokers quit smoking gradually. Furthermore, producers can also gain some commercial benefits from lower taxes because the regulations on these innovative products are imperfect. However, most tobacco producers have put massive efforts into producing electronic cigarettes, which most smokers accept and welcome.

However, new legislation was imposed when more recent information about vaping came out. Recently, some regions such as the US, Hong Kong, and mainland China have imposed stricter limitations on flavoured e-cigarettes because e-cigarettes remain addictive and the health consequences they cause remain controversial. Flavouring has targeted youngsters, and some reports exhibit an increasing number of teenagers vaping flavoured e-cigarettes because of their better taste compared to regular cigarettes. Even though vaping is less harmful, it can cause lung diseases and deaths. In February 2020, the Centres for Disease Control and Prevention (CDC) confirmed 2807 e-cigarette or vaping use-associated lung injury (EVALI) cases and 68 deaths attributed to that condition (Plaha). Therefore, governments' constraints on the repugnant market can stimulate innovation as firms need to find other ways to gain some profits. However, the consideration of the abhorrence will appear when more information is released about this new product.

2.2 Lock-Down Policy in Shanghai

Another recent example of government intervention in the repugnant market could be the transportation of materials during the Shanghai lockdown. Most people feel it abhorrent to deliver stuff if they were infected with COVID-19. However, some might insist on doing it because of substantial commercial benefits, despite the fact that this might accelerate the the spread of the virus. To better regulate the repugnant market, the Chinese government imposed the legislation that delivery workers must apply for health certificates, and the supply units must have a certification of authorisation. This law intends to control the spread of the virus more effectively to reduce the negative externalities and contain the outbreak of COVID-19.

However, getting the certification is complicated and time-consuming, resulting in a sharp decrease in the number of necessities that can be delivered. It led to a new repugnant market. Some certificated delivery workers or suppliers charge much higher prices as the demand highly exceeds supply, enabling them to gain substantial benefits. Moreover, plenty of intermediary businesses are springing up to profit from the price differences. All these contributed to a rapid increase in prices in Shanghai.

Taking the price of potatoes as an example, some agents bought potatoes at only 6 yuan per kilogram and sold them at 34 yuan per kilogram to generate a 466.7% mark up. In addition, in many communities, neighbourhood committees organised group purchasing of food materials to reduce the delivery cost per person. They usually make transactions with intermediaries rather than suppliers because is not easy to contact suppliers directly, especially during the lockdown. The asymmetric information speeds up the growth of a new repugnant market. Consequently, the government intervention in one offensive market might result in the creation of another one and impose higher burdens on the poor.

3 Transformation of Public Attitudes to Repugnant Markets

As Roth said, repugnance is hard to predict as it involves enormous normative adjustments (Roth 2007). Similar activities and transactions could be judged differently by people with different backgrounds at various times. There are usually debates over some transactions, and some government policies are controversial. One of the critical determinants should be the consensus environment of the current society. Here are some examples of the transformation in different directions.

3.1 Slavery

The slave trade was accepted to be legal until the period from the mid-eighteenth- to mid-nineteenth-century, some thought-provoking studies of the moral language of humanitarianism were raised by Margaret Abruzzo, leading to hot discussions upon whether slavery should be legalised (Moniz 2012). Eventually, after a long time of debates, the Abolition of the Slave Trade Act entered the statute books.

Interestingly, both anti-slavery and pro-slavery mentioned the concepts of humanitarianism and moral economy, but they involved different understandings. The conceptual framework of "Moral Economy" was come up with by Adam Smith, which became a rhetorical commonplace in both groups (Swaminathan 2007). McKenna also argues that Smith believes that an appropriate language is an excellent tool for expressing ideas and convincing the public by invoking their sympathy.

Abolitionists of slavery emphasised the immoral self-interest of the enslavers, promoting the sense of "civilised notation" through different media. People of all races need adequate human rights and freedom of choice. However, most planters chose to maximise their benefits by buying some enslaved people as cheaper labour to reduce costs and achieve higher profits. The increased the supply of people from Africa and made the trade more popular. Most enslaved people were used for land work and gold mining, involving much physical labour. They could not choose how

many hours they work and what they were responsible for. It is a definite violation of human rights and fairness. The poem (1778) called Hannah More's Slavery had a significant influence on the abolition of slavery, conveying the oppression Africans suffered in slavery (Swaminathan 2007).

On the other hand, the concept of the "Moral Economy" was also mentioned in the arguments for the slave trade. They considered Africans as "fallen", which is originated from the stories of Cain and the sons of Noah in the Bible. They believed the trades of enslaved people were the consequences of the free market and the planters gave some Africans struggling with life and death another way to make a living, which could be considered humanistic. Most enslaved people could live a more comfortable life, and there was no conflict between profits and mortality, and slavery could be a win–win position.

Even though slavery was eventually abolished, the arguments for pro-slavery can still invoke some thoughts of the true definition of repugnance. As a result, it is difficult to analyse and think accurately and rationally about whether the repugnant market should be regulated or not, especially when it comes to people's interests.

3.2 Life Insurance

According to Zelizer, the first life insurance organisations were established in the United States during the eighteenth century, and a dismal failure lasted for the first 50 years. At the time, people viewed life insurance as a criminal device competing with God to care for widows and orphans. As a result, people who buy life insurance would lose faith in God's goodness. However, after the 1840s, this story of struggles and failures became that of spectacular success. Hence many historians dated the birth of life insurance in the United States in 1840. The sudden boom in the life insurance market can be owed as much to a change in the mindset and the company's aggressive advertising. Much of the early opposition to life insurance believed that these insurance firms were, in fact, gambling with their lives. They feel that the speculative nature of a life insurance policy is tantamount to betting people's lives on a company that is considered hateful. The link between life insurance and gambling stifled the popularity of life insurance until the middle of the century when the concepts of economic risk-taking and rational speculation were distinguished from pure gambling (Khoury and Zelizer 1980). Consequently, people regarded life insurance as a security of life and were willing to make transactions.

4 Factors Affecting the Acceptance of the Repugnant Market

As shown above, people usually hold disparate views about some repugnant markets, and people's attitude towards some things has also altered dramatically with the development of the times. This section will provide evidence of frequent acceptance changes in the primary three repugnant markets and potential reasons of people changing their minds.

These three markets are three sorts of transactions, and all of them are connected with human bodies, which are hence mentioned the most as typical examples of repugnant markets in many relevant studies. Thanks to the increasing concern over these markets, there has been a revolution in the way society views these markets, yet they remain highly controversial.

After his article drew massive interest in those repugnant markets, Roth posted another in 2020, investigating the connection between repugnance and law or the law to forbid certain transactions. Roth factors out why one-of-a-kind jurisdictions have one-of-a-kind legal guidelines helping or banning unique markets. Those legal guidelines replicate the sentiment of the neighbourhood populations concerning the acceptability of the transactions in question.

All analysis of the repugnant market is based on normative judgment, which is complicated to justify and hard to predict. However, some factors influencing people's attitudes towards these repugnant markets can still be identified. Here the survey conducted by Roth is referred to (as seen in Fig. 1).

	Surrogacy	Prostitution	GKE
Current law	0.19 (0.023)	0.17 (0.026)	0.11 (0.020)
Under 35	0.034 (0.023)	−0.026 (0.026)	0.0067 (0.020)
Income level	0.0070 (0.0034)	0.0032 (0.0037)	0.0074 (0.0029)
College degree	−0.0016 (0.020)	−0.027 (0.023)	0.0097 (0.017)
Unemployed and looking	0.0025 (0.037)	−0.042 (0.041)	0.015 (0.030)
Single	−0.045 (0.028)	−0.0056 (0.031)	−0.014 (0.024)
Children (dummy)	0.016 (0.026)	0.0095 (0.028)	0.0027 (0.022)
Atheist	0.027 (0.025)	0.076 (0.029)	0.014 (0.021)
Religion intensity	−0.097 (0.030)	−0.15 (0.030)	−0.081 (0.027)
Social conservative	−0.042 (0.024)	0.031 (0.026)	−0.016 (0.020)
Immigration from high-income countries	0.00061 (0.00045)	0.0010 (0.0005)	−0.00019 (0.00038)
Immigration from low-income countries	−0.00060 (0.00045)	0.00058 (0.0005)	−0.00034 (0.00038)
N	2,225	2,225	2,225

All coefficients are stated as marginal effects. Current law = 1 if legal. There are 12 income levels. Religious intensity = 1 if religious attendance is at least once a week.

Fig. 1 Probit regression of support for legality on current law in country, age (under 35 dummy), and other demographic and opinion variables

4.1 Attitudes of Governments

From Fig. 1, many statistically significant coefficients can be found. They are highly likely to affect the probability of respondents accepting the transactions involving the three markets in the same direction. For example, the current law positively affects acceptance, indicating that government actions can influence citizens' perception of these markets, which is one of the most critical factors. Figure 2 illustrates the acceptance of these three markets in different nations and legislation related. It can be seen that over time, most people in all four countries have adopted these markets, especially the demand for surrogacy and the global kidney exchange, both of which exceed 60% of support. This is understandable because although there are pockets of repugnance in these markets, there are not many negative externalities and may even save lives and promote life expectancy. Like homosexuality, most people believe we should respect everyone's decisions as long as he or she does not severely impact the outside world.

In respect of differences among countries, there are some differences in the acceptance among these countries. There are some mutual effects between whether the transactions are legal and the acceptability of this market. If many citizens support this transaction, the enforced prohibition will create a large black market, making this legislation ineffective. Conversely, suppose that governments imposed restrictions on these transactions, citizens may regard them as repugnant more quickly as the government's responds can also act as a piece of new information which gives people a new way to think.

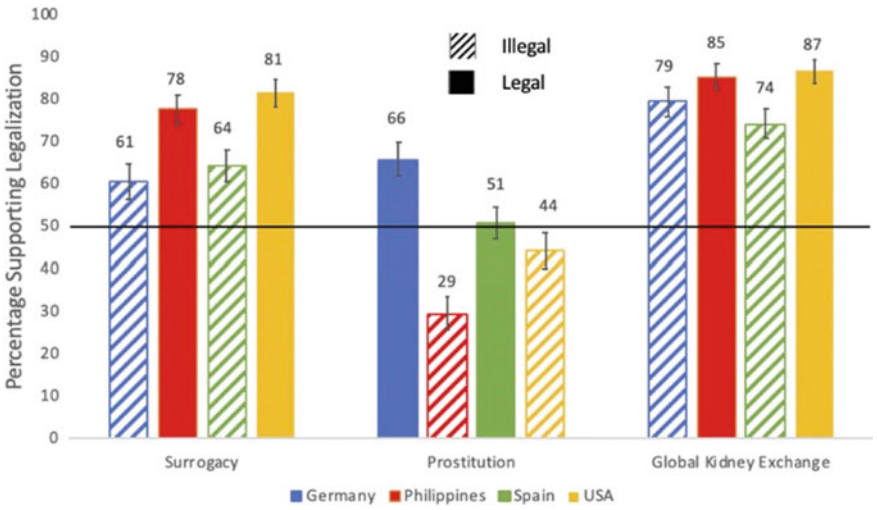


Fig. 2 Percentage of respondents who support legalization by scenario and country

4.2 Income Level

In addition, higher-income people have a higher probability of accepting these transactions. A possible explanation could be that they are more open-minded and absorb more information and thoughts, which makes them understand different groups of people better. Respondents who are atheists are more likely to support legality as they can involve more reasonable adjustments and find out potential benefits inside the transactions, rather than being disturbed by the feeling of disgust.

4.3 Some Other Factors

Some other factors that might negatively affect people's acceptance of the repugnant market include their religious intensity and whether they are single. One possible explanation could be that these groups of people are absorbed in a mono-cultural environment for a long time, which is hard to change their minds. There are also some factors which affect different repugnant markets in opposite directions, such as age groups, college-level, and unemployment. These factors illustrate the different views held by various respondents, which requires a more detailed analysis based on the particular market.

To summarise, according to the survey, some possible factors affecting people's acceptance of the repugnant market can be found. However, it is essential to note that the questionnaire only surveyed 2225 people, making the results biased. People who respond to this survey might not be the representative group of the population. Furthermore, the survey was conducted in Germany, Philippines, Spain, and the United States, which could be responded differently across countries. Hence, the results only provide insights into the possible reasons affecting the acceptance and still need further investigation.

5 Conclusion

Nowadays, an increasing number of people adopt the concept of moral economy and refuse some repulsive transactions possibly combined with negative externalities. The governments also take some actions to increase the awareness of repugnancy and discourage related transactions. However, enacting the policy requires more careful consideration as there might be unintended consequences, such as the black market and the emergence of new repugnant markets. Moreover, the procedures must be frequently reviewed and updated due to the changing definition and perception of repugnance. Over time, most markets have experienced massive transformations along with government legislation. Therefore, it is hard to predict the trends as it

usually involves normative judgments. Factors affecting the attitudes towards some repugnant markets could be the government laws, education, income level, etc.

However, many interesting points are still not mentioned in the paper. Firstly, we cannot ignore the difference in adoption and legislation among different nations, which could constrain transactions in the repugnant markets. For example, flavour vaping is banned in some countries while it is legal in others, reducing the need that the producers can target. Furthermore, the black market is sometimes encouraged to grow precisely because the different countries have different policies, such as the market for surrogacy. Therefore, considering the mutual effects among countries, we must investigate these factors deeply. Moreover, how firms inside the repugnant market respond to consumers' disgust and government constraints could also make a huge difference. Roth mentioned the close relationship between repugnant markets and technological barriers. Firms can always encourage innovation to make these transactions less detestable, such as transplanting pig kidneys into human patients. It usually depends on how quickly new technologies come out and their application to commercial transactions.

References

Alvin E, Roth AS (2020) Widespread repugnance contrasts with legal bans on controversial markets. Department of Economics, Stanford University, Palo Alto, CA 94305; and Department of Economics, University of Pittsburgh, Pittsburgh, PA 15260

Darcy WE, Allen CB (2021) Repugnant innovation (29 Sep 2021). Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3932730

Julio J, Elias NL (2017) Understanding repugnance: implications for public policy. World Med Health Policy

Khoury RM, Zelizer VA (1980) Reviewed work: morals and markets: the development of life insurance in the United States. University of North Carolina Press, pp 576–577

Leider SA (2010) Kidneys for sale: who disapproves, and why? Am J Transplant 10(5):1221–1227

Moniz AB (2012) Reviewed work(s): polemical pain: slavery, cruelty, and the rise of humanitarianism by Margaret Abruzzo. J Early Repub. https://www.jstor.org/stable/23315182

Nagy J, Petit P (2016) How to design and enforce tobacco excises? Retrieved from International Monetary Fund (Oct 2016)

Plaha MJ (n.d.) 5 Vaping facts you need to know. Retrieved from John Hopkins Medicine: https://www.hopkinsmedicine.org/health/wellness-and-prevention/5-truths-you-need-to-know-about-vaping

Roth AE (2007) Repugnance as a constraint on markets. J Econ Perspect 21(3):37–58

Swaminathan S (2007) Adam Smith's moral economy and the debate to abolish the slave trade, pp 481–507

Tetlock PE (2000) The psychology of the unthinkable: taboo trade-offs, forbidden base rates, and heretical counterfactuals. J Pers Soc Psychol 78(5):853–870

Factors Influencing Changes in Estimated Food Insecurity Rate of Developing Countries Before and After COVID-19

Yunfei Xu

Abstract As the COVID-19 pandemic has become a troublesome global issue these past few years, the worsening of global food security has been a vital challenge to be solved. This study investigates if there is a positive or negative relationship between a country's GDP per capita before COVID-19 and the change in estimated food insecurity rate before and after COVID-19, and between a country's confirmed COVID-19 rate and the change in estimated food insecurity rate. In the study, the author acquired three open data sources online, created box and whisker plots and scatterplots to visualize the distributions of variables and linear relationships between the independent variables and the dependent variable, and used significance tests to evaluate the significance of the linear models. The result shows no significant negative linear relationship between a country's GDP per capita and the change in estimated food insecurity rate and no significant positive linear relationship between a country's confirmed COVID-19 rate and the change in estimated food insecurity rate.

Keywords COVID-19 · Food insecurity · GDP per capita · Confirmed COVID-19 rate · Developing countries

1 Introduction

Global food security has been greatly impacted by COVID-19 in these three years, as high unemployment rates (Wolcott et al. 2020) disabled civilians from purchasing enough food, international trading restrictions limited food imports (Kerr 2020), and quarantine policies slowed down the food supply chain (Yu et al. 2020). Therefore, it is crucial to understand the relationship between these social-economic factors during COVID-19 and a country's vulnerability to food security during the pandemic. "The State of Food Security and Nutrition in the World 2021" demonstrated the malnutrition statistics in 2020 and concluded that Asia, Africa, and Latin America and

Y. Xu (✉)
Davidson College, Davidson, NC 28035, USA
e-mail: yuxu@davidson.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_142

the Caribbean had a sharper increase in undernutrition than the world from 2019 to 2020 (FAO, IFAD, UNICEF, WFP and WHO 2021). This illustrates that regions with lower economic status tend to experience more severe deterioration in food security due to COVID-19. Amare et al., by comparing the survey data about household food security before and after COVID-19 in Nigeria, concluded that households exposed to higher COVID-19 case rates or mobility lockdowns experience a significant increase in measures of food insecurity (Amare et al. 2021). This study suggests a possible positive relationship between case rates and household food insecurity measures.

However, there has not been any study that analyzes how the impact of COVID-19 on food insecurity is related to other social-economic factors on a national scale. Since most publicly shared economic data like GDP and total COVID cases are measured on a national scale, it is more convenient to build linear models and draw conclusions about the effect of these factors on food insecurity that can be applied to the whole world or a large part of the world. The goal of this study is to investigate if there is a positive or negative relationship between a developing country's GDP per capita before COVID-19 and the change in estimated food insecurity rate before and after COVID-19, and if there is a positive or negative relationship between a developing country's confirmed COVID-19 rate and the change in estimated food insecurity rate. The author obtained online data on the estimated share of the population that is food insecure, GDP per capita, and COVID cases; used box-and-whisker plots and error term scatterplots to rule out outliers; and built linear models that included significance tests between the independent variables and the dependent variable. Since there have been few studies about food security changes before and after COVID-19, this study is significant in drawing public attention to this troublesome global issue. Its relationship with GDP per capita would further warn people about the greater damage to food security these years in underdeveloped countries, which could suggest the United Nations or developed countries adjust international aid policies accordingly. Its relationship with COVID-19 rates could suggest that the local governments adjust policies about pandemic control, food supply, and quarantine.

2 Model Development

In this study, the basic theory is that a developing country's GDP per capita before COVID-19 negatively affects the change in estimated food insecurity rate, and a developing country's confirmed COVID-19 rate positively affects the change in estimated food insecurity rate. This theory can be more clearly illustrated by the following linear model:

$$\begin{aligned} Change\,in\,Estimated\,Food\,Insecurity\,Rate = \alpha_0 + \alpha_1(GDP\ per\ Capita) \\ + \alpha_2(Confirmed COVID-19 Rate) + \varepsilon \end{aligned} \tag{1}$$

In this linear model, the GDP per capita and the confirmed COVID-19 rate are the independent variables, and the change in estimated food insecurity rate before and after COVID-19 is the dependent variable. The author theorizes that the sign for α_1 is negative because as food production became lower and food trading became highly limited due to COVID-19, it would be even harder for countries with lower GDP per capita to get access to food resources as most of them would be first allocated to better developed countries. The author also theorizes the sign for α_2 to be positive because a higher confirmed COVID-19 rate correlates to greater social instability, drain of social resources to medicine, and stricter mobility policies, which leads to a restricted food supply chain and rising food price. The model is mostly complete as there are no other factors that would be strongly related to the change in the estimated food insecurity rate. Thus, the model might not contain autocorrelation or heteroscedasticity.

3 Discussion of the Data

Table 1 shows the data sources. GDP per capita before COVID-19 and confirmed COVID-19 rate are original data from the World Bank (World Bank) and European Centre for Disease Prevention and Control (European Centre and for Disease Prevention and Control 2021), collected cross-sectionally in 2019 and December 14th, 2020. While the change in estimated food insecurity rate before and after COVID-19 was further calculated by the author using original data from the US department of agriculture (Baquedano et al. 2021). USDA created an International Food Security Assessment report in 2019, but with the arrival of COVID, the projection became highly inaccurate, and thus the department updated the projection twice in August and September 2020, according to the state of COVID. The author calculated the difference between the estimate in September 2020 and the estimate in 2019, which reflects the impact of COVID-19 on a developing country's estimated food insecurity rate. The IFSA report involves 76 countries from Asia, Latin America and the Caribbean, North Africa, and Sub-Saharan Africa. Since this report is the only data source that includes food security measures before and after COVID-19 for individual countries, this study can only focus on the developing countries included in the report, and the conclusion can only be generated for developing countries instead of all countries around the world. All three data sources collected the data from national officials, so these are very credible data sources.

The data are suitable for testing the theory because they include 70 developing country samples, a large enough sample size to represent all developing countries, and each country sample includes all three variables with appropriate scales. Following data collection, the information is summarized using a sample statistics table (Table 2).

The dashed lines are Q1, the median, and Q3 of the corresponding variables, and the solid lines are the means of the corresponding variables.

Table 1 Variable descriptions and sources

Variable	Measure	Sources
Y (change in estimated food insecurity rate before and after COVID-19)	Change from the pre-COVID-19 estimate to the updated estimate of share of the population food insecure by IFSA	U.S. Department of Agriculture (n.d.)
X1 (GDP per capita)	GDP per capita before COVID-19	The World Bank (n.d.)
X2 (confirmed COVID-19 Rate)	Total confirmed COVID-19 cases per 1,000,000 persons	European Centre for Disease Prevention and Control (n.d.)

Table 2 Sample statistics

	Y (change in estimated share of food insecure)	X1 (GDP per capita)	X2 (Confirmed COVID-19 rate)
Minimum	0.00	228.21	5.72
25th percentile	2.40	829.05	501.80
Mean	4.02	2308.14	5689.23
Median	3.55	1693.21	1167.65
75% percentile	5.15	3518.70	6594.05
Maximum	15.00	8282.12	50,268.99
Interquartile range	2.75	2689.65	6092.25
Standard deviation	2.78	1808.62	8951.35
Correlation with Y		0.05	0.00
Correlation with X1			0.62

The dashed lines are Q1, the median, and Q3 of the corresponding variables, and the solid lines are the means of the corresponding variables.

All these tables and figures demonstrate that the degrees of dispersion for the three variables are very high, especially for the confirmed COVID-19 rate variable. The standard deviation of the change in estimated food insecurity rate variable, 2.78, is slightly larger than the interquartile range of it, 2.75, and the standard deviation of the confirmed COVID-19 rate variable, 8951.35, is much larger than the interquartile range of it, 6092.25, but in normal cases, standard deviations should be much smaller than the interquartile range. Only the GDP per capita variable has a standard deviation much smaller than its interquartile range, which is a normal case. Figure 1 shows that all three variables are highly screwed to the right and have many outliers. The potentially regression outliers might be Zimbabwe, Bolivia, and Tajikistan. These countries share the feature that the social-economic structures of the societies are highly vulnerable to great social change. Zimbabwe was suffering greatly from an economic crisis due to pandemic lockdown policies that resulted in tremendous unemployment (Muronzi 2020). The preexisting social inequality in

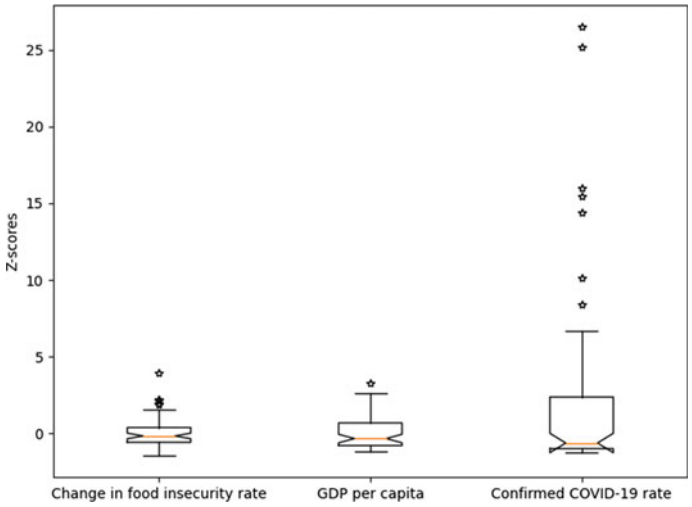


Fig. 1 Box and whisker plot for z-scores of all three variables

Bolivia became even more severe due to the pandemic (Hummel et al. 2021).While in Tajikistan, agriculture takes up a large section of GDP and citizen employment, so the pandemic's damage to agriculture had a huge effect on people's food security (USAID 2021). The potentially influential observations might be Dominican Republic (outliers of GDP per capita), Armenia, Azebaijan, Cape Verde, Colombia, Georgia, Moldova, and Peru (outliers of confirmed COVID-19 rate). These countries also share the feature that most of them are tiny countries. The tiny land area means that the population is very small and, thus, when dividing GDP by population, the ratio can rise very fast, and the tiny land area also means that when dividing number of cases by population the ratio can rise very fast.

4 Analyses

4.1 Bivariate Analysis

The sign of the trend line slope in Fig. 2 is positive, and the correlation coefficient between the change in estimated food insecurity rate and GDP per capita is 0.05, which is very low. Also, the data points deviate from the trend line to a large extent in Fig. 2, so there appears to be a weak positive linear relationship between the change in estimated food insecurity rate and GDP per capita. The sign of the trend line slope in Fig. 3 is negative, and the correlation coefficient between change in estimated food insecurity and population density is 1.9E−3, which is even lower than the previous correlation coefficient, 0.05. Also, the data points in Fig. 3 are mostly clustered in

a vertical line near the vertical axis except for some points with extremely large confirmed COVID-19 rate that pivot the trend line to show a negative slope, so there appears to be a weak negative linear relationship between the change in estimated food insecurity rate and the confirmed COVID-19 rate.

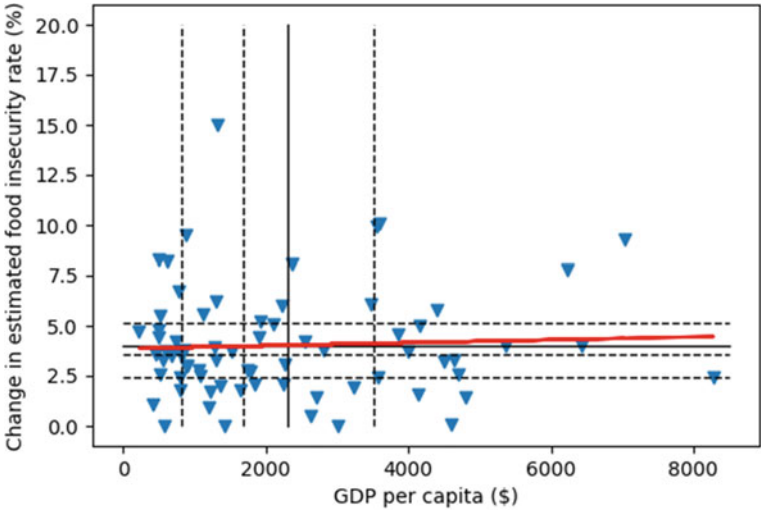


Fig. 2 Bivariate scatterplot of GDP per capita and change in estimated food insecurity rate

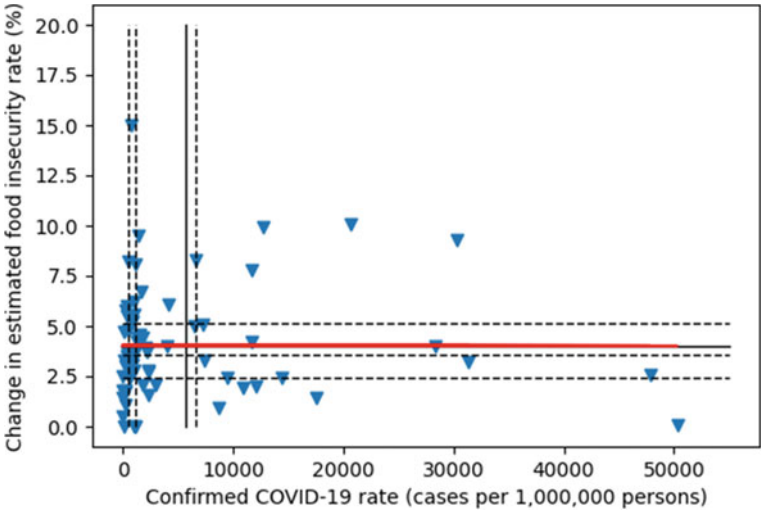


Fig. 3 Bivariate scatterplot of population density and change in estimated food insecurity rate

4.2 Multivariate Analysis

Table 3 demonstrates the regression results of a multivariate equation and two bivariate equations along with their statistical significance.

In Eq. (1), α_0, the y-intercept, is a meaningless extrapolation because the minima of GDP per capita and confirmed COVID-19 rate are 228.21 and 5.72, both greater than 0. The meaning of α_1 is that, holding the confirmed COVID-19 rate constant, when a country's GDP per capita before COVID-19 increases by one dollar, on average the change in the estimated share of the population food insecure before and after COVID-19 increases by 1.21E−3%. This value makes sense because only one extra dollar for everyone should not change a country's vulnerability of food security to the pandemic by much. The meaning of α_2 is that, holding the GDP per capita constant, when the total confirmed COVID-19 cases per 1,000,000 persons increases by 1, the change in the estimated share of the population food insecure before and after COVID-19 decreases by 1.36E−5. This value does not make sense because an extra COVID-19 case can only increase social instability and food insecurity rate instead of decreasing it.

The linear model of Eq. (1) is highly inaccurate because the coefficient of determination is only 3.96E−3 and the significance F is 0.13, much larger than 0.05, which means the coefficient of determination is not significantly larger than 0. In Eq. 1, the first null hypothesis is that $\alpha_1 = 0$, and the alternative hypothesis is that $\alpha_1 < 0$. The p-value is 0.70, larger than the significance level, so the null cannot be rejected and α_1 is not significantly smaller than 0. The second null hypothesis is that $\alpha_2 = 0$ and the alternative hypothesis is that $\alpha_2 > 0$. The p-value is 0.63, also larger than the significance level, so the null cannot be rejected and α_2 is not significantly smaller than 0. Although the signs of α_1 and α_2 are the opposites of the alternative hypotheses, since the p-values are smaller than 0.95, the seemingly opposite results are not significant. The correlation coefficient between the two independent variables is 0.62, which is smaller than 0.7 and does not signal a high degree of multicollinearity between the independent variables. If the multicollinearity were high, then the high multicollinearity would make it easier to accept the null hypotheses for the t-tests than it does for accepting the null hypothesis for the F-tests.

The signs of the estimated slope coefficients in Eqs. (2) and (3) are the same as those in Eq. (1), but the absolute value of α_1 is larger than that of β_1, and the absolute value of α_2 is larger than that of γ_2. However, the adjusted R^2 of the three equations are all negative, and the adjusted R^2 of Eq. (1) is smaller than that of both Eqs. (2) and (3). These changes mean that without holding the confirmed COVID-19 rate constant, the slope of the linear relationship between the change in estimated food insecurity rate and GDP per capita decreases, but the linear model becomes more accurate. Without holding GDP per capita constant, the slope of the linear relationship between the change in estimated food insecurity rate and confirmed COVID-19 rate decreases, but the linear model becomes more accurate.

Table 3 Comparison of regression results

	Eq. (1)	Change in estimated food insecurity rate $= \beta_0 + \beta_1(\text{GDP per capita}) + \varepsilon$ (2)	Change in estimated food insecurity rate $= \gamma_0 + \gamma_2(\text{Confirmed COVID} - 19 \text{ rate}) + \varepsilon$ (3)
Estimate of α_0, β_0, or γ_0	3.87***	3.86***	4.03***
Estimate of α_1 or β_1	1.21E−4	7.30E−5	
Estimate of α_2 or γ_2	− 1.36E−5		− 5.02E−7
Coefficient of determination	3.96E−3	3.44E−3	3.56E−6
Adjusted R^2	− 0.026	− 0.012	− 0.015
Model F-statistic	0.13	0.16	2.42E−4

Notes for the estimates of α_1, β_1, α_2, and γ_2 (t-test results) and for the Model F-statistics:
*One-tail statistically significant at $\alpha = 10\%$
**One-tail statistically significant at $\alpha = 5\%$
*** One-tail statistically significant at $\alpha = 1\%$

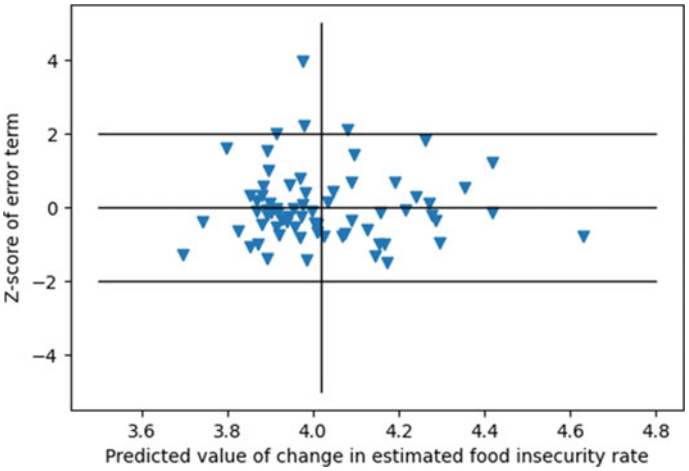


Fig. 4 Z-scores for the regression error terms against predicted values of change in estimated food insecurity rate

4.3 Analysis of Multiple Regression Residuals

Figure 4 shows the distribution of z-scores for error terms against predicted values of change in estimated food insecurity rate for Eq. (1).

The horizontal lines are at ei/se = 2, ei/se = 0, and ei/se = − 2, and the vertical line is at the mean of change in estimated food insecurity rate.

The p-value for the chi-square test that checks the normality of values of ei/se is 0.11, which is larger than the 10% significance level. Therefore, the error terms are normally distributed, which satisfies the conditions of t-tests and F-tests. The error terms are more densely clustered below the z = 0 axis than above the axis, so the assumption of homoscedasticity does not hold, which contradicts the prediction in the "model development" section. However, the assumption of no autocorrelation holds because the data are cross-sectional. There are three potential regression outliers—Zimbabwe, Bolivia, and Tajikistan. After eliminating the regression outliers, the coefficient of determination for Eq. 1 increases from 3.96E−3 to 0.013, α_1 increases from 1.21E−4 to 1.73E−4, and α_2 increases from − 1.36E−5 to − 1.41E−5. These changes are almost negligible. After eliminating the potentially influential observations the author identified in the "discussion of data" section, the coefficient of determination for Eq. 1 increases from 3.96E−3 to 0.017, which is negligible. What is surprising is that α_1 decreases from 1.21E−4 to − 1.26E−6 and α_2 increases from − 1.36E−5 to 9.83E−5. These are really big differences, and the signs also change. This analysis shows that there are too many extreme outliers for the independent variables such that they affect the linear model to a large extent. Therefore, the data of independent variables in this study are not very appropriate for generating linear models.

5 Discussion

Surprisingly, none of the slope coefficients in the three linear models demonstrates a significant correlation that supports the theory. In Eq. (1), α_1 is not significantly smaller than 0, which contradicts the first part of the theory that GDP per capita before COVID-19 negatively affects the change in estimated food insecurity rate before and after COVID-19. α_2 is not significantly larger than zero, which contradicts the second part of the theory that confirmed the COVID-19 rate positively affects the change in estimated food insecurity rate before and after COVID-19. In Eq. (2), β_1 is not significantly smaller than 0, which also contradicts the first part of the theory. In Eq. (3), γ_2 is not significantly larger than 0, which also contradicts the second part of the theory.

There is not a high degree of multicollinearity between the independent variables, the condition of no autocorrelation holds, and the effect of eliminating the regression outliers is very small. However, as the condition of homoscedasticity is not satisfied, the linear model is inaccurate in representing the data. Another issue with the data is that the potentially influential observations have a very large effect on the model. Surprisingly, they changed α_1 from positive to negative and α_2 from negative to positive. Despite the changing signs, neither of the two coefficients is significantly different from zero, so still, there is no significant linear relationship between change in estimated food insecurity rate and GDP per capita as well as between the change in estimated food insecurity rate and the confirmed COVID-19 rate.

6 Conclusion

The study investigated the linear relationship between two social-economic factors during COVID-19 and the estimated food insecurity rate before and after COVID-19. The analysis showed that there is no significant negative relationship between GDP per capita before COVID-19 and the estimated food insecurity rate and no significant positive relationship between the confirmed COVID-19 rate and the estimated food insecurity rate. Since there is no disclosure of real food security data for the year 2020 online yet, the study could only utilize the estimated values from an assessment report, which could be very different from the real effect of COVID-19 on food security these years. Therefore, future work is needed to repeat the process of this project on the real values of food insecurity before and after 2020 when these data become available online a few years later. With full disclosure of these data by lots of different departments and websites, the sample can also be expanded to developed countries in addition to the 76 developing countries covered by the IFSA report, such that the countries' different vulnerabilities to COVID-19 will be more noticeable.

Acknowledgements I'm thankful to Dr. David Martin, who introduced me to statistics and basic econometrics and conducted regression analysis in an econometrics course at Davidson College. I also appreciate Dr. Shlomo Ta'asan and Mr. Zhaomeng Wang, who deepened my understanding of

data science and enabled me to do regression analysis with Python. Finally, I would like to thank Ms. Huan Ni, my mentor in a series of summer camps and social events about sustainable development, as she inspired me to project my views on global issues like environmental protection and food security.

References

Amare M, Abay KA, Tiberti L, Chamberlin J (2021) COVID-19 and food security: panel data evidence from Nigeria. Food Policy 101:102099

Baquedano F, Zereyesus YA, Christensen C, Valdes C (2021) COVID-19 working paper: international food security assessment, 2020–2030: COVID-19 update and impacts of food insecurity (No. 2238-2021-610). https://www.ers.usda.gov/publications/pub-details/?pubid=100275

European Centre for Disease Prevention and Control (2021) Coronavirus disease 2019 (covid-19) [archive]: total confirmed coronavirus disease 2019 (covid-19) cases per 1,000,000 persons, 14 Dec 2020. Data Planet™ statistical datasets: A SAGE Publishing Resource, (10 Jan 2021). https://doi.org/10.6068/DP181A1CBD8662

FAO, IFAD, UNICEF, WFP and WHO (2021) The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. https://doi.org/10.4060/cb4474en

Hummel C, Knaul FM, Touchton M, Guachalla VXV, Nelson-Nuñez J, Boulding C (2021) Poverty, precarious work, and the COVID-19 pandemic: lessons from Bolivia. Lancet Glob Health 9(5):e579–e581

Kerr WA (2020) The COVID-19 pandemic and agriculture: short-and long-run implications for international trade relations. Can J Agric Econ Rev Can D'agroeconomie 68(2):225–229

Muronzi C (2020) Life's so tough': never-ending misery for crisis-hit Zimbabweans. In: Al Jazeera, vol 3. https://www.aljazeera.com/economy/2020/7/3/lifes-so-tough-never-ending-misery-for-crisis-hit-zimbabweans#:~:text=The%20country%20is%20deep%20in,currency%20is%20in%20short%20supply.

USAID (2021) Agriculture and food security. Retrieved 22 Oct 2021, https://www.usaid.gov/tajikistan/agriculture-and-food-security

Wolcott E, Ochse MG, Kudlyak M, Kouchekinia NA (2020) Temporary layoffs and unemployment in the pandemic. In FRBSF economic letter, vol 34

World Bank. GDP per capita (current US$), 23 Nov 2021. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?end=2020&start=1960

Yu X, Liu C, Wang H, Feil JH (2020) The impact of covid-19 on food prices in China: evidence of four major food products from Beijing, Shandong and Hubei provinces. China Agric Econ Rev ahead-of-print(ahead-of-print). https://doi.org/10.1108/CAER-04-2020-0054

The Impact of the Pandemic on International Soccer Clubs Such as FC Barcelona

Yufeng Hao

Abstract COVID-19 has undoubtedly had a huge impact on all walks of life, especially the tertiary industry represented by the service industry. In this industry, the sports industry is undoubtedly the most important part. Therefore, in the epidemic, most sports clubs have been hit hard during the epidemic, especially in Spain. This paper will focus on the impact of one of the largest sports clubs, FC Barcelona, during the epidemic, analyzing the impact of the epidemic on this type of international club by investigating both sporting and economic aspects, showing the sporting results and economic reports of FC Barcelona for the 2019–2020 and 2020–2021 seasons, and using programming software to derive the distribution of changes. Through the analysis of these data, the article concludes that the lack of spectators led to the poor performance of the team at home and also caused the team to lack sufficient ticket revenue. The combination of these two points led to the team's economic problems, so the main players had to be sold at low prices, which in turn made the team's performance deteriorate, and it has also led to a significant reduction in the team's intangible assets.

Keywords FC Barcelona · Covid-19 · La Liga · Soccer · Economy · Data

Y. Hao (✉)
College of Art and Science, Syracuse University, Syracuse, NY 13244, USA
e-mail: yhao03@syr.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_143

1 Introduction

Since February 2022, the COVID-19 epidemic had a huge impact on all walks of life, especially the tertiary industry represented by the service industry. In this industry, the sports industry is undoubtedly the most important part. Nowadays, various clubs and many sports leagues have set up data analysis departments to analyze data on players and teams and make changes in team management strategies and tactical strategies. After the outbreak of the epidemic, the investigation and research of these departments became more important (Fútbol 2022). In terms of team records, Cheng Ruihong, Ge Huanmin, and Cui Yixing from Beijing Sports University conducted data on the performance of football clubs in different leagues before and after the epidemic. Their research shows that after the rematch, the number of home defeats in the Korean Super League has increased significantly compared to the expected home game results, and the expected draws of the Argentine Super League and the Chinese Super League in neutral venues have also increased significantly, but the research on international clubs like Barcelona is not complete (Cheng 2022). The research topic of this article will focus on the competitive and economic impact of the epidemic on professional clubs, and through research to find out the relationship between the two. The article will show the results of FC Barcelona in the past three seasons in the form of a line graph and will also show the team's loss table in the past three seasons in a line graph. Using these two pictures to judge the trend of the team. The article will also be divided into two parts: competitive impact and economic impact. This article will help some analysts or team executives to more accurately understand the impact of the epidemic on the team, and it will also help fans understand the main operating structure of the club. At the same time, other researchers can also use the data collected in this article and the icons made in this article to conduct further research on clubs during the epidemic.

2 Methodology

2.1 Data

All the data about the team's athletics in the article are all from the official website of Sky Sport (Table and Sky sports), and all the data about the economy in the article are from the official website of Barcelona (FC Barcelona 2021a, b). As a membership club, Barcelona is obliged to hire a professional accounting firm to use it every year. English, Spanish, and Catalan produce financial statements for one fiscal year, so both data are authoritative enough. In the financial report, the article will not select all the items included in the profit and loss but only the items that have the greatest impact on the team's income.

2.2 *Influence on Athletics Level*

The best way to show the influence of the athletic level is to show change in the grade. The investigation will include a comparison of results in the same month of the 2017–2018 season, the 2018–2019 season, and the 2019–2029 season in La Liga. The article will use a formula to calculate the team's score, which is:

$$The\ grade\ of\ month = \frac{points}{rank * games} \tag{1}$$

where, points represent the total league points of the month; rank represents the average degree of difficulty of the month; games represent the number of games in this month (Fig. 1; Table 1).

To calculate the degree of difficulty, the article will use the rank of teams in the whole season, which means the team with a higher rank would have a lower degree of difficulty. In this graph, the seasons leading up to the pandemic (2017–2019, and the 2019–2020 season data through March) have almost similar trends. That is, after a good start, in October or November, after a month of performance setbacks, peak performance in the first three months of the year, and finally, maintain average performance in April or May.

At the beginning of the epidemic (July and August 2020), the team's record still maintained a normal level after a three-month break. But after the start of the new

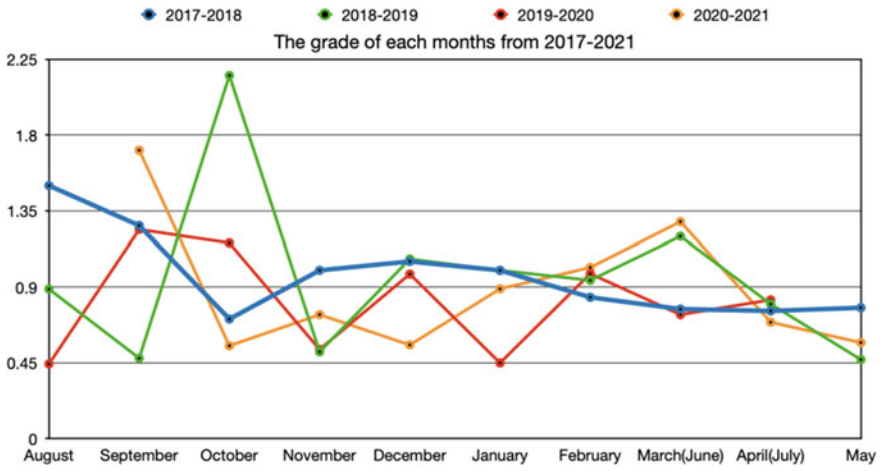


Fig. 1 The grade of each month from 2017 to 2021

Table 1 The graph of degree of difficulty

Rank	1	2	3	4	…	17	18	19	20
Degree of difficulty	0.25	0.5	0.75	1	…	4.25	4.5	4.75	5

season (the 2021 season), apart from winning the first round of the league at the end of September, the team's record fell sharply and did not return to normal levels until the beginning of the new year. These records are also a good reflection of the team's final ranking. In the two seasons before the epidemic, FC Barcelona won the La Liga championship. In the season when the epidemic began, Barcelona lost the championship in the penultimate round due to missed opportunities after the rematch. In the 2020–2021 season, FC Barcelona fell to the lower reaches of the league in November, only to return to the top four in March, and finally finished the season in third place in the league.

FC Barcelona is an attack-oriented team. The team mainly obtains the opportunity to shoot through the way of possession of the ball. In the decade 2011–2021, the average number of goals per season in La Liga is 1025.8, which means every team scores 51.29 goals per season. While the average number of goals for FC Barcelona is 102.7, which is significantly higher than the average number of goals in La Liga. However, in the 2020–2021 season, Barcelona scored 85 goals, while the average number of goals in La Liga in the season was 47.65.

From the data, it can be concluded that the average number of goals in La Liga after the epidemic has not had a huge impact, but the number of goals scored by FC Barcelona was drastically reduced. One of the main reasons for this phenomenon is the lack of fans. During the 2011–2021 period, Barcelona's average home win rate was 86.7%, but after the outbreak of the epidemic, this number dropped to 58.3%. It can be seen that the home game winning rate has decreased sharply. The drop also led to fewer goals scored by the team, which led to a decline in the record (Fig. 2).

In just the past 2021–2022 season, the number of goals scored by FC Barcelona has dropped to a record low in nearly two decades. The main reason for this situation is that Leo Messi, the top star of the team, left the team for economic reasons.

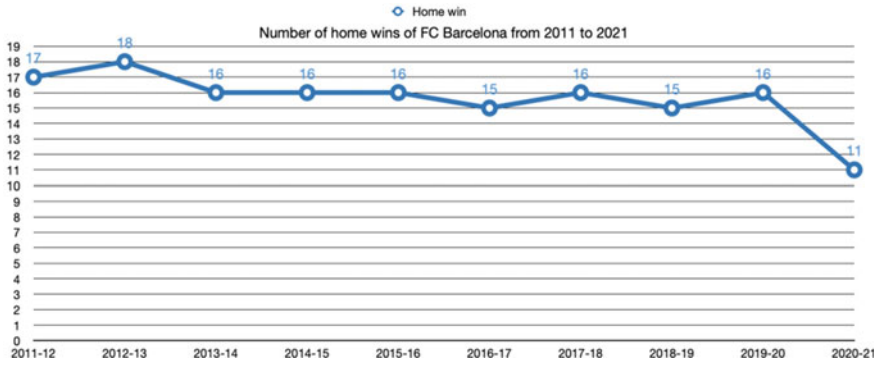


Fig. 2 Number of home wins of FC Barcelona from 2011 to 2021

2.3 Influence on Economic Level

As described at the beginning of this article, the impact of the epidemic on the tertiary industry is huge, especially in the absence of a large number of customers. Most of the service industry has lost its main source of income. The Barcelona club is also facing the same huge economic crisis. On August 6, 2021, the club officially announced that it could not renew the contract with the top star Leo Messi due to economic reasons. The main reason for the inability to renew the contract was the salary cap (Celik and Ince-Yenilmez 2017). In 2013, La Liga stipulated that a team's salary cannot exceed 70% of the total budget, while Barcelona's salary cap in the 2021–2022 season is only 97.9 million. While their main opponent, Real Madrid, has a salary cap of 739 million (Statista 2021). Such a low salary cap resulted in Barcelona failing to make a new contract with Leo Messi, which eventually led to the departure of the top star and the club's poor results in the 2021–2022 season. For the economic situation of Barcelona, the article will analyze the most important items in Barcelona's consolidated income statement from the 2018 to 2019 season to the 2020–2021 season. The first is the team's operating profit. The first of these is revenue, and the most important items in the team's revenue are revenue from games (mainly ticket and event revenue), revenue from season ticket holders and membership card holders, revenue from television broadcasts and television rights, and revenue from marketing and advertising. This is followed by employee benefits expense (player and staff earnings), followed by impairment losses and gains (losses) on disposal of non-current assets, which include impairment losses and losses (teams currently own players' worth and other intangible assets value) and gains (losses) on disposals, and the team's reserves. The second is the team's financial profit. Finally, the total profit (loss) of the team is obtained from these two profits (Figs. 3, 4 and 5).

As can be seen from this picture, the main factor causing the main economic difficulties for Barcelona is the decline in operating profit. In the decline in operations, the most important factor is the decline in revenue and impairment losses and gains (losses) on the disposal of non-current assets. In terms of revenue, although the team's broadcast expenses for the 2020–2021 season have increased, the lack of audiences and tourists has caused the team's ticket revenue and related market revenue to plummet after the outbreak began. At the same time, the team had to try to reduce salary expenditures due to reduced revenue (Fig. 6).

Therefore, in addition to delaying the payment of salaries for players, the team also had to sell some high-paid players at low prices, which also resulted in a decrease in the team's value and a decline in the team's buying and selling books, which made the team of intangible sports assets fell (Tovar 2020). In the end, the team's profit and loss statement went from a small profit before the epidemic to a loss of nearly 500 million in the 2020–2021 season. The article has a general understanding of the difficulties faced by the team during the epidemic by collecting data on the team's competition and economy. Therefore, in the face of an epidemic that is likely to last for a long time, clubs must come up with countermeasures. First of all, the club can gradually reduce the annual expenses, that is, wages and transfer fees, to reserve enough reserves to

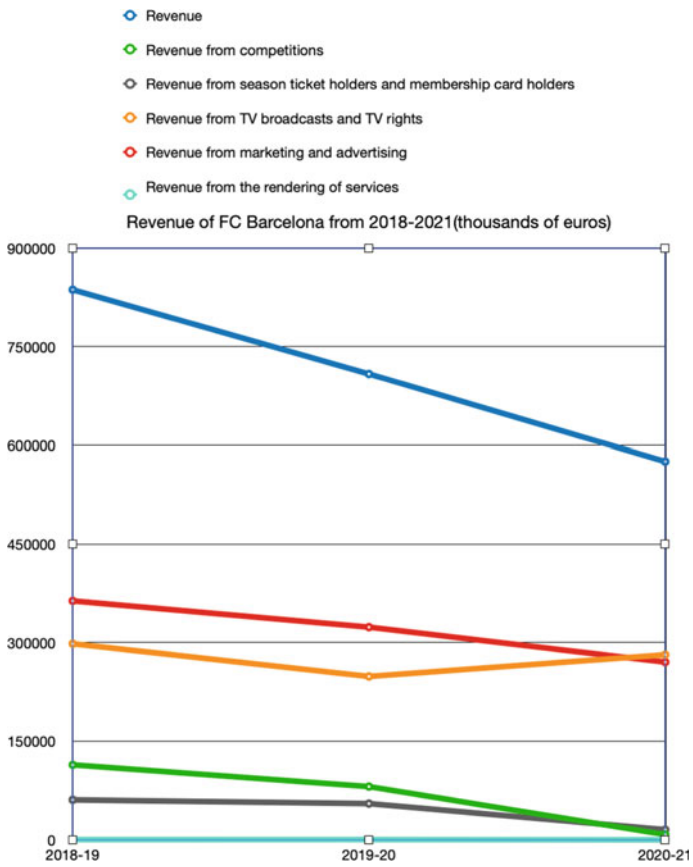


Fig. 3 Revenue of FC Barcelona from 2018 to 2021 (thousands of euros)

face future crises, but this will lead to a decline in the competitiveness of the team. Therefore, more clubs should try to reduce their dependence on tickets and the tourist economy, and clubs should try to rely more on broadcasting rights and the Internet to obtain income to reduce the impact on their economic structure in the event of a large-scale epidemic (Correia-Oliveira and Andrade-Souza 2021).

3 Conclusion

In general, the impact of the epidemic on FC Barcelona is two-fold. First of all, the lack of a home fan advantage makes the team's performance and goal efficiency decline. Secondly, the lack of fans and tourists makes the ticket revenue miss, which in turn makes the team unable to afford the salary cap and high wages, so it has to sell excellent players at low prices, resulting in the continued decline in performance.

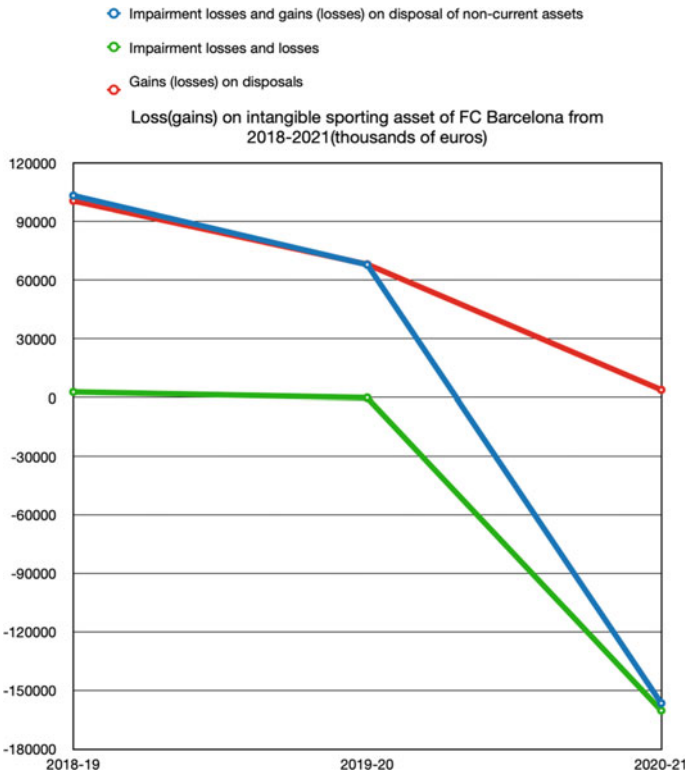


Fig. 4 Loss (gains) on intangible sporting asset of FC Barcelona from 2018 to 2021 (thousands of euros)

Therefore, clubs must come up with countermeasures. The article still has some limitations. The lack of fans has also led to the improvement of the team's away record. At the same time, the main reason for the current predicament of the Barcelona club also includes the aging of the team's lineup. Therefore, the team's current difficulties should not be solely responsible for the epidemic. Therefore, future research should include more clubs from different countries, but the problem that follows is that there are not many membership clubs like FC Barcelona, so it is often difficult to obtain financial reports of other teams.

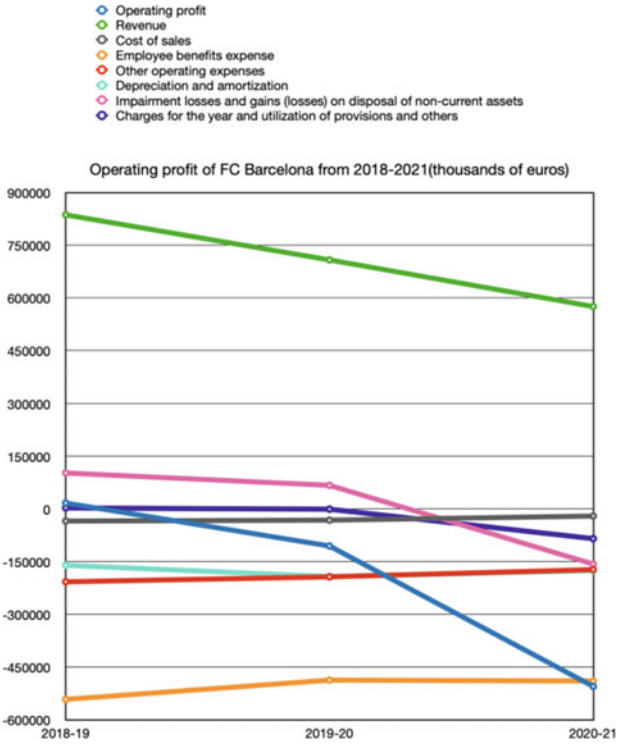


Fig. 5 Operating profit of FC Barcelona from 2018 to 2021 (thousands of euros)

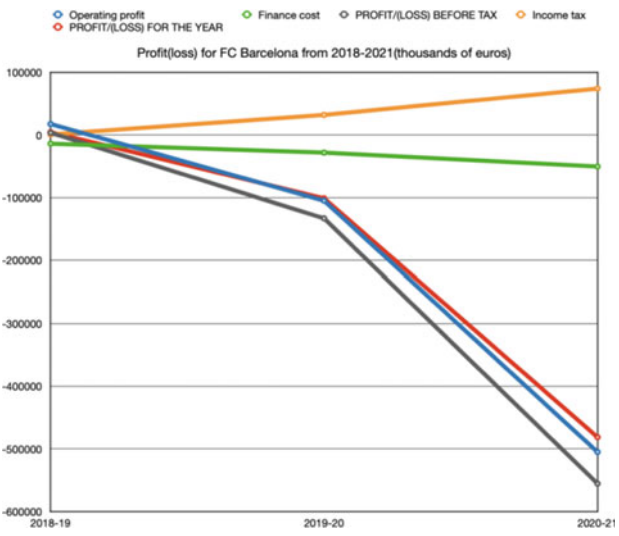


Fig. 6 Profit (loss) for FC Barcelona from 2018 to 2021 (thousands of euros)

References

Celik OB, Ince-Yenilmez M (2017) Salary differences under the salary cap in major league soccer. Int J Sports Sci Coach 12(5):623–634

Cheng B, Ge H, Cui Y (2022) A study on the impact of the new crown pneumonia epidemic on the performance of the world's mainstream professional football leagues after the rematch. https://kns.cnki.net/kcms/detail/detail.aspx?dbcode=CPFD&dbname=CPFDTEMP&filename=ZGTK202203033014&uniplatform=NZKPT&v=wajHUOcseq9XfXTw0AVRk3AXTtraVUMI8ginYs8g3q0Nd3BXbzz9XH4LTcgk2yGPQY4mkPbw_j8%3d

Correia-Oliveira CR, Andrade-Souza VA (2021) Home advantage in soccer after the break due to COVID-19 pandemic: does crowd support matter? Int J Sport Exerc Psychol 1–12

FC Barcelona (2021a) Annual Report 2019/20. https://www.fcbarcelona.com/fcbarcelona/document/2021a/06/20/db2e986a-d39c-4472-bee6-91627d0cf0ab/Libro-Memoria_ANG_compressed.pdf

FC Barcelona (2021b) Annual Report 2020/21. https://www.fcbarcelona.com/fcbarcelona/document/2021b/10/17/aefc9921-bf56-406c-ae05-3581e1de2a12/MEM_CLUB_2020_21_ENG.pdf

Global Fútbol (2022) Professional football is worth over €15.68B to the Spanish economy. https://newsletter.laliga.es/global-futbol/professional-football-is-worth-over-e15-68-bn-to-the-spanish-economy

Statista (2021) Squad spending limits in the highest professional soccer league in Spain for the 2021/2022 season (in million euros). https://www.statista.com/statistics/764962/budget-equipment-from-football-from-the-league-in-spain-2015-2016/

La Liga Table, Sky sports. https://www.skysports.com/la-liga-table

Tovar J (2020) Soccer, World War II and coronavirus: a comparative analysis of how the sport shut down. https://www.tandfonline.com/doi/full/10.1080/14660970.2020.1755270

Research and Analysis of Business Operation Mode Innovation

Take the Comparative Analysis Between Amazon and Taobao for Example

Xinjie Wu and Jiaqi Zhang

Abstract With the development of science and technology and affected by the epidemic, online shopping has gradually become popular. Therefore, Taobao and Amazon, two online shopping platforms with a great reputation in North America and China, were selected to compare their business models. In this paper, the paper methods used are comparative methods and second data. What will be involved in the full text is the analysis of the entire e-commerce industry, comparing the similarities and differences between Taobao and Amazon in their respective business models. Based on Taobao and Amazon's respective business models, this paper aims to explore the two companies' problems in their business models and provide some feasible solutions to these problems. The highlight of this article lies in the analysis and prediction of Taobao and Amazon's corporate culture and some data to help the development of online shopping platforms. It is concluded that a few scholars have researched innovation and corporate culture, so they have more innovations in business models, so Taobao and Amazon can develop better.

Keywords Amazon · Taobao · Business operation mode · Innovation · Comparative analysis

Xinjie Wu and Jiaqi Zhang contributed equally.

X. Wu (✉)
DeGroote Business School, McMaster University, Hamilton L8S 4L8, Canada
e-mail: wux84@mcmaster.ca

J. Zhang
Behavioral and Social Sciences, University of Maryland, College Park 20742, US

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_144

1 Introduction

1.1 Research Background

Nowadays, E-commerce has become an essential tool in human life. More and more people rely on phones and computers in their daily life. E-commerce in the United States originated in the early and middle 1990s. By 2015, there was a study about 240 million Internet users in the United States, with a penetration rate of 74.9%. About 3/4 of Internet users belong to online shopping, and the penetration rate of online shopping has reached 71.6% (Cao 2016). E-commerce in China began in the late 1990s but has developed rapidly in recent years. Taobao, founded in 2003, has seen its online retail sales rise from 750 billion yuan to 3.88 trillion yuan. It accounts for 40% of the global market. Online shopping in China reached $750 billion in 2016. The United States came in second with $312.1 billion. In 2016, the number of Internet users in China reached 730 million, and the number of mobile Internet users was 7.0 million, accounting for more than 95% of Internet users (Liang 2018). After 2020, COVID-19 outbreak worldwide. The global economy is affected by a viral epidemic. Unlike traditional industries, cross-border e-commerce is still developing rapidly, global trade volume remains high, and consumer choices begin to present a diversified state (Wang and Bai 2021). So the research on operation mode in E-commerce is significant.

1.2 Literature Review

This research analyzes business operation mode from the innovation side and uses comparative analysis in this study on Amazon and Taobao. First of all, this study had to define business operation mode. Because now this study didn't have any accurate definition of business operation mode. But my predecessor still had much comprehension of business mode. Michael Morris (2003) analyzed and summarised previous scholars' research perspectives and results and believed that the research on the definition of business model could be divided into three perspectives: economy, operation and comprehend strategy (Morris et al. 2005). proposed that the business model is the model and strategy that enables enterprises to obtain profits. Rappa (2003) proposed that the basic connotation of the business model is a method for enterprises to conduct business operations and self-maintenance to earn profits. Thus clearly explaining how enterprises position and profit in the value system (Homepage 2000).

Then, because this study analyzed business operation mode from the innovation side, this study had to Define and categorize innovation and find what innovation includes. OECD Think of innovation as the introduction of a new product or a qualitative change in an existing product, process innovation new to an industry, the opening of a new market, development of new sources of supply for raw materials or

other inputs, and changes in the industrial organization. Schumpeter believed that: first, innovation is endogenous in the production process. Second, innovation is a "revolutionary" change. Third, innovation also means destruction. Fourth, innovation must create new value. Fifth, innovation is essential to economic development. Sixth, the subject of innovation is entrepreneurs (Zhu 2013). Thirdly, because this study uses Amazon and Taobao for this paper's examples, this study looked up information about those companies. Taobao was founded in 2003 when China's Internet was still immature. Amazon, founded in 1995, is the largest online e-commerce company in the United States (Morris et al. 2005). Many articles already propose the difference between Taobao and Amazon. Amazon mainly adopts the B2C model—business-to-Consumer. Amazon adopted a strategy of large-scale expansion to exchange Business scale with huge losses. In order to attract individual users who want to trade, Taobao adopts a loose C2C model—Consumer to Consumer (Homepage 2000). Amazon uses both self-run logistics and third-party logistics. Taobao only has Third-Party Logistics (Cao et al. 2018). They have lots of activities. Taobao has rural Taobao, and Amazon has an implementation of "Seller Training Center" (Zhu et al. 2017; Cui 2021). Amazon's recommended system balances on many sides. Taobao has very high effectiveness and disadvantage of novelty (Hong et al. 2016).

Most articles and economists about business operation mode have different ideas. Each of them has its definition of business operation mode. Current articles about the difference between Amazon and Taobao had much different thinking and contrasting aspects. That is relatively comprehensive and very detailed. In contrast, scholars seldom analyze these two companies deeply and consider the reason from the back. Rarely do articles analyze operation mode from the innovation side or consider cultural and social influences.

1.3 Research Framework

This article includes these and will move forward. According to Schumpeter's theory of innovation and Slywotsky and Morrison, Rappa, and Michael Morris's idea of the definition of business operation mode, this study defines this paper's opinion of business operation mode, including Logistics, target customer strategy—sales methods, after-sales service, product innovation, and technology innovation. This study uses these five aspects to contrast two companies: Taobao and Amazon. Find the same and the different sides. Then this study deeply analyses the background, such as cultural influences and innovation. This study can also propose ways to help one company improve by using the other company for reference. Also, from a deep analysis of each company, this study came up with many ideas. Combined with previous people's ideas, It let us develop a system for this paper. This study will use them to provide new ways and methods to improve these companies.

2 Methodology

In this paper, the main research method used is the comparative method. Secondly, some other research methods are about second-hand data. A comparative study is a comparison and in-depth study of the similarities and differences between two or more objects. So in this paper, Taobao and Amazon will be compared for their business models through this comparison method. This study mainly compares Taobao and Amazon's business models, including logistic management, target customer strategies, marketing techniques, after-sales service, product innovation, and technological innovation. By comparing the two companies' business models, this study can clarify the similarities and differences between the two companies and improve some of their imperfect systems so that the two companies can develop their business models in the future and integrate into the markets of both sides. In addition, another method that will be used is the second data. It includes the data used in reliable study sites, industry analysis, substantive reports about the company in authoritative magazines, and explanations of the ontology company for its own company. To sum up, the main research method used in this article is the comparative method. The second method will be used as secondary data that are some literature, data, magazines, and the company's this study sites, such as Forbes, Statistics, and Shopify.

3 Result

3.1 Industry Analysis

Online shopping has always been very popular. Due to the epidemic's impact in 2019, people must be isolated at home, and online shopping has become a necessity of life. People can buy everything they need on the Internet, such as daily necessities, fresh fruits and vegetables, pet supplies, electronic products, and medicine. Therefore, after the outbreak began, the sales of online shopping platforms began to increase rapidly. In this Fig. 1, this study shows that the sales of online shopping platforms have increased steadily from 2014 to 2019. During 2019–2020, it increased more than ever before (Shopify Homepage 2021). And the Fig. 1 shows that in 2024, a network platform's sales are expected to reach 6388 billion US dollars. Another research showed that the global e-commerce market will expect to grow by 14.7% from 2020 to 2027 (Grand View Research 2016–2018). Therefore, online shopping platforms will be more popular in the future and will continue to grow.

Fig. 1 Analysis of the business models of the online shopping industry (Shopify Homepage 2021)

3.2 Comparative Analysis Between Taobao and Amazon

Taobao and Amazon have many similarities and differences. Amazon and Taobao are two large online shopping platforms that sell a wide range of items. At the same time, these two companies have extremely high customer utilization in their own countries. For example, Amazon's monthly users in the North American market can be as high as 197. The use of Taobao in the Chinese market can reach the first in the country. Every day, up to 299 people browse Taobao, this study site. Therefore, Taobao's position in the Chinese market and Amazon's position in the North American market are very similar. The disparity in data is also due to the population gap between North America and China. Secondly, both companies are relatively high in terms of user initiative recommendations. Both companies can very quickly and quickly capture customers' preferences on products. For example, when customers query products on public search this study sites, Amazon and Taobao's systems can quickly find that they are interested in these products to recommend them on their sales platform.

On the contrary, these two companies also pay great attention to and protect customers' privacy. If customers enter words related to products on some private social networks, Taobao and Amazon will not recommend products. Both companies consider that customers' privacy may be violated, so the platform is not favored by customers and effectively protects the company's image. At the same time, one thing the two companies have in common is the entrepreneurial spirit. Amazon and Taobao will set very high goals for the company and work towards them to provide customers with the best service. Of course, in terms of jobs, Amazon and Taobao have also

spent a lot of energy and effort. In order to better sell products, the two companies have created many activities, such as large-scale employee training and investment promotion in remote areas. This move can provide opportunities for people who want to sell goods and help them better manage their small businesses.

There are also many differences between Taobao and Amazon in business models, such as logistics, strategic marketing methods for target customers, after-sales service, and product innovation. Taobao still uses the traditional shipping method. However, Amazon has already started its shipping line, which is Amazon logistics, which opened its system as early as 2018 (Guo 2021). Amazon has a very mature supply chain process. Amazon forms its concise system of goods through employees, robots, a goods center, and a unique barcode, and can quickly deliver its goods to customers. Amazon has acquired nearly 200,000 robots in recent years to cooperate with Amazon employees and improve the supply chain system, which reduced the cost of convenient logistics and labor costs and helped them save a lot of unnecessary expenses. The two companies have different directions for the target group of customers. Taobao mainly uses the experimental market to attract customers to experience the platform for free. They will also cooperate with other platforms, large companies such as Alipay and Tmall, which can give customers more convenience and better user experiences. What Amazon attracts customers the most must be their exclusive Amazon logistics and personalization. So Taobao's platform is more popularised, and Amazon is close to the middle to the high-end market. As for after-sales service, Amazon will improve a little more than Taobao. Because Amazon is a B2C, they will pay more attention to the company's overall image to satisfy customers as much as possible through after-sales service. Taobao is a C2C company, and the businesses on all platforms are individuals, so Taobao is not responsible for after-sales service, so the service level of each business will be uneven (Er 2020).

Taobao and Amazon also have their strengths in product innovation. In 2007, Amazon launched an electronic reading product, Kindle. Although Kindle is an electronic product, it restores paper books' visual sense. Taobao launched Taobao reading. Taobao reading is a platform you can use anytime, anywhere on any device as long as you have a Taobao account. But the Kindle is still in the stage of reading only on its device. Taobao and Amazon still have many aspects of improving business models. Starting from Taobao, how can Taobao optimize their product quality, how can they improve the problem of too many fakes, how to improve after-sales service, and how can Taobao increase the diversification of products in foreign markets. And after the 618 events, the sales volume is much higher than before. Can Taobao improve the means of large-scale promotion? For Amazon, they can consider how to innovate more on Kindle products to make their products more convenient (Jiang et al. 2012).

4 Discussion

4.1 Problems Identified in the Taobao Platform

Fake Goods and the Goods are of Poor Quality. Solution: Firstly, Taobao needs to give higher requirements and thresholds for entering businesses. Nowadays, setting up a shop online and becoming a seller on Taobao is very easy. The customer only needs an identity certificate, without any money. Although that is very easy to operate, bad people also can be sellers easily. The higher requirement to become sellers can let them take on greater responsibility and reduce customer losses. Secondly, countries need to develop better copyright-related protection to reduce the production of fakes. In China, product copyright lacks protection, and people can use a trademark by making their stuff without buying a trademark. Countries' protection can prevent the root cause of fakes from the source.

Poor After-sales Service. Solution: Firstly, Taobao can produce its own logistics system. Contract with Amazon, only Taobao doesn't have its own logistics system. It only has third-party logistics, making management difficult and emergencies easy to happen. Different logistics companies have different norms. Taobao's logistics can make the logistics system more standardized. Secondly, Taobao and the third-party companies can sign a complete agreement. There are also some grey areas, such as if some people lose their products because of third-party logistics, they can't get extra money and have to be in full charge. These areas need a standard. Thirdly, Taobao can force sellers to provide free transportation insurance. Studies have shown that the more complete the freight insurance, the higher the customer satisfaction with the business. Therefore, dissatisfaction with the after-sales service may be caused by the imperfect after-sales insurance.

With Amazon, Taobao is not Global Enough and Can't Fully Meet the Needs of Foreigners for Shopping. Solution: Firstly, Taobao can set up some warehouses in foreign countries. For example, if Taobao wants to sell Chinese goods to Americans, Taobao can set up some American warehouses with some Chinese goods inside. Taobao's global shopping can buy goods from different countries but needs expensive transportation expenses. And after adding transportation expense, for most small goods, the prise of goods become 2 times to 3 times higher than normal. It also needs much time too. But what about Taobao setting up warehouses in target countries? The distance the goods need to pass has become much smaller than now. Also, because warehouses are inside the country, it doesn't need much time for transportation. Foreign products can arrive just as quickly. Although the distance of goods from the original country to the target country is still far and needs lots of time, the time customers accept goods is still guaranteed. Secondly, Taobao needs to improve its goods in foreign areas. According to some surveys, some Taobao users from other countries think the goods are monotonous. Taobao from other countries is not the same as Taobao in China. People only can buy limited kinds of goods. And Some

foreigners find foreign products on Taobao unattractive. So foreign Taobao needs to investigate the preferences of different cultures and launch products more in line with the aesthetics and needs of foreigners.

Sales Declined During Major Consumer Holidays. Solution: In the activity, if the price of goods is reduced and the consumption festivals are reduced, the sales volume and customer purchasing desire will increase. After this paper's observation and feedback from some users, this study believes that customers are unwilling to buy due to the low price reduction. At the same time, this study believes that the major online shopping platforms are creating new consumption festivals. The interval festivals are too short, which leads to a decrease in users' desire to buy.

4.2 Problems Identified by Amazon

The Product of Amazon: Kindle Sales are Down, and Amazon Kindle Will Withdraw from China in 2022–2023. Solution: Amazon can have a book app that people can use on their phones. This study analyzed the reason why sales of the Kindle are down. This study found that the decline of the Kindle had a lot to do with the progress and growth of mobile phones. Modern society's high dependence on mobile phones makes single-function products (such as Kindle) no longer suitable for the market and unable to meet the needs of consumers. On the other hand, reading systems launched by other online shopping platforms (such as JD Reading) are all mobile apps. They got many customers in China. At this point, if Amazon Books is transformed into an app, the advantages of cheap books, the large number of books and the full range of books, and years of experience in bookstore operation can be maximized. At this point, it is highly likely to win the competition with other similar apps.

Amazon in China is not Quick Enough. Solution: Amazon can build Amazon Flex in China and improve it in China. Amazon flex can let the customer's goods arrive faster. On average, it takes one to two days for the customer to receive the order. This study Also thinks Amazon can create some part-time jobs where the hours are very flexible about the carriage of goods, let the normal people do this job too. China has many people. Time flexible jobs are very attractive. They can do this job from morning to late at night. In addition, full-time employees can rent trucks provided by the company at a low price, encouraging full-time employees.

5 Conclusion

5.1 Findings

According to the analysis, it had found more fundamental differences: innovation in a different mode of business operation. Finally, the article presented the current problem in two companies. The article uses the different innovative business operation modes to perfect each other. This article put questions in different companies forward and found ways to solve the problems. Taobao has some problems: First, Taobao has fake goods, which are of poor quality. Taobao needs to give higher requirements and thresholds for entering businesses. Also, countries need to develop better copyright-related protection to reduce the production of fakes. Second, Taobao has Poor after-sales service. To avoid it, Taobao can produce its own logistics system. Taobao and the third-party companies can sign a complete agreement. Taobao can force sellers to provide free transportation insurance. Third, With Amazon, Taobao is not global enough and can't fully meet foreigners' shopping needs. Taobao can set up some warehouses in foreign countries. Taobao needs to improve its goods in foreign areas. Forth, Sales declined during major consumer holidays. If the price of goods is reduced more and the consumption festivals are reduced, the sales volume and customer purchasing desire will increase. Amazon has some problems: Firstly, kindle sales are down. Amazon can have a book app that people can use on their phones. Secondly, Amazon in China is not quick enough. Amazon can build Amazon Flex in China and improve it in China.

In recent years, there has been much online shopping, and different companies have innovative business models. This paper analyzes the models of two different e-commerce companies and finds their uniqueness and problems. Through comparison, more targeted suggestions and schemes can be put forward for the two companies to promote the better development of Taobao and Amazon, and the operation mode of the two companies can be perfect and meet customers' needs.

5.2 Limitations

However, there are still some problems with this article. The article almost all uses secondary data, which is obtained from magazines or other people's studies. This article lacks primary data. This article is not very professional and does not cite more professional knowledge. More methods such as surveys and interviews can be used in future studies to obtain data. In addition, more relevant professional academic knowledge can be cited to enrich this article.

References

Cao B (2016) Comparison of E-commerce between China and America from Taobao and Amazon. E-commerce (04):3–4

Cao Y, Lin HP, Shen YY (2018) Research on business model of third-party logistics enterprises under e-commerce environment. China Collective Econ (23):94–95

Cui PZ (2021) Straight into Alibaba's "hinterland" Amazon still favors Chinese sellers. IT Times (002)

Er WK (2020) A Study on relationship between customer relationship management (CRM) and customer satisfaction on Taobao website in Johor Bahru. J Arts Soc Sci 3(2):1–14

Grand View Research (2016–2018) E-commerce market size, share and trends analysis report by model type (B2B, B2C), By Region (North America, Europe, APAC, Latin America, Middle East & Africa), and segment forecasts, 2020–2027. https://www.grandviewresearch.com/industry-analysis/e-commerce

Guo X (2021) Analysis of business model, logistics operation and live broadcast of Amazon and Taobao under epidemic. In: 2021 3rd International conference on economic management and cultural industry (ICEMCI 2021). Atlantis Press, pp 244–247

Homepage, http://digitalenterprise.org/models/models.html,last. Accessed 2000

Hong L, Ren QH, Liang SX (2016) A comparative study on information service quality of recommendation system of domestic e-commerce websites—a case study of Taobao, Jingdong and Amazon. Libr Inf Serv 60(23):97–101

Jiang S, Zhang C, Huang B (2014) Analysis of the B2C mode of Mbaobao and strategies for vertical e-commerce. In: 2012 2nd International conference on computer and information application (ICCIA 2012). Atlantis Press, pp 1417–1420

Liang J (2018) Comparative study on differences between Chinese and American E-commerce enterprises—a case study of Amazon and Tmall. Sci Technol Innov Brand 72–75

Morris M, Schindehutte M, Allen J (2005) The entrepreneur's business model: toward a unified perspective. J Bus Res (58):726–35

Shopify homepage. https://www.shopify.ca/research/future-of-commerce/future-of-ecommerce#:~:text=Global%20ecommerce%20sales%20are%20expected,ecommerce%20sites%20across%20the%20globe.Last. Accessed on 27 Sep 2021

Wang MX, Bai J (2021) Analysis on the operation model of Amazon, a cross-border e-commerce company. Mod Mark (acad Ed) 06:140–141

Zhu FQ (2013) History of economic theory. Tsinghua University Press, Beijing

Zhu XY, Miao JX, Gu JP, Yang Y, Lin J (2017) Discussion on the development of Rural Taobao. Rural Econ Technol (22):68–75

An Analysis on Human Resource Management in Small and Medium-Sized Enterprises

Yuwei Deng

Abstract Small and medium-sized enterprises (SMEs) counted the majority of economic entities, and human resource management (HRM) has continuously been proved to be one of the essential corporate strategies for hundreds of years. Interestingly, they don't seem to integrate tightly. The possible explanations might be the objective resource shortage and subjective unwillingness. This paper provides a systematic analysis of the subjective and objective reasons for SMEs' lack of attention to HRM, as well as the potential benefits of strategic HRM, and offers corresponding recommendations. The paper argues that SMEs should incorporate the management concept and practices of strategic HRM into their own organizational management systems. Also, since SMEs may have difficulty in overcoming relatively poor social networks, it is suggested that governments and human resource agencies can help establish links between SMEs and strategic human resource specialists.

Keywords Small and medium-sized enterprises · Human resource management · Strategic human resource management

1 Introduction

Human resource, first proposed by Peter F. Drucker in 1954 (Marciano 2017), and its management science, human resource management, have grown for centuries and has gradually played an indispensable role in modern organization management theories and applications. Although researchers have put a lot of efforts and focuses on human resource management and made it a well-known and well-acknowledged discipline (Zhao et al. 2019), they barely investigated the connection and the suitability between SMEs and human resource management (Short and Gray 2018). In recent decades, though research papers and reports discussing human recourse practices in SMEs increased steadily (Cunningham and Rowley 2010), SMEs rarely established the

Y. Deng (✉)
Idaho State University, Pocatello, ID 83209, USA
e-mail: dengyuwe@isu.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_145

human recourse department and/or employ human resource practices (Viitala et al. 2020; Nguyen and Bryant 2004).

Based on this, in the following sections, this paper first systematically reviews the research history of human resource management, then analyzes the possible subjective and objective reasons resulting in wide neglect of the implementation of human resource management in SMEs, and finally provides corresponding recommendations for a better carry out of human resource management in SMEs.

2 The Research History of Human Resource Management

The origin of human resource management could be traced back to 1662 when William Petty elaborated the connection between labor and wealth, which preliminary proposed basic propositions of the labor theory of value (LTV) and concluded that labor was the father of wealth (Petty 1662). Adam Smith further pushed the LTV by demonstrating the division of labor and the exchange theory of value, systematically elaborated how the division of labor would enhance the productivity and national wealth under the implied assumptions that labor was a tool and could be replaced by machines or other labors (Smith 2008). Until the next generation of labor-related management theory, human resource management was better called personnel management because the concentration of management practices was to standardize the workers by using a series of pre-designed scientific standards.

The revolutionary upgrade of human resource management theory was proposed by Peter F. Drucker, who introduced the workers as 'human resource', which was comparable to all other resources in 1954. The turning point compared to the traditional personnel management theory was that Peter distinguished workers from tools due to the "ability to coordinate, to integrate, to judge, and to imagine" (Drucker 1954). Wight Bakke then described the human resource functions as "to the understanding, maintenance, development, effective employment, and integration" of the resource of people, and argued that the human resource was no less important than other resources like money and market, and human resource functions were as importance as other managerial functions, such as production and finance (Bakke 1961). Raymond E. Miles distinguished the human resource model from the formalistic human relation model and called for real actions, such as decentralization of decision-making power, cultivation of workers, and creation of an environment that all perspectives of the human resource could be fully utilized, rather than pretending to take care of satisfaction while the actual purpose is to consolidate authority (Miles 1965). Those, and the continuous research, started treating people in an organization as a resource to business success and developing strategies to best exploit, utilize, and maintain this resource. The name "human resource management" was given at this stage.

Managers and researchers in the following years gradually found that it was impracticable to implement one set of theoretical management practices to all kinds of organizations and individuals (Morse and Lorsch 1970). As the manager's recognition of the importance of human resources increasing, researchers claimed that the organizations require a more strategic-related human resource management to address the growing challenges of external competition and internal innovation (Tichy et al. 1981). The human resource practitioners, on the other hand, should not only be a "file keeper", but simultaneously perform as a business partner, a change agent, an administration expert, and an employee advocate (Ulrich 1997). Human resource management stepped into a new age that should better be called as "strategic human resource management".

3 Human Resource Management in SMEs

The definition of the small and medium-sized enterprises (SMEs) varies in criteria among countries—most of the definitions clarify SMEs against the number of employees in an organization, mostly from 50 to 300 (Cunningham and Rowley 2010). However, the various and confusing definition does not prevent SMEs from occupying the vast majority of registered enterprises in major economies (Harney and Alkhalaf 2020). Taking China as an example, at the Press Conference of the State Council Information Office on Jan 29, 2019, according to Wei Miao, the Minister of the Ministry of Industry and Information of China, SMEs counted as much as 99% of all Chinese enterprises.[1]

Although the statistics of various countries continuously demonstrate that SMEs are playing an increasingly important role in the economy, researchers have found that human resource management practices are attributed to be less sophisticated and informal in SMEs (Harney and Alkhalaf 2020). For instance, the larger organizations usually have various sets of criteria for employee selection, and the salary and benefit system is usually more systematic and scientific. As for the SMEs, on the other hand, they may be essentially lack of written job descriptions and the criteria for hiring, performance appraisal, and firing. A 2004 study surprisingly shows that there were only 10% SMEs providing complete and company-funded training programs and there were 62.9% SMEs having no human resource specialist presence (Nguyen and Bryant 2004).

A more recent study conducted by Glenn McEvoy and Paul Buller in 2013 further investigated the strategic-related similarities and differences between larger enterprises and SMEs (McEvoy and Buller 2013). This study revealed that with the organization size increases, human resource practitioners usually put more efforts on achieving strategic objectives and solving the strategic-related issues, while the

[1] Source: https://www.sohu.com/a/292445105_100006481.

human resource staffs in smaller organizations were reported spending more time on operational works, such as documentation and auditing. The top managers in larger organizations also showed a more open and welcome attitude toward the human resource professionals to perform as a strategic business partner.

In Mcevoy and Buller's work, the authors attributed the differences between larger and smaller organizations into organization life cycle (OLC). Indeed, under the assumption that organization development will inevitably bring about the expansion of scale, generally, the larger a business is, the stronger it is and the more resources (including capital, information, interpersonal, and social relationships, etc.) it can exploit. These extra resources endow the larger organizations much more opportunities to get in touch with and recruit human resource specialists. Then, the sophisticated and formal human resource system is constructed by the specialists and the operational and strategical works are clearly classified. Plus, large organizations are capable of paying off the outsourcing of operational works, or developing and utilizing high-tech means, to improve efficiency. In SMEs, however, top managers may argue that their enterprise is trapped at the beginning of this process—to have human resource specialists. Therefore, the larger organizations could free up the human resource staffs to deal more strategic tasks and gradually accumulate advantages in human resource far surpassing SMEs.

On the other hand, however, except the objective factors, the managers' subjective perception may also lead to the same consequence. The most possible managers' perceptions are classified as follows:

1 Managers have no conception and understanding of strategic human resource management. These managers are never or barely educated strategic human resource management and just simply treat the human resource professionals as recruiter and/or "salary calculator". In some extreme cases, some of this type of managers believe that the employees are tools but resources just like hundreds of years ago when the human resource staff were used to evaluate the quality of these tools and "repair" or replace them when needed.
2 Managers deny the benefits from strategic human resources and refuse to use them. This type of manager probably has employed some strategic human resource management practices. Unfortunately, however, unlike a successful marketing activity or a replacement of a more economical material that boosts the revenue significantly and shortly, these managers have not found satisfactory economic return in the short term. Other than money, managers may complain that the productivity boost brought by the human resource specialists with high salaries is even far worse than a small bonus. Therefore, strategic human resource management practices were abandoned, and human resource staff turned back to deal with personnel management.
3 Managers may approve the benefits from strategic human resource management but refuse to use it. These managers believe that the formal and sophisticated, and/or strategic-related human resource management practices belong to large organizations due to the much more complicated organizational construction. As for the SMEs, these managers believe that they should concentrate all, or at least

the vast majority of, the resource on production and sales for survival, rather than 'waste' resources and afford more communication and time costs by working on the future plan.

4 Benefits and Necessity of Human Resource Management

Those mentioned manager's perceptions regarding strategic human resource management are based on the misunderstandings. Human resource management as a discipline and a set of scientific practices has constantly developed for more than hundreds of years, not only because of the spirit of inquiring into the unknown that driving the researchers to keep investing efforts into the research but also because it is proved to be meaningful. The organizational performance improvement benefited by the managers who keep following and updating the managerial suggestions is the proof. From Adam Smith's labor division theory to Dave Ulrich's 4 roles model (Ulrich 1997), the managers who followed the earliest version of human resource management, which is the personnel management, equilibrated the job with its value to a certain extent, though imperfectly. Then, traditional human resource management was applied for solving the conflicts between managers, or organizations, and the workers. In recent decades, research continuously proved that strategic human resource management helps organizations with gaining competitive advantages (Barney 1991; Carmeli and Schaubroeck 2005) and the improvement of organizational performance (Combs et al. 2006; Uysal 2013).

Unfortunately, the benefits of implementing strategic human resource management do not come in the form of mouthwatering short-term financial returns. For instance, the essential difference between strategic human resource management versus marketing activity appears in their purposes: the optimization of management policies is devoted to the improvement of organizational performance, gaining and accumulating competitive advantages. Then, the economic returns, such as profit and market share, will be produced automatically in the long run through keeping winning the external competitions and continuously sweeping the losers out of the game. On the contrary, the marketing activities are specifically focused on the boosting of profits and market share. The shorter payback period is also accounted for the determination of the success of such activities. Strategic human resource practices boost "less" productivity than bonus due to the same reason: managerial policies looking for organizational improvement in the long run while the specific practices focus on certain department and a short-term feedback. Figure 1 shows the difference between strategic human resource and marketing activity for a better understanding.

Another misunderstanding is that SMEs managers believe that human resource management, whether strategical, belongs to large organizations only. Indeed, the much more complicated constructions in large organizations do require a more sophisticated management system, but it does not prove that strategic human resource management is meaningless to small-scaled organizations. Researchers have proved that the effects and benefits of human resource management can be applied to SEMs

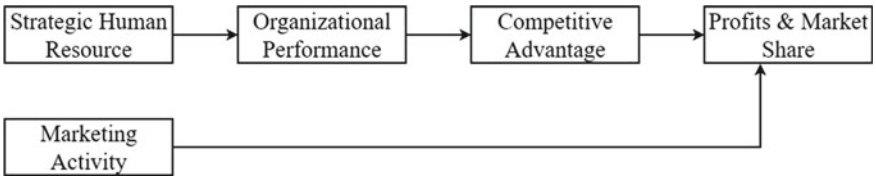


Fig. 1 Difference between strategic human resource and marketing activity

as well (Zhang et al. 2008; Knezović et al. 2020; Sels et al. 2006). However, managers may argue that the functions of strategic human resource management and its professionals in smaller scaled enterprises are very limited, and it is not necessary to specifically assign personnel for human resource deployment and management-supervisors and managers at all levels could be responsible for their own personnel management duty. Unfortunately, however, this is a "people governing people" method and shows deficient in at least three key points:

1 Stabilization: Managers' resignation and replacement may influence the management philosophy and method to a large extent. Especially, the higher level the manager is, the larger extent the influence will be. For example, the performance appraisal in large organizations is usually well-developed and widely known by supervisors at all levels. Although sometimes it is required to make necessary adjustments, the frequency and amplitude of such adjustments are extremely limited to avoid unacceptable impact on the stability of the entire organization. Therefore, the supervisors, regardless of their seniority in the position and their managerial level, could easily exam subordinates' performance by simply matching the data with standards.
2 Comprehensiveness: Manager's ability and work experience are destined to have shortcomings in certain areas. Generally, the higher the level of manager is, the more obvious this weakness will be. For instance, a finance director must be an expert in finance, but he/she is probably bad at employee incentive which results in a long-term poor performance in finance department.
3 Fairness: Supervisors' judgement and decisions may be influenced by the relationship with certain people or interest-related situations, such as a less late fee to his/her friend or a higher manager's relative. Even if sometimes the supervisor does make decision without selfishness, other employees may still misunderstand the intentions of the decision due to the inequality of information.

Is there a solution for the listed issues? The answer is yes. Those weaknesses could be simply and effectively resolved by another method called "rules governing people". The "rules" are a series of standards based on a formal, sophisticated, and strategic-related human resource management system, while establishing such a management system and adjusting it in time to keep it in line with the organization's strategic direction which happens to be the core function of the strategic human resource management. To the detail, the organizational culture and corporation strategy, such as mission, vision, and long-term objectives, in large organizations are

usually well-designed and tested by numerous competitions in the market while in the SMEs, they are usually presented as some sloppy sentences, even not at all. Strategic human resource management professionals could be enrolled in the reformation or creation. Then, under the guidance of corporate strategies, more detailed human resource management policies and practices can be developed, such as the recruit and training process, staff promotion standards, incentive programs, etc. Therefore, a human management system is constructed like a tree growth. This strategic human resource management system is stable and comprehensive because it is guided under the organizational culture and long-term strategy. It is also comparatively much fairer because the written documents prevent most mental interventions.

5 Conclusions and Recommendations

In conclusion, this paper mainly demonstrates the status quo of how widely and how well the human resource management is implemented in small and medium-sized enterprises and analyzes the possible reasons. Human resource management in SMEs is informal, less sophisticated, and less strategical, and this phenomenon might be the consequence of the limitation of resources and manager's wrong perceptions regarding strategic human resource management.

However, human resource management in SMEs, especially strategic human resource management, shows at least as no less importance and necessity as in large organizations because it benefits organizational performance in the long run. Compared to the "people governing people' method that may be more welcomed in SMEs, the strategic human resource provides the organization with a more stable, comprehensive, and fair management system. In a sense, strategic human resource management might play a more important role in SMEs because it helps with the establishment of corporate strategy from 0 to 1. Therefore, the owners and top managers of SMEs are suggested to seek strategic human resource management and treat such management as an essential part of the organizational strategy, allowing the strategic human resource professionals to get enrolled in strategy planning and implementing rather than staying in office for documentary tasks. SMEs should expect long-term returns for strategic human resource management but note that sometimes the return is not even profit-driven.

On the other hand, the local government, labor union, and human resource center may help with the connection to strategic human resource management specialists. For instance, the Small Business Development Center (SBDC) in the United States provides local small business with professional consulting for various topics. The consultants are mostly from the local universities, including senior and master students, and professors. Similarly, governments or other related agencies could organize similar leagues and provide the SMEs with professional human resource consultants. The consulting process could vary from a couple of weeks to several months, depending on the assessment from the consultants who are responsible for the case. In an ideal situation, the government could even create a large online

consulting platform so the SMEs could reach strategic human resource specialists around the nation. In addition to "borrowing" from such supportive organizations, it is also possible that the human resource agencies could create an association that allows strategic human resource management specialists to register and upload their requirements for job hunting, such as an acceptable work place and expected salary. This association is open to SMEs so the enterprises with limited social networks would have a chance to get connected with those specialists and hire them.

At last, the role and necessity of strategic human resource management are required to be widely advocated. Every business owner knows that a finance department is essential for companies of any scale, but not all of them believe that a human resource department is as necessary as the financial one. This is a social conceptual shifting and is time-consuming. Perhaps the call for an emphasis on relative academic research and government and related agencies' advocacy would accelerate this revolutionary process.

References

Bakke W (1961) The human resources function. Manag Int 1(2):16–24

Barney JB (1991) Firm resource and sustained competitive advantage. J Manag 17(1):99–120

Carmeli A, Schaubroeck J (2005) How leveraging human resource capital with its competitive distinctiveness enhances the performance of commercial and public organizations. Hum Resour Manag 44(4):391–412

Combs J, Liu Y, Hall A, Ketchen D (2006) How much do high-performance work practices matter? A meta-analysis of their effects on organizational performance. Pers Psychol 59:501–528

Cunningham LX, Rowley C (2010) Small and medium-sized enterprises in China: a literature review, human resource management and suggestions for further research. Asia Pac Bus Rev 16(3):319–337

Drucker PF (1954) The practice of management. Harper

Harney B, Alkhalaf H (2020) A quarter-century review of HRM in small and medium-sized enterprises: capturing what we know, exploring where we need to go. Hum Resour Manag 1–25

Knezović E, Bušatlić S, Riđić O (2020) Strategic human resource management in small and medium enterprises. Int J Hum Resour Dev Manag 20(2):114–139

Marciano VM (2017) The origins and development of human resource management. In: Academy of management proceedings. Academy of Management, pp 223–227

McEvoy GM, Buller PF (2013) Human resource management practices in mid-sized enterprises. Am J Bus 28(1):86–105

Miles RE (1965) Human relations or human resources. Harv Bus Rev 43(4):148–163

Morse JJ, Lorsch JW (1970) Beyond theory Y. Harv Bus Rev 48(3):61–68

Nguyen TV, Bryant SE (2004) A study of the formality of human resource management practices in small and medium-size enterprises in Vietnam. Int Small Bus J: Res Entrepreneurship 22(6):595–618

Petty W (1662) A treatise of taxes and contributions. McMaster University archive for the history of economic thought

Sels L, De Winne S, Delmotte J, Maes J, Faems D, Forrier A (2006) Linking HRM and small business performance: an examination of the impact of HRM intensity on the productivity and financial performance of small businesses. Small Bus Econ 26(1):83–101

Short HJ, Gray DE (2018) HRD in SMEs: a research agenda whose time has come. Hum Resour Dev Q 29(1):7–13

Smith A (2008) An inquiry into the nature and causes of the wealth of nations. In: Readings in economic sociology
Tichy NM, Fombrun CJ, Devanna MA (1981) Strategic human resource management. Sloan Manag Rev 13(2):59–71
Ulrich D (1997) Human resource champions: the next agenda for adding value and delivering results. Harvard Business School Press
Uysal G (2013) Progress of HRM to SHRM: human resources as capital. J US-China Public Adm 10(3):331–337
Viitala R, Vesalainen J, Uotila T-P (2020) SME managers' causal beliefs on HRM as success factor of the firm. J Small Bus Manag 1–25
Zhang Z, Wan D, Jia M (2008) Do high-performance human resource practices help corporate entrepreneurship? The mediating role of organizational citizenship behavior. J High Technol Manag Res 19(2):128–138
Zhao SM, Zhang M, Zhao YX (2019) A review on the past 100 years of human resource management: evolution and development. Foreign Econ Manag 41(12):50–73 (In Chinese)

Research on Investment Characteristics of Strategic Investors in China

Yuanhang Peng

Abstract In China's capital market, the investment actions of strategic investors have attracted people's attention and research. However, the information and data of these studies are too scattered, which has brought certain difficulties for people to study the development of strategic investment in recent years. This study adopted China's top ten strategic investors to analyze their investment actions, and summarizes and interprets the investment issues to explore the logic of Chinese strategic investment institutions. It believes that the current corporate services, cultural and entertainment sectors are the popular targets that strategic investors prefer. At the same time, strategic investors will also select investment projects based on the ecology of commerce. Most strategic investors prefer to select the cases within millions to tens of millions. The companies at the financing stage of round C are more likely to become their investment targets, which raise funds replenish liquidity and improve competitiveness. Meanwhile, through cooperation with financial institutions, strategic investors have made up for their own disadvantages in the capabilities of experience and provided a basic guarantee for operation performance of invested enterprises. This paper believes that strategic investment promotes the prosperity of the market, but in the future, as strategic investors grow, it should be concerned that their business activities may receive stricter supervision from government to avoid monopolistic behavior.

Keywords Strategic investment · Investment scales · Investment rounds

1 Introduction

With the strong rise of China's economy, an increasing number of Internet companies such as Alibaba and Tencent have rapidly developed and expanded their businesses through investment in the capital market. China's capital market has become active

Y. Peng (✉)
Princeton University, Princeton, NJ 08544, USA
e-mail: 15520951888@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_146

because of these strategic investors. These companies have increased the liquidity of funds, allowing many entrepreneurs and companies to obtain essential resources and funds at the critical stage of development, get out of the bottleneck period, and expand rapidly. The investment trends of strategic investors have always attracted attention, and each of their investment projects has been continuously followed up by financial media and research by relevant academic personnel. However, these studies always take a single investor as an example or discuss a single investment project of an investor. Few people discuss the investment trends and characteristics of investment models of various strategic investment institutions over a period of time from a macro perspective. At the same time, these strategic investment institutions rarely disclose their specific investment information, so the investment data and information of these investors are relatively lacking and scattered. The purpose of this research is to sort out the existing scattered data and information, analyze the information, and discuss the investment models and characteristics of strategic investment institutions. The following will take China's top ten strategic investment institutions as an example to conduct an empirical analysis of their key investment projects, investment scales, investment rounds, and selected joint investment partners in recent years to clarify the overall investment thinking and operations of China's strategic investment institutions.

2 Literature Review

The following is the research content related to strategic investment by predecessors. Liao studied Tencent's investment projects since 2020. According to Liao's research, since 2020, while Tencent has continued to increase its investment in the field of video games, it has also begun to expand other businesses, such as investing in cloud computing and enterprise services; on the other hand, in order to cooperate with Alibaba's, the fintech subsidiary Ant Group competed, and Tencent began to increase investment in the financial sector. In 2019 and 2020, it supported 18 and 15 fintech companies respectively (Liao 2020). Low studied Tencent's strategic investment strategy. Low pointed out in his research that Tencent is always grasping the changes in the world situation to change its investment strategy. For example, during the pandemic, distance learning became a new class mode, and Tencent quickly invested in Yuandao (homework tutoring application) and Dami Wangxiao (online class platform). At the same time, Tencent continued to increase investment in the game field, and began to look at other entertainment projects, such as Bilibili. But Low also pointed out that Tencent's investment is now facing fierce competition from Douyin and other technology companies, as well as pressure from increasingly stringent government scrutiny (Low 2021). Alibaba's investment strategy is studied in this research. According to research, Alibaba's investment focus is on e-commerce, logistics and consumption. Realize cross-platform cooperation by investing in more e-commerce platforms. At the same time, Alibaba has also invested in the logistics industry to further build Alibaba's logistics network. Moreover, as more and more

companies begin to upload data to the cloud, Alibaba has also increased its investment in the field of cloud computing. In terms of investment strategy, Alibaba tends to make a small amount of equity investment in the early stage to test the potential synergy between the invested company's products and the Alibaba platform. As the value increases, Alibaba will increase the amount of investment or direct acquisitions (Alibaba's venture capital investment strategy 2021). Bary analyzed Alibaba's investment in cloud computing in his research. According to Bary's research, since the pandemic, people's demand for online services has increased, which has prompted Alibaba to increase its investment in cloud computing, chips, and networking. Bary pointed out that the pandemic has had a huge impact on Alibaba's business. Alibaba's investment in cloud computing can help Alibaba to carry out a better digital transformation after the pandemic is over. This will also benefit Alibaba's and the competition between JD and Tencent (Bary 2021). Liao analyzed Xiaomi's strategic investment in his research. According to Liao's research, Xiaomi is building a huge IoT ecosystem. Through investment in the field of hardware equipment, Xiaomi continues to expand its business. Now Xiaomi is no longer a simple smartphone manufacturer, but has become a department store selling various daily products (Liao 2021).

Lunden studied Intel's investment projects. As a semiconductor giant, Intel's investment strategy has always emphasized the coordination between the invested products and Intel's own business. In Intel's investment projects, high-tech fields such as artificial intelligence, chips, and deep learning occupy a dominant position (Lunden 2021). Che studied Tencent's development prospects. He took Tencent's current products, domestic and overseas investments, financial conditions, and China's macroeconomic conditions as the starting point, and studied Tencent's development in the Internet company industry from both internal and external perspectives. Finally, Che believes that Tencent has very good development prospects. Compared with its peers, Tencent is a competitive company. In the future, the game industry will bring considerable benefits to Tencent (Che 2018). Heel and Kehoe studied how private equity firms can operate better. Heel and Kehoe selected 11 successful private equity companies and some private equity companies with poor performance, carefully studied and compared their operating models, and finally concluded five rules: carefully study professional knowledge; set up good performance reward mechanism; develop a good value creation plan and strictly implement it; invest more time; strengthen the management team as soon as possible (Heel and Kehoe 2005).

Chesbrough explored how companies screen possible high-return risk investments. To this end, Chesbrough collected and analyzed the venture capital experience of some companies. Chesbrough made a four-point summary of related investment strategies: strategies closely related to the current business; strategies that complement the current business; exploit new business areas; seek simple financial returns (Chesbrough 2002). Li et al. studied the impact of private equity on the governance of SMEs. In their research, the inherent problems existing in the governance of Chinese SMEs were mentioned, and then Li et al. proposed solutions to these problems: improving the ownership structure, perfecting the incentive mechanism and decision-making mechanism, which can better improve Internal and external governance issues attract more investors. These are the positive effects of private

equity on the governance of SMEs (Li et al. 2014). Gonzales and Ohara investigated the changes in Chinese venture capital investment in the United States from 2010 to 2017. Gonzales and Ohara collected data on Chinese investment in the United States over the past few years. According to their research, the amount of Chinese venture capital in the United States is increasing year by year, and the proportion of corporate venture capital in venture capital is also gradually increasing. In addition, life sciences and mobile application platforms are the preferred investment targets of more and more Chinese venture capitalists (Gonzales and Ohara 2019). Bernstein et al. studied the potential impact of private equity investment growth on the global economy by examining the relationship between private equity investment in 20 industries in 26 major countries and the growth rate of total output, employment and capital formation from 1991 to 2009. According to their research, private equity-supported industries will not be affected by greater economic shocks. Moreover, the level of leverage is driven by the cost of debt, rather than industry and company-specific factors that affect the leverage of listed companies. In general, Bernstein and others disagree with the view that private equity will adversely affect the economy (Bernstein et al. 2017).

3 Investment Tendency of Strategic Investment Institutions

With the rapid development of China's economy, more and more Chinese companies have become bigger and stronger. In order to maintain their core competitiveness, these companies use their huge capital and resources to make strategic investments. As shown in Table 1, the top ten strategic investment institutions in China are listed.

As shown in Table 1 and Fig. 1, it indicates that the field of corporate services is the first choice of many strategic investors. Among the 10 strategic investment institutions, 6 companies have invested heavily in the field of corporate services, which is the largest part of the investment plan. The six companies are Alibaba, Ant Financial, Baidu, Intel, Lenovo Ventures and Bytedance. The reason why corporate services are so popular with strategic investors is closely related to the current economic and social environment in China. With the improvement of China's domestic business environment, the increase in the number of companies has greatly promoted the demand for corporate services. Low-cost and high-efficiency management has become a key factor in whether companies can be competitive. This situation has prompted corporate services. On the other hand, the government has continuously introduced policies to speed up the construction of new infrastructure fields such as artificial intelligence, big data, and 5G, and give strong support to the development of informatization of business management. Under the influence of this background, corporate services have become one of the most valuable investment projects in the eyes of many strategic investors.

On the other hand, in the information age, with the popularization of smart phones, people's daily lives have become more diversified due to the Internet. Whether it is daily consumption or leisure and entertainment, all these needs can be met through

Table 1 Investment projects of top ten strategic investment institutions

	Maximum investment amount	The largest number of investments	Minimum investment
Tencent Investment	Life service area	Video game	Blockchain
Alibaba Strategic Investment Department	E-commerce, corporate services, cultural and entertainment media	E-commerce, corporate services, cultural and entertainment media	Blockchain
Xiaomi	Intelligent hardware, advanced manufacturing field	Intelligent hardware, advanced manufacturing field	Agriculture field
Ant Financial Services Group	Life services field	Financial field, enterprise service field	Sports, social networks, manufacturing
Baidu Investment Department	Cultural and entertainment media, automobile transportation, corporate services	Cultural and entertainment media, automobile transportation, corporate services	Blockchain
Intel Capital	Automobile transportation field	Corporate Services	Logistics, advanced manufacturing, social networking fields
Lenovo Ventures	Smart hardware, corporate services	Smart hardware, corporate services	Local life, tourism, games
Byte beating	Video game field	Cultural and entertainment media, corporate services	Real estate services, logistics, automobile transportation
Jingdong	E-commerce field, life services, automobile transportation field	E-commerce field, life services field, automobile transportation field	Games, tool software, advanced manufacturing, real estate services
Bertelsmann	Education, e-commerce, finance	E-commerce, education, real estate services	Corporate services, life services field

the Internet. Therefore, in addition to corporate services, other areas that are more favored by strategic investors include e-commerce, culture and entertainment media, and life services.

Also, using strategic investment to supplement the current company's business is also an investment strategy. This can be seen from the investment status of Xiaomi. Xiaomi was originally a smart phone company, but now more and more Xiaomi smart homes appear on the market, and smart speakers and TVs have become Xiaomi's new products. Obviously, Xiaomi's ambition is no longer just to focus on manufacturing smart phones, but to try to build its own IoT system. Therefore, it can be seen that in Xiaomi's investment projects, smart hardware and advanced manufacturing are the top priorities.

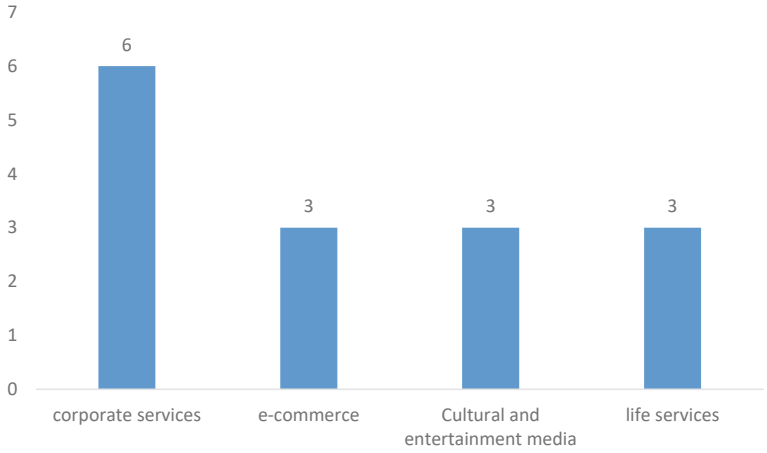


Fig. 1 The top four investment projects most popular with strategic investment

At the same time, it should be noticed that blockchain is the field where strategic investment institutions invest the least. Tencent, Alibaba, and Baidu have the smallest investments in the blockchain field. Although blockchain is now considered by many people as a technology that can bring huge changes to human society, there are still many risks in blockchain investment. Many blockchain projects are deliberately hyped by the market, and the lack of effective supervision by regulatory agencies has led to dramatic fluctuations in the prices of blockchain assets such as Bitcoin. At the same time, in addition to the slow transaction speed and high resource consumption caused by immature technology, blockchain transactions have also caused a series of legal issues and national security issues. Hence, the uncertainty of national policies also increases the risk of blockchain investment.

Figure 2 describes the investment scale of the top ten strategic investors. The valuation of the invested company can be seen from the scale of investment. Generally, companies in the tens of millions of valuation range have relatively mature business models, but sometimes these firms also encounter development bottlenecks. Capital and resources from strategic investors can help these companies get out of the bottleneck period; for strategic investors, while the risk of a company with a valuation of hundreds of millions is small, it will make investors lose too much bargaining power. Therefore, among these ten investment institutions, most of the investment scales of the institutions are maintained in the range of millions to tens of millions, and only Alibaba's investment scale has reached the level of hundreds of millions.

In general, most investors are cautious about medium-term investments (round B, round C). The reasons are as follows: In the round C of financing, many companies are prone to overvaluation, leading to falsely high financing costs; the invested company has insufficient market space and it is difficult to achieve higher profits; the company has not yet formed a mature business model.

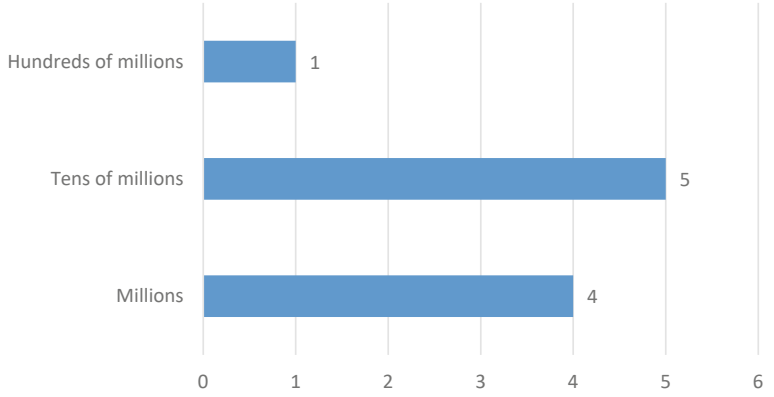


Fig. 2 The investment scale of the top ten strategic institutions

And Fig. 3 shows us such a message, that is, strategic investors generally tend to invest in the later stage (round C). Strategic investors believe that companies that can raise funds in the later stages have fully proven their value to investors. Companies in the late stage of financing have the following characteristics: the company has a clear profit model and mature operations; it has its own technological advantages; and its project prospects are good. Investors can greatly reduce risks by investing in such companies and can obtain considerable returns in the future (Table 2).

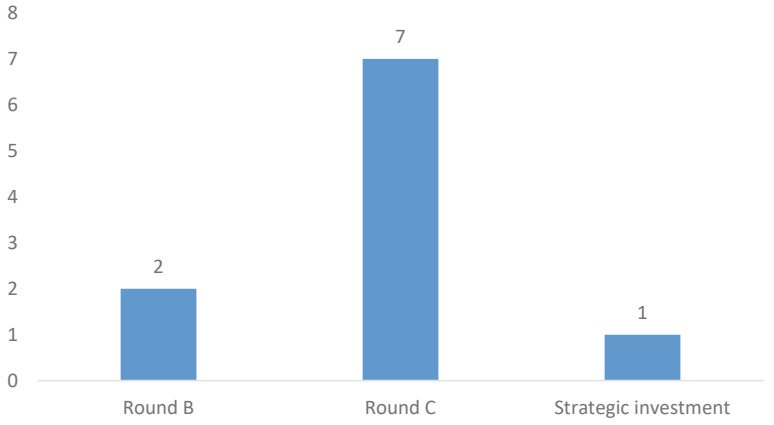


Fig. 3 Top ten strategic investment institutions' tendency of investment rounds

Table 2 Top ten strategic investment institutions' tendency of investment rounds

Strategic investment institutions	Investment round
Tencent Investment	Round C
Alibaba Strategic Investment Department	Round C
Xiaomi	Round C
Ant Financial Services Group	Strategic investment
Baidu Investment Department	Round C
Intel Capital	Round B
Lenovo Ventures	Round B
Bertelsmann	Round C
Byte beating	Round C
Jingdong	Round C

4 Strategic Investment Institutions Cooperation Partner Selection

Figure 4 reveals the cooperative investment institutions of the top ten strategic investors. It can be seen from this picture that Sequoia Capital has participated in most of the strategic investments. There are nine strategic investors working with it, namely Tencent Investment, Alibaba, Ant Financial, Xiaomi, Baidu, Intel, Lenovo Ventures, Bytedance and JD.com. The second largest partner of strategic investment institutions is IDG Capital. There are a total of eight institutions cooperating with them; followed by Jingwei China, with a total of four strategic investors cooperating with them.

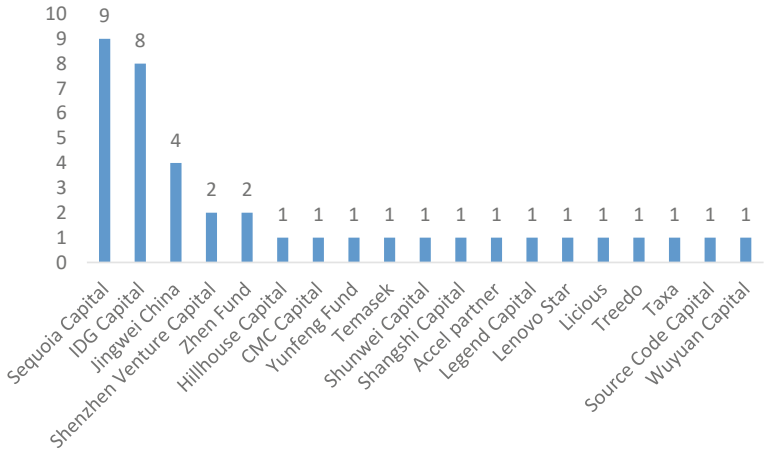


Fig. 4 Number of cooperative investment institutions participating in strategic investment

It can be seen that an increasing number of strategic investors are willing to cooperate with financial investment institutions. In fact, China's strategic investors and financial investors have a deep relationship. Many Chinese Internet companies, such as Ali and Tencent, have received support from financial investors in their initial stage. Therefore, strategic investors and financial investment institutions themselves also have a tacit understanding of cooperation. Secondly, this kind of cooperation is very beneficial to both parties. Compared with traditional financial investors, strategic investors lack investment management experience and weaker capital operation capabilities. Strategic investors cannot provide direct assistance for the company's future listing or third-party mergers and acquisitions, while financial investors have stronger financial capabilities. Therefore, strategic investors need to learn from the trading experience of financial investors in their investment; at the same time, financial investors can cooperate with strategic investors to obtain more shares, the former can sell more shares to obtain greater financial returns. In addition, strategic investors have more traffic and technological advantages. Therefore, the cooperation between the two parties has actually achieved a kind of complementarity.

A typical successful case of joint investment by strategic investors and financial investors is the investment of Alibaba and Sequoia Capital in Meituan. Meituan is an online platform established in 2010 that provides group buying and takeaway services. Meituan received US$50 million in Series B equity investment from Alibaba and Sequoia Capital in 2011, and another US$300 million in Series C financing in 2014. In the next few years, Meituan expanded rapidly. Relying on the takeaway service, it has made huge profits, and its market value has doubled. Meituan successfully listed on the Hong Kong Stock Exchange in 2018. Now it has become one of China's largest service industry e-commerce platforms. Alibaba and Sequoia Capital have contributed to the success of Meituan. Another example of cooperation between strategic investment institutions and financial investors is Cisco and Sequoia Capital. Cisco was founded in the 1980s as a company that made routers. The founders of Cisco are a couple of professors from Stanford University. They use their professional abilities to find and screen new technologies that may have great changes in human society around the world. As a partner, Sequoia Capital uses own financial processing ability helps Cisco to carry out venture capital investment and incubation. With the help of Sequoia Capital, Cisco expanded rapidly, completed mergers and acquisitions one after another, and finally became one of the most successful hardware equipment companies in the world (Table 3).

5 Conclusion

In recent year, strategic investment has greatly promoted Chinese market prosperity and provided great help to private companies that lack capital and resources. Strategic investors keep up with business trends, seize more business opportunities in a timely manner, and use strategic investments to expand their business. As for the strategic investors, improving the return by adjusting the investment amount and investment

Table 3 Cooperative investment institution

Strategic investment institutions	Most co-invested
Tencent Investment	Sequoia Capital, Hillhouse Capital, Matrix Partners China, IDG Capital, CMC Capital
Alibaba Strategic Investment Department	Yunfeng Fund, Sequoia Capital, IDG Capital, Temasek
Xiaomi	Shunwei Capital, Shangshi Capital, IDG Capital, Sequoia Capital, Shenzhen Venture Capital
Ant Financial Services Group	Sequoia Capital, Shenzhen Venture Capital, IDG Capital, Matrix Partners China
Baidu Investment Department	Sequoia Capital, IDG Capital, Jingwei China
Intel Capital	IDG Investment, Accel partner, Sequoia Capital
Lenovo Ventures	Legend Capital, Lenovo Star, Sequoia Capital, IDG Capital, Zhen Fund
Bertelsmann	Licious, Treedo, Taxa
Byte beating	Sequoia Capital, Zhen Fund, Source Code Capital, Wuyuan Capital, Matrix Partners China
Jingdong	Sequoia Capital, IDG Capital

rounds is essential. At the same time, the strong cooperation with financial institutions can make up for deficiencies in investment experience. However, as the power of strategic investment institutions penetrates into all areas of society, the company's monopoly in various industries will increase, resulting in a series of social problems. Therefore, in the future, the government may strengthen the supervision of these strategic investment companies to prevent the emergence of chaebols in China.

References

Alibaba's venture capital investment strategy (2021) Retrieved 30 July 2021, from https://www.cmcmarkets.com/en-au/opto/alibabas-venture-capital-investment-strategy

Bary E (2021) Alibaba makes 'major strategic move' with $28 billion cloud investment over next 3 years. Retrieved 30 July 2021, from https://www.marketwatch.com/story/alibaba-makes-major-strategic-move-with-28-billion-cloud-investment-over-next-3-years-2020-04-20

Bernstein S, Lerner J, Sorensen M, Strömberg P (2017) Private equity and industry performance. Manage Sci 63(4):1198–1213

Che J (2018) Investment analysis about China's IT Company—The Tencent Holdings Limited. Mod Econ 9(6):1112–1120

Chesbrough HW (2002) Making sense of corporate venture capital. Harv Bus Rev 80(3):90–99

Gonzales J, Ohara F (2019) Chinese venture investments in the United States, 2010–2017. Thunderbird Int Bus Rev 61(2):123–131

Heel J, Kehoe C (2005) Why some private equity firms do better than others. McKinsey Q 1(1):24–26

Li JJ, Wang FS, Ye YQ (2014) Influence of private equity on small and medium-sized enterprises corporate governance. In: 2014 International conference on management science and engineering 21th annual conference proceedings. IEEE, pp 1113–1120

Liao R (2021) Tencent investment stays on game in 2020. Retrieved 30 July 2021, from https://www.msn.com/en-us/news/technology/tencent-investment-stays-on-game-in-2020/ar-BB1czeVY

Liao R (2021) Xiaomi's investment house of IoT surpasses 300 companies | Financial Content Business Page. Retrieved 30 July 2021, from https://markets.financialcontent.com/stocks/news/read/39976533/xiaomi%E2%80%99s_investment_house_of_iot_surpasses_300_companies

Low D (2021) Inside Tencent's USD 17 billion foreign investment gamble | KrASIA. Retrieved 30 July 2021, from https://kr-asia.com/inside-tencents-usd-17-billion-foreign-investment-gamble

Lunden I (2021) Intel has invested $132M in 11 startups this year, on track for $300M–$500M in total. Retrieved 30 July 2021, from https://techcrunch.com/2020/05/12/intel-has-invested-132m-in-11-startups-this-year-on-track-for-300m-500m-in-total/

Research on the Fraud of U.S.-Listed Chinese Stocks

Yumeng Peng, Yan Fu, Tianhao Jiang, Xiaofan Fan, and Xuefei Meng

Abstract This research article introduced two important models in analyzing financial fraud, one is the M-Score model and the other is the F-Score model. At the beginning of this article, the introduction of these two models have been presented in details. In the following parts, by using a series of samples, including the big companies like Luck in coffee and EDU, the advantages and the limitations of these two methods will be totally presented to readers. In this way, this article will help the readers to understand the range of application of M-Score and F-Score models. Besides, this article also presented the complementation relationship between M-Score model and F-Score model. By presenting this relationship, the readers could better understand why these two methods are often used together. All the content mentioned above were expressed by words and tables, making them much easier to be understand by all the readers.

Keywords Financial fraud · M-score model · F-score model

Y. Peng
Accounting School, Zhejiang University of Finance & Economics, Hangzhou 310000, China
e-mail: pym0901@163.com

Y. Fu
Department of Economics, Business School, Xiangtan University, Xiangtan 41105, China
e-mail: sirena_yan@163.com

T. Jiang
Qingdao No. 2 Middle School of Shandong Province, Qingdao 266061, China

X. Fan
Business School, Hubei University, Wuhan 430062, China
e-mail: 201931112020043@stu.hubu.edu.cn

X. Meng (✉)
Oaks Christian School, Westlake Village 91362, USA
e-mail: xmeng@student.oakschristian.org

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_147

1 Introduction

Financial fraud is a common phenomenon in recent world. To solve this problem, it is necessary to provide investors with a useful method to analyze the financial information presented by all the companies. In this article, two efficient methods named M-Score model and F-Score model will be introduced to readers. And before introducing these two methods, there will be a special part to provide basic information about the common financial fraud behaviors that have already been listed by SEC. This part will be presented to provide some basic background information for the following content of this article.

At the beginning of this article, there will be the introduction of these two methods. And then, in order to prove these two models are helpful in analyzing the financial fraud phenomenon, this article will provide enough examples and make convincing statements by using these examples.

Firstly, this article will calculate a series of M-Score and F-Score results from companies like the lucking coffee, iQIYI, and China-biotics. These companies had already been judged as financial fraud by the SEC. In this part, the M-Score and F-Score results themselves and the related indexes will be used as the tools for finding the economic problems hidden behind all kinds of companies.

By comparing the M-Score and F-Score results of these companies with other companies without financial problems, the advantages of using these two methods will be clearly demonstrated to the readers.

Secondly, this article will answer another important question: whether the two methods are suitable for all kinds of companies? The answer is absolutely not and this article could give a specific explanation on why they cannot be. These limitations will make sense of an apparent conclusion, all the economic models are waiting to be improved by scholars and researchers.

Thirdly, as an important part of supplement, this article will make some useful suggestions on how to reduce financial fraud in current society. This article supported the ideas like improving relevant regulations and laws and keeping a cautious attitude while using the M-Score model and F-Score model.

2 Introduction to Financial Fraud

Article 16 of the announcement of auditing standards of the United States clearly stipulates that deliberately preparing false financial statements is financial fraud (Nian 2019). These years there have been several listed companies found making financial fraud. They use a variety of fraud methods. For instance, Luckin Coffee increased the book profit by falsely increasing the number of orders and the net selling price of each commodity (Kou and Cui 2020). However, Longtop started from the cost and transfers the cost through affiliated enterprises, so as to achieve the purpose of virtual increase of profit (Jiang 2014). Although the approaches making fraud are different

between the companies. The final purposes are similar, which are making the book profit considerable, taking the company's assets as their own and tax avoidance.

3 Model

Beneish M-score is a mathematical model that can be used to determine whether a company is likely to have manipulated its earnings. Days sales in a receivable index (DSRI), gross margin index (GMI), asset quality index (AQI), sales growth index (SGI), depreciation index (DEPI), sales and general and administrative expenses index (SGAI), leverage index (LVGI), and total accruals to total assets (TATA) are the eight indices involved in the calculation of the M-score (Vaidya and Srivastav 2022).

According to Beneish, GMI, AQI, SGI, DEPI, SGAI and TATA are all positively correlated with the probability of earnings manipulation (Beneish 1999). DSRI evaluates whether receivables and revenues balance over a two-year period. Exaggerated revenues and earnings are likely to cause a significant rise in DSRI. A gross margin index greater than one means that gross margins have decreased. AQI calculates the portion of total assets with uncertain future benefits. A DEPI larger than one shows that the pace of asset depreciation has slowed. The incentive of debt covenants to manipulate revenue is reflected in LVGI. Beneish suggests that with abnormal increase in accounts receivable, deterioration in gross margin, decline in asset quality, growth in sales and increase in accruals, the likelihood of manipulation increases. When a firm's M-score exceeds − 2.22, it implies that the firm has a high probability of becoming a manipulator. The higher the M-score value, the higher the probability of financial manipulation (Table 1).

Table 1 Calculation of M-score and the eight variables

M-score	$-4.84 + 0.92 * \text{DSRI} + 0.528 * \text{GMI} + 0.404 * \text{AQI} + 0.892 * \text{SGI} + 0.115 * \text{DEPI} - 0.172 * \text{SGAI} + 4.679 * \text{TATA} - 0.327 * \text{LVGI}$
DSRI	$(\text{Net Receivables}_t/\text{Sales}_t)/(\text{Net Receivables}_{t-1}/\text{Sales}_{t-1})$
GMI	$[(\text{Sales}_{t-1} - \text{COGS}_{t-1})/\text{Sales}_{t-1}]/[(\text{Sales}_t - \text{COGS}_t)/\text{Sales}_t]$
AQI	$[1 - (\text{Current Assets}_t + \text{PP\&E}_t + \text{Securities}_t)/\text{Total Assets}_t]/[1 - ((\text{Current Assets}_{t-1} + \text{PP\&E}_{t-1} + \text{Securities}_{t-1})/\text{Total Assets}_{t-1})]$
SGI	$\text{Sales}_t/\text{Sales}_{t-1}$
DEPI	$(\text{Depreciation}_{t-1}/(\text{PP\&E}_{t-1} + \text{Depreciation}_{t-1}))/(\text{Depreciation}_t/(\text{PP\&E}_t + \text{Depreciation}_t))$
SGAI	$(\text{SG\&A Expense}_t/\text{Sales}_t)/(\text{SG\&A Expense}_{t-1}/\text{Sales}_{t-1})$
LVGI	$[(\text{Current Liabilities}_t + \text{Total Long Term Debt}_t)/\text{Total Assets}_t]/[(\text{Current Liabilities}_{t-1} + \text{Total Long Term Debt}_{t-1})/\text{Total Assets}_{t-1}]$
TATA	$(\text{Income from Continuing Operations}_t - \text{Cash Flows from Operations}_t)/\text{Total Assets}_t$

Table 2 Calculation of F-score and the seven variables

rsst_acc	△Non-cash net operating assets/average total assets
ch_rec	△Receivables/average total assets
ch_inv	△Inventory/average total assets
soft_assets	(Total assets − net PP&E − cash & equivalents)/total assets
ch_cs	% change in (sales − △receivables)
ch_roa	Change in ratio of net income/average total assets
Issue	Equals 1 if long-term debt or common and/or preferred equity issued
Predicted value	− 7.893 + 0.790 * RSST_accr + 2.518 * ch_rec + 1.191 * ch_inv + 1.979 * soft_assets + 0.171 * ch_cs − 0.932 * ch_roa + 1.029 * issue
Predicted probability	$e^{(\text{PredictedValue})}/(1 + e^{(\text{PredictedValue})})$ where e = 2.71828183
F-score	Predicted probability/unconditional probability (0.0037)

Another fraud detection model is the Dechow F-Score model. It is calculated using seven different indicators: change in non-cash net operating assets (rsst_acc), change in receivables (ch_rec), change in inventory (ch_inv), percentage soft assets (soft_assets), change in cash sales (ch_cs), change in return on assets (ch_roa), and debt or equity issuance (issue). An F-score greater than 1 implies that the company is above normal risk, and an F-score greater than 2.45 suggests that the company is at high risk (Dechow et al. 2011) (Table 2).

4 Hypothesis and Sample Selection

In this research, we hypothesized that the models of M-score and F-score would be useful for the analysis of corporate financial risk and financial fraud. To test our hypothesis, we selected 10 pairs of U.S.-listed companies. In each pair, there is one Chinese company that has been accused of financial fraud and one company in the same industry that has not committed financial fraud. After the screening of the U.S.-listed Chinese stocks accused of financial frauds, we chose Luckin Coffee, iQIYI, RINO International Corporation, China Marine Food Group, NQ Mobile, Longtop Financial Technologies, China MediaExpress, China-Biotics, TAL Education Group, and China Green Agriculture as the sample stocks for analysis. We found Starbucks, Netflix, Albemarle Corporation, Whole Foods Market, Apple, American Express Company, Ericsson, BioCryst Pharmaceuticals, New Oriental Education & Technology Group, and Wells Fargo as the comparison stocks.

We collected the annual reports of these companies from the SEC website and looked for the data we needed for calculations in their annual reports. However, since the intervals between listing and delisting of these stocks were not long, and they stopped updating their financial reports after delisting, there were not many years of data that can be accessed on the SEC website. In addition, due to the limitation of

the M-score and F-score formulas, which require data from the current year and the past two years, we were unable to calculate the M-score and F-score for the first two years in the financial reports. Therefore, we ended up with a limited number of years for which M-score and F-score were available.

5 Data Statistics and Analysis

The number of fraudulent companies shall be arranged according to the value of M-scores and F-scores from large to small (Table 3).

Because Luckin coffee was listed in the United States in 2017 and delisted in 2019. Therefore, we can just find its financial statements of three years. Also, we compared Luckin coffee's M-scores from 2018 to 2019 with that of Starbucks in the same year. Even though it was pointed out that Luckin coffee committed fraud in 2019, we can see clearly that some indexes have been abnormal. We can find that Luckin coffee's GMI in 2018 was unexpectedly low, which means the gross profit margin increased sharply. Also, Luckin Coffee's SGI in 2018 was over 3000, which indicates the increased speed of sales was amazing. Companies with fast growth of this index are prone to fraud much more easily. Luckin coffee's TATA in 2018 was higher than Starbucks'. It might be related to the surplus operation. In 2019, we can find that the Luckin coffee's index of days sales in receivables was the highest compared with Starbucks and that of Luckin coffee in 2018. We can see that Luckin Coffee's accounts receivable in 2019 was twice as much as in 2018. Compared with Luckin coffee, Starbucks; DSRI was relatively steady, just floating up and down on 1. Judging from SGI in 2019, we found that the sales in Luckin coffee continued to go up. Therefore, It is not difficult for us to conclude that the abnormal value of M-scores of Luckin was due to its increase of sales, accounts receivable and accrued expense (Table 4).

The M-score of iQIYI in 2021 was much higher than any other years and that of Netflix which indicated extremely high risk of manipulation. However, the indicators of iQIYI in other years were in a stable trend, which were below the average risk. In contrast, Netflix's M-scores showed a steady fluctuation over the period from 2019 to 2021 which were adjacent to the level of average risk. From the variables of iQIYI, we could discover that DSRI ranked first with 70.9244 among DSRI of two companies in these years which revealed the imbalance of the ratio of receivable and sales. We speculate that it may derive from the purpose of exaggerating the sales for the current year by credit sales to identify the revenues in advance which was exactly the fraud method reported by professional organization (Table 5).

According to the statistics shown in the graph above, the M-score of RINO is higher than that of ALB in three years. Besides, M-scores of RINO (0.133, − 0.673) in these years were higher than that of non-manipulators (− 2.22) which indicates higher potential of manipulation. To figure out the factor that contributes to the uncommon M-score, we compared the indicators of RINO with that of ALB. What we discovered was that AQI in 2009 (4.846) was abnormal compared to the indicators

Table 3 Luckin coffee M-score versus Starbucks M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
Luckin coffee (2018)	0.114216016	− 5.875746147	0.377974296	3362.78	0.217194994	0.005131735	0.250956773	− 0.533272158	2989.361998
Luckin coffee (2019)	2.351149401	0.791907485	0.640076171	3.598134877	0.601766001	0.784820979	1.636360661	− 0.1637552	− 0.157774951
Starbucks (2019)	1.182890845	1.001234988	1.563980938	1.072376059	0.985246378	0.995778662	1.474753371	− 0.095532685	− 2.621892988
Starbucks (2018)	0.72115622	0.878194259	0.819041601	1.104199796	0.981351016	1.066383567	1.077625818	− 0.385661771	− 4.624468358

Table 4 iQiyi M-score versus Netflix M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
IQIYI (2018)	0.7388	0.6843	0.7932	1.4379	0.9739	1.0836	1.0074	− 0.2102	− 3.5833
IQIYI (2019)	1.2846	1.0410	1.7597	1.1603	0.9959	1.0828	0.8137	− 0.2305	− 2.7789
IQIYI (2020)	− 0.0106	1.5703	0.5554	1.0246	0.9808	0.9670	1.6624	− 0.1462	− 4.1635
IQIYI (2021)	70.9244	1.3870	1.3707	1.0285	0.9992	0.8856	1.0776	− 0.1457	61.5424
Netflix (2019)	0.9817	0.9637	1.2799	1.2762	1.0054	1.2588	0.9808	0.0549	− 1.9373
Netflix (2020)	1.0840	0.9845	− 0.0313	1.2401	1.0257	0.9588	0.9450	0.0703	− 2.2564
Netflix (2021)	1.1083	0.9339	1.2144	1.1881	1.0170	0.7799	0.8641	0.1148	− 1.5395

of its former year and ALB in three years which may be due to the manipulation of exaggerating the capitalization and deferring the cost to the remaining years in order to reach a higher profit. Meanwhile, the M-score of RINO in 2009 was the highest among these samples which represents the highest risk accordingly. It is obvious that SGI (5.9) and SAI (3.6) in 2007 were beyond others too much. After our research, we concluded that SGI was due to the surging of sales in 2007 and SAI was owing to the larger proportion of general and administrative expense resulted in the sharp upward tendency in 2007 (Table 6).

China Marine Food's M-scores over the period from 2007 to 2011 exceeded the average level of manipulation risk which presented a high risk. Meanwhile, the M-scores of Whole Foods remained constant around the average level during the period which showed a steady level of risk though it may appear moderate high risk in two years. From the analysis of the China Marine Food's variables, it can be found that the average number of DSRI surpassed that of Whole Foods a lot which may be due to the drastic change of ratio of receivables and sales over the years. Besides, The China Marine Food's M-score in 2010 ranked the first with 1.95 which was far more above the average level. Among its variables, there is an abnormal indicator (AQI) with 7.7427 (Sec.gov n.d.). It may reveal the drastic fall of the proportion of current assets and PPE in 2010.

According to the statistics shown in Table 7, NQ's M-scores exceeded − 2.2 before 2014, which indicates potential manipulator both in the year of 2012 and 2013. And compared with NQ, Apple's M-cores in 2012 and 2015 were well below—2.22, which shows a good financial position. However, Apple's M-scores in 2013 and 2014 exceeded − 2 even though this company has not been found to have committed fraud. Therefore, this model is not suitable for Apple to analyze financial fraud. And we find that NQ had some abnormal indexes in 2012 before it was found to have committed

Table 5 RINO M-score versus ALB M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
RINO (2009)	0.811657966	1.038773074	4.845528455	1.382501863	0.824595	0.882576391	0.511602884	0.15209727	0.133376939
RINO (2008)	1.117390539	1.237409819	0.699466647	2.190391896	1.0328681	0.430187625	1.020319883	0.1290286	− 0.607366445
RINO (2007)	0.632837344	1.04264596	0.108803484	5.914362255	0.143664426	3.605750312	0.339932845	0.61062971	3.754605891
ALB (2007)	1.078254195	0.873512234	2.699448499	0.986070072	0	1.044392789	0.852087014	− 0.004522968	− 1.896070965
ALB (2008)	0.729650951	1.08039637	0.939024206	1.056078767	0	0.985934499	1.192917454	− 0.046293073	− 3.053153834
ALB (2009)	1.235678954	1.023061346	1.064579851	0.81272801	0	1.025433672	0.870852739	− 0.06497114	− 2.773098728

Table 6 CMFO M-score versus WFM M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
CMFO (2007)	2.4438	0.9500	0.4971	1.3273	0.9406	1.1667	0.2299	0.2538	0.3145
CMFO (2008)	0.8599	0.9503	2.4380	1.3397	1.0742	2.6755	1.6831	0.2154	− 1.2463
CMFO (2009)	2.7405	1.1325	0.9835	1.4260	1.0575	0.7559	0.9239	0.2145	0.6417
CMFO (2010)	1.4616	0.9003	7.7427	1.7630	0.0412	1.8856	0.6423	0.1708	1.9502
CMFO (2011)	1.2055	1.3855	1.0646	1.1734	1.1416	1.4772	0.8306	0.0617	− 1.6283
CMFO (2012)	0.7204	0.9676	0.3654	1.0929	2.7010	1.6973	2.1117	0.0307	− 3.0721
WFM (2010)	1.1714	0.9953	0.9721	1.1224	1.0143	0.9874	0.6632	0.0798	− 1.7396
WFM (2011)	0.9684	0.9849	1.2167	1.1574	1.0103	0.9588	0.9047	0.0879	− 1.8384
WFM (2012)	0.8665	0.9913	0.9099	1.1041	1.0155	1.0338	1.0645	0.0995	− 2.1105

fraud. It is clear that its DSRI, AQI and SGI show some unusual circumstances related to the overestimation of revenue or profits, capitalizing more cost, deferring cost and sales growth. After being caught falsifying financial statements in 2013, NQ revised a lot of misbehaviours, hence, in 2014 and 2015, its M-scores were below − 2.22, which indicates the non-manipulator (Table 8).

The number of M-score of LONGTOP is higher than that of AXP in both years. It is indicated in the statistical research of M-score that the company which has higher M-score than − 2.22 means greater possibility of manipulation. Therefore, we can conclude that LONGTOP, which was about 0.799 and 1.657, has a higher chance of manipulation compared to AXP, whose M-scores were below − 2.22. Tracing its variables in both years of LONGTOP, we discover several abnormal numbers. AQI in 2009 was over 10, which was far more than that of in 2010 and AXP. Since this indicator reveals the risk of non-current assets liquidation and the intendancy of capitalization, it may point that LONGTOP exaggerated the capitalization and deferred the cost to the remaining years to reach a higher profit. Besides, DEPI in 2010 (22.78) was much higher than others which indicates the decrease of the rate of depreciation. In conclusion, two of the abnormal variables are focused on minimizing the cost of assets in common by which I mean transfer the cost to the assets by capitalization and reduce the depreciation in order to achieve a lower expense for the current year (Table 9).

The M-score of CCME is less than − 2.22 in 2009, which means it is likely that CCME committed financial fraud in 2009. We found that the SGI of CCME

Table 7 NQ M-score versus Apple M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
NQ (2012)	− 1.289513702	− 0.298486859	− 0.956687098	0.914031278	− 0.891851697	0.000474314	1	− 8.117800871	0.080566161
NQ (2013)	− 0.081966678	0.064015028	0.018700705	0.699139428	− 0.945317931	− 0.004100501	1	− 5.519522067	1.078855369
NQ (2014)	0.239626655	0.00940014	0.006502352	0.809346996	0.923216891	− 0.105832945	1	− 4.78507699	2.238994057
NQ (2015)	0.0170971	− 0.001435252	− 0.013819493	0.845563504	0.252883661	0.108311458	1	− 5.25489927	1.403985391
Apple (2012)	0.230961469	0.031585105	8.51963E− 05	0.851201836	0.462909965	− 0.185297515	1	− 4.665524355	2.520677789
Apple (2013)	0.009533655	0.011340142	0.005080091	0.850937198	0.117862561	− 0.043660737	1	− 5.077012527	1.67563264
Apple (2014)	− 0.052807522	0.019861498	0.001581446	0.851327861	0.057479643	− 0.013306349	1	− 5.146814815	1.563311916
Apple (2015)	0.002037596	− 0.002340171	0.000911556	0.849864816	0.313214188	0.02443659	1	− 5.154529992	1.551366062

Table 8 Longtop M-score versus AXP M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
LONGTOP (2009)	0.871239575	0.929103194	10.04100774	1.612597852	1.135150663	0.626799472	1.025175442	0.004780293	1.656978743
LONGTOP (2010)	1.380884806	1.05132896	0.860458126	1.590436141	22.77645757	0.480043593	1.406747645	−0.006323163	0.798942398
AXP (2009)	1.217508477	0.058870194	1.006579866	1.217508477	0	1.039200095	0.976076437	−0.033843674	−2.852406875
AXP (2010)	0.933821397	−15.66326128	0.994943267	0.933821397	0	1.174716527	1.006341892	−0.033251534	−11.70286947

Table 9 CCME M-score versus ERIC M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
CCME (2009)	0.2213	0.5444	− 0.1108	2.0507	0.0423	0.2739	1.3146	0.2669	− 1.7876
CCME (2010)	0.1592	0.9165	0.5913	1.0055	0.2237	0.9775	6.6275	0.0073	− 5.3493
CCME (2011)	0.2280	0.5936	− 0.9745	1.0504	0.1995	0.2625	1.2917	0.0086	− 4.1778
ERIC (2009)	0.2280	0.5936	− 0.9745	0.9517	0.1995	0.2625	1.2917	0.0082	− 4.2677
ERIC (2010)	0.9617	0.6547	− 1.2378	1.9523	0.2089	0.3478	1.2736	0.0043	− 2.8002
ERIC (2011)	0.2342	0.5940	− 1.1455	1.0565	0.1890	0.2677	1.2507	0.0073	− 4.2305

in 2009 is high. Although sales growth in itself does not imply manipulation of profits, faster-growing companies are more likely to engage in accounting fraud, putting pressure on managers to meet profitability targets because of the company's financial situation and capital needs. We also find that in 2010, LVGI of CCME was higher than 1, indicating that the enterprise had high financial risk, thus increasing the default risk of the enterprise. To avoid such a financial problem, CCME has an incentive to manipulate earnings even though the M-score of CCME in 2010 is less than − 2.22. After all, an M-score is only a probability indicator of financial fraud. Having an M-score lower than − 2.22 does not mean the company does not manipulate its financial statement. The M-score of ERIC is less than − 2.22 in each year, which suggests that companies are unlikely to engage in financial manipulation.

According to Table 10, we can clearly find that the M-score of CGA in 2009 and 2010 is higher than − 2.22, which indicates that the likelihood of financial manipulation in 2009 and 2010 is high. Besides, in 2009, the SAI of CGA was higher than 1, which shows that the enterprise sales and management expenses increased. Thus, we speculate that CGA was encountering problems of cost control in 2009. To avoid such a financial problem, the enterprise had incentive to improperly manipulate earnings. Moreover, we also find that the AQI of WFB in 2010 is also high. Since WELLS FARGO represents the proportion of future uncertain assets in the total assets, AQI is an important indicator in asset liquidation analysis. If AQI is greater than 1, it means that the company may increase the strength of cost extension (Table 11).

From the chart above. We can see the useful function of the M-Score method. Here are the two companies' M-Score results from 2008 to 2011, let's see what could be found from the data above. I mean, what could we know from the M-Score itself and the related indexes?

Table 10 CGA M-score versus WFB M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
CGA (2008)	0.0338	0.2278	− 2.2537	1.0507	0.0423	0.2739	0.1887	0.1669	− 3.9847
CGA (2009)	0.5222	0.9242	0.4221	1.4363	1.0424	2.6272	0.0715	0.7522	0.7444
CGA (2010)	1.0571	1.0312	4.0272	1.3232	0.8881	0.9396	− 0.0321	0.9751	3.9980
WFB (2008)	1.4712	0.5444	− 1.9372	1.0507	0.0423	0.2739	0.1887	0.1669	− 2.3673
WFB (2009)	0.1592	0.9165	0.5913	1.0055	0.2237	0.9775	6.6275	0.0073	− 5.3493
WFB (2010)	0.9734	1.0006	0.8508	0.9942	0.9473	0.9805	1.0328	0.0081	− 2.5450

Table 11 CHBT M-score versus BCRX M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
CHBT (2008)	0.6679	1.521	0	1.4123	2.1834	1.0154	1.1359	0.755	1.075
CHBT (2009)	0.8526	0.9815	0	1.2806	1.464	1.1983	0.8695	0.4445	− 0.6373
CHBT (2010)	0.97	0.783	0.8332	1.5013	1.1705	0.841	0.7194	0.4494	− 0.0094
CHBT (2011)	0.9307	1.194	0.9886	1.3397	0.8445	1.1112	0.5266	0.6359	0.9503
BCRX (2008)	0.3857	1	0.1757	0.794	0.9265	1.384	0.8303	0.5536	2.1873
BCRX (2009)	2.1341	1.0649	3.38	1.3187	0.9056	0.7381	0.8717	0.4303	1.933
BCRX (2010)	1.0718	0.9404	0.9437	0.8363	0.8803	1.3843	1.0237	0.4269	− 0.7043
BCRX (2011)	0.6126	0.9986	1.906	0.3149	0.9391	3.247	2.0334	0.1556	− 3.0856

Firstly, it is obvious that the M-Score of the CHBT was suspicious. From 2008–2011, the M-Score was all below − 2.22, which indicates that CHBT has a high probability of manipulation in these years.

Secondly, it is important to see the related indexes. We could see that the DEPI results of the CHBT company were far from the non-risk level. If the DEPI index is higher than 1, the enterprise probably used some special ways to lower the depreciation fees. For example, the company may provide false data of the useful life

Table 12 TAL M-score versus EDU M-score

Company (year)	Variable								
	DSRI	GMI	AQI	SGI	DEPI	SAI	LVGI	TATA	M-score
TAL (2018)	0.6629	1.0284	0.8534	1.6443	1.063	0.9771	0.7374	0.2251	− 0.97
TAL (2019)	0.6923	0.8894	1.214	1.4945	1.1432	1.1334	0.697	− 0.2143	− 3.2
TAL (2020)	0.8536	0.9898	1.067	1.277	1.0355	1.2129	1.6842	− 0.207	− 1.61
TAL (2021)	0.5925	1.0133	0.585	1.374	1.3989	1.2355	1.0497	0.1595	− 1.91
EDU (2018)	0.6995	1.0329	1.3597	1.3594	1.2152	1.079	1.0758	0.2449	− 1.14
EDU (2019)	0.8205	1.0166	0.9481	1.2652	0.9715	1.0016	1.0299	− 0.0578	− 2.7
EDU (2020)	1.0952	0.9992	2.3756	1.156	1.012	0.9706	1.232	− 0.0506	− 2.004
EDU (2021)	1.7359	1.0617	0.8228	1.195	1.0063	1.116	0.8993	0.0125	− 2.09

of the assets, which could help the profit higher than it should be. Certainly, these behaviors are totally illegal, but they may help to explain why the CHBT has such strange M-score results.

Besides, the AQI results of CHBT in 2008 and 2009 were totally abnormal, too (China Bio CHBT 2022). The AQI index was the percentage in which the PP&E and the Current Assets take in the Total Assets. If the CHBT could maintain a recording result as 0 for two years, which means that it needs no current assets in the operation of the company. This conclusion cannot be true unless the company becomes bankrupt (Table 12).

Here are another pair of contrasts, the TAL and the EDU, two companies competing in the educational industry. But TAL was the only one that was determined as financial fraud in 2020. This company could be used to show how to find out the unreasonable financial statement by using the M-Score method. In 2020, the M-Sore of TAL was − 1.61, higher than − 2.22. It is easy to come to the conclusion that in this year, the company has a higher probability of manipulation. And in order to explain why, it is necessary to analyze the related indexes at the right side of the M-Score row.

Firstly, the AQI index was higher than 1 in 2020 (TAL 2022), indicating that the quality of assets of TAL had dropped compared to before. Thus, the company has the tendency to capitalize the abnormal expense in these two years. In this way, the company could make the financial report still look perfect.

Secondly, the DEPI result of LVGI result also represented a problem about improper use of leverage of TAL in 2020. As far as the LVGI index reached above 1, the finance risk of this company would increase a lot at once. In this situation,

Table 13 iQiyi F-score versus Netflix F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
IQIYI (2018)	1.2369	− 0.0010	0.0000	0.8614	0.3986	− 0.2322	1	− 3.9682	5.0153
IQIYI (2019)	0.8678	− 0.0060	0.0000	0.8283	0.1694	0.0591	1	− 4.6094	2.6648
IQIYI (2020)	0.8017	0.0176	0.0000	0.7446	− 0.0127	0.0790	1	− 4.7864	2.2361
IQIYI (2021)	0.8709	0.0140	0.0000	0.8978	0.0357	0.0150	1	− 4.3780	3.3512
Netflix (2019)	0.9660	0.0031	0.0000	0.8357	0.3002	− 0.0310	1	− 4.4103	3.2448
Netflix (2020)	0.8484	0.0043	0.0000	0.7667	0.2380	0.0131	1	− 4.6778	2.4902
Netflix (2021)	0.9195	0.0046	0.0000	0.8351	0.1878	0.0466	1	− 4.5168	2.9205

the default risk of this company would be judged as D by Standard & Poor's. All in all, the M-Score method provided us a simple but efficient way to judge whether a company may have financial fraud behaviors or not. By looking at the M-Score itself and the related indexes, a lot of useful information could be collected by researchers.

Table 13 shows iQIYI's F-scores from 2018 to 2021 and Netflix' F-scores from 2019 to 2021. We find that both of these two companies in those years have high F-scores, exceeding 2.45, which indicates that iQIYI and Netflix have high financial risk or the risk which is above the normal level. However, Netflix is the company which has never been found to have any fraud in its financial statements, and iQIYI was just found to have financial fraud in 2020. Therefore, the F-score model is not suitable to analyze iQIYI and Netflix financial risk (Table 14).

From the graph above, we can find that all of China Marine Food's F-scores from 2009 to 2012 exceed 2.45, which indicates that China Marine Food had high financial risk during that period. Compared with China Marine Food, it is clear that Whole Foods' F-scores were just over 2 or close to 2, that means Whole Foods just had the financial risk above the normal level slightly. Exploring China Marine Food's indicators carefully, we can find there are several abnormal phenomenons. Its ch_rec was much higher than that of Whole Foods in the year of 2010 and 2012, that means its receivables increased sharply. It is an approach to whitewash sales growth. Additionally, its soft_assets also occupied a considerable part, such as intangible assets. And we can find clearly that all of China Marine Food's ch_cs in these years are higher than that of Whole Foods. More soft assets provide more opportunities to the company to satisfy the short-term profit by accounting change such as extension of depreciation period. However, its ch_roa were always below 0 but that of Whole Foods was always above 0 during these years. It needs us to think over later why China Marine Food's sales increased but net profit fell instead. Additionally, we

Table 14 CMFO F-score versus WFM F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
CMFO (2007)	0.3895	0.1168	0.0021	0.1800	− 0.0424	− 0.2376	1	− 5.6820	0.9176
CMFO (2008)	0.4665	0.0015	0.1281	0.2723	0.4363	− 0.0902	1	− 5.7162	0.8869
CMFO (2009)	1.0164	0.2345	− 0.0469	0.7681	0.1538	− 0.0157	1	− 3.9917	4.9000
CMFO (2010)	1.1292	0.3099	0.0638	0.8032	0.6732	− 0.0231	1	− 3.5046	7.8869
CMFO (2011)	1.0531	0.1531	− 0.0084	0.9151	0.3318	− 0.1554	1	− 3.7007	6.5164
CMFO (2012)	1.0195	− 0.1024	0.1931	0.7496	0.3883	− 0.0337	1	− 4.5716	2.7664
WFM (2010)	0.9857	0.0101	0.0032	0.4853	0.1345	0.0195	1	− 5.1138	1.6155
WFM (2011)	1.0860	0.0044	0.0078	0.5690	0.1601	0.0144	1	− 4.8731	2.0518
WFM (2012)	0.9690	− 0.0016	0.0073	0.5092	0.1069	0.0046	1	− 5.0904	1.6535

found that the F-score model exists some limitations because even though Whole Foods did not commit fraud during that period, its F-scores were still above 1.

Table 15 illustrates NQ's and Apple's F-scores from 2012 to 2015. We can see clearly that Apple's F-score in 2012 was higher than 2.45, which means that it had high financial risk. And that in 2013, 2014 and 2015 exceeded 1, that means it has the financial above normal level. However, Apple had never been found to have committed financial fraud. Therefore, we can see that this model is not suitable for Apple's financial analysis. As for NQ, we found that its F-scores in the year of 2013, 2014 and 2015 are above 1, which indicates that NQ has the financial above normal level. Tracing to the individual indexes, we can find several abnormal phenomena. We can see that NQ's ch_cs in 2013 and 2014 fluctuated violently, which might be related to the fraud of sales and account receivable. After excluding earnings management, the sales have been profitable since 2014. That means the sales increased in a more rapid way in 2014 but accounts receivable increased more quickly in 2013. Also, NQ's rsst_acc increased in 2014. The total accrual account contains many receivables, and the modification of receivables is usually a major way of financial fraud.

According to Table 16, F-scores of RINO in 2007 and 2008 in three years were above the normal risk and were even adjacent to the level of high risk (2.45). On the contrary, those of ALB remained stable at a low level which presented a stable and secure financial condition. We discovered that the RINO 's variable of ch_rec in 2007 and 2008 were far more than that in 2009 and that of ALB which indicated the surge of receivables over the period from 2006 to 2008. We deduced that it may derive from the change of credit policy to adapt to the competitive market and attract more customer resources or the modification of the revenues by inflating sales and identifying the revenues in advance. On top of that, the average level of ch-cs of RINO was higher than that of ALB over the period. Since this indicator shows the change in cash sales with the former year, it means that the proportion of cash sales of each year was climbing up steadily, though the receivables still took up a larger part compared to ALB (Table 17).

According to the statistics shown above, we can find that Luckin coffee's F-scores in 2018 and 2019 were less than 1. But Starbucks' in 2018 was higher than 2.45, that means Starbucks in 2018 had high financial risk. However, in fact, there was no fraud found in Starbucks, but Luckin coffee was found that made fraud in financial statements. Therefore, we can conclude that F-score has some limitations when used in the financial risk analysis of fraudulent companies. Let's explore why this phenomenon happened. We find that the calculation of the indexes of F-scores just use the differences between the year and the last. Hence, if the company has fraudulent motivations for several years, it might be difficult to detect by this model. Additionally, when the company's sales increase sharply due to the stimulation of the macro environment, the differences will be very considerable. And the final result will show that the company has high financial risks (Table 18).

The F-score of LTP in 2010 and AXP in 2009 and 2010 outnumbered 1 which indicated their risk of manipulation above normal level. Compared to the variables in 2009, rsst_acc in 2010 appeared to be abnormal which was almost five times of that in 2009. We projected that it may be due to the imbalance of the growth of

Table 15 NQ F-score versus Apple F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
NQ (2012)	6.149462183	0.468705874	4.032240912	0.00289662	0.315693743	2.544402577	0.463070163	− 0.040703542	1.953382745
NQ (2013)	0.701473992	1.222478389	1.686421943	2.143470491	0.64372759	0.977136746	1.182101895	− 0.042880915	− 1.637111162
NQ (2014)	1.605761142	− 0.830450769	1.58041383	0.674329697	0.884520471	2.522115549	0.72579722	− 0.108909965	− 3.640197916
NQ (2015)	0.321832108	− 3.300233876	1.047115905	3.066080125	0.9441242	0.162968857	3.082832798	− 0.082507835	− 4.442056496
Apple (2012)	0.230484461	0.530536167	1.067961125	0.266170139	3.940415605	0.436148498	0.697221607	− 0.103307525	− 4.012188264
Apple (2013)	1.408037137	0.922674993	1.069893214	1.445814742	1.08096477	0.913828334	0.910785237	0.283482143	− 0.339811181
Apple (2014)	1.097707169	1.166029111	0.967510846	1.092020855	0.604740714	0.987788149	1.337727254	0.238811594	− 1.269880791
Apple (2015)	1.245976371	0.975029694	1.087775285	1.069539524	1.040289758	1.035386597	1.361503283	− 0.091369442	− 2.716577954

Table 16 RINO F-score versus ALB F-score

Company (year)	Variable							
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	F-score
RINO (2009)	0.119177876	0.024305174	0.022252498	0.433550655	0.415657802	0.185913388	1	0.672546015
RINO (2008)	0.070656965	0.33696646	0.011338711	0.722332362	0.557370011	0.19384685	1	2.447094303
RINO (2007)	0.61062971	0.368339088	0.004263152	0.704145955	0.673445632	0.172539465	1	3.931995189
ALB (2007)	0.100335821	0.009440299	0.035261194	0.95385159	0.0893445	− 0.0485739	1	0.008402843
ALB (2008)	− 0.099842188	− 0.0342276	0.023180782	0.91183432	0.099001794	− 0.089905141	1	0.006082665
ALB (2009)	0.028875111	0.000496014	− 0.067812223	0.888600289	− 0.279996007	− 0.243066003	1	0.006803402

Table 17 Luckin coffee F-score versus Starbucks F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
Luckin coffee (2018)	− 1.330238993	0.002405527	0.076723062	0.272332942	1	− 0.67997802	1	− 6.47376811	0.416492067
Luckin coffee (2019)	0.407772672	0.005190779	0.035558694	0.303006445	2.576796022	0.370119305	1	− 5.791108121	0.82305224
Starbucks (2018)	− 0.002161077	− 3.6234E− 05	7.45932E− 06	0.39207001	0.117189884	− 1.55939883	1	− 4.616483878	2.646133822
Starbucks (2019)	− 0.061379565	0.008580782	0.005943379	0.525572853	0.057264387	0.164818103	1	− 5.987514469	0.676651599

Table 18 Longtop F-score versus AXP F-score

Company (year)	Variable							
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	F-score
LONGTOP (2010)	0.33475219	0.075625333	0.002961922	0.40903752	0.267352648	0.033068087	1	1.014556022
LONGTOP (2009)	0.077782737	0.028249125	0.011917343	0.252073282	0.25836493	0.032758647	1	0.544809118
AXP (2009)	0.026083133	0.013029576	− 0.081055156	0.970483481	− 0.487492293	− 0.149102808	1	1.937300546
AXP (2010)	0.004106352	0.016469719	0.204579025	0.965576005	0.104370464	0.431754572	1	1.722410113

Table 19 CCME F-score versus ERIC F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
CCME (2009)	0.3214	0.0345	0.0503	0.3526	0.0714	0.0019	1	− 5.755082	1.013750
CCME (2010)	1.3214	1.0345	1.0003	0.0752	0.0529	0.0032	1	− 1.868981	1.405449
CCME (2011)	0.0719	1.0342	0.0758	0.0852	0.0382	0.0023	1	− 3.939806	1.039498
ERIC (2009)	− 0.0614	0.0052	0.3792	0.0882	0.0198	0.7129	1	− 6.934274	1.008240
ERIC (2010)	− 0.0024	0.0054	0.8192	0.0452	0.0163	0.4359	1	− 6.190652	1.011249
ERIC (2011)	− 0.3827	0.1982	0.0817	0.0923	0.0157	0.0032	1	− 6.387597	1.010322

the non-cash net operating assets which presented a drastic conversion of the capital structure. Meanwhile the AXP's F-score showed a high risk which was contradictory to the fact. After making a comparison to the variables of LTP, we concluded that this discrepancy may result from the unique characteristic of this company from its indicators of soft assets in these years. AXP is a financial IT enterprise whose current assets, like deposits and placement to other banks, occupy a large proportion of its assets to adapt to the daily operations which can account for the eccentric phenomenon (Table 19).

The F-score of CCME in 2009 is larger than 1, which means it is likely that CCME committed certain financial frauds in 2009. We find that ch_rec of CCME in 2009 is fewer than those of other years, indicating that CCME may have an obviously inadequate operating situation compared with following years. Thus, in order to attract more investors, CCME probably manipulated their earnings. We also find that the F-score of Eric from 2009 to 2011 is also higher than 1. However, there is no evidence to show that Eric committed any financial fraud from 2009 to 2011. The reason why this phenomenon happens is probably because of the high value of ch_inv of Eric. Probably Eric in these three years had many inventories that were not sold to the markets, which created high value of ch_inv, causing abnormal F-score (Table 20).

The F-score of CGA in each year is more than 1, so we can easily conclude that CGA may commit financial frauds in these three years. Besides, we can find that the difference of F-score in these three years is large. Why does this happen? We think it is likely that the company had various operational problems in different areas over the years. Thus, the high F-score and the huge difference in the change of F score from year to year inevitably lead us to suspect the existence of financial fraud in CGA from 2009 to 2010. However, F-scores of WFB in 2009 and 2010 are also higher than 1. However, there are no reports about financial frauds in 2009 and 2010. We deem that the abnormal value of F-score of WFB is caused by high value of soft_assets,

Table 20 CGA F-score versus WFB F-score

Company (year)	Variable								
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	e	F-score
CGA (2008)	0.0504	0.0234	0.0214	0.4339	0.0679	0.3294	1	− 6.176477	1.011320
CGA (2009)	0.7896	0.3389	0.0365	0.3924	0.0859	− 0.4562	1	− 4.126967	1.025736
CGA (2010)	0.1417	0.3975	0.0517	0.6849	0.0457	0.3892	1	− 4.689080	1.024245
WFB (2008)	0.0221	0.0234	0.0813	0.7542	0.3247	0.3268	1	− 5.447284	1.016002
WFB (2009)	0.0159	0.0351	0.0642	0.7892	0.2893	− 0.0319	1	− 5.045567	1.019780
WFB (2010)	0.0356	0.0162	0.0019	0.7051	− 0.2561	0.1423	1	− 5.573845	1.015019

which represents assets such as human resources, brand, and technology of WFB is in large proportion of overall assets (Table 21).

Looking at these two companies and it is easy to discover they have the similar F-Score results within the 4 years. While this result can't support the summing-up as CHBT has no financial problems. It is necessary to look at other aspects in this form. If we continue to compare the rss_acc index results of CHBT and BCRX in 2020, it is easy to know that the CHBT had a possibility of fraud in this year. The

Table 21 CHBT F-score versus BCRX F-score

Company (year)	Variable							
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	F-score
CHBT (2008)	− 0.2123	− 0.01168	0.00219	0.1671	0.6772	− 0.0058	1	0.362
CHBT (2009)	− 0.0503	0.01124	0.00144	0.1564	0.1953	− 0.00216	1	0.392
CHBT (2010)	0	0.0372	0.00303	0.1207	0.4115	− 0.0097	1	0.425
CHBT (2011)	0.2136	0.0213	0.00276	0.1465	0.3882	0.0633	1	0.48
BCRX (2008)	0.211	− 0.2378	0	0.6786	0.175	− 0.00134	1	0.72
BCRX (2009)	0.6778	0.3264	0.0943	0.683	− 36.87	0.0146	1	4.31
BCRX (2010)	0.4397	− 0.0297	− 0.0456	0.8573	0.2466	− 0.085	1	2.29
BCRX (2011)	− 0.0152	− 0.1983	− 0.0059	0.7866	− 33.15	− 0.242	1	0.935

Table 22 TAL F-score versus EDU F-score

Company (year)	Variable							
	rsst_acc	ch_rec	ch_inv	soft_assets	ch_cs	ch_roa	Issued	F-score
TAL (2018)	0.3788	0.000056	0.001	0.67	0.6442	0.0098	1	1.57
TAL (2019)	0.3545	0.000031	0.00068	0.59	0.4971	0.0213	1	1.27
TAL (2020)	0.1214	0.000055	0.0033	0.6	0.277	− 0.124	1	1.21
TAL (2021)	0.2482	− 8.6E−05	0.0016	0.69	0.3733	− 0.0005	1	1.42
EDU (2018)	0.2892	− 0.00005	− 0.0025	0.613	0.359	− 0.02	1	1.27
EDU (2019)	0.1888	0.00003	− 0.0027	0.558	0.265	− 0.031	1	1.053
EDU (2020)	0.2685	0.00014	0.00036	0.73	0.156	− 0.0012	1	1.51
EDU (2021)	0.401	0.00052	− 1.7E−05	0.756	0.194	− 0.029	1	1.87

rss_acc index is the abbreviation of the ratio of non-cash net operating assets and average total assets. As for this index, unless the company did not have any non-cash operating at all, it could not be 0 in any other cases. But, as everyone knows, none of the companies in the world could satisfy this strange precondition.

Put it in other way, this result was very likely to be false, meaning that CHBT had made a false declaration of financial condition in 2010. But this comparison of F-Score results also has some limitations. Another example will be given below to illustrate this fact (Table 22).

As the supplements of the previous part. The TAL and EDU will be used as the comparison for explaining the limitations of the F-Score method. Looking at the F-Score results of these two companies is basically useless, these two sets of the data are almost the same. This situation suggests that the F-Score itself could not reveal whether the certain company is fake or not. But this defect still has some solutions to remedy. One of the most efficient ways was to analyze the related indexes, too. For instance, the TAL indeed has a similar result in F-Score with EDU. But the ch_rec index of CHBT in 2010 is forty times less than that of EDU (New Oriental EDU n.d.). The ch-rec index means the ratio of receivable to average total assets and as a sad truth is that average total assets of the two companies were nearly the same. If these above data were right, the conclusion could be the TAL has such little receivables? While the financial statement said TAL has expanded by 20% in this year, making the profits increased by 7% to 8%, making it so hard for the TAL's receivables so many times lower than EDU.

To summarize the above, the F-Score method does really have some limitations. When using this method, the users should keep the awareness of multifaceted analysis. Besides looking at the related indexes, it is quite necessary to calculate other indexes like the M-Score or other factors in the balance sheet.

6 Conclusion

According to the above data analysis, we can conclude that both the M-Score model and the F-Score model play an important role in the discovery of financial fraud. Besides, we believe that as the sample size increases, m-Score and F-Score will also become more accurate and persuasive. From the data of sample analysis, we can find that many Chinese companies listed in the U.S. do have financial fraud problems (Tables 23 and 24).

However, in the analysis process, we also found that F-Score was not applicable to the analysis of some companies. For example, The F-score of Luckin coffee in 2018 and 2019 was less than 1, and the F-score of CHBT from 2008 to 2011 was also less than 1. Among the ten samples of companies we collected, M-score can detect abnormal financial statements of all sample companies, and the success rate of identifying financial fraud of sample companies by F-Score reaches 80%. It can be concluded that for those companies where F-Score is not applicable, the reasons why abnormal F-Score values occur are that The F-Score model cannot obtain complete data due to the different disclosure contents and details of Financial reports in China and the United States, that considering that the research variables of F-Score model are selected based on the fraud symptoms of listed companies

Table 23 Accuracy rate of the M-score model

M-score	Predicted value		
Observed value	Fraud samples	Non-fraud samples	Accuracy rate (%)
Fraud samples	9	1	90
Non-fraud samples	7	3	30

Table 24 Accuracy rate of the F-score model

F-score	Predicted value		
Observed value	Fraud samples	Non-fraud samples	Accuracy rate (%)
Fraud samples	8	2	80
Non-fraud samples	7	3	30

in the United States, fraud symptoms of listed companies may be different due to the differences in economic environment between China and the United States. In addition, according to the calculation formula of M-Score, we also find that M-Score may not be particularly effective for those companies that deliberately conceal their income.

In order to earn the trust of investors in the market, some companies adopted a risky way such as financial fraud to deceive investors, which not only infringes on the legitimate rights and interests of investors, but also is not conducive to the healthy development of the market. It is not hard to see the reason for financial fraud: motivation of interest, flawed supervision system, insufficient professional skills of auditors.

In order to reduce the occurrence of financial fraud in the market in the future, we need to further perfect the supervision system and improve the relevant laws and regulations at the same time (Teng 2013). Besides, we also need to improve the quality of the regulatory staff. Only in this way the property of the investors can get effective safeguard. In short, in order to be able to build a healthy market environment and realize the sustainable development of the economy, it is essential to improve the system and the strict examination of the regulatory bodies in the market to put an end to the financial fraud of enterprises. Besides, based on the drawbacks of F-Score and M-Score models mentioned above, we should also optimize the F-Score model and M-Score model according to the fraud characteristics and data of Chinese listed companies, and supplement the variable system in order to Construct a model for fraud identification in Chinese companies' financial reports.

Acknowledgements All the authors are the first authors.

References

Beneish MD (1999) The detection of earnings manipulation. Financ Anal J 55(5):24–36

China Bio CHBT. Hithink Flush Information Network (n.d.) Retrieved from: http://stockpage.10jqka.com.cn/CHBT/finance/?sort=2. 17 May 2022

Dechow PM, Ge W, Larson CR, Sloan RG (2011) Predicting material accounting misstatements. Contemp Account Res 28(1):17–82

Jiang Z (2014) The determinants of financial fraud and the selection of signaling strategy among U.S.-listed Chinese companies. Retrieved from: https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201402&filename=1014223275.nh. 17 May 2022

Kou X, Cui C (2020) Analysis and insights of the financial fraud of Luckin coffee. Res Finance Account 8:50–55

New Oriental EDU. Hithink Flush Information Network (n.d.) Retrieved from: http://stockpage.10jqka.com.cn/EDU/. 17 May 2022

Nian J (2019) Research on the identification of financial fraud in listed companies. Retrieved from: https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201902&filename=1019142076.nh. 17 May 2022

Sec.gov (n.d.) Retrieved from: https://www.sec.gov/Archives/edgar/data/0001099977/000114420409015500/v143592_10k.htm. 17 May 2022

TAL good future. East Money Information (n.d.) Retrieved from: http://emweb.eastmoney.com/pc_usf10/FinancialAnalysis/index?color=web&code=TAL. 17 May 2022
Teng X (2013) The research of the detection of earning manipulation of Chinese listed companies—measured by M-score
Vaidya D, Srivastav AM (2022) Beneish m-Score. WallStreetMojo. Retrieved from: https://www.wallstreetmojo.com/beneish-m-score/. 20 April 2022

A Kidney Matching System Balancing Utility and Equity

Shiqi Chen

Abstract The kidney transplant community is striving to optimise the use of grafts and mitigate the unfairness in access to transplantations in the context of the acute shortage of kidneys, highlighting the significance of the way that kidneys are allocated. In current practice, cadaveric kidneys are allocated through Kidney Allocation System (KAS), while kidney exchanges occur in Kidney Paired Donation (KPD) programs. This article proposes a kidney matching system aimed at balancing equity and utility considerations. The matching mechanism is designed based on Gale's Top Trading Cycles (TTC) algorithm and includes a series of marking schemes for utility and equity purposes. Meanwhile, efforts are made to enlarge the kidney pool by integrating KAS and KPD and increasing the large-scale applicability of the system. This article provides a possible system design for the kidney allocation problem.

Keywords Kidney matching system · Top trading cycles · Marking schemes

1 Introduction

Numerous people are suffering from End-Stage Renal Disease (ESRD), which is treated with dialysis or, better still, kidney transplantation (Lim et al. 2016). Grafts are obtained from deceased or living donors. Transplantation can be conducted when the donor and recipient are compatible in terms of ABO blood groups, Human Leukocyte Antibody (HLA) and crossmatch. Patients with compatible willing donors (usually relatives, spouses, or friends) receive transplants with no or little waiting time, whereas patients without compatible willing donors are registered on a waitlist for kidneys from deceased donors and altruistic donors. The average waiting time in the United States is over three and a half years resulting from the extreme kidney shortage. According to the Organ Procurement and Transplantation Network (OPTN) (2022), 43,617 patients were newly registered on the kidney transplant waitlist in

S. Chen (✉)
Zhejiang Zhuji Middle School, Zhuji 311800, China
e-mail: 2487944284@qq.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_148

2021, while there were only 19,186 donors in the same period. Scarcity highlighted, the design of the kidney matching system is attached with great significance.

Any matching system dealing with the allocation of scarce resources should take into account both equity and utility, and has to make compromises between these two considerations, with the tension noticed (Friedewald et al. 2013). In terms of utility, matching the estimated patient and graft longevity is deemed to optimise the utilisation of the donated kidney and reduce the need for retransplantation (Schulte et al. 2018). In line with this principle, OPTN implemented a new Kidney Allocation System (KAS) in 2014 employing two tools respectively for patient and graft longevity estimation—the Estimated Post-Transplant Survival (EPTS) score and Kidney Donor Profile Index (KDPI). As for equity, unfairness exists in the disparity in access to transplants, which is caused by imbalances in blood groups, sensitivity, geography, et cetera (Stewart et al. 2018). In terms of blood-group compatibility, type O patients can only receive kidneys from type O donors, while type O donors are compatible with all patients. This puts type O patients at a disadvantage. The Panel Reactive Antibody (PRA) score measures how likely a person's blood contains antibodies against a specific donor. Patients with high PRA scores are deemed as highly sensitised, which means they have less hope of getting a compatible match (Montefiore Medical Center n.d.). Notably, the 2021 reform of KAS replaced the concept of the Donor Service Area (DSA) with the "250 Mile Radius", which is promising in mitigating the inequity caused by geographical disparities (Hardie 2021).

Apart from optimising the use of the existing kidneys, the kidney community has also been striving to alleviate kidney scarcity by incentivising living donations. A successful practice is Kidney Paired Donation (KPD), where medically incompatible patients and donors are rematched to form compatible pairs, increasing the transplantation rate directly and benefiting the patients on the waitlist by reducing competition (Ferrari et al. 2015). While donors in incompatible pairs have good a reason to participate in the KPD program, namely to obtain a compatible kidney for their intended recipients in return, donors in compatible pairs lack the motivation to participate in the program (Sönmez et al. 2020). Nevertheless, the participation of compatible pairs is considered a necessity to bring out the full potential of the KPD program by enlarging the pool of exchange (Sönmez et al. 2020).

Given these, this article aims to propose a kidney matching system balancing equity and utility to obtain sound matching outcomes. Relevant research is sorted out in the literature review, followed by the model and selection schemes. Strength analysis of the system lies in Sect. 3.2 and limitations are identified in Sect. 3.3. Finally, in the conclusion is an overview of the article.

2 Literature Review

2.1 Utility-Based Scoring and Equity Considerations in the Kidney Allocation System

The KAS decides how cadaveric kidneys are assigned to the patients on the waitlist. In the early stage, the practice of kidney allocation was limited to the local scale and decisions were usually made by the staff of the transplant centre (Stegall et al. 2017). In 1999, the roadmap for national organ allocation policy—the "OPTN Final Rule" was released, where the sound medical judgement, the optimisation of donated organs, the avoidance of wastage of organs and futile transplants as well as the promotion of access to transplantation were emphasised (Stegall et al. 2017). Later in 2003, when cadaveric kidneys were assigned in the light of waiting time and HLA matching, commented as heavily weighted to equity (Stegall 2009), the Kidney Transplantation Committee of OPTN (OPTNKC) was delegated by the OPTN Board to review the current system and making improvements based on the Final Rule (Friedewald et al. 2013; Stegall et al. 2017). Since then, relevant research proliferated.

Kidney allocation should not only consider medical aspects but also ethical issues, namely, utility and equity (Friedewald et al. 2013; Taherkhani et al. 2019). In terms of utility, the mismatch of the expected survival time between patients and grafts can lead to either retransplantation or underutilisation of grafts (Schulte et al. 2018). To deal with this problem, scoring strategies were proposed to stratify both patients and donated kidneys. Back in 1999, Wolfe et al. found that the increase in life expectancy due to transplantation varied with patient groups by age, gender, ethnicity, etc. (Wolfe et al. 1999). Based on this research, the notion of Life Years From Transplant (LYFT), was then proposed for patient stratification (Wolfe et al. 2008). Further, in 2008, methodologies for calculating the LYFT score were summarised by Wolfe et al. (2008). However, commented as not adding significant predictive power, LYFT was ultimately eliminated from the Estimated Post-Transplant Survival (EPTS) scoring system, where time on dialysis, candidate age, prior transplant and diabetes status are contained (OPTN 2020; Xu et al. 2012). An example of EPTS scoring is exhibited in Table 1.

As for kidney stratification, Alexander, Vaughn and Ojo et al. discussed the concept of marginal kidneys, which were previously deemed non-transplantable and therefore discarded due to factors like cold ischemia time, and the suitability of allowing these kidneys to be transplanted to mitigate the critical shortage of kidneys (Alexander and Vaughn 1991; Ojo et al. 2001). In their 2001 study, Ojo et al. also noticed the potential utility improvement from appropriate donor-recipient matching in the context of marginal cadaveric kidney transplants and noted the necessity of a prospective evaluation (Ojo et al. 2001). With the expanded criteria of donors proposed by Alexander in 1992, Ratner et al. investigated the results of kidney transplants with Expanded Criteria Donors (ECDs) and found them acceptable but with higher risks of graft failure (Ratner et al. 1996). Deceased donors were then classified into Standard Criteria Donors (SCDs) and ECDs, decided by four features including

Table 1 An example of EPTS scoring (Friedewald et al. 2013)

Age (y)	Dialysis duration (y)	Diabetes	Prior transplants	EPTS (%)
18	0	No	No	1
25	0	No	No	1
18	2	No	No	2
25	5	No	No	5
25	2	No	Yes	7
40	0	No	No	8
18	0	Yes	No	12
25	0	Yes	No	12
40	5	No	No	17
50	0	No	No	18

donor age, serum creatinine, death from cerebrovascular accident and hypertension (Rao and Ojo 2009). In an attempt to increase the precision of risk assessment, Rao et al. proposed the Kidney Donor Risk Index (KDRI), a continuous indicator of donor quality with lower KDRI values implying higher quality and vice versa (Rao et al. 2009). This model, compared to the ECD versus SCD dichotomization is improved in granularity and predictive power by including fourteen donor and transplant variables which are significantly associated with the graft survival (Rao et al. 2009). To match the EPTS scores which are displayed as percentages and thus fit the needs of the "longevity matching" scheme, the KDPI (see Fig. 1) is developed as a remapping of the KDRI onto a cumulative percentage scale (Gill et al. 2016). For example, donors with a KDPI of 60% have a KDRI greater than 60% of all investigated donors. Contemporary kidney quality scoring systems are comprehensively reviewed by Lee and Abramowicz (2015).

In the new KAS started in 2014 in the United States, KDPI and EPTS formed the base of the "longevity matching" scheme, which is aimed at improving the utilisation of donated kidneys. As a compromise to equity, kidneys with the top 20% quality are allocated to patients with the top 20% estimated longevity, while the rest kidneys are allocated considering waiting time, HLA-DR matching and Calculated Percent Reactive Antibody (CPRA), failing to harvest the full utility from the absolute matching. Xu et al. questioned the validity of "diabetes status" in EPTS scoring, for the lack of distinction among the diabetics, affecting the accuracy of estimation (Xu et al. 2012). They were also concerned about the reduced probability of allocation to young diabetics who actually get the most LYFT, and that comorbidities of diabetes rather than diabetes itself are likely to be more important drivers of post-transplant mortality (Xu et al. 2012). Gupta et al. discussed the unsuitability of KDPI as a tool to make the binary decision—acceptance or rejection of a cadaveric kidney (Gupta et al. 2014). Other worries in terms of the scoring system are discussed by Klintmalm and Kaplan and many other scholars (Klintmalm and Kaplan 2017). In

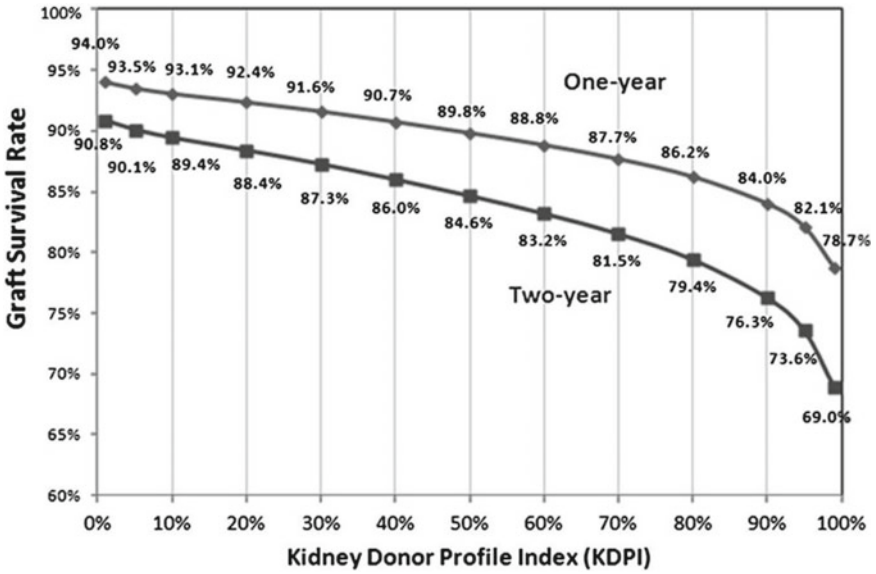


Fig. 1 Estimated graft survival rates by KDPI (Friedewald et al. 2013)

particular, Hippen et al. pointed out a potential unintended consequence, namely a decline in living donations (Hippen et al. 2011).

Equity, measuring the fair access for all patients to transplantation is another focus of research. Martins et al. discuss the low chance for minorities to receive Deceased Donor Kidney Transplantation (DDKT) and thus advocate expanding the use of blood type A2 incompatible DDKT among blood type B ethnic minorities (Martins et al. 2018). Stewart et al. refer to the unfairness brought by the disparity in geography, blood-groups matching, diagnosis and sensitivity (Stewart et al. 2018). While the prioritisation of highly sensitised patients is generally accepted as a method to approach equity, Klintmalm and Kaplan note that many sensitisations are caused by previous transplants (Friedewald et al. 2013; Klintmalm and Kaplan 2017). Therefore, if the system "favours" highly sensitised patients, then patients with a previous transplant will be prioritised over those who have never received a transplant, which is controversial in terms of both equity and utility considerations.

2.2 The Kidney Paired Donation

Increasing living donor transplantation not only alleviates the acute shortage of transplantable kidneys but also offers prominent prognostic advantages over deceased donor transplantation (Nemati et al. 2014), thus having been attracting the attention

of the kidney transplantation community. While it is difficult to encourage more altruistic donors, the increase in living donation can be achieved through KPD (or kidney exchange), where incompatible donor-patient pairs are swapped to form compatible pairs (Ferrari et al. 2015).

The concept of KPD was first developed by Rapaport in 1986. The basic modality of KPD is a two-way exchange, where two incompatible donor-patient pairs swap donors and overcome the biological barriers (Rapaport 1986; Ross et al. 1997). For instance, donor 1 with blood group A cannot donate to his intended recipient 1 with blood group B; likewise, donor 2 with blood group B cannot donate to his intended recipient 2 with blood group A. In this instance, after donors are swapped, new-formed pairs are both compatible in terms of blood-group matching. The concept was then generalised into n-way KPD (Glorie et al. 2013). In KPD practice, transplants are performed simultaneously by default lest a donor backs out after his target recipient has undergone a transplant. Due to logistical constraints, such as lack of operating rooms, in most cases n is three or four, however, this is sufficient to meet the need for efficiency (Roth et al. 2007). Out of the consideration of highly sensitised patients, larger exchanges are proven to be beneficial (Ashlagi et al. 2012). List exchange is another kidney exchange program, which is discussed by Roth et al. and reviewed by Glorie et al. (Glorie et al. 2013; Roth et al. 2004). Apart from concepts concerning "cycles" mentioned above, much research is conducted on "chains", such as unspecific donor chains and NEAD chains and brings substantial benefits. Since this article is focused on the part of cycles, studies on chains are not reviewed here. Meanwhile, Gentry et al. and Lloyd E. et al. research the possibilities, substantial benefits and ethical controversies of altruistic unbalanced paired kidney exchanges involving compatible patient-donor pairs (Gentry et al. 2007; Lloyd et al. 2010). Moreover, Sönmez et al. proposed the kidney exchange scheme incentivising the participation of compatible pairs and studied the equity and utility outcomes (Sönmez et al. 2020).

In 2004, kidney exchange was first formulated as a market-design problem by Roth et al. and Gale's Top Trading Cycles (TTC) was introduced. TTC algorithm was published by Shapley and Scarf and is attributed to Gale (Shapley and Scarf 1974). The algorithm was proposed to find the core in such a market where (1) There are n traders, each with an indivisible and transferable good; (2) A trader never wants more than one good; (3) The only market activity is the reallocation of ownership of indivisible commodities in the light of the traders' sequential preferences (Shapley and Scarf 1974). If an allocation is at the core, then no coalition of traders would rather reclaim their original goods and reallocate these goods among the members of the coalition. The algorithm flow is illustrated in the housing market as follows.

Step 1: Each trader points to his favourite house while each house points to its initial owner.
Step 2: Remove all cycles and allocate each house in a cycle to the trader pointing to it.
Step 3: If there are remaining traders, go back to Step 1.

3 The Kidney Matching System

3.1 The Model

The kidney matching system includes a kidney matching problem, a kidney matching mechanism and a matching outcome. A kidney matching problem comprises a finite set of patient-donor pairs A, a finite set of patients without donors PW, a finite set of deceased donors DD and a finite set of altruistic donors DA. Let $C \subset A$ denote the set of compatible patient-donor pairs. Likewise, let $I \subset A$ denote the set of incompatible patient-donor pairs. Each pair a consists of patient pa and donor da. In like manner, each compatible pair c consists of patient pc and donor dc; each incompatible pair I consists of patient pi and donor di. Assume that both altruistic and deceased donors have no intended recipients.

Every patient p is attached with a priority mark mt. The priority mark is determined by factors concerning equity, which is elaborated in Sect. 3.1.2. Define Maximum Area Available (MAA) as the maximum range available to implement the system. In MAA, define Feasible Time (FT) as the time duration within which the damage done to the cadaveric kidney because of leaving the body is acceptable. We say a deceased donor and a patient are FT sensible to each other if the time taken to transport the kidney to the patient is less than FT. For each patient p, Gp denotes the set of his compatible donors, including a deceased donor only if he is FT sensible to p and dp denotes the initial donor of patient p. Each patient p has a strict preference $\prec p$ over $Gp \bigcup \{dp\}$, associated with the expected longevity of the kidney graft in his body and the surgical success rate, which is elucidated in Sect. 3.1.1.

The kidney matching mechanism is proposed based on the TTC mechanism reviewed in Sect. 2.2. A list of pairs (pa1, da1), (pa2, da2), …, (pak, dak) forms a cycle if $pa1 \rightarrow da2 \rightarrow pa2 \rightarrow \ldots \rightarrow dak \rightarrow pak \rightarrow da1 \rightarrow pa1$. A collection of cycles is called a Feasible Collection (FC) if no cycles intersect, and no more cycles can be added without causing an intersection. The kidney matching mechanism returns a matching outcome, given a kidney matching problem. The mechanism is operated when new donors participate, and the procedure is as follows.

Step 0: Formulate priority marks following the instruction in Sect. 3.1.2. If there are n donors without intended recipients (altruistic donors and deceased donors), they are each paired to a patient from PW with the highest priority marks (a deceased donor can only be paired with an FT sensible patient), forming n new pairs. Include all pairs in the matching mechanism and refer to them as initial pairs.
Step 1: Formulate preferences as instructed in Sect. 3.1.1.
Step 2: Each patient points to all donors preferable to his initial donor and his initial donor; each donor points to his initial patient.
Step 3: Locate all Feasible Collections (FCs). In each FC, remove all cycles and in each cycle, assign each donor to the patient pointing to him. Therefore, each FC generates an Intermediate Outcome (IO).

Table 2 Preferences, longevity-matching marks (m_u) and priority marks (m_t)

p_{i1} (0.56)		$pc1$ (0.83)		$pc2$ (0.72)		$pc3$ (0.51)		$pw1$ (0.74)	
$\prec p$	m_u	$\prec p$	mu	$\prec p$	mu	$\prec p$	mu	$\prec p$	mu
$dpc1$	0.8	$dpi1$	0.2	$dpc1$	0.7	$dd1$	0.9	$dpc1$	0.1
$dpc2$	0.4	$dpc3$	0.8	$dpc2$	0.4	$dpc3$	0.5	$dpc2$	0.6
$dpc3$	0.9	$dd1$	0.5	$\emptyset$		$dpc2$	0.6	$dd1$*	/
$dpi1$	/	$dpc1$	0.4			$dpc1$	0.7	$\emptyset$	
$\emptyset$		$\emptyset$				$dpi1$	0.3		
						$\emptyset$			

Note Values in brackets are priority marks. dd1* denotes that (pw1, dd1) is an incompatible pair. Since (pi1, dpi1) and (pw1, dd1) are incompatible pairs, longevity-matching marks have no meaning for them, therefore are not formulated. While (pi1, dpi1) (pc1, dpc1) (pc2, dpc2) (pc3, dpc3) are spontaneous patient-donor pairs, (pw1, dd1) is an "artificial" pair formed in Step 0. The execution of Step 2 and Step 3 are illustrated in Figs. 2 and 3. For illustration simplicity, the directed lines from patients to their initial donors are not exhibited, which means cycles like p1 → d1 → p1 are not demonstrated

Step 4: Apply the TTC algorithm to all IOs. Eliminate an IO, if TTC returns a matching that is different from the matching in the IO.
Step 5: Calculate the hybrid mark (described in Sect. 3.1.2) for each IO, determine the matching outcome using IO selection rules (described in Sect. 3.1.2) and end the procedure. If a deceased donor remains incompatibly assigned, unpair the corresponding pair and reassign him to the pw ∈ PW with the next highest priority mark to form a new pair, triggering the matching mechanism again.

There is an example, with preferences, priority marks and longevity matching marks of patients demonstrated in Table 2.

After testing the Pareto efficiency of eight IOs (A–H) by employing TTC in Step 4, efficient IOs (A)(C)(E)(F) are reserved.

In Step 5, IOs (A)(C) are reserved in accordance with IO selection rule 1 for maximising the number of operations. According to Table 1, the hybrid mark of IO (A) is 1.491, while that of IO (C) is 2.077. Therefore, IO (C) is determined as the matching outcome, which is $\begin{pmatrix} pi1 & pc1 & pc2 & pc3 & pw1 \\ dpc3 & dpi1 & dpc1 & dd1 & dpc2 \end{pmatrix}$.

The Formulation of Preferences. To formulate preferences in the interests of patients, I introduce four assumptions and the corresponding rationales. Generally, the post-transplant longevity of a cadaveric kidney is significantly shorter than that of a living donor's kidney (Nemati et al. 2014). Therefore, it is reasonable to assume that every patient p finds living donor kidneys preferable to cadaveric kidneys. The KDPI is a percentile measuring the cadaveric kidney quality with ten variables. All indices are also appropriate for measuring the quality of living donor kidneys, except for "donor status after circulatory death" and "cause of death". To accommodate this system, the KDPI is generalised so that the quality of living donor kidneys is measured in the same way as that of cadaveric kidneys, but with those two indices indicating

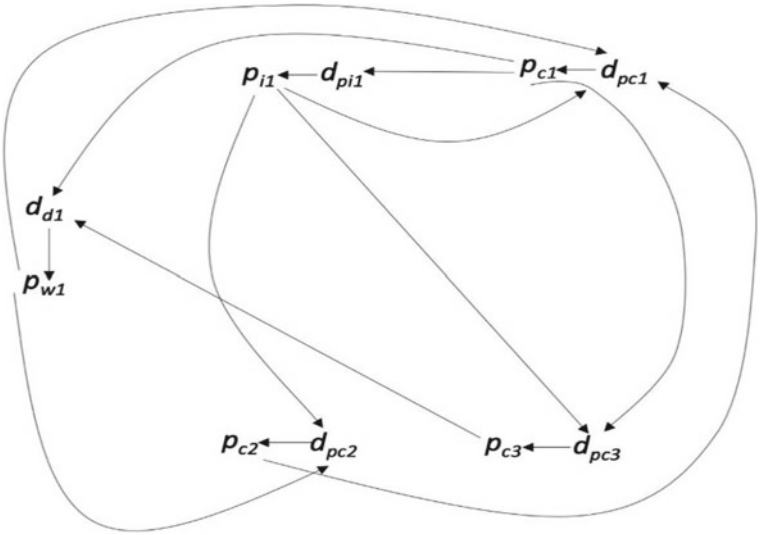


Fig. 2 The execution of step 2

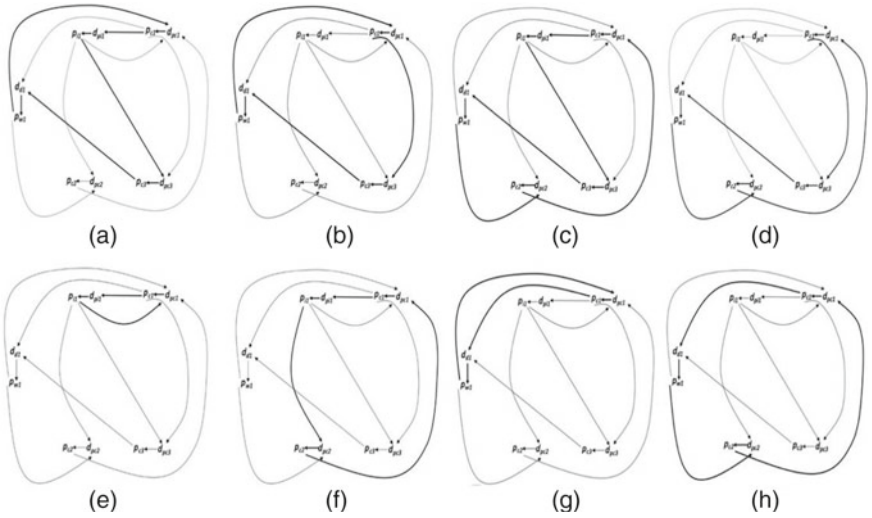


Fig. 3 Feasible collections in step 3

the best quality. To clarify, a higher KDPI implies a lower kidney quality. Therefore, the second assumption is developed as every patient p prefers a kidney with lower KDPI. In addition, when the matching rate in terms of medical indices such as HLA and crossmatch reaches a certain percentage, the patient-donor pair can be deemed as compatible. However, a higher percentage of the matching rate can theoretically

provide a better prognosis of surgery by reducing rejection reactions and helping the donor cells engraft as well as improve the operation success rate. So, the third assumption is that every patient p is more willing to be allocated a kidney with a higher medical matching rate. Lastly, I assume that in every pair, donor preferences are in alignment with patient preferences.

To block strategic behaviours, the strict preference of any patient p over $Gp \bigcup \{dp\}$ is formulated by a clearinghouse based on the assumptions above, given the information about kidney donors and the medical matching rate of every potential patient-donor pair.

Selection Schemes. Selection happens twice in the kidney matching mechanism. First, pws are selected by the priority mark to be paired with donors without intended patients in Step 0. Second, the matching outcome is selected from efficient Intermediate Outcomes (IOs) in Step 5, in the light of IO selection rules. Selection schemes are designed to reflect equity and utility. In this article, utility is divided into two aspects—individual utility, which is reflected in the formulation of preferences and total utility on which selection schemes focus. The individual utility is defined as the success rate and prognosis of surgery, whilst the total utility is defined as the optimisation of the graft longevity. Meanwhile, equity is defined as fair access for all patients to transplantation. In this section, two marking schemes for selection—priority mark and hybrid mark, are elucidated in order, followed by the description of IO selection rules.

Crucial medical indices for organ transplantation are blood groups, HLA, CPRA and crossmatch. In terms of blood groups, type O patients are only compatible with type O donors, while type A patient is compatible with type A and O donors, type B patient is compatible with type B and O donors and type AB patient is compatible with donors of all blood types. Therefore, type O donors are "over-demanded", which is detrimental to type O patients for they only find type O donors acceptable. Similarly, patients with a high score of CPRA are considered to be sensitised, which means it is harder for them to find a compatible donor. According to Montefiore Medical Center, sensitised patients wait three to four times longer than unsensitised patients for a compatible kidney from a deceased donor. Meanwhile, waiting time is also an important consideration for equity and is a dominant factor for priority ranking in many existing systems. Given these, an equitable scheme is proposed for priority marking to mitigate the unfairness caused by blood types and sensitivity, while preserving the waiting time element. Marks are given in terms of these three aspects. For any patient p, the priority mark is denoted as mtp, the mark given for his donor's blood type is denoted as mbp, his CPRA score (a percentage ranging from 0 to 99%) is denoted as map, and the mark given considering his waiting time (starting from entering the system) is denoted as mwp. First, marks a, b, c ($1 \geq a > b > c > 0$) are respectively associated with patients with donors of blood group O, A or B and AB. In another word, if the blood group of donor dp is O, mbp = a. Second,

$$mwp = \frac{\text{waiting time of } p}{\text{the longest waiting time among existing patients}} \tag{1}$$

Therefore, for each patient p_i and p_c, priority mark

$$mtpi = \frac{map \times (mbp + mwp)}{2} \tag{2}$$

For each patient p_w, the priority mark

$$mtpw = map \times mwp \tag{3}$$

The priority mark is used in pw selection in Step 0 and serves as a component of the hybrid mark.

The TTC algorithm guarantees a unique outcome that is in the core, which means no coalition of agents would rather reclaim their outside choices and re-exchange them among the members of the coalition. Since in the proposed mechanism, a patient is allowed to point to all choices preferable to his outside choice and his outside choice, the property of returning a unique core allocation does not hold in this context. Rather, multiple Intermediate Outcomes (IOs) are returned after Step 3, among which Pareto inefficient IOs are eliminated in Step 4. Therefore, before we perform Step 5, there are multiple Pareto efficient IOs available. Since we cannot have them all, a hybrid marking scheme for IO selection on account of total utility and equity is proposed.

Matching patient and donor by age is believed to increase the use of the donated kidney since the potential longevity of a young kidney is more likely to be realised in a young recipient (Friedewald et al. 2013). American Society of Nephrology points out that 6850 graft years could have been saved between 1990 and 2002 if age matching had been observed (American Society of Nephrology 2004). However, a good age matching does not necessarily imply a good matching between the estimated post-transplantation longevity of the recipient and kidney, which is not only determined by age but also by factors like duration on dialysis (patients) and serum creatinine (donors). The EPTS score and KDPI are two percentiles developed by the Scientific Registry of Transplant Recipients (SRTR) indicating the estimated longevity of recipients and cadaveric kidneys respectively. To be clear, a higher KDPI corresponds to the shorter estimated longevity of kidneys and a higher EPTS score indicates lower estimated longevity of recipients. The hybrid marking scheme employs them (EPTS and the generalised KDPI) to measure longevity matching and intends to increase the total utility by optimising the potential longevity of kidneys. By doing so, not only will the recipients benefit, but also the patients without donors will benefit from the reduced need for retransplantation. Therefore, the longevity matching mark, denoted as mu, is a representative of total utility. For every patients p with donor dp,

$$\mathrm{m_{up}} = 1 - \frac{|KDPIdp - EPTSp|}{|KDPIdp - EPTSp|\max} \tag{4}$$

To be clear, $|KDPIdp - EPTSp|\max$ represents the maximum value among all patient-donor pairs. Hence, for every patient p with donor d_p, the hybrid mark is

$$mhp = mup \times mtp \tag{5}$$

and for every IO, the hybrid mark is the sum of individual hybrid marks.

Based on the principle of maximising the number of transplantations, IO selection rule 1 is set as choosing IOs including the maximum number of compatible pairs. In case the outcome is not unique, set rule 2 as choosing the IO with the highest hybrid mark mh.

3.2 Strengths of the System

Opportunity Identification and Utilisation. The kidney matching mechanism is designed based on the TTC algorithm and adopts marking schemes to achieve utility and equity considerations.

Compared to TTC, the proposed mechanism allows each patient to point to multiple preferable donors rather than the most preferred one. By doing so, multiple IOs are yielded in Step 3, whereas Pareto efficiency (a situation where one cannot get better off without making anyone else worse off) is no longer guaranteed. However, Pareto efficiency in respecting preferences is crucial since the preferences of patients are formulated in the light of the success rate and prognosis of surgery, reflecting the individual utility of patients. This defect is corrected by conducting Step 4, where IOs are examined by TTC, and inefficient ones are identified immediately. This is because TTC is individually rational (no one will get worse off by participating in the algorithm) and Pareto efficient, so TTC will not change the matching in an efficient IO but change the matching in an inefficient IO.

Although Pareto efficiency is important, it does not reflect equity and total utility, which are defined in Sect. 3.1.2. Therefore, even though TTC immediately guarantees a Pareto efficient outcome, to capture utility and equity, the modified mechanism is proposed.

Multiple efficient IOs after Step 4 offer space for further utility and equity achievements. First, the target of maximising the number of transplantations can simply be reached by reserving the IOs including the most compatible pairs and eliminating others. Second, the utilisation of grafts is improved by arranging marks for longevity matching. Third, the priority mark is designed considering equity only.

Benefits in Terms of Equity and Utility. Equity achievements are reflected in the marking schemes, where unfairness resulting from blood types and sensitivity are mitigated.

As explained in Sect. 3.1.2, blood group *O* patients are penalised in matching since blood group *O* donors are extremely "over-demanded". To correct this unfairness, some countries like Britain, choose to initially match the donor to a patient with the same blood group when allocating cadaveric kidneys, which is later referred to as the strict blood-type rule. Nevertheless, utility is likely to suffer a loss since some

patients could have been matched with a preferred donor without the strict blood-type rule. For example, consider a situation where

1. patient p_1: blood-type A

   patient p_2: blood-type AB deceased donor d_1: blood-type A

   deceased donor d_2: blood-type O;
2. $d_1 \prec_{p1} d_2, d_2 \prec_{p2} d_1$.

With the strict blood-type rule obeyed, the matching will be $\begin{pmatrix} p1 & p2 \\ d1 & d2 \end{pmatrix}$. However, if the restriction were removed, the matching would be $\begin{pmatrix} p1 & p2 \\ d2 & d1 \end{pmatrix}$, where both patients are strictly better off in the light of their preferences. Instead of setting the blood type as the first "barrier", the proposed mechanism alleviates this unfairness by incentivising the "supply" of blood-type O donors, that is giving a higher mb to the patient with a donor whose blood type is "popular". Likewise, highly sensitised patients and those with long waiting times are given higher marks in the priority scheme.

In the example in Sect. 3.1, the matching outcome returned by the kidney matching mechanism is (pi1, dpc3), (pc1, dpi1), (pc2, dpc1), (pc3, dd1), (pw1, dpc2). Given the same kidney matching problem, the matching returned by TTC is (pi1, dpc1), (pc1, dpi1), (pc2, dpc2), (pc3, dpc3), (pw1, dd1). Refer to these two outcomes as outcome 1 and outcome 2 in order and compare them in multiple dimensions. First, the sum of longevity matching mark of outcome 1 is calculated to be 3.3, while that of outcome 2 is 1.9, which in a way reflects the better performance of the proposed mechanism in total utility, that is improving the utilisation of graft. Second, in outcome 1 are 5 compatible pairs, whereas, in outcome 2, there are only 4 compatible pairs, showing the strength of the proposed mechanism in maximising the number of transplantations. Third, by joining either the kidney matching mechanism or TTC, no patient will get worse off, indicating the individual rationality of both mechanisms. Therefore, patients, especially compatible pairs have an incentive to join the kidney matching mechanism, which improves the possibility of compatible matching, and the general quality of kidneys. Fourth, both mechanisms are Pareto efficient. Even though outcome 2 gives pi1 a preferable matching to outcome 1, outcome 1 outweighs outcome 2 in the sense of more equitable access to transplantation.

In brief, since both mechanisms are efficient, individual utility reflected by preferences cannot be compared. However, the kidney matching mechanism offers more fair access to transplantation and better use of graft longevity, while reserving the incentive for all individuals to join. Furthermore, the participation of compatible pairs brings external benefits.

Efforts to Enlarge the Kidney Pool. An important aim of the kidney matching mechanism is to enlarge the kidney pool. In this article, efforts are made in three aspects—combining the KAS and KPD, incentivising the participation of compatible pairs (explained in Sect. 3.2.2) and improving the mechanism applicability at scale.

I assume that living donors are willing to travel within the Maximum Area Available (MAA) to avoid graft loss resulting from long transporting time.

Large MAA and the integration of KPD and KAS are both desired to increase the possibility of compatible matching by enlarging the kidney pool. A large MAA helps patients find compatible donors who are outside the previous small MAA, while KPD and KAS integration introduces deceased donors into kidney exchange, increasing the successful matching rate, especially for highly sensitised patients. In the current practice, KAS and KPD are two separate programs, with the former for deceased donor allocation and the latter for patient-donor pair exchange. In the proposed kidney matching system, these two programs are combined, such that patient-donor pairs, deceased donors, and patients without donors are all included. There is an example for showing the benefit brought by the KPD and KAS integration. Consider two patient-donor pairs (p1, d1) and (p3, d3), one patient p2 without an initial donor and one deceased donor d2. Preferences are as follows: d3 $\prec$ p1 d2, d1 $\prec$ p2 d3, p3 only finds d1 compatible (For simplicity, only compatible donors are shown in preferences). In current practice where KAS and KPD are performed separately, only two compatible pairs, (p1, d3) and (p3, d1) can be achieved. In the proposed system where KAS and KPD are integrated, all three patients can be paired with not only a compatible donor but also with the most preferred one by forming a larger cycle: p1 $\rightarrow$ d2 $\rightarrow$ p2 $\rightarrow$ d3 $\rightarrow$ p3 $\rightarrow$ d1 $\rightarrow$ p1.

Although both methods can bring sound effects separately, a problem arises when their combined use is attempted, that is deceased donors can ultimately be matched with a patient far away demanding long-range transportation, which increases the risk of graft loss. That is why Feasible Time (FT) is introduced. A deceased donor is only ranked on a patient's preference list and assigned to a patient pw in step 0 if the donor is FT sensible to the patient. Because patients' preferences are respected, risks due to long transporting time are blocked in the first place. Moreover, since FT is only applied to deceased donors, the geographical flexibility of living donation is reserved. Hence, the integration of KPD and KAS is available in a large MAA.

4 Conclusion

Despite the strengths, limitations are identified. First, this article does not take into account the specificities of pediatric patients. Therefore, to integrate the pediatric patient group into the whole system, modifications should be made. Second, factors chosen to reflect utility and equity may not be comprehensive and accurate. A more careful selection of variables should be conducted to bring out the full potential of the system. Fortunately, variables for utility and equity considerations are easy to be modified without changing the structure of the system. Third, though the ideal MAA is the whole globe, multiple constraints make it difficult to be fulfilled. On the one hand, there is no international consensus on a single kidney matching system. On the other hand, logistic issues are faced if the system is to be implemented since there will be numerous compatible pairs yielded, which demands simultaneous

surgeries to prevent the sudden withdrawal of donors. Proposed suggestions are (1) Start practice on small scales where the supply and demand of surgery resources are balanced. (2) Redesign the system, learning from the research on some chains where the simultaneity of surgery is not demanded. (3) Introduce mandatory contracts where donors are not allowed to leave the system after the matching outcome is yielded. However, the ethical base of this suggestion seems to be controversial. Furthermore, objective difficulties exist in information collection and the determination of MAA and FT. Significant funding is also needed to enable living donors to travel to patient sites in order to optimise the geographical flexibility of living donations.

New possibilities are emerging. With the development in the medical field, prospective drugs and techniques like immunosuppressor and desensitisation are introduced. Many researchers are conducting novel studies on integrating these new elements into kidney matching mechanisms to achieve more utility and equity benefits. Meanwhile, the exchange between different organs has been practised, which may also be a chance to increase the number of transplantations. In addition, international kidney matching programs are promising in increasing the possibility of finding a compatible match and mitigating the blood group imbalance as the proportion of blood groups varies by race.

After reviewing the relevant literature and the current practice in kidney matching, this article proposes a kidney matching system in the hope of sound matching outcomes in terms of utility and equity, which are respectively defined as the optimal use of grafts and equitable access to transplantations. The kidney matching mechanism is designed based on the TTC algorithm. The major modification is allowing each patient to point to multiple donors rather than only the most preferred one, which yields multiple Intermediate Outcomes (IOs). After testing the Pareto efficiency of IOs, IO selection rules reflecting utility and equity are used to determine the matching outcome. Another major consideration of the system is to enlarge the kidney pool, which helps to increase the chance of compatible matching and improve the matching outcome. This target is approached by first integrating KAS and KPD and second improving the large-scale applicability of the system. Limitations of the system are identified in four aspects with targeted suggestions proposed. In addition, new developments in the medical field, as well as novel practices in the transplantation community, provide valuable implications for future research.

References

Alexander JW, Vaughn WK (1991) The use of ‘marginal’ donors for organ transplantation. The influence of donor age on outcome. Transplantation 51(1):135–141

American Society of Nephrology (2004) Matching kidney donors and recipients: age really does matter. https://www.newswise.com/articles/matching-kidney-donors-and-recipients-age-really-does-matter

Ashlagi I, Gamarnik D, Rees MA, Roth AE (2012) The need for (long) chains in kidney exchange. Working Paper No. 18202; Working Paper Series, National Bureau of Economic Research

Ferrari P, Weimar W, Johnson R, Lim W, Tinckam K (2015) Kidney paired donation: principles, protocols and programs. Nephrol Dial Transplant 30(8):1276–1285
Friedewald JJ, Samana CJ, Kasiske BL, Israni AK, Stewart D, Cherikh W, Formica RN (2013) The kidney allocation system. Surg Clin North Am 93(6):1395–1406
Gentry SE, Segev DL, Simmerling M, Montgomery RA (2007) Expanding kidney paired donation through participation by compatible pairs. Am J Transplant 7(10):2361–2370
Gill J, Dong J, Rose C, Gill JS (2016) The risk of allograft failure and the survival benefit of kidney transplantation are complicated by delayed graft function. Kidney Int 89(6):1331–1336
Glorie K, Haase-Kromwijk B, van de Klundert J, Albert Wagelman A, Weimar W (2013) Allocation and matching in kidney exchange programs. Transpl Int 27(4):333–343
Gupta A, Chen G, Kaplan B (2014) KDPI and donor selection. Am J Transplant 14(11):2444–2445
Hardie M (2021) How kidney allocation changed in 2021. https://surgery.wustl.edu/how-kidney-allocation-changed-in-2021/.
Hippen BE, Thistlethwaite JR, Ross LF (2011) Risk, prognosis, and unintended consequences in kidney allocation. N Engl J Med 364(14):1285–1287
Klintmalm GB, Kaplan B (2017) The kidney allocation system claims equity: it is time to review utility and fairness. Am J Transplant 17(12):2999–3000
Lee APK, Abramowicz D (2015) Is the Kidney Donor Risk Index a step forward in the assessment of deceased donor kidney quality? Nephrol Dial Transplant 30(8):1285–1290
Lim HJ, Koo TY, Lee J, Huh KH, Park JB, Cho J, Lee S, Ro H, Han S, Park B, Park S, Chung W, Park SK, Kim C, Kim SJ, Kim YS, Ahn C, Yang J (2016) Health-related quality of life of kidney transplantation patients: results from the KoreaN Cohort Study for Outcome in Patients with Kidney Transplantation (KNOW-KT) study. Transpl Proc 48(3):844–847
Lloyd E, Emily R, Victoria E, Joan K, Donald K, David C, Ilona W (2010) The altruistic unbalanced paired kidney exchange: proof of concept and survey of potential donor and recipient attitudes. Transplantation 89(1):15–22
Martins PN, Mustian MN, MacLennan PA, Ortiz JA, Akoad M, Caicedo JC, Echeverri GJ, Gray SH, Lopez-Soler RI, Gunasekaran G, Kelly B, Mobley CM, Black SM, Esquivel C, Locke JE (2018) Impact of the new kidney allocation system A2/A2B → B policy on access to transplantation among minority candidates. Am J Transplant 18(8):1947–1953
Montefiore Medical Center (n.d.) Kidney transplant program—highly sensitized patients—New York City—Montefiore Einstein Center for Transplantation. https://www.montefiore.org/nephrology-kidney-transplant-program-highly-sensitized-patients.
Nemati E, Einollahi B, Lesan Pezeshki M, Porfarziani V, Fattahi MR (2014) Does kidney transplantation with deceased or living donor affect graft survival? Nephro-Urol Mon 6(4):e12182
Ojo AO, Hanson JA, Meier-Kriesche H-U, Okechukwu CN, Wolfe RA, Leichtman AB, Agodoa LY, Kaplan B, Port FK (2001) Survival in recipients of marginal cadaveric donor kidneys compared with other recipients and wait-listed transplant candidates. J Am Soc Nephrol 12(3):589–597
OPTN (2020) A guide to calculating and interpreting the estimated post-transplant survival. https://optn.transplant.hrsa.gov/media/1511/guide_to_calculating_interpreting_epts.pdf.
Organ Procurement and Transplantation Network (2022) OPTN metrics. https://insights.unos.org/OPTN-metrics/
Rao PS, Ojo A (2009) The alphabet soup of kidney transplantation: SCD, DCD, ECD—fundamentals for the practicing nephrologist. Clin J Am Soc Nephrol 4(11):1827–1831
Rao PS, Schaubel DE, Guidinger MK, Andreoni KA, Wolfe RA, Merion RM, Port FK, Sung RS (2009) A comprehensive risk quantification score for deceased donor kidneys: the kidney donor risk index. Transplantation 88(2):231–236
Rapaport FT (1986) The case for a living emotionally related international kidney donor exchange registry. Transpl Proc 18(3):5–9
Ratner LE, Kraus E, Magnuson T, Bender JS (1996) Transplantation of kidneys from expanded criteria donors. Surgery 119(4):372–377
Ross LF, Rubin DT, Siegler M, Josephson MA, Thistlethwaite JR, Woodle ES (1997) Ethics of a paired-kidney-exchange program. N Engl J Med 336(24):1752–1755

Roth AE, Sonmez T, Unver MU (2004) Kidney exchange. Q J Econ 119(2):457–488
Roth AE, Sönmez T, Ünver MU (2007) Efficient kidney exchange: coincidence of wants in markets with compatibility-based preferences. Am Econ Rev 97(3):828–851
Schulte K, Klasen V, Vollmer C, Borzikowsky C, Kunzendorf U, Feldkamp T (2018) Analysis of the Eurotransplant Kidney Allocation Algorithm: how should we balance utility and equity? Transpl Proc 50(10):3010–3016
Shapley L, Scarf H (1974) On cores and indivisibility. J Math Econ 1(1):23–37
Sönmez T, Ünver MU, Yenmez MB (2020) Incentivized kidney exchange. Am Econ Rev 110(7):2198–2224
Stegall MD (2009) Developing a new kidney allocation policy: the rationale for including life years from transplant. Am J Transplant 9(7):1528–1532
Stegall MD, Stock PG, Andreoni K, Friedewald JJ, Leichtman AB (2017) Why do we have the kidney allocation system we have today? A history of the 2014 kidney allocation system. Hum Immunol 78(1): 4–8
Stewart DE, Wilk AR, Toll AE, Harper AM, Lehman RR, Robinson AM, Noreen SA, Edwards EB, Klassen DK (2018) Measuring and monitoring equity in access to deceased donor kidney transplantation. Am J Transplant 18(8):1924–1935
Taherkhani N, Sepehri MM, Shafaghi S, Khatibi T (2019) Identification and weighting of kidney allocation criteria: a novel multi-expert fuzzy method. BMC Med Inform Decis Mak 19:182
Wolfe RA, Ashby VB, Milford EL, Ojo AO, Ettenger RE, Agodoa LYC, Held PJ, Port FK (1999) Comparison of mortality in all patients on dialysis, patients on dialysis awaiting transplantation, and recipients of a first cadaveric transplant. N Engl J Med 341(23):1725–1730
Wolfe RA, McCullough KP, Schaubel DE, Kalbfleisch JD, Murray S, Stegall MD, Leichtman AB (2008) Calculating life years from transplant (LYFT): methods for kidney and kidney-pancreas candidates. Am J Transplant 8:997–1011
Xu S, Williams ME, Pavlakis M, Breu AC (2012) The UNOS 'preferential allocation' concept proposal for the allocation of deceased donor kidney transplants: implications for patients with diabetes. Nephrol Dial Transplant 27(3):869–871

The Association Between Physical Activity and Sleep Characteristics in People Aged 65 and over: National Health and Nutrition Examination Survey (NHANES) 2017–2018

Minghui Wang and Jinyi Liu

Abstract *Background*: People aged 65 and up have a wide range of sleep issues. Pharmacological interventions often are associated with side effects and low adherence. Physical activity (PA) is a non-pharmacological intervention that has been shown to be effective. *Objective*: The goal of this study was to see if there was a link between physical activity and sleep characteristics in adults aged 65 and up. *Methods*: Sleep characteristics and physical activity intensity (non, moderate, vigorous) data from NHANES 2017 to 2018 were analyzed. Participants included in the analysis were aged $\geq$ 65 years and had completed data from the NHANES sleep disorder questionnaire. Logistic regression was conducted with moderate and vigorous intensities as the exposure and sleep duration, snore frequency, daytime dysfunction, and trouble sleeping as the outcome and included adjustment for confounders. *Results*: Moderate and vigorous-intensity physical workouts are significantly connected with longer sleep duration as compared to the non-exercise group. (66.9% vs. 79.3%, $p < 0.001$; 66.9% vs. 77.9%, $p < 0.001$). However, vigorous exercise is associated with increasing snore frequency (60.6% vs. 68.8%, $p = 0.02$). Logistic regression showed moderate exercise (OR = 1.8, 95% CI: 1.36 to 2.40), and vigorous exercise (OR = 1.56, 95% CI: 1.13 to 2.18) have significant impact on recommended sleep duration. *Conclusions*: Our study shows that the elderly who kept moderate to vigorous PA habits are more likely to meet the recommended sleep duration, which is beneficial for their cognition.

Keywords Physical activity · Sleep duration · Logistic models · The elderly · NHANES

M. Wang (✉)
Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing 100069, China
e-mail: wangminghui927@163.com

J. Liu
Department of Molecular, Cell and Developmental Biology, University of California Santa Cruz, Santa Cruz 95064, USA

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_149

1 Introduction

Becoming elderly is often accompanied by a variety of sleep complaints and sleep disorders, which can reduce the quality of life and hasten the onset of cognitive dysfunction in elderly citizens (Memon et al. 2020). According to numerous studies, adults aged 65 and up experience various kinds of sleep issues, for example, short sleep duration or too long sleep duration (Štefan et al. 2018). Although pharmacological interventions are supposed to be effective in treating these sleep disorders, they often are relevant to a series of side effects and low adherence by the patients. Therefore, PA is a promising non-pharmacological intervention that may be used as an effective treatment for sleep disorders.

People with poor sleep quality are at higher risk for cognitive decline. A study of 100 participants aged $\geqslant 55$ found that maintaining cognitive function necessitates a certain amount of sleep (Lucey et al. 2021; Abd El-Kader and Al-Jiffri 2019). A cohort study of 5247 participants, whose mean age was 63 ± 8 years, has shown that long sleep duration (> 9 h) was associated with worse neurocognitive performance than short sleep duration (< 6 h) (Ramos et al. 2020). A cross-sectional study with 894 senior citizens (mean age 80 ± 3 years) discovered that the link between sleep and physical activity is bidirectional, with those who report long sleep duration (> 9 h) and those who report good sleep quality being more likely to satisfy PA standards, recommended by WHO, than those who report poor sleep quality (Štefan et al. 2018). Variables that have a significant impact ($p > 0.001$) in this study include female gender, alcohol-consuming habit, mental disorders, and chronic diseases. Research has shown that poor sleep quality is correlated with an increased risk for Aβ-amyloid accumulation, an Alzheimer's disease biomarker, while higher levels of PA are correlated with reduced Aβ-amyloid accumulation (Brown et al. 2019; Bennie et al. 2021).

A randomized controlled trial (RCT) with 69 middle-aged sedentary adults found that physical activity training would improve subjective sleep quality in sedentary individuals of middle age. After 12 weeks of high-intensity interval training group with whole-body electromyostimulation (HIIT-EMS) training intervention, the overall sleep duration, sleep efficiency, and wake after sleep onset of those subjects were all enhanced (Jurado-Fasoli et al. 2020).

Conventionally, it was believed that physical activity can promote sleep duration and quality due to thermoregulation and energy expenditure. However, some researchers propose that exercise promotes sleep quality via anti-inflammatory cytokines. They suspect that as people aging, increased pro-inflammatory and reduced anti-inflammatory cytokines in the bloodstream can exacerbate sleep disturbance (Lucey et al. 2021; Abd El-Kader and Al-Jiffri 2019). They have observed a reduction in TNF-α and IL-6 levels and increased IL-10 levels after aerobic exercise intervention, which indicates that physical activity may serve an anti-inflammation role in senior individuals, which in turn promotes their sleep quality. Other possible putative pathways for exercise's anti-inflammatory effects include a decrease in visceral fat mass; a decrease in the amount of pro-inflammatory monocytes in the

blood (Timmerman et al. 2008), and an increase in the numbers of regulatory T cells in the blood (Wang et al. 2012).

There are various studies conducted on sleep using the NHANES database such as sleep disorders and association with mortality (Huyett et al. 2021); the link between sleep and hypertension (Li and Shang 2021); and relationship between sleep duration and health markers in individuals in the United States (You et al. 2021). In addition, there are quantities studies on physical activity using the NHANES database. A cross-sectional analysis of 15,822 US adults in this study was conducted by Smith et al. exploring the relationship between physical activity, sedentary behavior, and cannabis consumption. And the relationship between exercise training and bone density in older adults was examined (Jain and Vokes 2019). Thus, sleep and exercise are vital for our health, especially for the elderly.

Our study distinguishes itself from existing literature in that our study population is nondemented elderly who are aged 65 and over. There is seldom research that has been conducted on this population. The parameters are also different from the existing literature because we analyze sleep duration, snore frequency, daytime function, and whether they have trouble sleeping. Furthermore, The National Health and Nutrition Examination Survey (NHANES) collects information on physical activity as well as sleep characteristics, which provides an opportunity to fill the existing research gap.

Therefore, our main objective in this research was to explore the association between physical exercise and sleep characteristics in individuals aged 65 and over. The primary hypothesis was that PA may lead to longer sleep duration. The secondary hypothesis was that PA may lead to healthier sleep duration according to the recommendation and reduce the risk of snoring, trouble sleeping, and daytime dysfunction.

2 Materials and Method

2.1 Study Design

NHANES is a cross-sectional study of non-institutionalized US residents conducted by the National Center for Health Statistics of the CDC (Centers for Disease Control and Prevention 2022). The Sleep disorder dataset, as well as the physical activity dataset from NHANES 2017–2018, were analyzed. Adults aged $\geq$ 65 years (N = 1392) collected during 2017–2018 are included in this analysis. Among the 1392 participants, 706 are male and 686 are female. The participants were interviewed at home by experienced researchers via the computer-Assisted Personal Interview (CAPI) system. Baseline data on age, sex, educational level, marital status, anxiety, depression, smoking, and drinking were all collected in the demographic dataset.

2.2 Physical Activity

The Physical Activity questionnaire in this database consists of questions based on the Global Physical Activity Questionnaire (GPAQ), which gives interview data on physical activities at the respondent level (Keating et al. 2019). According to the questionnaire, we can know whether the participants engage in different intensities of exercise, such as non-exercise, moderate or vigorous exercise. Sedentary time was included as a covariate.

2.3 Sleep Characteristics

The Munich Chronotype Questionnaire regarding sleep time, snore frequency, trouble sleeping, and daytime function was adapted to this questionnaire (Roenneberg et al. 2007). A previous study concluded that the elderly should sleep no less than 6 h or more than 9 h to gain the best cognitive benefit (Ramos et al. 2020). Therefore, in our study, we define the recommended sleep hours as 6–9 h.

2.4 Statistical Analysis

Univariate analysis (Chi-squared test) and Mann–Whitney U test were used to examine distributions of selected characteristics for the moderate or vigorous exercise group and the control group. Unconditional logistic regression models were conducted to calculate the odds ratios (OR) and 95% confidence intervals (CI) for the association between the exercise intensity and the risk of each sleep characteristic (non-exercise as a reference). We also examined linear trends across exercise intensity in adjusted models and found the subset of model features using AIC and BIC selection. The Hosmer–Lemeshow test was conducted to evaluate the goodness of fitted models. Cook's distance was used to test the outliers, and variance inflation factor (VIF) was used to calculate the collinearity among the predictor variables. All tests of statistical significance conducted were 2-sided, being performed via R Studio software (Version 4.1.2; Vienna, Austria).

3 Results

3.1 Summary Statistics

Data obtained from NHANES 2017–2018 was used in this study. 1392 adults (≥ 65 years old) who completed the interview were enrolled in our study. Table 1

displays the descriptive characteristics of this study population according to exercise intensities. Differences in sleep duration, recommended sleep duration, snore frequency, trouble sleeping, daytime dysfunction, and covariates were tested between different exercise intensity groups. Compared to the non-exercise group, moderate exercise group observed no statistical differences in male gender (41.5% vs. 49.9%, $p = 0.133$), PHQ-9 score (1.0 vs. 1.0, $p = 0.235$), and smoke habit (79.8% vs. 83.8%, $p = 0.212$). Participants that are moderately active are inclined to be slightly younger, married, accept higher education cultivation (college or above), and consume alcohol for now. Compared to the non-exercise group, vigorous exercise group showed that there is no statistical differences in PHQ-9 score (1.0 vs. 1.0, $p = 0.066$), and smoking (79.8% vs. 84.3%, $p = 0.296$). Participants that are vigorously active are more likely to be younger, male, married, well-educated, and consume alcohol.

Comparisons of different exercise intensities in sleep characteristics were presented in Table 2 and figure B1, B2, B3, B4. Participants who had moderate activity are also more prone to satisfy the recommended sleep duration, compared to the group with non-exercise habit (79.3% vs. 66.9%, $p < 0.001$). However, no statistical differences were found in sleep duration (8.0 vs. 8.0, $p = 0.297$), snore frequency (60.6% vs. 65.2%, $p = 0.135$), trouble sleeping (31.4% vs. 31.1%, $p = 0.988$), and daytime dysfunction (59.8% vs. 59.1%, $p = 0.844$) between these two groups. Compared to the non-exercise group, individuals with vigorous-exercise habit are more likely to meet the recommended sleep duration (66.9% vs. 77.9%, p

Table 1 Selected characteristics of the study population ($N = 1392$)

Variables	Total	Non-exercise	Moderate exercise		Vigorous exercise	
	$n = 1392$	$n = 625$	$n = 469$	p value	$n = 298$	p value
Age (year)	73.0 (68.0, 80.0)	75.0 (69.0, 80.0)	73.0 (69.0, 79.0)	0.004	70.0 (67.0, 76.0)	< 0.001***
Male, *n* (%)	706 (50.7)	282 (45.1)	234 (49.9)	0.133	190 (63.8)	< 0.001***
Married, *n* (%)	725 (52.3)	296 (49.8)	246 (52.5)	0.092	183 (61.4)	< 0.001***
Collage and above, *n* (%)	707 (50.8)	274 (43.8)	260 (55.4)	< 0.001	173 (58.1)	< 0.001***
PHQ-9, score	1.0 (0.0, 4.0)	1.0 (0.0, 4.0)	1.0 (0.0, 4.0)	0.235	1.0 (0.0, 4.0)	0.066
Smoking, *n* (%)	573(82.2)	237(79.8)	202(83.8)	0.212	134(84.3)	0.296
Alcohol, *n* (%)	658 (58.5)	255 (54)	237 (61.4)	0.035	166 (62.4)	0.033*
Sedentary (minute)	300.0 (180.0, 480.0)	360.0 (240.0, 480.0)	300.0 (180.0, 420.0)	< 0.001	240.0 (180.0, 360.0)	< 0.001***

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 2 Sleep characteristics of the study population ($N = 1392$)

Variables	Total	Non-exercise	Moderate exercise		Vigorous exercise	
	$n = 1392$	$n = 625$	$n = 469$	p value	$n = 298$	p value
Sleep duration (hour)	8.0 (7.0, 9.0)	8.0 (7.0, 9.0)	8.0 (7.0, 9.0)	0.297	8.0 (7.0, 9.0)	0.26
Recommended sleep duration, *n* (%)	1022 (73.4)	418 (66.9)	372 (79.3)	< 0.001	232 (77.9)	< 0.001
Snore frequency, *n* (%)	890 (63.9)	379 (60.6)	306 (65.2)	0.135	205 (68.8)	0.02
Trouble sleeping, *n* (%)	442 (31.8)	196 (31.4)	146 (31.1)	0.988	100 (33.6)	0.553
Daytime dysfunction, *n* (%)	825 (59.3)	374 (59.8)	277 (59.1)	0.844	174 (58.4)	0.728

< 0.001) and with increased snore frequency (60.6% vs. 68.8%, $p = 0.02$). However, there is no statistical differences observed between these two group in sleep duration (8.0 vs. 8.0, $p = 0.26$), trouble sleeping (31.4% vs. 33.6%, $p = 0.553$), and daytime dysfunction (59.8% vs. 58.4%, $p = 0.728$).

3.2 Model Results

Logistics regressions were fitted to explore the association between exercise intensity and selected characteristics of sleep (Fig. 1, C1, C2, C3). The model was selected via AIC and BIC. The final model was based on AIC selection. More details are in Table A.

After adjusting for other covariates, Fig. 2 shows that being married (OR = 1.49, 95% CI: 1.17, 1.91), education level (OR = 1.25, 95% CI: 0.97, 1.59), depression (PHQ.9, OR = 0.97, 95% CI: 0.94, 0.99), moderate exercise (OR = 1.8, 95% CI: 1.36, 2.40), and vigorous exercise (OR = 1.56, 95% CI: 1.13, 2.18) have significant impact on recommended sleep duration. Compared to vigorous exercise, moderate exercise shows more impact on recommended sleep duration. As for snore frequency, age (OR = 0.94, 95% CI: 0.92, 0.94), being married (OR = 2.58, 95% CI: 2.04, 3.27), education level (OR = 0.75, 95% CI: 0.59, 0.94), and alcohol consumption (OR = 1.8, 95% CI: 1.41, 2.29) are positively associated with increased snore frequency while smoking (OR = 0.65, 95% CI: 0.45, 0.94) has a negative association with snore frequency shown in figure C1. Age (OR = 0.98, 95% CI: 0.96, 1.00) has a negative association with trouble sleeping while female gender (OR = 1.24, 95% CI: 0.98, 1.58), married status (OR = 1.13, 95% CI: 0.89, 1.44), and depressive disorders (OR = 1.14, 95% CI: 1.11, 1.17) are positively associated with trouble

sleeping shown in figure C2. Age (OR = 1.02, 95% CI: 1.00, 1.04), education level (OR = 1.25, 95% CI: 1.00, 1.56), depression (OR = 1.13, 95% CI: 1.09, 1.17), and sedentary time (OR = 1.00, 95% CI: 1.00, 1.00) have positive association with daytime dysfunction shown in figure C3. The model diagnosis results have shown that our model is well-fitted.

4 Discussion

Our results, on one hand, supported our hypothesis that moderate and vigorous-intensity PA is associated with healthier sleep duration in the elderly over 65 years old. Our results have shown that PA may lead to healthier sleep duration, supporting exercise benefits of sleep as earlier studies (Chennaoui et al. 2015; Kovacevic et al. 2018). However, some of the results are contrary to our hypothesis, as many other studies reveal that physical activity may increase sleep duration. Štefan et al. found that all kinds of exercise can prevent the decrease in sleep duration in the elderly, among which the high-intensity interval training group has the greatest influence (2018). However, the population we observed was different, especially the age group of their study (mean age 80 ± 3 years) was much older than ours, which may explain the difference. Besides, the total time of physical activity intervention is likely to be different. In those interventional studies, exercise training is usually required for at least 3 months. However, in our study, the NHANES PA dataset only reported the exercise information in the last month. It is likely that some of the subjects just started moderate-to-vigorous exercise only in the past month, and that the change in their sleep duration was not reflected in an increased duration but met the recommended duration instead.

On the other hand, we surprisingly observed that vigorous exercise might be associated with increased snort frequency, which means that physical activity is not invariably beneficial for the elderly, depending on its intensity. However, one study focused on how PA predicts complaints of snoring in women reveals that, in middle-aged women, a lack of self-reported physical activity is linked to future habitual snoring (Sporndly-Nees et al. 2014). Another study also found that physical activity maintained an independent, protective effect on snoring in adults in 18–64 years (Brown et al. 2019; Bennie et al. 2021). Overall, those two studies focused on different gender, age groups, and PA intensities than ours, which may explain this difference. Besides, vigorous PA may act as physical stress leading to enlargement of tonsils in the oropharynx and obstructive sleep apnea (Jordan et al. 2014; Patel 2019).

Finally, we hardly found any association between physical exercise and trouble sleeping or daytime dysfunction. However, that's controversial among diverse studies. A systematic review found that sleep length, sleep efficiency, sleep disruption, and daily functioning did not differ substantially between exercise groups (Yang et al. 2012).

On the contrary, an RCT study revealed that the physical exercise group had significantly reduced insomnia symptom severity 6 months after baseline (Hartescu et al. 2015). In general, daytime dysfunction and trouble sleeping are subjective and hard to self-report. It is likely those parameters change after those objective measurements including sleep latency, total sleep length, and wake after sleep onset.

Our study has several strengths. First, the authoritative NHANES database makes the results more credible. Second, we assessed PA, sleep length, and other sleep parameters using previously validated questionnaires, with the prescribed recommended sleep duration. Third, all four models were selected by AIC and were adjusted for covariates.

However, our study has several limitations. First, although we used validated questionnaires, those self-reported questionnaires may cause survey bias. Participants could, for example, over-or under-estimate their PA habits or forget the precise sleeping characteristics, resulting in significant report bias as well as the social desirability effect. Second, depression, the variable contained in models for recommended sleep duration and daytime dysfunction, is proven to have an interaction with sleep. However, considering that numerous studies have kept this variable for its importance, we didn't exclude it from our models. Third, the relationships between sleep parameters and PA must be regarded with caution due to the cross-sectional methodology.

5 Conclusions

Our research reveals that senior citizens who kept moderate to vigorous PA habits are more likely to meet the recommended sleep duration, which is beneficial for cognitive function. These results suggest the significance of physical exercise in the elderly over 65 years old. Future studies should focus on how much, how frequent, or what types of physical exercise should the elderly do to mitigate the risks of various kinds of sleep disorders and gain more health benefits.

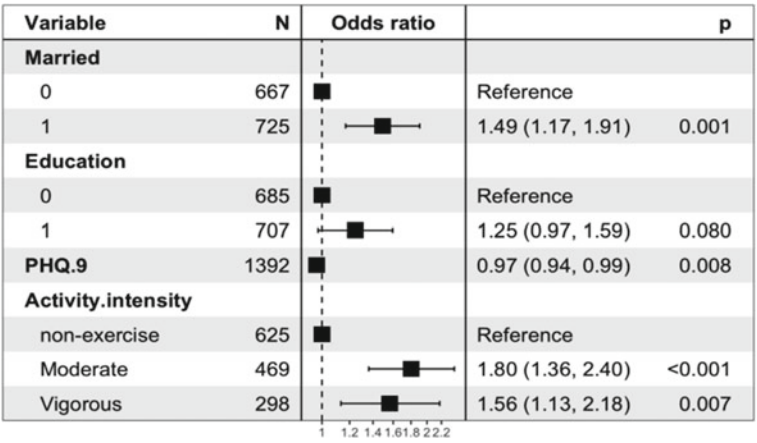


Fig. 1 Association between exercise intensity and recommended sleep duration. *Note* Married = 0 means single while married = 1 means married. Education = 0 means less than college while education = 1 means college and above

References

Abd El-Kader SM, Al-Jiffri OH (2019) Aerobic exercise modulates cytokine profile and sleep quality in elderly. Afr Health Sci 19(2):2198–2207. https://doi.org/10.4314/ahs.v19i2.45

Bennie JA, De Cocker K, Duncan MJ (2021) Associations of muscle-strengthening and aerobic exercise with self-reported components of sleep health among a nationally representative sample of 47,564 US adults. Sleep Health 7(2):281–288. https://doi.org/10.1016/j.sleh.2020.08.004

Brown BM, Peiffer J, Rainey-Smith SR (2019) Exploring the relationship between physical activity, beta-amyloid and tau: a narrative review. Ageing Res Rev 50. https://doi.org/10.1016/j.arr.2019.01.003

Centers for Disease Control and Prevention (n.d.) NHANES 2017–2018 questionnaire data. Centers for Disease Control and Prevention. Retrieved from: https://wwwn.cdc.gov/nchs/nhanes/search/datapage.aspx?Component=Questionnaire&Cycle=2017-2018. 2 April 2022

Chennaoui M, Arnal PJ, Sauvet F, Léger D (2015) Sleep and exercise: a reciprocal issue? Sleep Med Rev 20:59–72. https://doi.org/10.1016/j.smrv.2014.06.008

Hartescu I, Morgan K, Stevinson CD (2015) Increased physical activity improves sleep and mood outcomes in inactive people with insomnia: a randomized controlled trial. J Sleep Res 24(5):526–534. https://doi.org/10.1111/jsr.12297

Huyett P, Siegel N, Bhattacharyya N (2021) Prevalence of Sleep disorders and association with mortality: results from the NHANES 2009–2010. Laryngoscope 131(3):686–689. https://doi.org/10.1002/lary.28900

Jain RK, Vokes T (2019) Physical activity as measured by accelerometer in NHANES 2005–2006 is associated with better bone density and trabecular bone score in older adults. Arch Osteoporos 14(1):29. https://doi.org/10.1007/s11657-019-0583-4

Jordan AS, McSharry DG, Malhotra A (2014) Adult obstructive sleep apnoea. Lancet (London, Engl) 383(9918):736–747. https://doi.org/10.1016/S0140-6736(13)60734-5

Jurado-Fasoli L, De-la-O A, Molina-Hidalgo C, Migueles JH, Castillo MJ, Amaro-Gahete FJ (2020) Exercise training improves sleep quality: a randomized controlled trial. Eur J Clin Invest 50(3):e13202. https://doi.org/10.1111/eci.13202

Keating XD, Zhou K, Liu X, Hodges M, Liu J, Guan J, Phelps A, Castro-Piñero J (2019) Reliability and concurrent validity of Global Physical Activity Questionnaire (GPAQ): a systematic review. Int J Environ Res Public Health 16(21). https://doi.org/10.3390/ijerph16214128

Kovacevic A, Mavros Y, Heisz JJ, Fiatarone Singh MA (2018) The effect of resistance exercise on sleep: a systematic review of randomized controlled trials. Sleep Med Rev 39:52–68. https://doi.org/10.1016/j.smrv.2017.07.002

Li C, Shang S (2021) Relationship between sleep and hypertension: findings from the NHANES (2007–2014). Int J Environ Res Public Health 18(15). https://doi.org/10.3390/ijerph18157867

Lucey BP, Wisch J, Boerwinkle AH, Landsness EC, Toedebusch CD, McLeland JS, Butt OH, Hassenstab J, Morris JC, Ances BM, Holtzman DM (2021) Sleep and longitudinal cognitive performance in preclinical and early symptomatic Alzheimer's disease. Brain: J Neurol 144(9):2852–2862. https://doi.org/10.1093/brain/awab272

Memon AA, Coleman JJ, Amara AW (2020) Effects of exercise on sleep in neurodegenerative disease. Neurobiol Dis 140:104859. https://doi.org/10.1016/j.nbd.2020.104859

Patel SR (2019) Obstructive sleep apnea. Ann Internal Med 171(11):ITC81–ITC96. https://doi.org/10.7326/AITC201912030

Ramos AR, Tarraf W, Wu B, Redline S, Cai J, Daviglus ML, Gallo L, Mossavar-Rahmani Y, Perreira KM, Zee P, Zeng D, Gonzalez HM (2020) Sleep and neurocognitive decline in the Hispanic Community Health Study/Study of Latinos. Alzheimers Dement 16(2):305–315. https://doi.org/10.1016/j.jalz.2019.08.191

Roenneberg T, Kuehnle T, Juda M, Kantermann T, Allebrandt K, Gordijn M, Merrow M (2007) Epidemiology of the human circadian clock. Sleep Med Rev 11(6):429–438. https://pubmed.ncbi.nlm.nih.gov/17936039

Sporndly-Nees S, Asenlof P, Theorell-Haglow J, Svensson M, Igelstrom H, Lindberg E (2014) Leisure-time physical activity predicts complaints of snoring in women: a prospective cohort study over 10 years. Sleep Med 15(4):415–421. https://doi.org/10.1016/j.sleep.2013.09.020

Štefan L, Vrgoč G, Rupčić T, Sporiš G, Sekulić D (2018) Sleep duration and sleep quality are associated with physical activity in elderly people living in nursing homes. Int J Environ Res Public Health 15(11). https://doi.org/10.3390/ijerph15112512

Timmerman KL, Flynn MG, Coen PM, Markofski MM, Pence BD (2008) Exercise training-induced lowering of inflammatory (CD14+CD16+) monocytes: a role in the anti-inflammatory influence of exercise? J Leukoc Biol 84(5):1271–1278. https://doi.org/10.1189/jlb.0408244

Wang J, Song H, Tang X, Yang Y, Vieira VJ, Niu Y, Ma Y (2012) Effect of exercise training intensity on murine T-regulatory cells and vaccination response. Scand J Med Sci Sports 22(5):643–652. https://doi.org/10.1111/j.1600-0838.2010.01288.x

Yang P-Y, Ho K-H, Chen H-C, Chien M-Y (2012) Exercise training improves sleep quality in middle-aged and older adults with sleep problems: a systematic review. J Physiother 58(3):157–163. https://doi.org/10.1016/S1836-9553(12)70106-6

You Y, Luo J, Elstgeest LEM, Zhang Y, Tan SS, Raat H (2021) Associations between health indicators and sleep duration of American adults: NHANES 2011–16. Eur J Public Health 31(6):1204–1210. https://doi.org/10.1093/eurpub/ckab172

County-Level Covid-19 Influencing Factors Difference Between Metro and Non Metro Areas in USA

Hongjian Zhu, Xinyi Wang, and Yinan Chen

Abstract Since 2019, covid-19 disease has caused huge disaster in terms of public health, social economy, globalization etc. Inequality between metro regions and non-metro regions have aggravated the negative impact of covid-19. Our study take data of US counties up to 5.12, 2022 nationwide as example to deeper dig into the rural–urban disparity in covid-19 incidence. Based on previous research, we mainly take 6 dimensional factors into consideration: healthcare source, vaccination source, population age structure, racial structure, public attitude toward vaccination and Social Vulnerability Index. Firstly, we have visualized the covid-19 cases by man and explore the metro and non-metro difference of 18 variables using mean values difference test (u test). All 18 variables as well as covid-19 cases has reached significance difference level (u value larger than $u_{(0.05)} = 1.96$). Then, we apply multiple linear regression model to explore the relation between the 6-dimensional factors and covid-19 incidence. The covid-19 cases of metro counties are more sensitive to vaccination status, public attitude toward vaccination as well as racial structure. Finally, Grey correlation analysis method was used to explore the correlation between covid-19 cases and other 5 periodic variables. The correlation coefficients of non-metro counties (0.9081 and 0.9334 for covid-19 inpatient bed utilization and covid-19 hospital admissions per 100k respectively) are higher than metro counties (0.8016 and 0.8487 for covid-19 inpatient bed utilization and covid-19 hospital admissions per 100k respectively).

Keywords Rural–urban disparity · Linear regression model · Grey analysis

H. Zhu (✉)
School of Ecology and Environment, Northwestern Polytechnical University, Xi'an 710021, China
e-mail: hongjian_zhu@mail.nwpu.edu.cn

X. Wang
College of Letters and Science, University of Wisconsin Madison, Madison 53706, USA

Y. Chen
Chongqing Depu Foreign Language School, Chongqing 401320, China

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_150

1 Introduction

Covid-19 has been widespread worldwide causing more than 495 million affirmed cases on April 8, 2022. Outbreak of covid-19 has been studied from different perspectives including its origin, seriousness, inequality. The differences in demographic and socioeconomic factors determine the various levels of risk, which cause different incidences and mortality rates. In order to reflect the structural inequalities in society, we will investigate the county-level accessibility of vaccination and other health care infrastructures by referring to the urban–rural differences. The accessibility of health care services greatly influenced the spread of the COVID-19 virus. To be specific, the rate of vaccination at the county-level in rural and urban areas is useful to explore the spread of COVID-19. In USA, the rural area along with urban area that do not belong to larger labor market areas can be attributed to non-metro regions. There is huge difference between metro regions and non-metro regions in terms of Transportation, community quality of life, as well as life satisfaction (Mattson et al. 2021).

2 Literature Review

Scholars have to explored deeply into the difference of urban and rural infection rates. Vaccination rates in urban and suburban areas have outnumbered that of rural areas (Kirzinger et al. 2021). Social vulnerability was clearly defined in the research conducted by Neelon et al. (2021) and the counties with higher social vulnerability would be more likely to have higher cases of COVID-19 and higher mortality rates related to COVID-19 (Neelon et al. 2021).

Moreover, more research was done to explore the difference of covid-19 vaccination accessibility between metro and non-metro areas. Counties with higher levels of vaccine hesitancy and social vulnerability would be more vulnerable to be infected by the virus (Crane et al. 2021). The underlying mechanism of vulnerability was explored numerous studies. The low-socioeconomic counties with more children, single parents, and disabled individuals were inclined to have lower range of coverage and greater degrees of social vulnerability (Barry et al. 2021).

The metro and non-metro difference was also evaluated. Mostly rural counties had higher incidence and fatality rates than mostly urban counties. Additionally, one more unit of increase of the people with colored skin such as American Indians and Hispanics would lead to greater CFR (Iyanda et al. 2021).

The racial factor can further affect the rates of COVID-19 infection and death rates in different counties. The black people are less likely to get access to health care resources, which implied a lack of health care knowledge and presence of racial bias (Anderson and Ray-Warren 2022).

Not only socioeconomic status and ethnicity but also sex, age, and urban–rural differences can account for the disparities of coverage of medical infrastructure. First-dose coverage in urban areas was 16.9% greater than that in rural areas. The proportion of adults over 18 years old getting their first dose of the vaccine was different between rural and urban counties (Saelee et al. 2022). Greater prevalence of vaccinations led to lower morality rate (Harris 2021). Murray (2021) agreed with Saelee et al.'s research result and declared that the cooperation between employees in the field of public health and religion could help expand the coverage of vaccines and prevent the spread of the COVID-19 virus (Murray 2021).

Difference in education and personal habit are also emphasized. The difference in education and personal habit, such as smoking, would enhance the difficulties for the people in different counties to access the vaccines and other health services. State-level difference of vaccination courage should be overcome by setting up local sanitation section and outreach supports. In order to understand the underlying reasons of unequal distribution of vaccines, more complicated causes were defined and investigated. Through a study of 2701 U.S. counties, latent class analysis was utilized to statistically explore the enormous impact of heterogeneous geographic spread in county-level disparities in confirmed cases and dead people (Khan et al. 2022). The same conclusion of socioeconomic, geographic and political differences among the counties was verified in the research conducted by Megahed et al. (2021). Moreover, the statistical analysis of Dobis and McGranahan explored the rural–urban differences between metro and non-metro areas. The percentage of people in rural areas with health conditions was approximately 20% more than people in urban area. Furthermore, rural areas have more serious aging problem; more people do not have health insurance; more people live far from hospitals.

Except for the aging problem, the social vulnerability group also included children. Sparks et al. (2021) investigated people's, especially children's inclination to get vaccinated between metro and non-metro areas (Sparks et al. 2021). Compared to adults, 14% of children aged 5–11 years old got vaccinated in rural counties, whereas around 23% of children within the same age range got vaccinated in metro counties. For cumulative death rate, cumulative death rate was higher in rural counties and cumulative case rate was higher in urban counties (Ullrich and Mueller n.d.). Overall, the previous research has much done work on urban–rural difference of covid-19. However, there is little research on the metro and non-metro difference. Based on our literature review, COVID-19 infection between urban areas and rural areas differed greatly in the U.S.A. Also, the socioeconomic factors, medical resources as well as population aging group differed. Our research has taken six main dimensions into consideration: vaccination status, population age structure, healthcare accessibility, public attitude towards vaccination, racial structure as well as the social vulnerability index.

3 Methodologies

3.1 Data Collection Method

Aiming to figure out the county level pandemic situation, Centers for Disease Control (CDC) has tried to combine three datasets about covied-19: new hospital admissions per 100k population in the past 7 days, the percent of staffed inpatient beds occupied by covid-19 patients, and total new confirmed cases per 100k population in the past 7 days. The county level pandemic situation is figured out by the higher of the new admissions and inpatient beds metrics, based on the present level of new confirmed cases per 100k population in the past 7 days. New hospital admissions and the percent of recorded inpatient beds occupied by covid-19 inpatients indicates the present external stress on the public health system.

Data on new covid-19 confirmed cases functions as an warning index of potential stress increases in public health system in an early stage of a pandemic wave. Moreover, the dataset also contains county level vaccination status. Dataset contains all vaccinated population from various of facilities including jurisdictional partner clinics, retail pharmacies, long-term care facilities, dialysis centers, Federal Emergency Management Agency and Health Resources and Services Administration partner sites, and federal entity facilities.

The CDC has also collected data on hesitancy of covid-19 vaccination. To support state level communication and collect public attitude towards pandemic situation, ASPE has developed multiple level predictions of hesitancy rates which utilize the contemporary federal information. The dataset mainly contains two parts: the U.S. Census Bureau's Household Pulse Survey (HPS) and Census Bureau's 2019 American Community Survey (ACS). The HPS includes national information on residents' intentions to be vaccinated with available access and other demographic and social information. The ACS includes national demographic and geographic information.

3.2 Dataset Description

Our data are from the USA county level vaccination and COVID-19 Community Level in CDC. The original dataset mainly contains vaccination, health service population and public hesitancy information of USA counties up to 2022.5.12 (7 day together). Due to the missing values, we delete the information of counties with missing values. We finally obtain the information of 3051 counties with integrated values. Based on previous research we have learned that the health service area population, COVID-19 hospitalization rate, vaccination rate and risk age group population (people over 60 or 65 and people aged 5–17) can influence the county level covid-19 cases rate. Therefore, the columns we choose from the original datasets are as Table 1 shows.

Table 1 Definition of selected columns

Variables	Definition
Covid cases per 100k	New COVID-19 cases per 100,000 population (7-day total)
Administered_Dose1_Recip	People with at least one dose by state of residence
Series_Complete_Yes	Total number of people who are fully vaccinated
Booster_Doses	Total number of people who have received a booster (or additional) dose
Census2019	2019 census population
Census2019_5to17Pop	2019 census population for 5–17 years of age
Census2019_18PlusPop	2019 census population for ≥ 18 years of age
Census2019_65PlusPop	2019 census population for ≥ 65 years of age
health_service_area_population	Health service area population (2019 census estimate)
covid_inpatient_bed_utilization	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)
covid_hospital_admissions_per_100k	New COVID-19 admissions per 100,000 population (7-day total)
Estimated hesitant	Estimate of percentage of adults who are "probably not" or "definitely not" to get vaccinated
Estimated hesitant or unsure	Estimate of percentage of adults who are unsure to get vaccinated
Estimated strongly hesitant	Estimate of percentage of adults who are definitely not to get vaccinated
SVI	Social Vulnerability Index
CVAC.level.of.concern.for.vaccination.rollout1	CVAC index values range from 0 (lowest concern) to 1 (highest concern)
Percent non-Hispanic American Indian/Alaska Native	Percent of county population that is non-Hispanic American Indian/Alaska Native
Percent non-Hispanic Asian	Percent of county population that is non-Hispanic Asian
Percent non-Hispanic Black	Percent of county population that is non-Hispanic Black
Percent non-Hispanic Native Hawaiian/Pacific Islander	Percent of county population that is non-Hispanic Native Hawaiian/Pacific Islander

In contrast to roughly classifying the vaccination status, the vaccination status is strictly classified into 3 statuses: population receiving only 1 dose, population fully vaccinated and population received booster dose.

3.3 Data Processing

Based on previous research, selected columns of original dataset are supposed to be transformed into new variables. To eradicate the influence of dimension and to reduce the range among variables, we need to use ratio to replace actual values. For example, COVID-19 cases per 100k which is obtained by multiplying the ratio between number of COVID-19 confirmed cases and county population times 100,000 is used to replace the number of COVID-19 confirmed cases. By similar process, covid-19 hospital admissions per 100k, population who received booster a dose per 100k, population aged 5–17 per 100k and population over 65 have per 100k can be obtained as tables shows. Vaccinated population status is strictly classified while original dataset is not strictly classified. We classify the population vaccination into 3 categories: population with only 1 dose, population only fully vaccinated, population fully vaccinated with booster dose. Hence, the people with only one dose per 100k by state of residence is obtained by the difference between population receiving at least one dose per 100k and total population fully vaccinated per 100k. Population only receiving full vaccination per 100k is obtained by difference between fully vaccinated population per 100k and population receiving booster dose per 100k. The ratio between health service area population and county population is used to replace the number of health services and health service areas population. Social Vulnerability represents the ability to survive when confronted by external stresses on human health, stresses such as natural or human-caused disasters, or disease outbreaks. Social Vulnerability Index in the table is published by CDC to measure Social Vulnerability. Higher level index means the county is stronger in terms of resisting external stresses. Table 2 shows the transformed variables.

3.4 Statistical Analysis

The counties are classified into two parts: metro counties and non-metro counties. The following analysis will be held based on the two parts respectively. Finding the missing values, we excluded the counties with missing values and visualized the covid-19 cases distribution. Mean value difference test (u test) is utilized to confirm the difference. To find the relation between covid-19 cases per 100k and among those variables, we use multiple linear regression model to fit the variables. The model was evaluated by R square, normality, independence and variance. Considering that covid-19 cases changes over time, we have utilized Grey Correlation Analysis method to explore the relation between covid-19 cases and other periodic variables. The degree

Table 2 Variables and definitions

Variables	Definition
Covid cases per 100k	New COVID-19 cases per 100,000 population (7-day total)
DoseI_per100k	Population accepted one dose vaccine per 100k
Full_per100k	Population fully vaccinated per 100k
Booster_per100k	Population accepted booster dose
pop5to17_per100k	Population aged from 5 to 17 per 100k
pop18to65_per100k	Population aged from 18 to 65 per 100k
pop65_per100k	Population aged over 65 per 100k
health_area_population_ratio	Ratio between county population and health service area population
covid_inpatient_bed_utilization	Percent of staffed inpatient beds occupied by COVID-19 patients
covid_hospital_admissions_per_100k	New COVID-19 admissions per 100k
hesitant_per100k	Adults who are "probably not" or "definitely not" to get vaccinated per 100k
hesitantunsure_per100k	Adults who are "unsure" to get vaccinated per 100k
stronglyhesitant_per100k	Adults who are "definitely not" to get vaccinated per 100k
SVI	Social Vulnerability Index
CVAC.level.of.concern.for.vaccination.rollout	CVAC Index values range from 0 (lowest concern) to 1 (highest concern)
non.Hispanic.American.Indian.Alaska.Native_per100k	Population of non-Hispanic American Indian Alaska Native per 100k
non.Hispanic.Asian_per100k	Population of non-Hispanic Asian per 100k
non.Hispanic.Black_per100k	Population of non-Hispanic Black per 100k
non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k	Population of non-Hispanic Native Hawaiian Pacific Islander per 100k

of correlation is a measure of the degree of correlation between the factors of two systems, which varies from time to time or object to object. Grey system theory puts forward the concept of grey relational degree analysis for each subsystem, aiming to seek the numerical relationship among subsystems (or factors) in the system through certain methods (Wang et al. 2022). Therefore, grey relational analysis provides a

quantitative measure for the development and change of a system, which is very suitable for dynamic history analysis. We visualized the periodic fluctuation of the variables (covid-19 cases per 100k, covid-19 inpatient bed utilization, covid-19 hospital admissions per 100k, population accepted only 1 does vaccine per 100k, population fully vaccinated per 100k, population accepted booster doses per 100k) from 2022.2.24 to 2022.5.12. Aiming to accurately reflect the tendency and to reduce the difference among variables, all the periodic variables are standardized by z-score method. Finally, the variables with standardized values are take into the Grey system model. The analyzes are performed by R studio-cloud and matlab 2019b.

4 Results

4.1 Covid-19 Cases Distribution

Figure 1 shows the geographical distribution of USA covid-19 cases up to 2022.5.12. Different colors represent different pandemic risk level. Nationwide, the medium risk level counties and high-risk level counties concentrate in the northeast part of USA close to the frontier with Canada. The pandemic situation of east USA is more serious than the west USA. In central region of USA, there are more non-metro counties than metro counties. Figure shows the covid-19 cases frequency distribution. The covid-19 cases of non-metro counties is more concentrated than metro counties.

In non-metro counties, 91.4% counties own covid-19 cases lower than 200 per 100k. In metro counties, 91.4% counties own covid-19 cases lower than 300 per 100k. Figure shows the covid-19 cases boxplot of metro counties and non-metro counties. In general, the covid-19 cases level of metro counties (125.0554, 91.34 for mean value and median value respectively) is higher than covid-19 cases level of non-metro counties (73.25159, 41.21 for mean value and median value respectively). The u test result is 12.18869, larger than $u_{(0.05)} = 1.96$ indicating that the mean values difference has reached significance level. Non-metro county Loving County, Texas state has the highest covid-19 cases value 2958.58 per 100k nationwide, much higher than the highest value 1483.84 per 100k of metro county (Armstrong County, Texas state).

4.2 Summary Statistics of Modified Variables

Descriptive statistics for demographic age group variables, social variables, medical source variables and public attitude variables for metro counties and non-metro counties are presented in table in the appendix. Table 3 shows the mean values test (u test) results. Among the 18 variables, the mean values difference of population aged from 5 to 17 per 100k and population of non-Hispanic Native Hawaiian/Pacific Islander

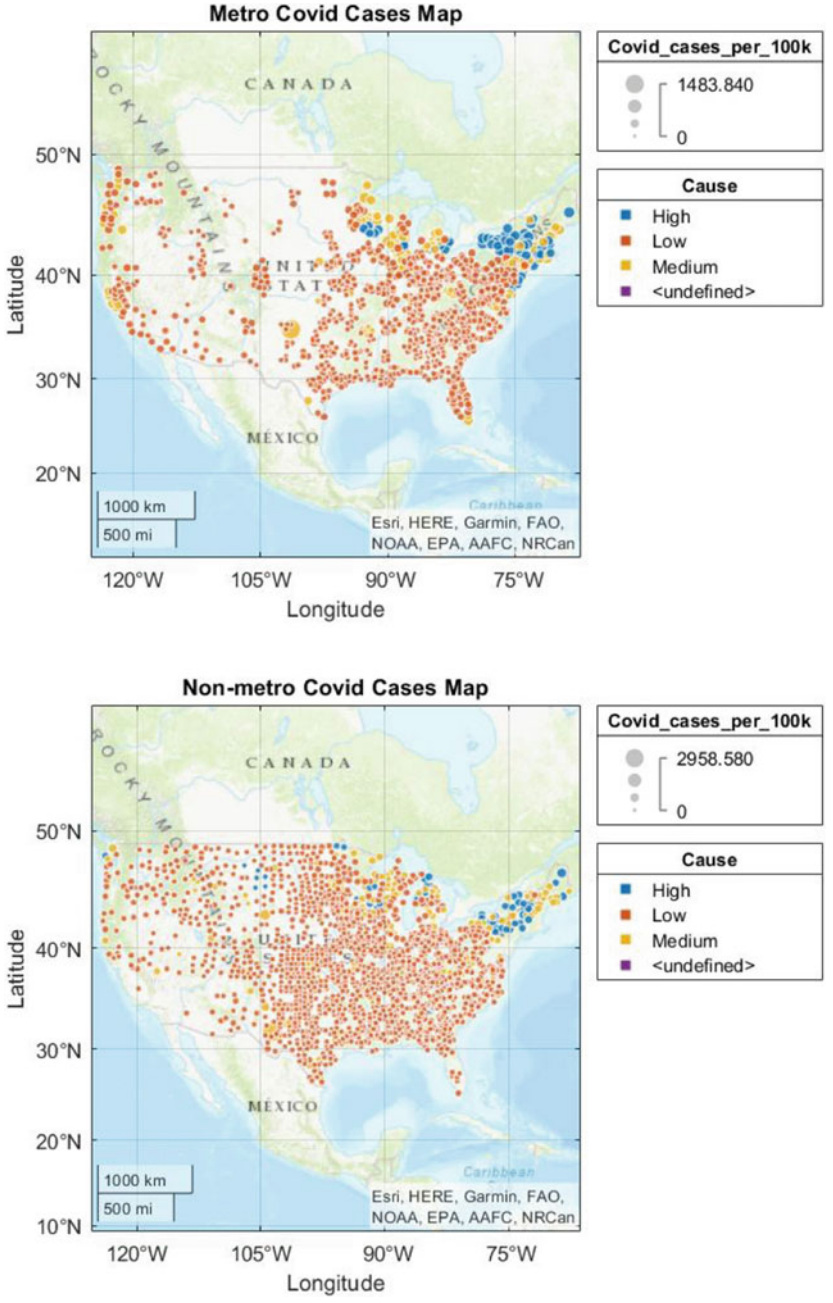


Fig. 1 Covid-19 cases distribution of metro counties and non-metro counties

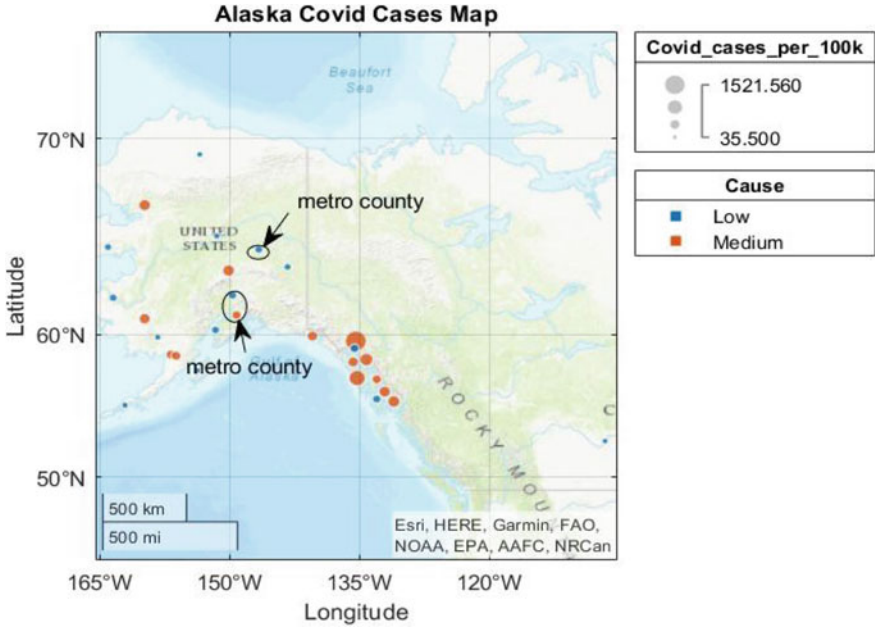


Fig. 1 (continued)

has reached significance level (u value larger than $u_{(0.05)} = 1.96$, smaller than $u_{(0.01)} = 2.58$). Other 16 variables has reached extremely significant level (u value larger than $u_{(0.001)} = 3.30$).

4.3 Regression Results

Table 4 shows the linear regression results. Variables colored by yellow means that the variable can only influence covid-19 cases of metro or non-metro county. There is huge difference between the influencing factors. The covid-19 cases of metro counties are more sensitive to vaccination status. Population accepted 1 dose vaccine per 100k and population accepted booster dose vaccine per 100k can significantly influence the covid-19 cases of metro counties. Meanwhile, only population fully vaccinated per 100k can significantly influence the covid-19 cases of non-metro counties. About the healthcare variables, the covid-19 hospital admissions per 100k can significantly influence the covid-19 cases of metro counties but has little influence on covid-19 cases of non-metro counties. When it comes to public attitude variables, the covid-19 cases of metro counties are more sensitive to the public attitude. Population who are unsure to be vaccinated can significantly influence the covid-19 cases of metro counties but has little influence on covid-19 cases of non-metro counties. Concern level of vaccination can significantly influence the covid-19 cases of metro counties

Table 3 Mean value difference

Variables	u value	Significance level
DoseI_per100k1	6.075485	***
Full_per100k1	13.45634	***
Booster_per100k1	7.402913	***
pop5to17_per100k1	2.494055	*
pop18to65_per100k1	22.76146	***
pop65_per100k1	19.71053	***
health_area_population_ratio1	3.684877	***
covid_inpatient_bed_utilization1	11.24189	***
covid_hospital_admissions_per_100k1	9.586037	***
hesitant_per100k1	13.66798	***
hesitantunsure_per100k1	14.24249	***
stronglyhesitant_per100k1	13.86145	***
CVAC.level.of.concern.for.vaccination.rollout1	7.542206	***
non.Hispanic.American.Indian.Alaska.Native_per100k1	8.0177	***
non.Hispanic.Asian_per100k1	15.92815	***
non.Hispanic.Black_per100k1	5.636616	***
non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k1	2.521284	*
SVI	11.28505	***

but has little influence on the covid-19 cases of non-metro counties. Finally, covid-19 cases of metro counties are more sensitive to racial structure than non-metro counties. In metro counties, non-Hispanic Asian population per 100k and non-Hispanic Native Hawaiian/Pacific Islander population per 100k can significantly influence the covid-19 cases. In non-metro counties, only non-Hispanic American Indian/Alaska Native population per 100k can significantly influence the covid-19 cases. Non-Hispanic Black population has positive relation with covid-19 cases in metro counties and has negative relation with covid-19 cases in non-metro counties.

4.4 Linear Regression Model Diagnosis Results

The R square values of linear regression models are 0.5674 and 0.3732 of metro counties and non-metro counties respectively. Therefore, the results can be well fitted by linear regression model. Figures 2 and 3 show QQ plots of normality in metro counties and non-metro counties respectively. Red lines are the fitted straight lines and 95% confidence interval. Most of the points are around the fitted normal straight line.

Table 4 Regression results

Metro status	Variables	Estimates	Probability	Significance level
Metro	**DoseI_per100k1**	**0.001278**	**0.036253**	*
	Full_per100k1	**− 0.000279**	**0.324435**	
	Booster_per100k1	0.0029	< 2e−16	***
	pop5to17_per100k1	− 0.009867	0.076724	
	pop18to65_per100k1	− 0.0041	0.35035	
Metro	pop65_per100k1	− 0.006827	0.103148	
	health_area_population_ratio1	0.1589	0.044011	*
	covid_inpatient_bed_utilization1	15.47	1.04e−11	***
	covid_hospital_admissions_per_100k1	**4.308**	**0.000007**	***
	hesitant_per100k1	− 0.01628	0.000001	***
	hesitantunsure_per100k1	**0.00496**	**0.016395**	*
	stronglyhesitant_per100k1	0.009435	0.006956	**
	CVAC.level.of.concern.for.vaccination.rollout1	**− 50.44**	**0.000083**	***
	non.Hispanic.American.Indian.Alaska.Native_per100k1	**0.000814**	**0.272426**	
	non.Hispanic.Asian_per100k1	**0.002992**	**0.000327**	***
	non.Hispanic.Black_per100k1	0.000265	0.208913	
	non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k1	**− 0.02586**	**0.034059**	*
	SVI	− 21.89	0.095385	
Non-metro	**DoseI_per100k**	**− 0.0005**	**0.052076**	
	Full_per100k1	− 0.000625	0.119435	
	Booster_per100k1	0.003779	< 2e−16	***

(continued)

Table 4 (continued)

Metro status	Variables	Estimates	Probability	Significance level
	pop5to17_per100k1	− 0.003751	0.410775	
	pop18to65_per100k1	0.001304	0.699451	
	pop65_per100k1	− 0.0032	0.332784	
	health_area_population_ratio1	0.2793	< 2e−16	***
	covid_inpatient_bed_utilization1	17.95	< 2e−16	***
	covid_hospital_admissions_per_100k1	**0.1775**	**0.799079**	
	hesitant_per100k1	− 0.0102	0.000947	***
	hesitantunsure_per100k1	**0.001561**	**0.395786**	
	stronglyhesitant_per100k1	0.01007	0.001221	**
	CVAC.level.of.concern.for.vaccination.rollout1	**3.673**	**0.757885**	
	non.Hispanic.American.Indian.Alaska.Native_per100k1	**0.000661**	**0.015522**	*
	non.Hispanic.Asian_per100k1	**− 0.001108**	**0.515629**	
	non.Hispanic.Black_per100k1	**− 0.000002**	**0.992788**	
	non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k1	**− 0.003974**	**0.736061**	
	SVI	**− 16.38**	**0.166608**	

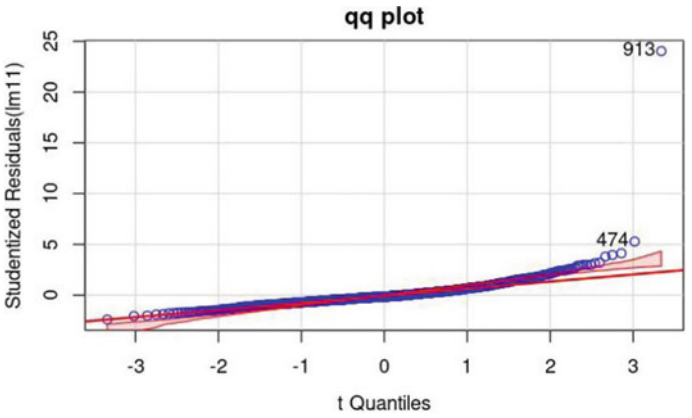


Fig. 2 Metro normal qq plot

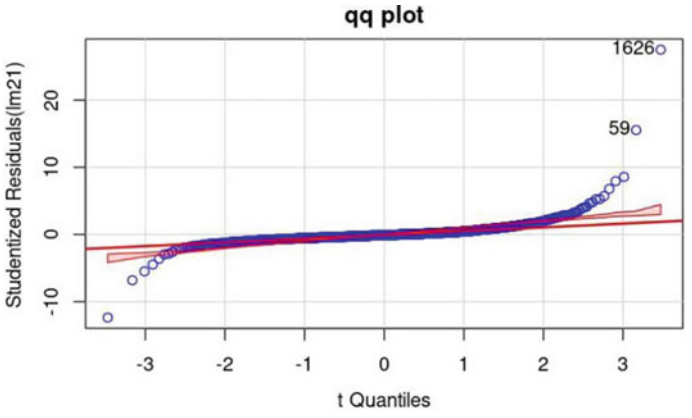


Fig. 3 Non-metro normal qq plot

Figures 4 and 5 show residual plots of metro counties and non-metro counties respectively. The distribution indicates that there is no problem of heteroscedasticity.

4.5 Grey Analysis Results

Figures 6 and 7 show the tendency of periodic variables after z-score standardization. Nationwide, the covid-19 bed utilization and covid-19 hospital admissions have similar fluctuation trend with covid-19 cases. From 2022.2.24 to 2022.5.12, covid-19 cases of metro counties showed a downward trend and then an upward trend, while non-metro counties showed a downward trend. Nationwide, the population

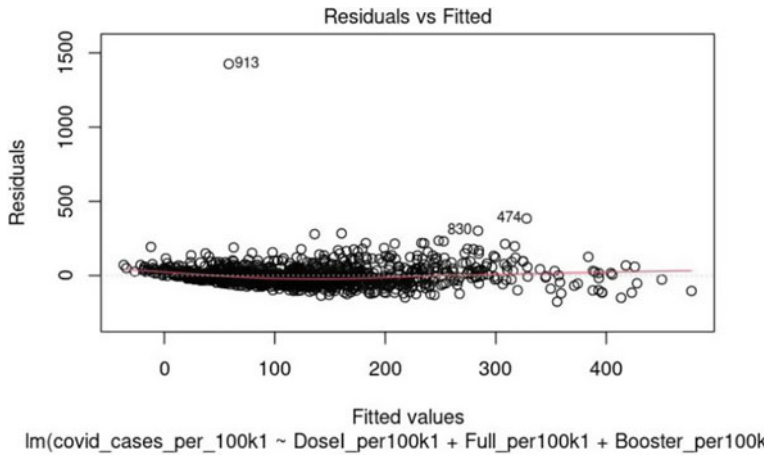


Fig. 4 Metro residual plot

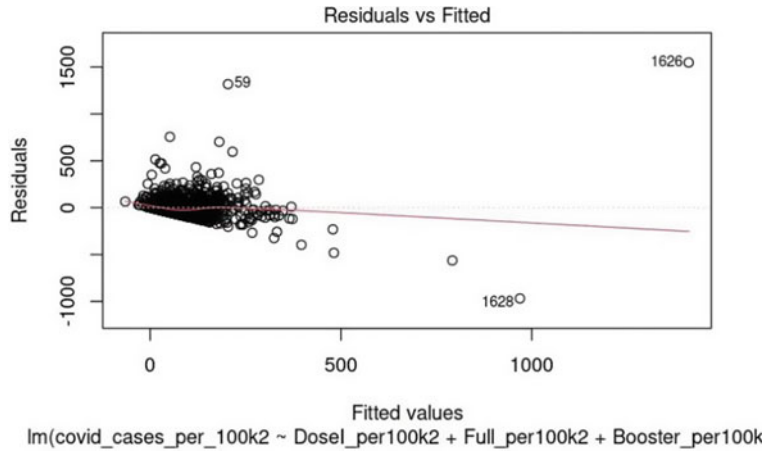


Fig. 5 Non-metro residual plot

accepted 1 dose per 100k and the population fully vaccinated shows a downward trend while the population accepted booster dose shows an upward trend. The fluctuation trend of non-metro counties was more volatile than the fluctuation of metro counties especially for population accepted 1 dose per 100k and the population fully vaccinated.

Table shows the Grey analysis results. Nationwide, the covid-19 inpatient bed utilization and covid-19 hospital admissions per 100k have the highest correlation with covid-19 cases. The correlation coefficients of non-metro counties (0.9081 and 0.9334 for covid-19 inpatient bed utilization and covid-19 hospital admissions per 100k respectively) are higher than metro counties (0.8016 and 0.8487 for covid-19

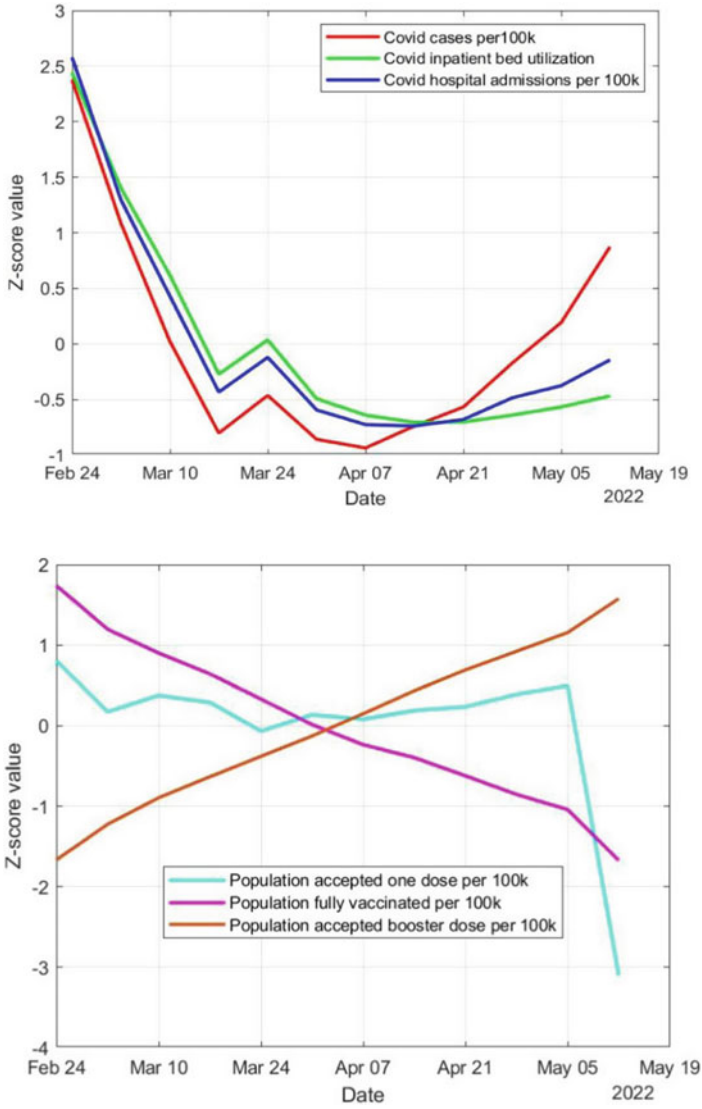


Fig. 6 Periodic tendency of metro county

inpatient bed utilization and covid-19 hospital admissions per 100k respectively) (Tables 5, 6 and 7).

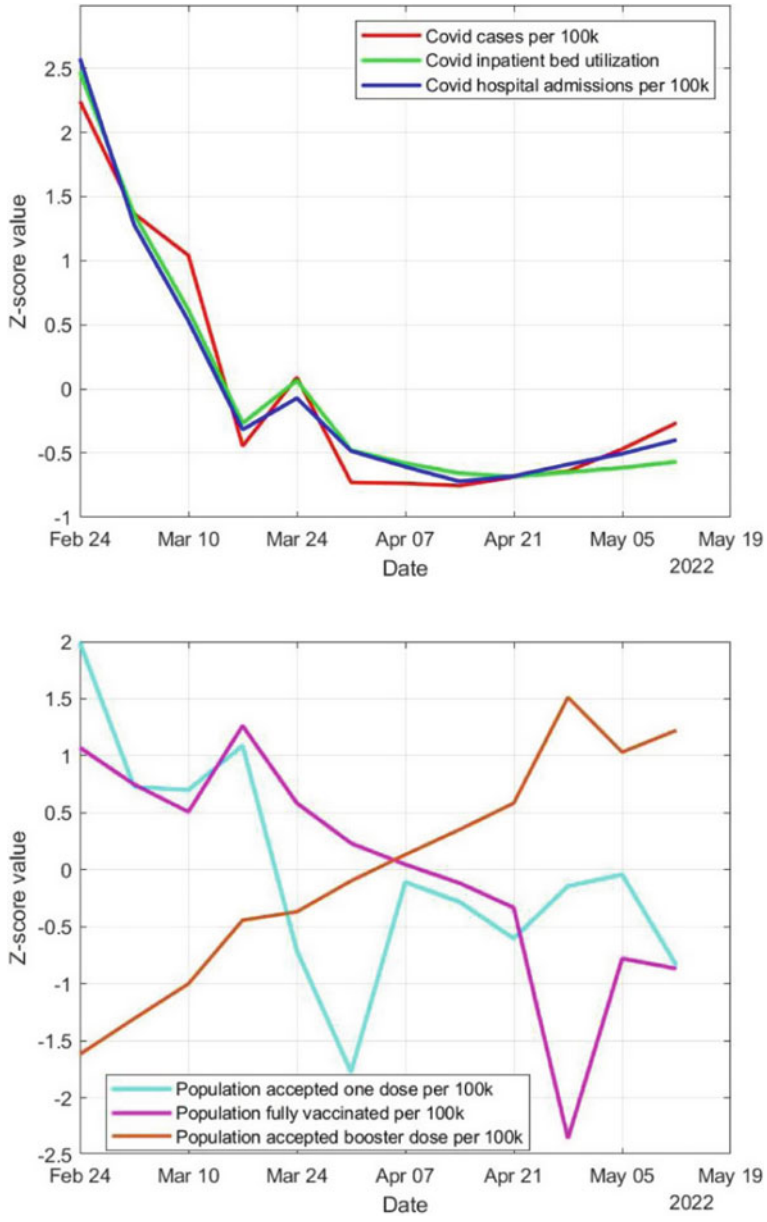


Fig. 7 Periodic tendency of non-metro county

Table 5 Correlation coefficients

Variables	covid_inpatient_bed_utilization	covid_hospital_admissions_per_100k	DoseI_per100k	Full_per100k	Booster_per100k
Metro	0.8016	0.8487	0.4682	0.4713	0.446
Non-metro	0.9081	0.9334	0.5712	0.5684	0.5495

Table 6 Summary statistics of metro county

Metro variables	Min	Max	Median	Mean	Std
Covid cases per 100k	0	1483.84	91.34	125.0554	112.9825
DoseI_per100k	98.35686	58,775.28	7263.764	8383.845	4848.024
Full_per100k	8040.928	259,603.9	30,620.69	31,554.19	10,099.52
Booster_per100k	315.1494	58,895.94	23,644.93	24,632.33	9733.821
pop5to17_per100k	5180.486	27,532.17	16,356.51	16,320.25	2283.148
pop18to65_per100k	34,731.16	78,026.19	60,106.94	60,248.47	3343.88
pop65_per100k	4859.265	58,173.99	17,354.55	17,650.35	4232.17
health_area_population_ratio	1	471.4911	5.114098	14.36361	29.82553
covid_inpatient_bed_utilization	0	11.8	1.5	1.916479	1.666398
covid_hospital_admissions_per_100k	0	32.7	4.1	4.869384	3.873265
hesitant_per100k	2690	26,700	12,190	11,980.64	4366.676
hesitantunsure_per100k	4990	32,330	17,610	17,599.5	5191.074
stronglyhesitant_per100k	1860	18,240	7870	7758.734	3004.777
SVI	0	1	0.44	0.4574588	0.2720531
CVAC.level.of.concern.for.vaccination.rollout	0	0.99	0.43	0.4315785	0.2732706
non.Hispanic.American.Indian.Alaska.Native_per100k	0	80,610	230	691.2749	3059.766
non.Hispanic.Asian_per100k	0	36,280	1260	2404.961	3492.665
non.Hispanic.Black_per100k	0	78,390	5550	10,982.35	13,511.22
non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k	0	2410	30	83.00087	193.6519

Table 7 Summary statistics of non-metro county

Non-metro variables	Min	Max	Median	Mean	Std
Covid cases per 100k	0	2958.58	41.21	73.25159	115.2043
DoseI_per100k1	0	347,553.9	5842.26	6859.328	8989.927
Full_per100k1	4567.308	75,775.18	26,234.94	27,046.4	6714.804
Booster_per100k1	108.058	55,124.56	20,723.1	22,105.4	8073.305
pop5to17_per100k1	5496.922	29,782.84	16,050.46	16,093.82	2657.702
pop18to65_per100k1	43,632.75	81,899.91	57,206.77	57,267.26	3762.113
pop65_per100k1	6086.12	43,266.23	20,483.59	20,893.75	4680.627
health_area_population_ratio1	1	5008.663	7.904151	29.09559	169.9195
covid_inpatient_bed_utilization1	0	11.8	0.8	1.230927	1.577062
covid_hospital_admissions_per_100k1	0	42.3	2.3	3.436459	4.208796
hesitant_per100k1	3830	26,700	13,950	14,247.94	4565.059
hesitantunsure_per100k1	7550	32,330	19,800	20,345.74	5119.38
stronglyhesitant_per100k1	2070	18,240	8900	9372.244	3294.639
SVI1	0	1	0.55	0.5362961	0.2924764
CVAC.level.of.concern.for.vaccination.rollout1	0	1	0.56	0.549236	0.2887656
non.Hispanic.American.Indian.Alaska.Native_per100k1	0	91,900	320	2569.436	9420.153
non.Hispanic.Asian_per100k1	0	39,630	460	688.8356	1397.032
non.Hispanic.Black_per100k1	0	87,230	1315	8009.831	15,077.79
non.Hispanic.Native.Hawaiian.Pacific.Islander_per100k1	0	3400	0	64.80506	192.6714

5 Discussion

Overall, there is a huge difference between metro counties and non-metro counties in the field of county-level factors related to COVID-19 infection, and the rural counties are inclined to have greater incidence and mortality rates. Interestingly, our research has found that the population over 65 and population under 18 has no significant correlation with the county level covid-19 incidence which was found to be significantly correlated in previous research (Wang et al. 2021). Moreover, Social Vulnerability Index has no significant correlation with covid-19 cases either. Our research has also given an insight into the correlation between covid-19 cases and public attitude toward vaccine which has not been mentioned by previous research. In both metro and non-metro counties, public attitude can influence covid-19 cases with different degrees.

However, there are some limitations. Firstly, in our research did not take enough periodic pandemic variables into consideration. There is a lack of periodic data for public attitude variable, race variables as well as population age structure. According to the hypothesis test, some of the values in the two datasets are dramatically different, while others are nearly identical. We believe that some variables are conceptually linked to the spread of the virus and can have a significant impact on the results. However, separating the dataset by metro and non-metro states may overlook these factors.

For future studies, it is better to apply time series model to study the periodic pandemic fluctuations and classify the period into several stages. Natalie C. DuPre used group trajectory analysis and logistic regression model to combine the time factor and county level factors (DuPre et al. 2021). Furthermore, taking certain pandemic period as base line and comparing difference among different stages for cross verification would be more effective to get more efficient results. Finding the correlation between county level factors and covid-19 cases, we can try to make a comprehensive evaluation model to assess the pandemic safety level of each county. For example, entropy method, an objective weight method can be used without the interference of subjectivity (Neogi 2022). To obtain better weights of variables, we might use different kinds of comprehensive evaluation methods and compare the different weights and county level scores. Moreover, we can further explore the significance of variables.

References

Anderson KF, Ray-Warren D (2022) Racial-ethnic residential clustering and early COVID-19 vaccine allocations in five urban Texas counties. J Health Soc Behav. https://doi.org/10.1177/00221465221074915

Barry V, Dasgupta S, Weller DL, Kriss JL, Cadwell BL, Rose C, Pingali C, Musial T, Sharpe JD, Flores SA, Greenlund KJ, Patel A, Stewart A, Qualters JR, Harris LT, Barbour KE, Black CL (2021) Patterns in covid-19 vaccination coverage, by social vulnerability and urbanicity—United

States, December 14, 2020–May 1, 2021. MMWR. Morb Mortal Wkl Rep 70(22). https://doi.org/10.15585/mmwr.mm7022e1

Crane MA, Faden RR, Romley JA (2021) Disparities in county covid-19 vaccination rates linked to disadvantage and hesitancy. Health Aff 40(11):1792–1796. https://doi.org/10.1377/hlthaff.2021.01092

DuPre NC, Karimi S, Zhang CH, Blair L, Gupta A, Alharbi LM, Alluhibi M, Mitra R, McKinney WP, Little B (2021) County-level demographic, social, economic, and lifestyle correlates of covid-19 infection and death trajectories during the first wave of the pandemic in the United States. Sci Total Environ 786:147495. https://doi.org/10.1016/j.scitotenv.2021.147495

Harris JE (2021) Covid-19 incidence and hospitalization during the delta surge were inversely related to vaccination coverage among the most populous U.S. counties. Health Policy Technol 100583. https://doi.org/10.1016/j.hlpt.2021.100583

Iyanda AE, Boakye KA, Lu Y, Oppong JR (2021) Racial/ethnic heterogeneity and rural-urban disparity of covid-19 case fatality ratio in the USA: a negative binomial and GIS-based analysis. J Racial Ethnic Health Disparities 9(2):708–721. https://doi.org/10.1007/s40615-021-01006-7

Khan SS, Krefman AE, McCabe ME, Petito LC, Yang X, Kershaw KN, Pool LR, Allen NB (2022) Association between county-level risk groups and COVID-19 outcomes in the United States: a socioecological study. BMC Public Health 22(1). https://doi.org/10.1186/s12889-021-12469-y

Kirzinger A, Sparks G, Brodie M (2021) KFF COVID-19 vaccine monitor-rural America-findings. KFF. Retrieved from: https://www.kff.org/report-section/kff-covid-19-vaccine-monitor-rural-america-findings/. 27 April 2022

Mattson J, Brooks J, Godavarthy R, Quadrifoglio L, Jain J, Simek C, Sener I (2021) Transportation, community quality of life, and life satisfaction in metro and non-metro areas of the United States. Wellbeing Space Soc 2:100056. https://doi.org/10.1016/j.wss.2021.100056

Megahed FM, Jones-Farmer LA, Zhao L, Rigdon SE (2021) Modeling the differences in the time-series profiles of new COVID-19 daily confirmed cases in 3,108 contiguous U.S. counties: a retrospective analysis. PLOS ONE 16(11). https://doi.org/10.1371/journal.pone.0242896

Murray T (2021) Stay-at-home orders, mobility patterns, and spread of covid-19. Am J Public Health 111(6):1149–1156. https://doi.org/10.2105/ajph.2021.306209

Neelon B, Mutiso F, Mueller NT, Pearce JL, Benjamin-Neelon SE (2021) Spatial and temporal trends in social vulnerability and covid-19 incidence and death rates in the United States. https://doi.org/10.1101/2020.09.09.20191643

Neogi D (2022) Capturing the differential impacts of easing COVID-19 restrictions: application of a hybrid model of entropy and TOPSIS. Int J Math Eng Manag Sci 7(2):231. https://www.proquest.com/docview/2645989845

Saelee R, Zell E, Murthy BP, Castro-Roman P, Fast H, Meng L, Shaw L, Gibbs-Scharf L, Chorba T, Harris LTQ, Murthy N (2022) Disparities in covid-19 vaccination coverage between urban and rural counties—United States, December 14, 2020–January 31, 2022. MMWR. Morb Mortal Wkl Rep 71(9):335–340. https://doi.org/10.15585/mmwr.mm7109a2

Sparks G, Hamel L, Kirzinger A, Stokes M, Brodie M (2021) KFF COVID-19 vaccine monitor: differences in vaccine attitudes between rural, suburban, and urban areas. KFF. Retrieved from: https://www.kff.org/coronavirus-covid-19/poll-finding/kff-covid-19-vaccine-monitor-vaccine-attitudes-rural-suburban-urban/. 27 April 2022

Ullrich F, Mueller K (n.d.) Brief no. 2020-9 April 2022 http://www.public-health.uiowa ... Retrieved from: https://rupri.public-health.uiowa.edu/publications/policybriefs/2020/COVID%20Longitudinal%20Data.pdf. 27 April 2022

Wang L, Zhang S, Yang Z, Zhao Z, Moudon AV, Feng H, Liang J, Sun W, Cao B (2021) What county-level factors influence COVID-19 incidence in the United States? Findings from the first wave of the pandemic. Cities (London, England) 118:103396. https://doi.org/10.1016/j.cities.2021.103396

Wang Z, Bouri E, Ferreira P, Shahzad SJH, Ferrer R (2022) A grey-based correlation with multi-scale analysis: S&P 500 VIX and individual VIXs of large US company stocks. Financ Res Lett 48:102872. https://doi.org/10.1016/j.frl.2022.102872

Supply Chain Finance and Blockchain Technology

Yishu Wang

Abstract Digital supply chain finance is a financial innovation product of the combination of blockchain technology and traditional supply chain finance. This paper constructs the theoretical framework of enterprise mortgage financing from banks in the supply chain network, and analyzes the economic operation principle of digital supply chain finance and its advantages and disadvantages compared with traditional supply chain finance. In order to prevent ethical risks like enterprise information manipulation and malicious fraud, the study found that when the quantity and quality of information on the supply chain reach certain levels, the enterprise-related information revealed by the blockchain's consensus mechanism will be close to the actual information. This will allow banks to offer sufficient accessibility for supply chain businesses and enough affordable financing options. Banks, on the other hand, are better suited to avoid and control risks through conventional offline due diligence when the number of chain firms is few or the quality of chain information cannot be assured. Theoretically, this paper shows that digital supply chain finance based on blockchain technology will become a more effective and inclusive financial support method in the future with the popularization of blockchain technology in the supply chain and the improvement of enterprise digitization level.

Keywords Blockchain · Supply chain finance · Financial technology

1 Introduction

China is currently going through a crucial phase of economic development. The economy and society have always been concerned with the issue of small and medium-sized business financing that is complicated and expensive. In particular, COVID-19's impact on the financing needs of small and micro businesses is even more difficult to satisfy. The People's Bank of China and several other departments

Y. Wang (✉)
Shanxi University of Finance and Economic, Taiyuan 034000, China
e-mail: wangyishu2023@163.com

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_151

jointly presented opinions on standardizing the development of supply chain finance and promoting the steady circulation, optimization, and upgrading of the supply chain industrial chain in September 2020. They recommended that financial institutions and entity enterprises should improve information sharing and coordination and standardize the development of supply chain finance. Since Nakamoto put forward the concept of blockchain, decentralization and reducing fraud have been the focus of extensive attention and discussion in the academic community, which has also had a far-reaching impact on supply chain finance. At this stage, China's blockchain financial model is still in the exploratory stage. As a result, this paper builds on prior research, investigates the connection between conventional supply chain finance and digital blockchain finance and the quantity of supply chain enterprises, examines the implementation of the two models, and makes pertinent recommendations in an effort to resolve the conundrum of supply chain finance development and aid in the high-quality development of businesses and the economy.

2 Literature Review

2.1 Current Situation of Supply Chain Finance

Small and medium-sized businesses constitute a significant component of the Chinese economy and are crucial to the country's economic growth, however, "small and medium-sized enterprises will be more vulnerable to financing constraints in the asymmetric credit market, which is caused by the opacity of financial information." (Wang and Zhang 2003). Banks, especially large state-owned commercial banks, have high cost and insufficient incentive to collect soft information of small and medium-sized enterprises, and there are natural disadvantages in providing financing services for small and medium-sized enterprises (Yifu 2001; Yilin and Yifu 2019). Nowadays, under the downtown pressure on the economy of COVID-19, "SMEs that have not been solved by small and medium-sized enterprises lead to difficulties in real capital operation and great downward pressure on the overall economy." (Ju'e and Chen 2020) in order to solve the severe cash flow pressure and break the financing constraints of small and medium-sized enterprises, the urgency and necessity are further highlighted." from institute of financial technology in Tsinghua University.

2.2 Existing Supply Chain Financial Technology and Problems

Practice has proved that supply chain finance is closely related to the real economy and has a significant influence on enterprise financing. "Supply chain finance can organically combine finance and real economy to form an emerging business form

that can solve enterprise financing problems under the premise of reasonable risk and interact with multiple subjects" (Song and Hu). We must enhance financial institutions' information identification and risk control capabilities, as well as incorporate information technology and big data into their decision-making processes, in order to address the financing issues facing small and medium-sized businesses. Little progress has now been made. For example, the big technology credit model (Cornelli et al. 2020). However, this big technology credit model is only for small and micro enterprises or self-employed households, does not pay attention to the enterprise level, and is not suitable for some enterprises that rely on offline supply chain networks. In addition, another widely used is digital supply chain finance. "Supply chain finance provides financial products and services for core enterprises and their upstream and downstream enterprises. Financial goods and services are provided by supply chain finance to core businesses as well as their upstream and downstream counterparts. The data mostly comes from the capital chain, information flow, and logistics, and it reflects the production activities of businesses that are produced by the core businesses and their upstream and downstream businesses during the transaction process (Hu and Huang 2009). However, the occurrence of the case of fake warehouse single pledge loan fraud of Shanghai steel trade enterprises explains this technology also has disadvantages—it is difficult for banks to identify the authenticity of information. As opposed to mining the enterprise's credit and risk information through a large digital footprint and big data risk control technology, the focus of enterprise data "online" is to rely on the consensus mechanism of blockchain, smart contracts, and other technical means to ensure the non tamperability and traceability of online information, as well as to complete the tasks of information screening, risk prevention, in-process, and p The challenge and pressing issue that traditional supply chain financing faces is ensuring the validity and dependability of pertinent information about lending firms (Nakamoto 2008). Taking the goods mortgage financing in Shanghai as an example, under the digital supply chain financial technology, it is difficult for banks to have sufficient grasp and understanding of the real situation of supply chain enterprises. Secondly, according to the currently available and mature means, if banks want to solve the authenticity problem, they need to detect on a large scale and pay huge monitoring costs, and there is still a regulatory blind spot. Such loopholes lead to frequent chaos of "false mortgage" and "multiple mortgages for one goods". The blockchain can record the daily inventory and disposal information of goods captured by the delivery system based on Internet of things technology in real time, so as to ensure that all participants in the alliance chain system can understand the real state of goods in the whole process and reach a consensus on relevant information, so as to prevent the false mortgage of goods. Recently, many scholars have studied the methods to solve this problem. Blockchain technology can improve the authenticity and transparency of inventory, logistics, capital flow, and other information verification in the supply chain, transmit the signal of the company's operational capability to investors, and then assist high-quality enterprises in obtaining financing concessions at a lower signal cost, as demonstrated by Chod et al. (Chod et al. 2020).

Based on the signal game model, Liang and Zhang (2020) found that after the integration of blockchain technology and banking, the cost of tampering or falsifying information by small and medium-sized enterprises will increase, and the lending market will shift from the traditional mixed equilibrium to the separate equilibrium, so that small and medium-sized enterprises with different risk types can obtain financing. According to Guo and Chen (2020), blockchain technology may promote efficient coordination between various financial institutions in the supply chain, view the track of information transmission, and enhance the system for financial oversight and risk management. Although blockchain technology has gained widespread acceptance in academia as a solution to the information asymmetry issue, more research is still required to fully understand how blockchain fundamentally alters the operating principle of supply chain finance, especially how to clearly differentiate between the benefits and drawbacks of digital supply chain finance and traditional supply chain finance. This is what this paper will mainly discuss.

3 Optimal Concealment Strength Model

Digital supply chain finance and conventional supply chain finance are the two supply chain models covered in this essay. In the event that there is a digital supply chain, banks conduct digital credit evaluation according to the information registered by upstream and downstream enterprises of the supply chain on the blockchain platform; Under the condition of a traditional supply chain, banks evaluate the enterprises applying offline due diligence. We suppose that the supply chain is made up of a number of upstream and downstream businesses, and that banks lend money to those businesses. Under such conditions, we only consider that the representative enterprise of a non core enterprise needs financing and applies to the bank for goods mortgage loan. Lending enterprises and banks will conduct a three-stage game process. In the first stage, the loan enterprise sends a loan application to the bank and mortgages the goods to the bank. At the same time, the bank conducts due diligence on the enterprise. At this time, the lending enterprise has two strategic behaviors to ensure the maximization of interests, real mortgage (i.e. providing full and real goods) or fraudulent mortgage (i.e. falsely reporting the value of collateral or charging more than one goods). When the enterprise chooses a fraudulent mortgage, the enterprise should consider the cost paid by the bank to cover up the goods and reduce the fraud found in the collateral during the due diligence c. In the second stage, the bank decides to approve the loan or reject the loan application according to the results of loan due diligence. Assuming that the probability of the bank discovering the fraud of the loan enterprise through due diligence is z, and the probability of the bank discovering the fraud when checking the authenticity of the information through the investigation of the upstream enterprise is, in which the accuracy of the information between the upstream enterprise and the loan enterprise is measured. When the n-level upstream enterprise of the loan enterprise is investigated, there is a probability of discovering the fraudulent mortgage behavior of the loan enterprise. In the third stage, the loan

enterprise sells goods and repays the principal and interest of the loan. When the loan enterprise chooses the real mortgage, the enterprise will use the mortgage funds for the capital turnover of production and operation and generate income i, The probability distribution function of bank to i is f (i). i is private information for the enterprise, so the bank can only obtain imperfect information, i.e. the probability distribution of I. the loan enterprise will use part of the benefit to paying the loan principal and interest and R to the bank, and the remaining income I-R belongs to the enterprise. If the loan enterprise aims to defraud the loan, it will choose fraudulent mortgage. After obtaining the funds, it will not be put into production and operation, and has no willingness to repay, so it is impossible to redeem the collateral on the repayment date, and the collateral will be paid by the bank The bank disposed of it by itself, and the loan formed bad debts. In this case, the bank blacklisted the enterprise and will no longer provide any loans to the enterprise. In the process of due diligence, the information obtained by banks can be roughly divided into two categories: one is verifiable information and the other is difficult to verify the information. We assume that the probability z of collateral fraud discovered by the bank is divided into two parts: x from verifiable information and ε from difficult information, $z = x + \varepsilon$.

Under the traditional supply chain finance mode, if the loan enterprise chooses fraudulent mortgage, the optimal concealment strength $s_0(x)$ is:

$$s_0(x) = \begin{cases} 1 - \sqrt{\frac{\tau}{x(1-m)\prod_{i=1}^{n}(1-\rho^i(x+\varepsilon))}}, & x \in \Omega \\ 0, & x \notin \Omega \end{cases} \tag{1}$$

And $\Omega = \left\{x | x \prod_{i=1}^{n}\left(1 - \rho^i(x + \varepsilon)\right) \leq \tau/(1 - m)\right\}$.

Under the digital supply chain finance mode, if the loan enterprise chooses fraudulent mortgage, the optimal concealment strength $s_{bc}(x)$:

$$s_{bc}(x) = \begin{cases} 1 - \sqrt{\frac{\tau}{x(1-m)(1-x)^n}}, & x \in \Omega_0 \\ 0, & x \notin \Omega_0 \end{cases} \tag{2}$$

And $\Omega_0 = \{x | x(1 - x)^n \leq \tau/(1 - m)\}$.

4 Comparison Between Two Supply Chain Finance Models

First, consider the simplest case, that is, there are only loan enterprises and one upstream enterprise in the supply chain. The proposition will be derived from formulas (1) and (2).

Proposition 1: when only two enterprises (loan enterprise and its first level upstream enterprise) in the supply chain are connected, if $x \geq /(1 - \rho)$. Under the digital supply chain finance mode, the strategic information manipulation motivation of loan enterprises is lower; if $0 < x < /(1 - \rho)$. Under the traditional supply chain

finance mode, the strategic information manipulation motivation of loan enterprises is lower.

Proposition 1 demonstrates that businesses using the digital supply chain finance model have less incentive to make fraudulent loans when the chain's information quality is high compared to the old supply chain finance model (see Fig. 1). Blockchain technology has two impacts on the information structure of supply chain finance. On the one hand, the verifiable information recorded on the blockchain is not lost in the transmission process. Compared with the traditional due diligence means, banks can obtain more accurate information provided by affiliated enterprises from the blockchain technology platform, and the probability margin of banks finding fraudulent mortgage increases $(1 - \rho)x$. On the other hand, because the blockchain cannot record and transmit information and is difficult to verify, compared with the traditional supply chain financial model, the probability of banks finding fraudulent mortgages in the digital supply chain financial model is also reduced. When blockchain technology brings positive effects for banks to prevent corporate mortgage risks $(1 - \rho)x$. When x is greater than the negative effect, blockchain technology helps banks identify and prevent the mortgage risk of enterprises, that is, under the digital supply chain financial model, enterprises have lower motivation to cover up fraud.

The main findings of proposition 1 can be summarized in Fig. 1. When the information quality of the upstream chain is very low ($x \to 0$), the degree of information asymmetry between the lending enterprise and the bank is still high under the digital supply chain financial model. If the lending enterprise has fraudulent mortgage behavior, it can successfully evade bank supervision with a high probability even if it

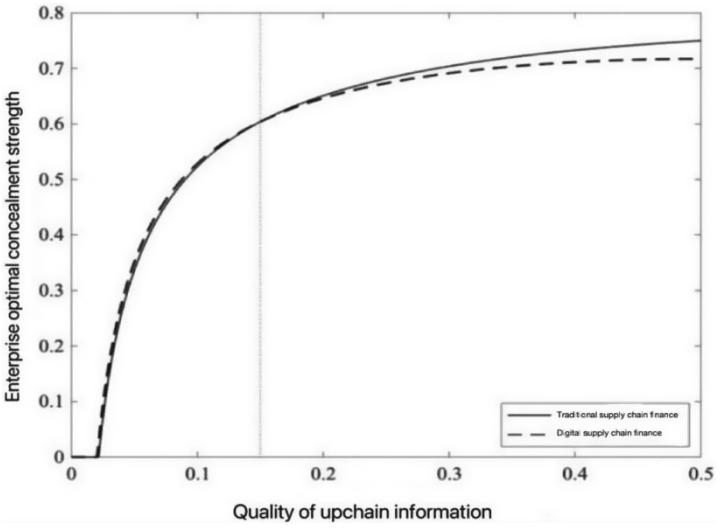


Fig. 1 Comparison of the optimal concealment strength of enterprises (the case of two enterprises on the chain)

does not take any disguised measures. At this time, the enterprise has no motivation to disguise fraud. However, when the quality of information on the chain is slightly improved but the overall level is still low (left side of the intersection of Fig. 1, in the digital supply chain finance mode, because the bank cannot obtain the information that is difficult to verify, the loan enterprise is more motivated to manipulate the small amount of verifiable information that the bank can only grasp. At this time, the bank is more suitable to prevent the mortgage risk of the loan enterprise through the traditional offline investigation method (to obtain the information that is difficult to verify). When the quality of upstream information is high (the right side of the intersection of Fig. 1, under the digital supply chain finance mode, affiliated enterprises can provide banks with more accurate information. Even if the lending enterprises pay high cover up costs, it is difficult to have a decisive impact on the authenticity of the bank's verification of collateral. Under the balance of the cost and benefit of the implementation of cover up measures, compared with the traditional supply chain financial model, the intensity of enterprise concealment measures is lower. However, the conclusion of the proposition will alter when the number of businesses in the supply chain steadily grows. Look at the circumstances of the supply chain's first five, ten, fifteen, and twenty businesses (as shown in Fig. 2).

Figure 2 shows two important conclusions. First, when the number of enterprises on the chain increases gradually, even if the quality of information on the chain is not high, the performance of the digital supply chain financial model in preventing information manipulation of loan enterprises is also better than that of traditional supply chain financial model, which shows that there is a mutual substitution relationship between the number of enterprises on the chain and the quality of information on the chain. With more businesses involved in the supply chain and a constant extension of the information chain, there is a greater risk of inaccurate information being transmitted between businesses when using the old supply chain finance model. Large-scale supply chain networks are the only ones for which the digital supply chain finance model is appropriate.: the more enterprises in the supply chain, the larger the base of enterprises that can participate in the information chain, the more affiliated enterprises that participate in cross verification, the closer the information revealed by the blockchain consensus mechanism is to the real information, and the easier the fraud of loan enterprises is to be found, so the lower the subjective willingness of enterprises to choose fraud. When there are enough enterprises on the chain, the digital supply chain financial model can also effectively prevent the moral hazard of information manipulation of loan enterprises, even if it does not rely on the difficult verification information that cannot be on the chain and only depends on the verifiable information recorded on the blockchain. Second, in the digital supply chain finance mode, with the improvement of the quality of information on the chain, the optimal concealment strength of loan enterprises after fraud presents an inverted U-shaped change trend (first increase and then decrease). The improvement of information quality on the chain has two effects. First is the "defense effect". With the help of blockchain technology platforms, banks can observe more accurate information about lending enterprises and have a greater probability to verify the authenticity of collateral. For defensive purposes, once enterprises decide to cheat

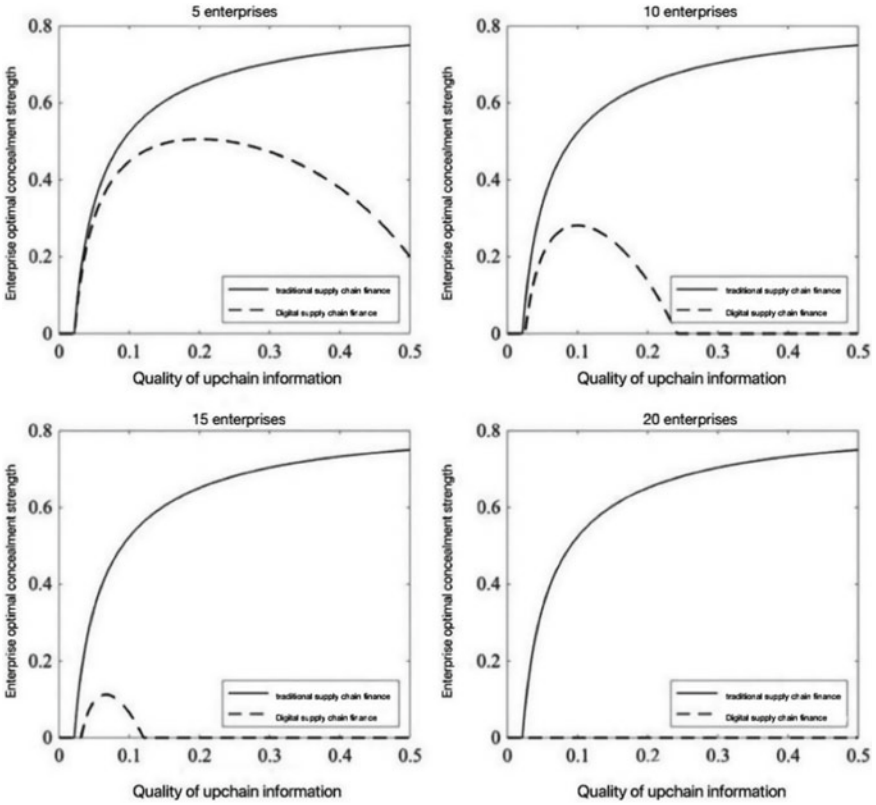


Fig. 2 Comparison of the optimal concealment strength of enterprises

collateral, they have a stronger motivation to cover up to avoid the due diligence of banks. The second is "synergy". The improvement of information quality in the chain also means that supply chain enterprises share more information with each other and have stronger synergy in information verification. At this time, even if the lending enterprise unilaterally conceals its own data information, it is very likely that the bank will find the suspicion of collateral fraud because it is inconsistent with the information provided by other upstream enterprises. When the quality of uplink information is relatively low, the "defense effect" is dominant; When the quality of information on the chain is relatively high, "synergy" is dominant, so the optimal concealment strength of loan enterprises shows a trend of increasing first and then decreasing. When there are enough enterprises in the chain, "synergy" becomes more prominent, and the willingness of loan enterprises to cover up fraud will be lower and lower, or even no longer have any willingness to cover up. Further, we test the limit case, that is, when the number of upstream enterprises in the supply chain tends to be infinite, we compare the differences in strategic information manipulation motivation between the two supply chain finance models. It can be proved that

$lim_{n\to\infty} s_0(x) \geq lim_{n\to\infty} s_{bc}(x) = 0$. This indicates that as the chain's number of businesses approaches infinite, the digital supply chain finance mode will no longer be feasible, the lending enterprises will no longer have any motivation for strategic information manipulation. However, under the traditional supply chain finance mode, even if banks can conduct due diligence on more or even all affiliated enterprises and master more sufficient information about the collateral of loan enterprises, they still can not completely eliminate the moral hazard of strategic information manipulation of loan enterprises. This finding shows how the creation of a blockchain-based digital supply chain finance ecosystem encourages and cultivates entrepreneurs' integrity in order to create a market-credible system. Proposition 2 summarizes the above findings.

Proposition 2: with the increase of the number of enterprises in the supply chain, compared with the traditional supply chain financial model, the loan enterprises are less willing to carry out strategic information manipulation under the digital supply chain financial model; When the number of enterprises on the chain is large enough, the lending enterprises will no longer take any strategic information manipulation action.

5 Conclusion

According to the findings, there are differences between the advantages of traditional supply chain finance and digital supply chain finance depending on the quantity and caliber of upstream data. Banks are better suited to select the conventional supply chain finance model when the number of chain firms is low or the quality of chain enterprises cannot be assured. At the moment, banks' due diligence plays a major role in preventing moral hazard in business operations. Banks are better suited to prevent the risk of financing enterprises by using blockchain technology and based on the information cross-verification of affiliated enterprises in the supply chain, so as to provide enterprises with financing services with the greatest possibility and lowest cost. This is due to the gradual increase in the number of enterprises in the supply chain and the effective guarantee of the quality of information in the supply chain.

References

Chod J, Trichakis N, Tsoukalas G, Aspegren H, Weber M (2020) On the financing benefits of supply chain transparency and blockchain adoption. Manag Sci 66:4359–4919

Cornelli G, Frost J, Gambacorta L, Rau R, Wardrop R, Ziegler T (2020) Fintech and big tech credit : a new database. BIS Working Papers, No. 887

Guo J, Chen C (2020) Research on the development and innovation of supply chain finance driven by blockchain technology. J Xi'an Jiaotong Univ (Soc Sci Ed) 2020(3)

Hu Y, Huang S (2009) Supply Chain Finance: background, innovation and concept definition. Financ Res 2009(8)
Liang H, Zhang X (2020) Can the integration of blockchain and bank solve the financing dilemma of small and medium-sized enterprises. Contemp Econ Manag 2020(5)
Lin Y, Li Y (2019) Development of small and medium-sized financial institutions and financing of small and medium-sized enterprises. Econ Res 2001(1)
Nakamoto S (2008) Bitcoin: a peer-to-peer electronic cash system. Unpublished Manuscript
Song H, Lu Q, Yu K, Qian C (2019) How do knowledge spillover and access in supply chain network enhance SMEs' credit quality? Ind Manage Data Syst 119(2):274–291. https://doi.org/10.1108/IMDS-01-2018-0049
Wang X, Zhang J: Bank credit rationing and SME loans—a theoretical model of endogenous collateral and enterprise scale. Econ Res 2003(7)
Zhang Y, Lin Y, Gong Q (2019) Enterprise scale, bank scale and optimal banking structure—from the perspective of new structural economics. Manag World 2019(3)

An Empirical Study on Portfolio Selection in Hong Kong Stock Market

Peizhao Yu

Abstract The study of financial asset allocation model has always been an important issue in investment research. This paper replicates Fama's experiment to observe the relationship between risk diversification and the number of assets in the portfolio based on the assets of the Hang Seng Index. In addition, using the Markowitz mean–variance model, this paper constructs a minimum variance portfolio, a maximum return portfolio with a certain risk and a maximum Sharpe index portfolio based on monthly time series data of six stocks selected from six representative industries in Hong Kong stock market. It is found that based on historical data, communications and energy were the best-performing sectors in the Hong Kong stock market.

Keywords Portfolio optimization · Markowitz mean–variance model · Hong Kong stock market

1 Introduction

1.1 A Subsection Sample

Markowitz's portfolio theory was founded in 1952. For the first time, it discussed determining optimal asset portfolios in the economic system based on the relationship between the rate of return and risk of assets (Markowitz 1952). From then on, portfolio optimization models have been widely used to guide selection of financial assets. Investors conduct portfolios to diversify idiosyncratic risk. The Hong Kong stock market is among the largest stock exchanges in the world, with an aggregate market cap of more than $38 trillion as of 2022. It is known to be one of the most important and active stock markets in the world. Therefore, it has undoubted theoretical and

P. Yu (✉)
Southwestern University of Finance and Economics, Chengdu, Sichuan Province, China
e-mail: 2016120374@jou.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_152

practical value to apply Markowitz's portfolio theory to portfolio building in Hong Kong stock market.

There are a lot of research on optimal portfolios. Some scholars have compared the mean–variance model with other models. For example, Zhang found that when short selling is not allowed, the effective frontier of the mean-VAR portfolio is a subset of the effective frontier of the mean–variance portfolio (Zhang 2008). Zhu, Qiu and Liu found that the results of the Minimax model were significantly better than the MV model when the optimal solutions of the two groups of models were simulated respectively (Zhu et al. 2002). Some scholars have studied the optimal portfolio strategy based on a certain stock market. For example, Wu studied the relationship between the size of the portfolio and risk in the Shanghai Stock Exchange (Wu 1998). Zeng, Zhang and Zhang applied the Markowitz portfolio model to Chinese stock market, selecting five stocks from A-shares to build portfolios (Zeng et al. 2009). The research results show that the Markowitz model has certain applicability in the investment selection of Chinese stock market. Gokgoz and Atmaca studied the overall portfolio optimization problem of the Turkish electricity market and obtained the solutions of the portfolio optimization problem for three different scenarios (Gokgoz and Atmaca 2012). Li and Teo studied portfolio optimization across uncertain physical financial markets (Li and Teo 2021). However, previous studies do not adequately address portfolio selection based on different sectors in the Hong Kong stock markets.

The empirical process in this paper can be summarized as follow. First, this paper replicated Fama's experiment with 50 stocks with complete data among the stocks included in the Hang Seng Index; second, 6 stocks were selected to represent the six industries of internet, banking, energy, communications, automotive and sportswear brands respectively; third, this paper constructed certain portfolios by the selected stocks, i.e., minimum variance portfolio, high expect return portfolio and maximum Sharpe ratio portfolio.

The rest of this paper can be structured as follow. Section 2 is the method; Sect. 3 show the results and Sect. 4 presents the conclusion.

2 Methods

2.1 Fama Experiment

Fama conducted an empirical study on the relationship between the number of assets in the asset portfolio and risk diversification based on the New York stock market and found that when the number of stocks reaches a certain limit, almost all idiosyncratic risks can be dispersed, while systematic risks cannot be reduced (Fama 1976). In other words, the quantity of assets in the portfolio is not the more the better. A suitable amount of assets is very important in structuring the asset portfolio. This paper replicate the Fama experiment using 50 stocks from Hangseng. First, a single

stock was selected randomly. It's standard deviation of return was about 11%. An equally weighted portfolio of two securities was then created using this stock and a second randomly chosen security. The standard deviation fell as the idiosyncratic risk diversified. Step by step, all 50 stocks were included to form an equally weighted portfolio.

2.2 Mean–Variance Analysis

Markowitz (Markowitz 1952, 1991; Huang and Liang 2021; Kenig 2021; Castellano and Cerqueti 2014; Rubinstein 2002) established the method to calculate the expected return and risk of the portfolio as well as the efficient frontier theory. Furthermore, mean–variance model was formed for the optimal allocation of assets. There are two most important indicators in this model, portfolio return and risk. These two indicators are calculated as follows:

$$r_p = \sum w_i \cdot r_i \tag{1}$$

$$\text{Var}\,[r_p] = \sum_{i,j} w_i \cdot w_j \cdot \text{Cov}\left[r_i, r_j\right] \tag{2}$$

where r_p represents portfolio return, r_i and r_j are i the returns of stocks i and j, respectively, w_i and w_j are the weights of stocks i and j in the portfolio. Var denotes the variance of portfolio return, representing the total risk. Cov denotes the covariance between two assets. Usually, it is supposed that the weights of the samples in the model satisfy the following conditions:

$$\sum_i w_i = 1 \tag{3}$$

This paper considers short-selling, indicating the weight of stocks can be negative. The Sharpe ratio is a standardized measure of stock performance that takes into account both return and risk. The Sharpe ratio of one portfolio can be achieved by the following equation:

$$\text{Sharpe Ratio} = \frac{E(R_P) - R_f}{\sigma_P} \tag{4}$$

where $E(R_P)$ is the expected return of the portfolio, R_f is the risk-free rate, and σ_P is the standard deviation of the portfolio.

3 Results

3.1 Fama Experiment

This paper collected HangSeng stocks data from Yahoofinance (https://finance.yahoo.com/), containing the monthly time series of prices of the 66 stocks which compose the index Hang Seng, from December 2009 to December 2021. Since not for all stocks prices are available over the entire period, this paper focuses on complete time series only, which are 50 of them in total, to replicate the Fama experiment. Figure 1 shows the standard deviation of portfolio return as a function of the number of stocks in the portfolio. In Fig. 2, the dark grey region represents the systematic risk, while the light grey region corresponds to the idiosyncratic risk. After 9 of stocks selected in the portfolio, the standard deviation almost did not decrease anymore, which means most of the diversification of idiosyncratic risk can be achieved with 9 stocks.

However, after analyzing 50 assets, it is difficult to find stocks representing 9 industries from the data because there may be problems with too much granularity. At the same time, as can be seen from Fig. 2, the reduction in idiosyncratic risk between 6 and 7 stocks in the portfolio is much greater than that between 5 and 6 stocks. Therefore, we decided to choose six stocks in different sectors to construct the portfolio. In this paper, we chose six representative companies, i.e., 'TX' 'ICBC' 'PC' 'CM' 'BYD' 'ANTA' from six different industries, internet industry, banking industry, energy industry, communications industry, automotive industry

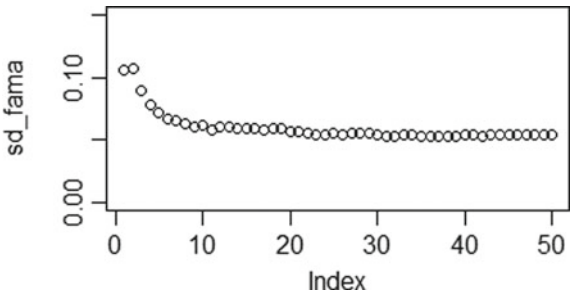


Fig. 1 Standard deviation of portfolio return as a function of the number of stocks in portfolio

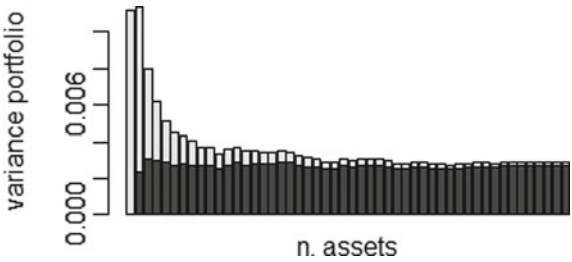


Fig. 2 Systematic risk and idiosyncratic risk of the portfolio

Table 1 Descriptive statistics of the selected assets

	'TX'	'ICBC'	'PC'	'CM'	'BYD'	'ANTA'
Mean	− 0.0142	0.0052	0.0096	0.0041	0.0028	− 0.0106
Variance	0.0075	0.0056	0.0057	0.0025	0.0249	0.0113
Max	0.2610	0.3403	0.1992	0.1543	0.5836	0.3590
Min	− 0.1771	− 0.2267	− 0.1613	− 0.1246	− 0.3657	− 0.2299

and sportswear brands industry. The development of these six industries in China is very rapid, and they can represent almost all aspects of social production and life. In addition, time series of prices data were transferred to time series of returns, where returns are defined as the following form. Table 1 lists the mean, variance, maximum and minimum of 6 stocks' returns.

$$R_t = \frac{P_t}{P_{t-1}} - 1 \tag{5}$$

As shown in Table 1, PC has the largest average return, while TX has the smallest average return. Meanwhile, the return of BYD has the largest variance, which is consistent with the fact that it has the largest maximum and the lowest minimum. CM has a minimum total risk, with the lowest maximum return and the largest minimum return.

3.2 Minimum Variance Portfolio

For risk-averse investors, risk reduction is an important investment consideration. For example, many equities pension and annuity products aim to build a portfolio of certain investment return with minimum risk. This paper constructed certain portfolio MV with minimum variance as shown in Fig. 3. As Table 2 indicates, the variance of portfolio MV is 0.0021, lower than the 6 stocks, indicating portfolio can achieve risk diversification and obtain lower risk at the same level of return. Besides, 'CM' has the largest weight in minimum volatility portfolio, accounts for 3.1538. 'PC' has the second large proportion in the portfolio, which is around 2.1579. 'BYD' 'ANTA' and 'TX' were short in this portfolio with − 2.4642, − 0.2817 and − 2.4272, respectively. Communication is an industry with relatively mature development, large asset scale, and relatively high entry barriers, so its investment risk may be low. Therefore, the communications industry may not be a high-yield market for risk-minded investors. However, when the macro situation fluctuates greatly, investors can achieve certain hedging purposes by investing in the stocks of these two industries in the Hong Kong stock market. For risk-averse investors, the auto, sports brands and internet sectors with higher risk levels should be reduced in their portfolios. As can be seen from

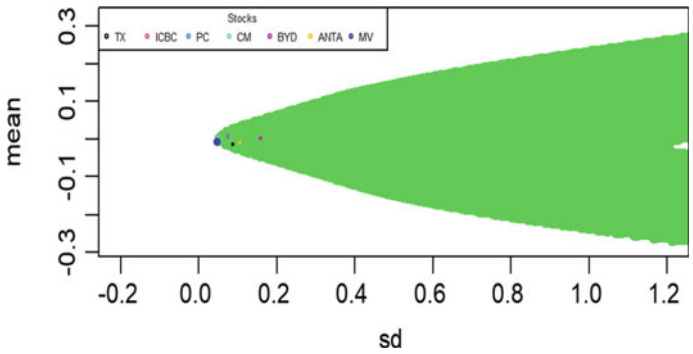


Fig. 3 Plot of 6 stocks and minimum variance portfolio

Table 2 Variance of six stocks and asset weights in portfolio

	'TX'	'ICBC'	'PC'	'CM'	'BYD'	'ANTA'
Variance	0.0075	0.0056	0.0057	0.0025	0.0249	0.0113
Portfolio weight	− 2.4272	0.8614	2.1579	3.1538	− 2.4642	− 0.2817
Variance	0.0021					
Sharpe ratio	0.2260					
Return	0.0152					

Fig. 3, PC and CM have higher returns and lower risks, thus completely surpassing BYD and ANTA.

3.3 High Expected Return Portfolio

In the process of investing in the security market, investors usually determine what level of risk they are willing to tolerate and build portfolios that can obtain the maximum return based on a specific risk level. Therefore, this paper first takes the average variance of 6 stocks, which is 0.0096, and then uses it as the variance of the portfolio to calculate the portfolio composition with the highest return. Table 3 clearly shows that taking these six stocks as investment objects, when the variance of the portfolio is determined to be 0.0096, the maximum return reaches 0.0602. Among them, PC and CM have the largest stock return, and as expected, they also account for the largest proportions in the portfolio, with 4.6700 and 3.1538 respectively. In contrast, TX was short at 5.0000. In addition, it is worth noting that as the variance of the portfolio is determined at a higher level, it returns about 4 times that of the minimum variance portfolio.

Table 3 Return of six stocks and asset weights in portfolio

	'TX'	'ICBC'	'PC'	'CM'	'BYD'	'ANTA'
Return	− 0.0142	0.0052	0.0096	0.0041	0.0028	− 0.0106
Portfolio weight	− 5.0000	1.7611	4.6700	3.1538	− 0.4405	− 4.0254
Return	0.0602					
Sharpe ratio	0.1256					
Variance	0.0096					

3.4 Maximum Sharpe Ratio Portfolio

The Sharpe ratio is a widely used indicator for investment decision-making and evaluation, and is known for its simplicity, convenience of understanding, and ease of comparison. Many investors regard it as an important condition for selecting securities. As shown in Table 3, the highest Sharpe ratio is worked out as 0.2971, which is obviously higher than Sharpe ratios of these 5 single stocks. Figure 4 shows where the maximum Sharpe ratio portfolio located, which is also the tangent point between the line passing through the risk-free asset and the efficient frontier. The weights of 5 stocks in the portfolio are also shown in Table 4. It is clear that to form a portfolio with highest Sharpe ratio, one should long the ICBC, PC, CM and BYD but short the other 2 stocks. To be more specific, 'PC' and 'CM' have the largest proportion, both account for 2.1579, while 'TX' was short to a quite large extent. Energy and communications have grown steadily over the past decade and far outperformed several other sectors on the Hong Kong stock market.

In the case of investing risk free asset, the efficient line is defined by the line passing through the risk-free rate, and all the portfolios over the efficient line share the same Sharpe ratio as without risk free asset condition. It is concluded that in the Hong Kong stock market, at least to a certain extent, it is more beneficial for investors to allocate more stocks in the energy, communication and banking sectors. On the contrary, the Sharpe ratio of automobile industry, Internet industry and sports

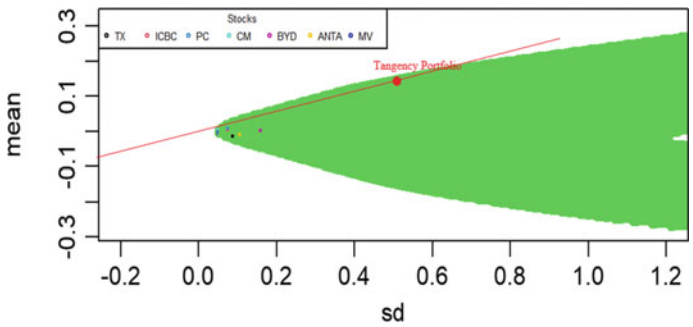


Fig. 4 Plot of 6 stocks and maximum Sharpe ratio portfolio

Table 4 Sharpe ratio of 6 stocks and asset weights in portfolio

	'TX'	'ICBC'	'PC'	'CM'	'BYD'	'ANTA'
Sharp ratio	− 0.1838	0.0477	0.1052	0.0479	0.0074	− 0.1154
Portfolio weight	− 4.0000	1.6842	2.1579	2.1579	0.7368	− 1.7368
Sharpe ratio	0.2971					
Variance	0.3606					
Return	0.1088					

clothing brand industry are less than 1, indicating that the risk to obtain a certain income is high, so investment is not recommended.

4 Conclusion

This paper is aimed to applying Markowitz's mean–variance model to study the investment portfolios of the energy industry, communication industry, automobile industry, Internet industry, sports brand industry and banking industry in the Hong Kong stock market and constructed three different asset portfolios. This paper finds that the composition of the three asset portfolios has a certain degree of convergence. Among them, the communication industry and the energy industry have the highest proportions in the asset portfolio, while the Internet industry and the sports brand industry have the lowest proportions, which is related to the development of different industries. Investors should allocate more funds to the communications and energy industries. The limitation of this paper is that only one representative company is selected for each industry, further discussions may focus on more companies.

References

Castellano R, Cerqueti R (2014) Mean-variance portfolio selection in presence of infrequently traded stocks. Eur J Oper Res 234:442–449

Fama EF (1976) Foundations of finance. Futures markets, vol 2. Basic Books, New York, pp 1–17

Gokgoz F, Atmaca ME (2012) Financial optimization in the Turkish electricity market: Markowitz's mean-variance approach. Renew Sustain Energy Rev 16:357–368

Huang WL, Liang J (2021) Markowitz optimal Portfolio study for carbon finance Market. Oper Res Fuzziol 11(2):9

Kenig E (2021) Portfolio selection in non-stationary markets. Algorithm Finance (Preprint):1–13

Li B, Teo KL (2021) Portfolio optimization in real financial markets with both uncertainty and randomness. Appl Math Model 100:125–137

Markowitz HM (1952) Portfolio selection. J Finance 7:77–91

Markowitz HM (1991) Portfolio selection: efficient diversification of investment. Basil Blackwell, Cambridge

Rubinstein M (2002) Markowitz's "portfolio selection": a fifty-year retrospective. J Finance 57(3):1041–1045
Wu SN(1998) An empirical study on the relationship between portfolio size and risk in Shanghai Stock Market. Econ Res J 4:9
Zeng YM, Zhang J, Zhang Q (2009) An empirical study of Markowitz model in stock market optimal portfolio selection. J Xiangtan Normal Univ (Soc Sci Ed) 31(4):4
Zhang P (2008) A comparative study of mean-variance and mean-var portfolios without short selling. Chin J Manag Sci 04:30–35
Zhu FY, Qiu WH, Liu SC (2002) An empirical comparison between portfolio mean-variance model and minimax model. Chin J Manag Sci 10(6):13–17

Portfolio Optimization in Different Industries in the Hong Kong Financial Market

Xun Zhang

Abstract Portfolio optimization is increasingly vital in current financial industry. Portfolio construction can decrease the unsystematic risk as the number of the stocks in portfolio increase. It can ensure investors to have a high expected return in a low standard deviation. This paper aims to analyze the efficient frontier of portfolio in 3 investment conditions. They are investing without short selling and risk-free asset added, with short selling and the last condition is investing with short selling and risk-free asset added. By replication of Fama experiment, the number of stocks to construct an investment portfolio should reasonably be 3 in order to decrease the standard deviation. The results show that, when investing with only short selling, investors can get a highest-Sharpe portfolio than other two conditions; when investing with both short selling and risk-free asset added, investors can get highest-return portfolio than other two conditions; when investing without short selling and risk free asset, the portfolio of the lowest standard deviation is the same as the one when investing with only short selling.

Keywords Portfolio optimization · Short selling · Risk free asset · Sharpe ratio

1 Introduction

HK is a significant and huge capital market to the world economy. HK capital is the tunnel which connects the world and China mainland. HK is a potential stock market as its proximity to mainland China. It is the world's no. 1 offshore RMB bond market and home to the world's no. 1 offshore RMB liquidity pool. On top of it, HK ranked among the world's 6th financial centers ranked 7th globally in "international experience" and ranked 1st among Eastern Asian economies in talent competitiveness and availability of a skilled global workforce.

X. Zhang (✉)
University of Shanghai for Science and Technology, Shanghai, China
e-mail: 1915080128@st.usst.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_153

In recent years, there are countless studies focusing on portfolio optimization. However, few of them provides multiple choices for different kinds of investors such as risk-averse, risk-seeking using different investing modes (short selling, adding risk free asset). Chang, N. Young, Liu and Chung only researched on optimizing the stock portfolio through short selling (Chang et al. 2018); Gunasekaran and Ramaswami used hybrid intelligent system of ANFIS and CAPM for stock portfolio optimization (Gunasekaran and Ramaswami 2014); And some other researchers also studied portfolio optimization using fresh approaches. For instance, Chen, Lu and Lin find an intelligence approach for group stock portfolio optimization with a trading mechanism (Chun et al. 2020); Kim, Young Shin discuss a new portfolio optimization method on the new market model, which is an extension of Markowitz's mean–variance optimization. The new optimization method considers not only reward and dispersion but also asymmetry in tails (Kim 2022). Hernandez Jose Arreola, Kang and Yoon examine the spillovers and resource allocation characteristics of a portfolio of precious metal commodities and global/regional equity markets using a directional spillover index and portfolio optimization methods (Hernandez et al. 2022). Notably, portfolio construction in the HK such a market seems limited and there is not too much portfolio construction analysis in such a specific market, which raises our great interests to explore this issue.

The concrete investigations in this paper can be summarized as follows. First, replicate the Fama's experiment to pick out how many numbers of stocks should be built as portfolio. Second, using the method of randomly assigned proportion of each stock in specific range and plotting the mean and variance of each situation, there are three conditions to analyze. The first one is portfolio construction without short selling and risk-free asset added. It can get a portfolio that has highest Sharpe ratio. The second condition is investing with short selling, it can get the same portfolio with lowest standard deviation. The last condition is to construct a portfolio with both short selling and risk-free asset added.

2 Method

2.1 Fama Experiment

It is an experiment that can assist investors to decide how many stocks should be constructed as a portfolio in a specific market, in order to decrease the unsystematic risk. The experiment can indicate the invertors when the number of stocks reach to n, the risk begins to be stable, and it is appropriate to invest such a number stock in that market to decrease the risk at most.

2.2 Mean–Variance Analysis

Mean–variance analysis is the process of weighing risk, expressed as variance, against expected return (Leonard et al. 2011; Lionel and Branko 2006; Oswaldo and Rodrigo 2005; Bob and Harry 2002; Philippe 1994). Investors use mean–variance analysis to make investment decisions. Investors weigh how much risk they are willing to take on in exchange for different levels of reward. The return on the investment is an unknown variable that has different values associated with different probabilities of that asset. Mean–variance analysis essentially looks at the average variance in the expected return from an investment. The mean–variance analysis is a component of Modern Portfolio Theory. Commonly, the weights for assets in one portfolio satisfy the following conditions.

$$\sum_{i=1}^{n} Weight_i = 1 \tag{1}$$

The $Weight_i$ is the proportion of an asset in the portfolio. The n is the number of stocks picked. $\sum_{i=1}^{n} Weight_i = 1$ should be equal one. If $Weight_i$ is negative, it means that the investment portfolio including short selling. The $Asset\ Return_i$ is the expected return on usually annual basis. The return of a portfolio annually can be calculated as follows.

$$Profolio return = w^T E(R_i) \tag{2}$$

$$Profoilo standard deviation = w^T \wp w \tag{3}$$

The w_i is the weight vector. The R_i is the return of a single asset. Where $\wp$ is variance covariance matrix. The Sharpe ratio is used to help investors understand the return of an investment compared to its risk. The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. The higher the Sharpe ratio is, the higher return each unite of risk can bring.

$$Sharpe ratio = \frac{E(R_p) - R_f}{\sigma_p} \tag{4}$$

The $E(R_p)$ is the expected return of portfolio, R_f is the risk-free rate, and σ_p is the standard deviation of the portfolio. The portfolio with the highest Sharpe ratio is the tangency portfolio between the efficient line and efficient frontier.

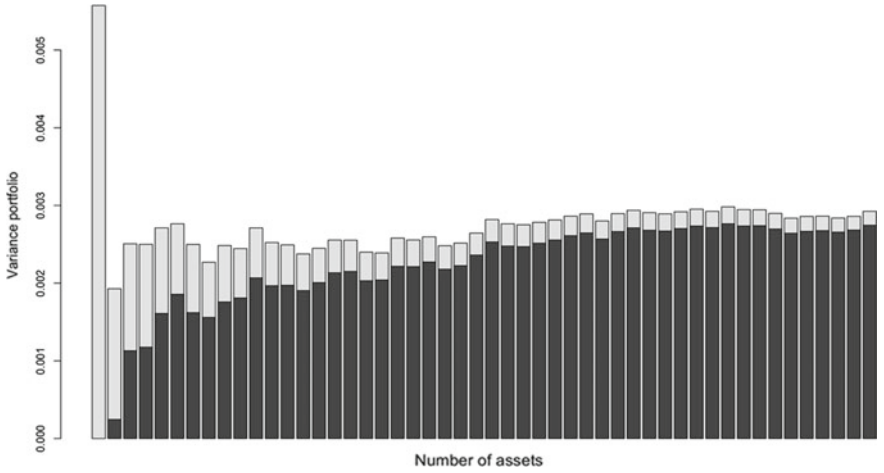


Fig. 1 Fama experiment

3 Results

3.1 Fama Experiment

Replicating the Fama experiment using the stocks which have collected can get that how many stocks should investors invest in current market is reasonable.

According to the graphic above after simulating the Fama's experiment, the light gray is the non-systematic risk, and the dark gray is the systematic risk. As the number of stocks increase, the non-systematic risk decreases, the systematic risk increases, and the standard deviation become more still. It can be inferred from the chart above, when the number of stocks reach to three the standard deviation (risk) become stable. And the risk of investing 3 stocks is much smaller than investing only one stock (Fig. 1).

3.2 Data

As replication of Fama experiment, three stocks are recommended. 3 three stocks are among the 50 stocks from HK stock market that have complete time series. The time series of them are from December 31, 2009 to 31 December 2021. These three stocks are the "Bank of China Ltd", "BYD Co. Ltd" and "ENN Energy Holdings Ltd" respectively. The reason why they are being chosen as they have the highest three Sharpe ratio. The higher Sharpe ratio is, the higher return each unit risk can bring (Table 1).

Table 1 Descriptive statistics of the selected assets

Annually	Bank of China Ltd	BYD Co. Ltd	ENN Energy Holdings Ltd
Mean	0.115	0.137	0.127
Std. dev	0.033	0.040	0.037
Sharpe ratio	3.485	3.425	3.432
Max	0.199	0.334	0.376
Min	− 0.161	− 0.176	− 0.213

Through visualizing the data, it can discover that the 'ENN Energy Holdings Ltd' has the highest average annual return, meanwhile, it has the highest maximum monthly expected return and highest minimum monthly loss. While the 'Bank of China Ltd' has the lowest average annual return, however it has the highest Sharpe ration. When it comes to variance, 'BYD Co. Ltd' is the highest, while 'Bank of China Ltd' is the lowest.

3.3 Portfolio Investment Without Short Selling

In order satisfy this condition, investors need to invest in each share of the three stocks chosen below randomly proportion, the weight of each stock is positive, and they add together equal to one.

After plotting the efficient frontier by using method of randomly assigning the proportion of each stock, the chart based on first scenario is showed above. There are 80,200 conditions (spots) on the chart above. The tangency point can be found on efficient frontier, which is also the highest-Sharpe-ratio point lies at. On top of that, it can be inferred that there is not a possible portfolio which have higher return than the BYD Co. Ltd. However, there is a portfolio that has the lowest standard deviation compared to the three stocks. The highest expected return which situates on the efficient frontier is when total money is invested in BYD Co. Ltd. Following is the concrete outcome on different requirement. Highest return on the efficient frontier: This point is at the most right of the efficient frontier. It is actually where BYD Co. Ltd lies at when 100% funds are invested in BYD Co. Ltd. The expected return is 0.0114 * 12 * 100% = 13.68% annually. Lowest standard deviation: The graphics above indicates obviously the only point at the most left tangency to a vertical line is the lowest-risk portfolio. The return and standard deviation of it can be calculated. The return is 0.01027 * 12 * 100% = 12.32% annually, the standard deviation is 0.0188 annually. The proportion of fund that should assign each stock is 0.494, 0.216, 0.290. Highest Sharp ratio: In order to find the highest Sharpe ratio, the first thing need do is to find the efficient frontier, since the tangency portfolio on it, also the highest-Sharpe-ratio portfolio. The technique to find the highest-Sharpe-ratio portfolio is the line tangent to efficient frontier. The slop of that line is the Sharpe ratio can be calculated by the equation before, and the outcome is 0.01046/0.0658

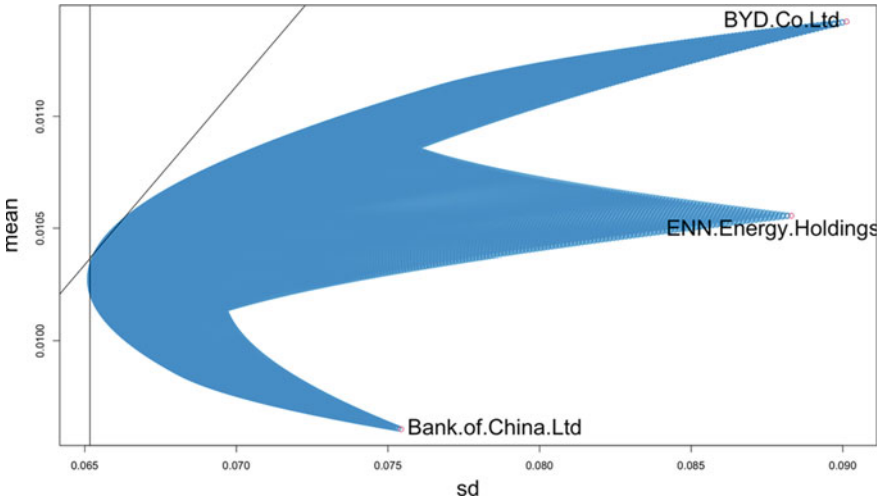


Fig. 2 Mean-standard deviation of three stocks in different weight

Table 2 The weight of each stock should be invested in

	Bank of China Ltd	BYD Co. Ltd	ENN Energy Holdings Ltd
Highest return	0	1	0
Lowest standard deviation	0.494	0.216	0.290
Highest Sharpe ratio	0.3860	0.3133	0.3007

$= 0.1590$. The concrete proportion invested in each company is respectively 0.3860, 0.3133, 0.3007 (Fig. 2; Table 2).

3.4 Portfolio Investment with Short Selling

It can be realized by investing in each share under a different proportion with short selling. However, there is likely that the proportion invested in each security is possible to be negative. Negative proportion means selling the stock right now and buy it back at a future date (Fig. 3).

In condition two, investors use the short selling to build their optimal portfolio. By simulating case two on Rstudio, the outcome is shown above. There are 22,500 spots on the chart above and the possible range of each proportion starts from -1 to

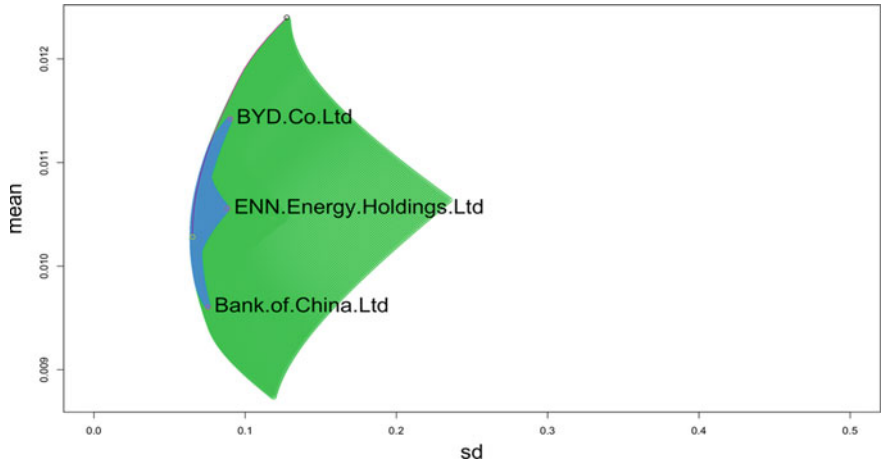


Fig. 3 Mean-standard deviation of three stocks—with short selling

1. The case two has much more area plotted with dark color than case one. It shows that there are countless kind of possible portfolios which have higher expected return than the three stocks. The efficient frontier is plotted with blue; it is much longer than the efficient frontier in the case one. By not only witnessing from the chart above or by calculation, the highest Sharpe ratio in the case two are higher than the case one. Because the slop of efficient frontier is more inclined in the case two. The lowest-risk portfolio is the same to the case one, because they are completely the same point. It is plotted with black color on the chart above. The highest return on the efficient frontier is also at the most right. Highest return on the efficient frontier: It is $(14.88\% - 13.68\%)/13.68\% * 100\% = 8.77\%$ higher than the point in the case one, achieving $0.0124 * 12 * 100\% = 14.88\%$ annually. The portfolio can be built when the proportional fund invested in these three companies should be $-1, 1, 1$. Lowest standard deviation: the lowest-standard-deviation portfolio is completely the same to the case one, dotted orange color. Highest Sharp ratio: By calculation, the portfolio of highest Sharpe ratio is $(0.0105 - 0)/0.0657 = 0.1598$. The proportion of fund invested in three company is 0.396, 0.315, 0.289 respectively (Table 3).

3.5 Portfolio Investment with Short Selling and Risky-Free Asset

Finally, it comes to the last case. After additionally investing in a risk-free asset, there are totally 4 assets for portfolio construction. The efficient chart is shown above. There are 21,600 (60 * 60 * 60) conditions (spots) on the chart above. The possible weight of each stock ranges from -1 to 1. The chart above demonstrates that investors get an efficient frontier plotted with purple color line on the chart

Table 3 The weight of each stock should be invested in

	Bank of China Ltd	BYD Co. Ltd	ENN Energy Holdings Ltd
Highest return	− 1	1	1
Lowest standard deviation	0.494	0.216	0.290
Highest Sharpe ratio	0.396	0.315	0.289

above. On the efficient frontier of case three, there are numerous possible portfolios on a straight line of efficient frontier that has same Sharpe ratio and, meanwhile, the highest Sharpe ratio. When after adding the risk-free asset, the shape of the chart above is different from case one and two, because the most part of efficient frontier becomes more like a line. The highest-return point on the efficient frontier is at the most right of efficient frontier and it is marked orange color. Highest return on the efficient frontier: It is much $(25.56\% - 14.88\%)/14.88\% * 100\% = 71.77\%$ higher than the point in the case one, achieving $0.0213 * 12 * 100\% = 25.56\%$ annually. The proportion of fund which should invest in three companies are − 1, 1, 2 and the proportion invested in risk-free asset is − 1. Lowest standard deviation: the lowest-standard-deviation portfolio is when all the funds are invested in the risk-free asset. But it is nonsensical as it is not a portfolio construction. Highest Sharp ratio: The number of highest-Sharpe-ratio point in case one and case two is only one. However, the portfolios in case three that have highest Sharpe ratio is too many, all the points on straight part of the efficient frontier are satisfied. By the formulation inferred before, the highest Sharpe ratio is $(0.0100 - 0.0017)/0.0621 = 0.1337$ (Fig. 4; Table 4).

3.6 Comparison

As shown in Table 5, when adding risk-free asset and allowing the short selling, investors may get the prefer portfolio.

3.7 Scenario Simulation

The chart above reflects return change when an investor construct portfolio under condition three of investing with short selling and a risk-free asset added in different risk. If he or she wants to find a portfolio with highest Sharpe ratio. The weight they invest in each asset should depend on what kind of investors they are. If they are risk-seeking investors and have 1 million equities, they should choose right point on

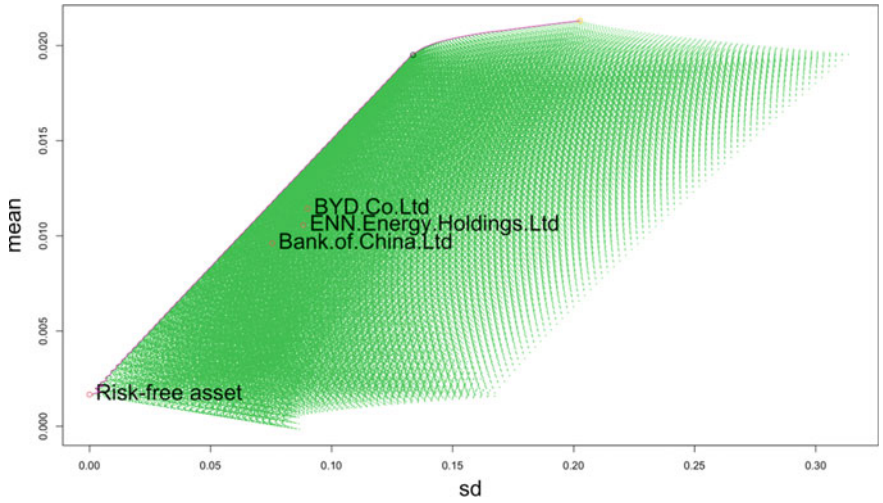


Fig. 4 Mean-standard deviation of three stocks with risk free asset added

Table 4 The weight of each stock should be invested in

	Risk-free asset	Bank of China Ltd	BYD Co Ltd	ENN Energy Holdings Ltd
Highest return	− 1	− 1	1	2
Lowest standard deviation	NA	NA	NA	NA
Highest Sharpe ratio	Infinite	Infinite	Infinite	Infinite

Note NA—it is pointless to discuss the portfolio of lowest standard deviation in this condition. Infinite—there are infinite portfolios of highest Sharpe ratio under this condition

Table 5 The return, standard deviation and the Sharpe ratio in different conditions

	No condition	With short selling	With short selling and risk-free asset
Highest return (%)	13.68	14.88	25.56
Lowest risk	0.0188	0.0188	NA
Highest Sharpe ratio	0.1590	0.1598	0.1337

the line above as much as possible. If the investor is risk-averse, they should choose the left point on the line above as much as possible. Above chart are the return changes with the standard deviation when an investor has 1million equity investing in different weight (Fig. 5).

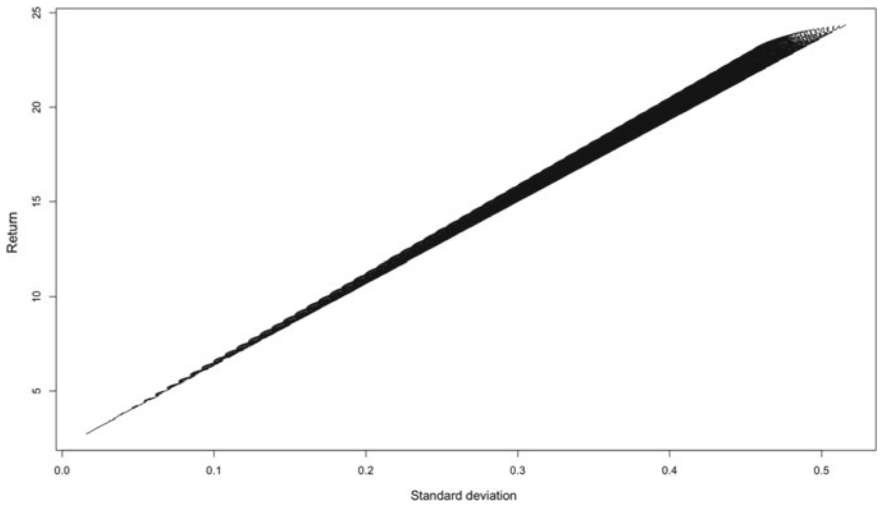


Fig. 5 Return of portfolio in different standard deviation

4 Conclusion

At present, in terms of portfolio optimization, most of essays only focus on the general market situations and without considering short selling and risk-free asset in their portfolio. The study of this essay takes the HK as target market of portfolio construction, and additionally analyze the portfolio under three conditions. The first condition is investing without short selling and risk-free asset added. It is a common investment method and the portfolio that has lowest standard devotion can be found. The weight of this portfolio is the same as the portfolio in condition two that is investing with only short selling. However, the portfolio of highest Sharpe ratio in condition two is higher than the portfolio in condition one. The reason is that from observation of Figs. 2 and 3, the slope of point in Fig. 3 of highest Sharpe ration is higher than the point in Fig. 2. When it comes to the condition 3 that is investing with short selling and risk-free asset, a portfolio that has highest expected return can be found on the most right of efficient frontier. This portfolio has far higher expected return than the portfolio of highest return in condition one and condition two. On top of that, numerous portfolios with the same highest Sharpe ratio can be found on the part of efficient frontier. There is only one portfolio of highest Sharpe ratio in condition one and two.

References

Bob K, Harry J (2002) A Mean-variance analysis of self-financing portfolios. Manag Sci 48(3):427–443

Chang et al (2018) Behavioral stock portfolio optimization through short-selling. Int J Model Optim 8(2):125–130

Chun H, Cheng Y, Cheng B (2020) An intelligence approach for group stock portfolio optimization with a trading mechanism. Knowl Inf Syst 62(1):287–316

Gunasekaran M, Ramaswami KS (2014) A hybrid intelligent system of ANFIS and CAPM for stock portfolio optimization. J Intell Fuzzy Syst 26(1):277–286

Hernandez J, Kang S, Yoon S (2022) Spillovers and portfolio optimization of precious metals and global/regional equity markets. Appl Econ 54(20):2320–2342

Kim Y (2022) Portfolio optimization and marginal contribution to risk on multivariate normal tempered stable model. Ann Oper Res 1–29

Leonard C, Zhao Y, William T (2011) Mean-variance versus expected utility in dynamic investment analysis. CMS 8(1–2):3–22

Lionel M, Branko U (2006) Static mean-variance analysis with uncertain time horizon. Manag Sci 52(6):955–964

Oswaldo L, de Rodrigo B (2005) A multi-period mean-variance portfolio selection problem. Rev Bras Finanç 3(1):101

Philippe J (1994) Mean/variance analysis of currency overlays. Financ Anal J 50(3):48–56

Research on Marketing Strategy of Luxury Hotel

Chengyu Luo

Abstract With the development of China's tourism industry, the luxury hotel industry as a high-end service industry has also developed rapidly around the world. The luxury hotel has won the favor of the majority of successful business people through professional and high-standard services. But so far, few scholars have studied the marketing strategies of luxury hotels. This article explores how to exploit marketing mix to reach more consumers. This paper analyzed and researched the marketing strategy of the luxury hotel, Four Seasons Hotel, through the 4P theory. The marketing strategies of luxury hotels were explored and discussed through SWOT analysis. Ultimately it was concluded that price, place, promotion and product all influence consumer behavior. Finally, this paper put forward improvement measures for four seasons hotel. It included adhering to innovation, emphasizing brand marketing, introducing green marketing, strengthening service marketing and the improvement of its system, strengthening network marketing, expanding new marketing channels and other methods to attract more consumers.

Keywords Four seasons hotel · Marketing mix · Marketing strategy · Marketing model

1 Introduction

1.1 Background

The hotel industry is one of the major customer service industries worldwide, and the development of tourism is one of the key reasons for the development of the hotel industry. In the past ten years, with the continuous development and changes

C. Luo (✉)
International Education Cooperation College, Tianjin University of Commerce-Florida International University, Tianjin 300000, China
e-mail: cluo005@fiu.edu

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_154

in the hotel industry, the number of high-income groups has increased (Meng 2019). In order to meet the increasing demand for services from various customers, it has spawned continuous efforts to improve their personalization by focusing on catering to consumer preferences.

A luxury hotel is one with world-class service, world-class equipment, and complete systems, capable of providing a wide variety of delicacies. In addition to this, luxury hotels also have privacy and uniqueness, which can bring a good experience to every guest (Xiao 2019).

According to a report by the United Nations World Tourism Organization, the global tourism industry continued its strong growth in 2015, with annual international tourist arrivals expected to grow by 3–4% to reach 1.8 billion by 2030 (Okumus 2004; Xin 2007). Raising a hotel company used to require a significant capital investment, but over the past decade, many hotel groups have grown by adopting an "asset-light" management model rather than owning properties, which has grown by franchising their brands to third parties. As a result, there are more and more hotels around the world, and the number of international chain hotels is also increasing day by day, all of which demonstrates the confidence of the global hotel industry.

The separation of hotel categories has happened over time as there are more and more of them, and the categorization is getting more and stricter. Luxury hotels have gained more and more attention from the public in recent years as a representative cluster of the best hotels, although research on these establishments is lacking.

After reviewing and researching relevant literature, it is found that the current research on hotels mainly focuses on the design and construction of hotels. For example, Yang Bo studied how to design the exterior and interior facilities of luxury hotels (Yang 2014); Shen Jie studied how to build green luxury hotels (Shen 2021); in addition, regarding marketing research, Ma Yanguo only analyzed the importance of the hotel's marketing analysis (Ma 2016). But there is no research on hotel marketing management and even less research on marketing strategy in the luxury hotel industry.

1.2 Research Gap

Specifically, with the development of the worldwide travel industry and the interest for enhanced housing, there is a rising worth put on the expectation for lavish inns, alongside the globalization of the lodging business and the developing purchaser interest for customized encounters. Obviously, how could upscale lodgings make marketing intends to attract more clients in China? Taking care of this issue is the first concern.

There is significant differentiation between the movement and improvement of luxurious lodgings and that of standard motels. Top luxurious lodgings based on client experience. Thus, this paper wants to fill the opening in this investigation by focusing on the promoting methods of top extravagant lodgings. It is believed that the investigation of the hotel's exhibition in this paper can get inspiration from other rich lodgings in terms of publicizing, to attract extra buyers.

1.3 Fill the Gap

Firstly, this paper discusses and analyzes the research background and main research significance of luxury hotel. Second, this paper has carried on the basic theoretical analysis of hotel marketing strategy, mainly analyzes the theory and supporting point that hotel marketing is good at using. The third article introduces the Four Seasons Hotel and its marketing status. Fourth, this paper analyzes the problems existing in the current marketing situation of Four Seasons Hotel through 4P. Fifth, based on 4P, this paper puts forward corresponding revisions and suggestions to the marketing strategy of Four Seasons Hotel, and gives the hotel marketing mix strategy. In the final conclusion, the insufficiency of Four Seasons Hotel's marketing strategy is comprehensively analyzed and suggested, and the whole research is summarized.

2 Literature Review

2.1 Marketing Mix Theory

The theory of marketing theory is under 100 years, but since an applied science is firmly joined with training, combined with the developing interest for promoting exercises, its hypothetical improvement has shown a pattern of increasingly fast and enhanced. Marketing procedure theory, as a concentrate on the way of behaving of undertakings because of natural changes, is especially remarkable in its materialness, and its improvement heading is likewise extremely attractive (Feng 2003). In the book "Basic Moss Marketing" distributed in 1960 by Professor Kathy of the University of Michigan, the book brought up that, from one viewpoint, ventures ought to look at different outside ecological elements, and then again, they ought to figure out marketing blend systems as needs be. The development of the 4Ps theory excited extraordinary social repercussions around then and to be sure assumed areas of strength for an in advancing the marketing theory and practice around then.

The advanced significance of the 4Ps combination theory at that time was that it pointed out that promotion was only an integral part of marketing, and only by organically combining promotion strategies with other strategies such as products, prices, and channels, could it be possible to better meet customer needs and greatly improve the company's performance (Gao 2003). Competitiveness provides enterprises with valuable marketing ideas. The marketing mix is the core element designed by an enterprise to accomplish its marketing objectives. Simply put, a marketing mix is a tool that businesses and marketers use to help determine what a product or brand offers.

Marketing Mix 4P is a theory to determine product strategy and product mix, and its 4 Ps represent four parts: Product, Price, Place, and Promotion. Under the target market positioning conditions, the combination of products, prices, channels, promotions, and other marketing methods, so as facilitates its active role. As the basic

theory of management marketing, the theory believes that uncontrollable factors such as politics, law, economy, humanities, geography, etc. that affect the organization cannot anticipate and control will have an impact on the effect of marketing activities; while the products, prices, channels, Controllable factors such as promotions also affect marketing activities (Kotler 1967; Collier 1991). Consequently, creating and executing a viable marketing mix is the main concern of marketing exercises. In present day ventures, marketing supervisors see this theory as an exemplary marketing theory, and they all attempt to accomplish the best marketing mix under the theory in marketing exercises.

2.2 Important Results

Price is an important factor affecting market demand, which has a crucial impact on the purchase behavior of price-sensitive consumers and stimulates consumers' desire to buy. Usually, lower prices than competitors make it easier for consumers to accept. Li Ying asserts that the pricing needs to conduct market research on the income level of local tourists. Excessive prices will yield customers with limited budgets to abandon their purchases (Li et al. 2018). During the marketing research on "chayanyuese" milk tea, Zhou Fan observe that adjusting the price of the same category of milk tea to be lower than that of competitors or adopting long-term discounts can attract more consumers (Zhou 2022). Zhao Jia asserts that the price of the product should not be higher than the average market price (Mou and Zhao 2021).

The design and quality of the product are very important. Consumers' first impression and perception of a product come from the product's design. With the reduction of the differentiation of similar products and the improvement of brand homogeneity, consumers use less and less rationality when choosing brands. Therefore, it is more important to describe the brand image than to emphasize the functional characteristics of the product. Relying on the brand design of the product can attract more new consumers, but only the quality of the product can make consumers repeat purchases and avoid the loss of consumers. Mei Xiyu asserts that most consumers will focus on a specific brand, and the design of the product can immediately grab consumers' attention and guide consumers to buy. The packaging of a product is one way to attract consumers (Mei 2021). Zhang Chenghui asserts that the quality of products is the key reason why customers always choose their products (Zhang 2019).

In the era of rapid development of the Internet, online sales channels are more important than offline ones. Zhaodaming concluded in his research on the business model design of fried chicken shops that online sales account for 90% of total sales (Zhao 2022). Ma Bin clearly pointed out that the hotel is a special product in the hotel's marketing model. Customers will not learn about the hotel through offline channels (Ma 2022). They will only judge and choose according to the information on the Internet.

In terms of promotion, influential KOLs and KOCs will build bridges between brands and consumers, rapidly expanding their popularity. Zhou Fan asserts that it is easier for them to share the evaluation of products or services to gain the recognition of other consumers, drive other people's consumption behavior, and form a popular effect, which can form a virtuous purchase cycle and complete the promotion of the brand (Zhou 2022).

The 4Ps in this article represent product: product and its functions from the perspective of customers, for hotels, it is design, brand, standardized service, and personalized service; price: hotel price and total pricing policy; channel: Various channels of the hotel; Promotion: The way of hotel promotion. The success of a brand is inseparable from precise positioning and catering to target consumers, and adjusting products and promotion strategies in response to changes in consumer preferences.

3 Method

3.1 Research Design

Researchers in previous studies on hotels mostly used SWOT and qualitative analysis. For example, Zhou Zijian and Zou Liang conducted research on Hilton Hotels by using SWOT analysis and qualitative analysis and finally put forward targeted countermeasures to solve the hotel's marketing difficulties (Zhou and Zou 2019). This paper adopts the qualitative analysis method to conduct a SWOT analysis for the research object. Qualitative analysis is mainly based on the researcher's intuition and experience, a method of making judgments on the nature, characteristics, and development and change of the research object (Li and Liu 2022). The SWOT model has prominent systematic and structural characteristics, which is helpful for the actual development of modern enterprises and the planning of marketing strategies in a targeted manner. Using the SWOT model analysis method, the current management problems of hotel enterprises can be clarified, and perfect strategic planning can be carried out according to the corresponding market laws.

3.2 Four Seasons Hotel

Four Seasons Hotel and Resorts opened its first motel in downtown Toronto, Canada in 1961, catering to a new generation of international business travelers at the time. The simple and unpretentious design contains the innovative business philosophy of Mr. Isadore Sharp, the founder, and chairman of the group: that is, to relieve the pressure of business travel for guests with considerate and personalized services, and a new hotel experience is thus created in the first hotel. It was staged at the Four

Seasons Hotel. Building on the success of the company's first hotel in Europe, the Inn on the Park, today's Four Seasons Hotel London on Park Lane, Mr. Sharp has firmly grasped the elements of success, thereby establishing The future development direction of the group is to manage a high-quality medium-sized hotel specializing in providing distinguished services with moderate scale, spacious guest rooms, friendly and friendly staff, and meticulous service. Even in a competitive market dominated by traditional large-scale hotels, Four Seasons stands out with its successful positioning. As it continued to expand, Four Seasons became the first hotel group to introduce non-traditional amenities in North America at the time, such as in-room bathroom amenities, bathrobes, hair dryers, and two-line telephones, which are now available It has become an industry standard. Today, it has more than 90 hotels and resorts in nearly 40 countries and has more than 60 hotel development plans in the pipeline. Four Seasons has been named one of the best hotel groups in the world by Travel + Leisure magazine and Zagat Guide (Homepage 2022).

3.3 SWOT Analysis

Strength. Four Seasons Hotel has great advantages in terms of location and product quality.

First of all, the location of the Four Seasons Hotel is very special. Four Seasons Hotel chooses prime locations in various cities, with convenient transportation and beautiful scenery. In hotels of the same specification, convenient transportation can often attract consumers better. Because hotels are not the destination for tourists, local attractions and business districts are their final destination.

Secondly, Four Seasons Hotel adheres to the people-oriented principle and provides each customer with personalized customized services. The facilities inside the hotel are very high-end. Four Seasons and Simmons have jointly launched three mattresses, which guests can choose according to their preferences: firm, medium, and soft, without the need to replace the bottom pad. High-quality hardware facilities and personalized services can provide consumers with a perfect accommodation experience.

Compared with the noise and light pollution that may exist in cheap express hotels, luxury hotels can provide customers with a quiet and comfortable environment to attract more consumers.

In addition, the Four Seasons Hotel has a brand-exclusive private jet with the English words and brand logo of the Four Seasons Hotel on the fuselage, which can accommodate 52 guests. To provide fast transportation services for some customers, customers can determine the specific flight time according to their own time.

Weakness. The weakness of Four Seasons Hotel is that the price of the room is higher, the marketing model is backward and the sales channel is single.

Four Seasons Hotel rooms are more expensive and an audience is a small group. Most tourists have a limited budget and prefer to spend on entertainment rather than

accommodation. So, they still choose the Express Hotel. The marketing method of Four Seasons Hotel is backward, and it still uses the traditional marketing mode, which is not suitable for the marketing needs of luxury hotels in the Internet era. The model of network marketing is not taken seriously, the concept of green marketing has not yet penetrated the hotel, and the market competitiveness is limited. Traditional marketing methods can't attract consumers' attention in time, which leads to most consumers not knowing what luxury hotels can offer, but only noticing their high prices. In addition, the sales channel of the Four Seasons Hotel is too single. It only relies on third-party platforms as its main sales method. To ensure the exposure and ranking of hotels on third-party platforms, hotels have to hand over a lot of money to third-party platforms to maintain their rankings. The result is a substantial increase in the cost of hotels, in the form of continued increases in the price of rooms, which can greatly reduce consumers' willingness to buy.

Opportunity. The opportunity for Four Seasons Hotel lies in the rapid development of China's tourism industry, which brings more consumers, and the changes in business methods brought about by technological progress to reduce the cost of the hotel.

The Four Seasons Hotel in China is located in an economically developed area of China, and there are many scenic spots and historical sites around to attract tourists. For example, the West Lake in Hangzhou can attract consumers to the Four Seasons Hotel in Hangzhou. After the epidemic is over, there will be a peak period in tourism, and the hotel market will expand. In addition, the development of science and technology will bring new marketing models, and customers can intuitively experience the facilities and services of luxury hotels through virtual technology. The concept of a green hotel will be popularized. Regardless of whether the hotel's building materials or operating models will be changed, the green hotel model will reduce the hotel's operating costs. This will also lead to lower prices for rooms, thereby attracting more consumers.

Threaten. With the homogenization of hotel products, the gap between hotels of various specifications will become smaller and smaller. As a competitor of luxury hotels such as Four Seasons Hotel, the price advantage of budget hotels will become more and more obvious.

The products and services of economy hotels are the most cost-effective, and their low prices are their biggest advantages. And economy hotels allow tourists to stay in a comfortable accommodation environment while controlling costs. Economy hotels focus on the cleanliness of rooms and the comfort of the accommodation experience. Therefore, the market scope of budget hotels is large, and tourists are not all wealthy. Under comprehensive consideration, many tourists will reduce their investment in accommodation. The increase in labor costs in China has led to an increase in the overall operating cost of the hotel, and the hotel has to increase the price of the room to continue to be profitable. But raising prices will yield consumers to lose their willingness to buy, especially during the epidemic, when the economic situation is not good, and some tourists do not have enough money to pay the high prices.

4 Results and Discussion

4.1 Results

In general, the advantages of the Four Seasons Hotel lie in its convenient location, convenient transportation, and surrounding attractions to attract tourists. High-end facilities and equipment provide customers with a good accommodation experience. Personalized customized services will also attract customers to come again. After the epidemic, there will be a peak period of tourism, and the Four Seasons Hotel can expand the market. The rapid development of green hotel concepts and technology will bring new opportunities to Four Seasons Hotel. However, the higher room prices in luxury hotels can yield most consumers to lose their willingness to buy. At the same time, with the rapid development of active hotels, the market competitiveness of luxury hotels will decline rapidly.

4.2 Discussion

The product, price, location, and promotion of a luxury hotel will affect consumers' purchase intention, that is, whether consumers will stay or not. First of all, hotel rooms and internal facilities, as hotel products, will affect consumers' purchasing intentions to a certain extent. No one would choose to stay in a hotel with dilapidated facilities. Second, prices also have an impact on consumers. Lower prices will make it easier to attract consumers to stay. Third, the place has less impact on consumers. Few people will choose a luxury hotel because of the convenience of transportation. Even if the historical sites can attract tourists, most of them will choose a more affordable express hotel. Finally, the single sales channel and lack of advertising make most consumers unaware of the difference between luxury hotels and other hotels. No reason was given to make them willing to spend.

For Four Seasons Hotel, the hotel's main sales "products"—in addition to the hotel's hardware, hotel "products" more means the hotel's services, experience, and feelings. The Four Seasons philosophy is personalized service. In the room service, in addition to "twice a day" cleaning, the cosmetic products of the hotel's Turndown service must also keep changing brands at all times. At the same time, the hotel's "pillow menu" should also be updated in real-time, so that guests feel that even in a hotel full of history, it can still be fresh. It is suggested that the Four Seasons Hotel will include a differentiated "combination" of guest rooms and catering, and present it to guests in different styles, hoping to be welcomed by guests with different tastes and expand its potential market share.

The responsiveness of hotel prices and the speed of price adjustment based on the market is an important factor for luxury hotels to maximize revenue (Kuo et al. 2021). It is particularly important to understand the booking trends of surrounding hotels, and then formulate future room prices in real-time and follow up price adjustments.

Adopt a dynamic pricing model to reduce the overall room price in the off-season of travel. At different times of the same day, the room price is adjusted according to the occupancy rate. If the occupancy rate is low, the room price will be reduced, while a high occupancy rate will increase the room price.

The "direct guest sales" of hotels usually refer to hotel products and services sold by hotel sellers to individuals or companies, such as official website reservations (Jian-Min 2007).

Website Booking: Having a proper hotel website is still one of the best ways to improve your marketing strategy. In the current digital age, more and more reservations are made through the website. At the same time, it is suggested that Four Seasons Hotel should try to develop its APP system, make convenient reservations by scanning the QR code and leave the necessary information on the mobile terminal. It would be even more thoughtful if you could make direct restaurant reservations through dynamic images, and select "extra services" such as the seat you want. This booking model also reduces the amount of money that needs to be paid to third-party platforms.

Due to the variety of sales channels, indirect sales have gradually become the main sales method for luxury hotels. Diversifying channels is very important for hotels to maximize potential sales (Wang 2010). Through diversification, hotels can cover a large number of population and customer groups. Hotels with multiple sales channels will benefit significantly during the off-season when reservations are required.

In addition to traditional marketing methods, in the development of the modern hotel industry, network marketing has become an important marketing method, because it has the characteristics of high efficiency, economy, and convenience. Therefore, the Four Seasons Hotel cannot ignore the positive significance of network marketing and should start to build its website. It can refer to the design of other boutique hotels to improve the hotel profile, facilities, and equipment, service items, price concessions (promotional information, member discounts), features, etc. For specific content, it should be ensured that the website can realize instant booking, and a custom message board (forum) should be set up to give customers space and rights to comment. To improve the publicity effect of the website, the text content should be fully integrated with pictures and videos, the role of interactive marketing should be actively played, and the hotel's network marketing should be established to truly reflect the core of the marketing mix. On the other hand, webcasts and short videos are the source of information for most people nowadays. The hotel can find KOLs and KOCs with traffic to come to the hotel to shoot so that viewers can see the hotel's internal environment and facilities in advance.

Through the analysis of the Four Seasons Hotel, it can be concluded that the price will greatly affect the purchase intention of consumers, and lower prices are more likely to attract consumers. Similarly, the higher the quality of the product, the better it can meet the needs of consumers. Diversity of channels is very important. Having multiple channels can attract more people. Online channels of hotels account for most of the total sales. Combining KOLs and KOCs can indeed increase the traffic of the hotel, to obtain more profits.

5 Conclusion

With the rapid development of China's tourism industry, and steady social and economic growth, people's income is also increasing, and the demand for hotels is constantly increasing. A hotel is not just a place to stay, it has to undertake more recreational activities. Luxury hotels are constantly striving to improve service by focusing on catering to consumer preferences. Therefore, it is necessary to study and discuss the best marketing strategies of luxury hotels in our country to promote better and faster development of luxury hotels to attract consumers better.

Taking Four Seasons Hotel as an example, this paper discusses its advantages, disadvantages, threats, and opportunities combined with the 4P theory, and puts forward suggestions for its existing marketing problems.

This article argues that Four Seasons should improve its marketing strategy in several ways. Adhere to innovation, emphasize brand marketing, introduce green marketing to strengthen service marketing and the improvement of its system, strengthen network marketing, and expand new marketing channels to attract more consumers.

To a certain extent, this paper fills the gap in research on luxury hotel marketing strategy. This article also serves as a reference for luxury hotel executives who want to improve their marketing strategies to attract more consumers.

Limited by subjective factors such as time and the author's knowledge, the research in this paper has some shortcomings. For example, the understanding of the Four Seasons Hotel is not very deep. Therefore, there may be deficiencies in the observation of its marketing and the collection of data. Therefore, when specific strategies and suggestions are proposed, the operability may be low, and it remains to be seen, for further practical testing. This is also the main research direction of this paper in the future.

References

Collier DA (1991) New marketing mix stresses service. J Bus Strategy 12(2):42–45

Feng RX (2003) The profound transformation of marketing strategy theory—from 4Ps to 4Rs. J Hebei Eng Technol Vocat Coll 67(4):54–55

Four Seasons Hotel Homepage. https://www.fourseasons.com/zh/landing_pages/four-seasons-hotels-in-china/about_four_seasons/. Accessed 1 July 2022

Gao SJ (2003) China marketing collection. Fortune Today 45(22):28

Jian-Min WU (2007) Research on the function and space influence of Chinese tourism websites. J Anhui Agric Sci 35(4):1139–1140

Kotler P (1967) Marketing management: analysis, planning, and control. J Mark 37(1):15–16

Kuo S, Nathania C, Wang AL, Chen WL, Yap BM (2021) Study on the experimental marketing and customer intention of design hotel. Tour Hotel Manag: Engl Vers 6(6):14

Li F, Liu C (2022) Research on professional growth strategies of novice mathematics teachers based on SWOT analysis. J Cap Normal Univ (Nat Sci Ed) 23(3):62–67

Li Y, Xie Y, Wang G (2018) The research on marketing strategy of catering chain enterprises based on 4P theory. Foreign Econ Relat Trade 3(3):12–28

Ma YG (2016) Discussion on the connotation and management of hotel marketing. Shopp Mall Mod 15(28):65–66
Ma B (2022) Research on marketing strategy optimization of Sheraton Qiandao Lake Resort Hotel. Mod Bus Ind 43(8):59–61
Mei XY (2021) Analysis of Michelle Bingcheng's marketing strategy based on 4P marketing theory. News Cult Constr 12(17):145–146
Meng Q (2019) Time is on China's side under the global change. China's Foreign Trade 4(7):335–345
Mou YZ, Zhao J (2021) Research on the marketing strategy of pure electric vehicles in large users based on 4P theory. Technol Innov 66(19):14–15+17
Okumus F (2004) Implementation of yield management practices in service organizations: empirical findings from a major hotel group. Serv Ind J 24(6):65–89
Shen J (2021) "Green Hotel" construction research strategy of my country's tourism hotel industry. Contemp Tour 19(4):32–33
Wang B (2010) Strategic analysis of hotel marketing communication based on reservation channel. J Jixi Univ
Xiao W (2019) New hotels define new luxury. Bazaar Jewelry 11(4):208–209
Xin W (2007) A brief analysis on the epoch evolution and developmental trend of tourism resources exploitation. Tour Sci 7(6):45–61
Yang B (2014) Luxury and details—five-star hotel design. China Build Decor 45(6):71–73
Zhang H (2019) Research on Xinyi Rural tourism development based on marketing 4P theory. J Xinyu Univ 24(6):14–18
Zhao DM (2022) Business model design based on internet + fried chicken shop. MA thesis, Jilin University
Zhou F (2022) Based on the 4P theory, analysis of the marketing strategies of Chayan Yuese to generation Z. News Commun 9:12–14
Zhou ZJ, Zou L (2019) Research on the development countermeasures of Dalian R&F Hilton Hotel based on SWOT analysis. Bus News 11(26):3–5

How Culture Could Affect the Negotiation

Haoze Wang

Abstract Business negotiation is not only the exchange and cooperation based on the economic interests of the negotiating parties but also the collision and communication between different cultures. With the development of globalization, more and more enterprises are conducting business with oversea partners, where negotiation plays a significant role in the process of communication. International business negotiation is affected by many factors such as politics, economy, and culture of their respective countries and nations, among which cultural factors are the most difficult to grasp. If mishandled, unnecessary misapprehensions may be caused as barriers in the way to cooperation. Therefore, by summarizing the aspect where different negotiation styles may occur, this paper provides a framework of how seven cultural factors may affect negotiation on an empirical basis as well as suggestions and strategies for negotiators to adopt. As a result, the cultural reasons behind the different behaviors can make negotiators with different cultural backgrounds understand each other, thus paving the road to successful cooperation.

Keywords Negotiation · Culture · International business

1 Introduction

Anytime people cannot achieve their goals without the cooperation of others, they are negotiating. As a ubiquitous social activity, negotiation is a way for people to fulfill their interests through communication (Thompson et al. 2009). Since enterprises seek and realize a profit through interaction with various parties, business negotiation plays a significant role in the performance and operation of enterprises. For example, when purchasing and merchandising, enterprises should negotiate with their supplier for

H. Wang (✉)
Central University of Finance and Economics, Beijing 100000, China
e-mail: 2019312188@email.cufe.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_155

a lower purchasing price and distributor for a higher selling price; when conducting mergers and acquisitions, enterprises should negotiate with the other part for a fair price. Without negotiation, enterprises will not sustain their performance. Without proper negotiation, enterprises will be in a passive position and even fail to safeguard their interests (Rahwan et al. 2003).

With the improvement of technology and globalization, more and more enterprises are facilitated to conduct economic activities with foreign enterprises. As a way of communication, negotiation becomes unprecedentedly vital to ensure the success of cooperation. However, unlike the way to cope with negotiators within the same culture, the way to deal with negotiators from a different culture can be much more complex. Affected by different lifestyles and ideologies, negotiators, on behalf of their enterprises, may have different practices and attitudes towards the same matter. Ignoring such differences may lead to failure of negotiation, that is, the failure to fulfill the respective interests of both sides. Therefore, a clear understanding of cultural differences raises the possibility of the success of cross-cultural negotiations.

Many researchers working in the field of negotiation have greatly contributed to the completion of the negotiation. In the book Negotiation Behaviors, the author Dean G. Pruitt, as an experimental social psychologist, focus on the motives, perceptions, and other micro-processes underlying the behavior of negotiators and on the results of laboratory experiments on negotiation. At the same time, culture has already been in the scope of negotiation research. In Examining Cultural Intelligence and Cross-Cultural Negotiation Effectiveness by Kevin S. Groves, culture intelligence (CQ) is put forward to evaluate a negotiator's competence when facing a negotiation with different cultural background (Groves et al. 2015). Besides the theoretical analysis, there is research on practical strategies of negotiation. For example, In the article international business negotiation strategies based on bargaining power assessment: the case of attracting investments by Kęstutis Peleckis, the purpose is to provide a theoretical model for developing and implementing international business negotiation strategies, based on bargaining power assessment, and to test its feasibility (Peleckis 2016). Even though there are lots of research have been done on various aspects including negotiation theory, negotiation strategy, and cultural analysis of negotiation, there is not a simple framework of how culture affects negotiation, which can be more practical for enterprises to refer to when negotiating.

The content of this research is to propose an analytic framework of how culture affects business negotiation, based on seven detailed aspects with the inspiration of Hofstede's Model of Cultural Dimensions (Hofstede 2012). Such a frame can work as a reference or checklist for enterprises to be negotiating in a cross-cultural context. It is hoped that this paper along with the framework can fill the gap in the field of negotiation. The paper is composed in such a way. First, the introduction of negotiation and culture are proposed to facilitate the combination of them. Then, an analytic framework including seven detailed aspects is proposed to introduce the general negotiation differences between cultures and to serve as a checklist reminding the negotiators of what should be paid attention to. At last, there is a conclusion including findings and suggestions for future studies.

2 Negotiation and Culture

2.1 Definition, Origin, and Introduction of Negotiation

Negotiation is typical social behavior for humans to bargain over what more than one side desires. The essence of negotiation is interest-based communication. Negotiation is the act of realizing interests and meeting needs. With a clear purpose, negotiators have clear and independent interests to be drawn from the negotiation. Interest is the foundation and main driver of negotiation. The history of negotiation can be traced back to the tribal era. It is generally agreed that the first negotiation originated from the war between tribes. Later, with the development of society, war became a tool when the contradictions between political organizations were irreconcilable. Once the interests of war reach the goals of political groups, it will turn into negotiation to bring peace back. Negotiation in modern times is conducted with political purposes and economic interests, often representing the interests of a group and company.

Negotiation is a deciding process to solve the problem of allocating limited resources. Since the status of the participants are mostly close, as the prerequisite of negotiation, the satisfaction of interest depends on every participant, from which a mutual reliant relationship is established. Such a relationship gives rise to the phenomenon that every independent move may obtain benefits but with a tangible or intangible cost of self or the other. Every coordinated move may maximize the interest of both sides. However, due to psychological factors, greed and selfishness explain a commonly seen mindset is to seek all and leave none, known as distributive bargaining, which mostly leads to failure (Fisher et al. 1991). Reaching Nash equilibrium, the best result that serves both sides' interests, requires a solid relationship and strong mutual trust. Both sides should focus on their interest and compromise on less important things. Such a method is known as interest-based bargaining.

2.2 Definition and Introduction of Culture

Culture refers to the sum of the material and spiritual wealth created by human beings in the process of social practice. Culture is the way of thinking, values, lifestyles, norms of behavior, art, science, and technology of a country or nation that is condensed and dissociated from the material, and can be inherited and disseminated. It is a generally recognized ideology for communication, and it is the distillation of perceptual knowledge and experience in the objective world.

Though some cultures share some similarities, each culture is unique due to its unique forming conditions. Such differentiation makes intercultural activities complicated. With globalization, there are more intercultural activities. People from different cultures view the world from different perspectives and positions, and their understanding of trade goals and ways of expressing ideas are different. Generally speaking, everyone will inevitably bring their assumptions, prejudice, and other

cultural characteristics into interaction with people from another culture. In negotiation, ignoring the difference between both cultures may lead to frustration and communication failure (Gelfand and Brett 2005).

3 An Analytic Framework of the Influence of Culture on Enterprise Negotiation

3.1 Negotiation Goal

The general goal for every negotiator remains the same, which is to obtain success of own interest. However, influenced by different cultures, the specific goal of negotiators may vary from person to person. There are two common types of goals, namely, contract-oriented goals and relationship-oriented goals.

The contract-oriented goal means the negotiator will pay more attention to the current interest, in other words, to successfully sign a contract of the ongoing negotiation rather than constructing a long-term relationship. Generally speaking, a contract-oriented way of negotiation is more applicable for negotiators from western countries, especially capitalist countries. As a component of western culture, capitalism stresses the practical spirit. Seizing the current and tangible opportunities to satisfy the interest is the essence of practical spirit. On the other hand, for such cultures as Chinese culture, the key point of the negotiation may lie in the establishment of a long-term relationship, which allegedly is the relationship-oriented goal. The main purpose of the negotiation is to establish a relationship with the other side, and even a failure to sign a contract doesn't mean the failure of the negotiation. In Eastern culture, people develop the ideology that success comes from mutual support and attach great importance to social connections. It can be proved by plenty of Chinese idioms, such as "Business is off while friendship is on". The initial establishment of the relationship provides more opportunities for future cooperation. However, it is not absolute that negotiators from the west hold contract-oriented goals and those from the east hold relationship-oriented goals, and it doesn't mean that the two purposes can't be achieved simultaneously. No matter in which culture, a signed contract along with a long-term relationship is welcomed.

3.2 Negotiation Attitude

The negotiation attitude is determined by the type of negotiation. Normally, distributive negotiation results win-lose attitude, and integrative negotiation results win–win attitude. A distributive attitude views the other part as the confrontational rival while an integrative attitude views the negotiation or the problem as the common enemy. With different cultural backgrounds, negotiators tend to adopt different attitudes. For

the west, still affected by capitalism, the concept of winner takes all are deeply rooted in the culture. Companies seek the interest of their own first and then are concerned about the interest of the other side. While in oriental culture, harmony prevails. It is bad for one company's reputation to take advantage of the other one and seek merely own interest. With the development of globalization, businesses have enlarged the scope of performance with businesses from other cultures. However, it has been proved and become a consensus that only a win–win attitude will be truly mutually beneficial. Companies adopting such an attitude can help to build a good reputation and thus attract more cooperation.

3.3 Negotiation Style

Negotiation style includes the company's style and the negotiator's style. Both of them are influenced strongly by culture. The company's negotiation style varies from culture to culture, including formality, location, and so on. For formality, in some cultures, ritual is an important way to show respect. For example, some companies take negotiators as honored guests and hold reception and seeing-off for them. On the other hand, some cultures take problem-solving as the priority and pay less attention to formality. In terms of locations, most formal negotiations are taken place at the conference table. However, in some cultures, negotiations are taken place at such less formal places as dinner tables. For example, affected by the culture of drinking, Chinese negotiators would like to take the dinner table as their battlefield (Jiang 2011). And plenty of ideas are made by such way of negotiation between Chinese enterprises.

The personal style of negotiators includes several detailed aspects, including the ways to speak, dress, and interact with others. Negotiators with a formal style will address others by their titles, focus on the negotiation only and avoid irrelevant issues. Negotiators with an informal style, on the other hand, may address others by their first names to show friendship and talk about something irrelevant to the idea to develop a closer interpersonal relationship. For the dressing, it is generally agreed that a formal suit is a symbol of formality. However, negotiators with informal styles may choose casual wear and pay less attention to the outfit. They may even take off the jacket and roll up sleeves to indicate he is earnest.

In different cultures, people have different ways to show formality. As mentioned above, for example, an American negotiator may show friendship and manner by calling others by their first names at a first meeting while a Japanese negotiator will never do so, since in Japanese culture calling others by their first names is a behavior of disrespect (Tinsley 1998). Due to the diversity of formality in different cultures, negotiators should understand and respect the culture of the other side, and try to make no misunderstanding by making culturally ambiguous moves. As the safest rule, both sides should adopt a generally-considered formal posture and way of communication.

3.4 Communication

As the essence of negotiation, communication includes speech and body movements, which are also affected heavily by cultures. It is crucial to correctly understand the speech made by a negotiator from another culture. The inaccuracy may lead to unnecessary stress. For example, the use of "yes" and "no". In Japanese culture, "yes" is often used in conversation, but it represents a response rather than an answer, that is, on most occasions "yes" stands for "yes, I heard you" instead of "yes, I agree with you." In some cultures, a direct type of communication is emphasized, such as in American culture, while in others cultures indirect and circumlocutory type is promoted, such as in Chinese and Japanese culture. The former will express ideas clearly and pay less attention to restricting their body movements or facial expression, just like outgoing personalities. The latter will be more cautious about what they say and what they do since their culture teaches them not to be direct (Tinsley 1998). For example, when the then-American president Jimmy Carter was to visit Japan, the Columbia Broadcasting System (CBS) was designated to take charge of all broadcasting of the president in Japan. One of the CBS American employees flew to Japan two weeks in advance to make arrangements for the personnel and devices and negotiate with a Japanese broadcasting company. He put forward many exorbitant requirements, and directly expressed his views, while the representative of the Japanese side was silent. At the end of the first round of negotiations, no agreement was reached. Two days later, an official of CBS arrived in Japan to conciliate the deadlock. He apologized for CBS being rude and asked euphemistically whether they could provide any support. Feeling respected, the Japanese company soon started to discuss the contract with CBS.

The difference is also obvious when a question is proposed in negotiations. Negotiators with a simple type of communication will directly answer but those with a complex type may indicate it vaguely. That will leads to a circumstance where an alleged "negotiable" from an indirect negotiator may already stand for a clear denial, but the direct negotiator takes "negotiable" seriously. Such misunderstanding may harm the credibility between two companies and lead to the failure of future cooperation.

3.5 Sensitivity to Time

It is believed that Germans are always punctual while Italians always show up late. Japanese take a long time to settle a deal while Americans are quick deciders. Different cultures show varying degrees of sensitivity to time. Punctuality is a basic factor in demonstrating respect. If a negotiator shows up at the negotiation late, it is believed to be a humiliation to the other side. However, for late arrival, different cultures have different customs. In Italy, Spain, and Indonesia, it is innocuous to show up late, no matter on formal or casual occasions. It is the culture that shapes their slow

pace. In China, like most other countries, being late can be a very serious problem. In Chinese culture, it is suggested that negotiators show up ahead of schedule since even showing up exactly on time can be considered as not showing sincerity.

The accuracy of time including schedules and deadlines varies in different cultures. For example, the agreed day of delivery in the contract. Some cultures take the agreed day of delivery exactly as the written day, not a day late, while some cultures take it as a rough schedule that the delivery can be made a little ahead or behind the plan. For example, Germans are rigid about agreed times. Even though force majeure, if not agreed upon in the contract in advance, can not be the excuse for delaying. When negotiating, such details should be cleared to make further misunderstandings.

Time projected to spend on the negotiation process is different in different cultures, due to different goals to pursue. American negotiators who pursue high efficiency and contract-oriented negotiation may value time more in the process. Their ultimate goal is to get the contract signed and their mindset is that time is money. As practical negotiators, Americans like to reduce pointless formalities and get down to discussion and contract to sign as soon as possible. Chinese negotiators, by contrast, pursuing the goal of establishing a long-term relationship, are not afraid of wasting a large amount of time on irrelevant issues which can show hospitality and lay a solid foundation for long-term cooperation. In Chinese culture, being hurry and trying to shorten negotiating time can be considered as being aggressive or hiding something. To conclude, it is not to say that which culture values time more than another but that different cultures pursuing different goals lead to this result. Sensitivity to time can be decisive to negotiation as a detailed way to show manner. When conducting negotiations with companies with different cultures, the company can not be too careful about time. It is better to understand the other side's culture of the time, or, at least adopt the safest and internationally-acknowledged way which is to make sure everything is on time (Adair et al. 1986).

3.6 Form of Agreement

No matter the goal of negotiation is to sign a contract or establish a relationship, a successful negotiation produce output in written form which can be a formal contract or an agreement. Culture affects the formation and the degree of details of the contract. There are two general ways to form a contract, frame type, and building type. English negotiators, like to lay the framework of the contract and then fill it as a whole with the other sides when negotiating, by the common and mutually agreed principles. For French negotiators, unlike frame type, building type is often adopted. That is, after reaching an agreement on major transaction principles, name all the detailed conditions and requirements first and put them together to form a contract. During the formation of the contract, they would like to change and fix the details back and forth (Graham and Rodgers 1994).

The degree of details of the contract varies from culture to culture. Americans prefer a specific contract with almost all anticipated situations and details into consideration because their ultimate goal of negotiation is the contract itself. American culture's strong rule consciousness affects them to refer to the contract even when there is an unforeseen situation. On the contrary, the Chinese prefer a general contract over a specific one, with the ultimate goal of relationship establishment. Harmony is attached to great importance in Chinese culture. Whenever there arises an unforeseen situation, it is the relationship rather than the contract they depend on to solve the problem. In such cases, different cultures result in different solutions, thus resulting in misunderstanding, though both sides intend to solve the problem.

3.7 Other Specific Cultural Differences

There is also other cultural differences to pay attention to during the negotiation. Such details may not affect the result decisively but may influence the other side's impression, and the opportunity to establish or consolidate the relationship. For example, the different meanings of the body language. Thumbs up is a compliment in most cultures, but it is an insult in the culture of some Islamic countries. Generally, nodding means, yes, and shaking the head means no, but it is the opposite in the culture of some Southeast Asian countries. Considering the cultural difference may make the process more unhindered and reduce unnecessary misunderstandings.

4 Conclusion

Culture is one of the significant factors in international business interaction. Negotiators from different countries and regions have different negotiating methods due to the influence of their cultures. When conducting intercultural negotiations, the enterprise should not be more cautious to avoid violating cultural taboos. If familiar with the culture of the other side, it is best to follow their cultural customs to demonstrate sincerity and respect. If unfamiliar, it is always appropriate to follow the international conventions. The essence of negotiation is communication. The way culture affects negotiations resembles the way it affects communication. There is no strict standard to refer to when conducting intercultural negotiations, as there is none in intercultural communication. Among the factors affecting negotiators' styles, different goals and attitudes may be the most irreconcilable conflicts in negotiations. They are also the hardest to be understood by the other party because they are caused by different ideologies rooted deeply in minds. Moreover, personal styles, different ways of communication, the various degree of sensitivity to time, the form of agreement, and other cultural differences are more detailed to affect the negotiation. If dealt with properly, these factors can be helpful to establish a good relationship, at

least at the personal level, and be further helpful to win cooperation in the negotiation. Fortunately, with the increasing number of international business activities in recent years, a tacit agreement has been made that both sides share the same goal which is mutual benefit. Negotiators from different cultures should be more inclusive and understanding. However, it does not mean that no attention needs to be paid to cultural differences. With the premise of the agreement on the same goal, awareness of the specific difference can help a lot. This paper summarizes the general features and traits of different negotiation styles of negotiators in different cultures. Future studies can be more concentrated on the specific differentiation of negotiation styles. For example, to make a total reference classifying styles in terms of countries with different cultures. However, such a reference requires a huge database and many real business negotiation cases to support.

References

Adair W, Brett J, Lempereur A, Alain O, Shikhirev P, Tinsley C, Lytle A (1986) Culture and negotiation strategy. J Bus Ind Mark 20(1):87–109

Fisher R, Ury W, Patton B (1991) Getting to YES: negotiating agreement without giving in, 2nd edn. Houghton Mifflin Company, New York

Gelfand M, Brett J (2005) The handbook of negotiation and culture. Adm Sci Q 50(1):46–54

Graham JL, Rodgers MW (1994) Explorations of negotiation behaviors in ten foreign cultures using a model developed in the United States. Manag Sci 40(1):72–95

Groves KS, Feyerherm A, Gu M (2015) Examining cultural intelligence and cross-cultural negotiation effectiveness. J Manag Educ 39(2):209–243

Hofstede GJ (2012) Cultural differentiation of negotiating agents. Group Decis Negot 21:79–98

Jiang L (2011) Comparison of the difference between Chinese and western drinking culture. Asian Soc Sci 7(5)

Peleckis K (2016) International business negotiation strategies based on bargaining power assessment: the case of attracting investments. J Bus Econ Manag 17(6):882–900

Rahwan I, Ramchurn SD, Jennings NR (2003) Argumentation-based negotiation. Knowl Eng Rev 18(4):343–375

Thompson L, Wang J, Gunia B (2009) Negotiation. Annu Rev Psychol 491–515

Tinsley C (1998) Models of conflict resolution in Japanese, German, and American cultures. J Appl Psychol 83(2):316–323

Carbon Emission Accounting of Soda Production by Solvay Process

Beijia Yuan

Abstract Solvay process is the most important production method of manufacturing Soda at present. However, few studies are available on the calculation method and statistical caliber of carbon emissions in Solvay alkaline process. At present, there is no unified index for carbon emission management accounting all over the world. This paper analyzes the calculation method of carbon emission in the Soda production process of Solvay alkaline process based on relevant literature and guidance documents. With one production case taken as an example, the carbon emission per ton of soda is calculated.

Keywords Carbon emission · Solvay production process · Accounting

1 Introduction

China has made it clear that it will strive to achieve "carbon peak" by 2030 and "carbon neutral" by 2060 (Xi 2020). Clarifying the sources of carbon emissions in the production process and establishing specific carbon accounting standards and methods are the basis for carbon peaking and carbon neutrality.

Soda industry is the basic industry for developing national economy and improving people's living standard, and it is also one of the industries with high energy consumption and high emission (State Environmental Protection Administration of China 2005). The soda industry chain covers salt mining, industrial ammonia fixation and coke anthracite preparation (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008). By 2021, China's soda ash production capacity will reach 32.93 million tonnes, of which the Solvay process will account for approximately 45% (National Bureau of Statistics of China 2022). The carbon emission of soda ash industry in China is quite huge, but there are few researches on the systematic analysis of the carbon emission of Solved-alkali process in China at present.

B. Yuan (✉)
Business College, East China University of Political Science and Law, Shanghai, China
e-mail: 190514010056@ecupl.edu.cn

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2023

X. Li et al. (eds.), *Proceedings of the 6th International Conference on Economic Management and Green Development*, Applied Economics and Policy Studies,
https://doi.org/10.1007/978-981-19-7826-5_156

Establishing carbon accounting standards can help identify the steps and causes of excess emissions in production processes, which can also indicate direction for improvements. The purpose of this paper is to analyse the scope and calculation methods of the carbon emission accounting of the decalcifying method by referring to relevant international literature and guidance documents from authoritative bodies.

2 Solvay Process and the Main Carbon Emission Process

Carbon emissions from Solvay's production processes can be divided into two main categories, firstly direct emissions, which are CO_2 (or other equivalent greenhouse gas CO_2 equivalent) from the combustion of primary energy sources such as coal, anthracite and secondary energy sources emitted directly into the atmosphere, in the case of Solvay's alkali production process direct emissions are calcined limestone and calcined heavy alkali; the second category of indirect emissions are industrial processes that require the consumption of electricity, such as compressed gas, blowers, circulating mother liquor and gases (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008; Czaplicka et al. 2021). Almost all Solvay processes are associated with indirect carbon emissions. Figure 1 is a simple block diagram of Solvay process, showing the type of energy consumed in the process.

In the figure, E represents electricity, CW represents circulating water, LS represents fresh steam, CA represents compressed air, and C represents coke.

It should be noted that in the lime firing process, some newly built Solvay soda plants directly purchase finished lime and CO_2, or purchase part of finished lime and CO_2, and only the self-firing part is included in the calculation of carbon emissions (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008; Czaplicka et al. 2021).

3 Solvay Process Carbon Emissions Accounting

3.1 Carbon Emission Accounting Scope Determined

In order to avoid double-counting or omission of carbon emissions between sectors or enterprises, *IPCC 2019, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter refer to as *2006 IPCC Guidelines*) (Calvo Buendia et al. 2019) have a strict definition of the sectors that generate carbon emissions.

Soda ash production is classified as an emission from the chemical industry. Direct emissions from soda ash production (including lime burning and heavy soda roasting as described in Chap. 3) require carbon emissions to be calculated in tonnes of soda ash product.

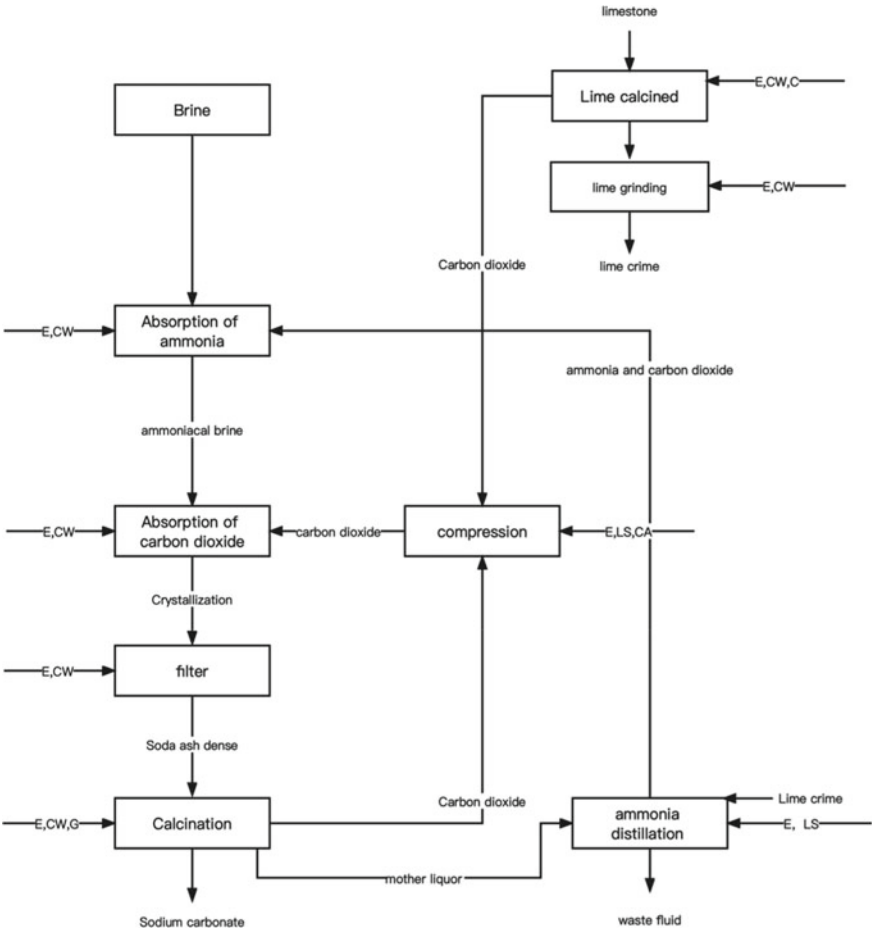


Fig. 1 Solvay alkali production process and energy consumption (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008; Czaplicka et al. 2021)

However, whether indirect emissions from energy sources such as electricity need to be accounted for in the carbon emissions of a tonne of product needs to be distinguished. If the power source is a public power plant, which is defined in *2006 IPCC Guidelines* as "main activity is to provide public service enterprises, they may be public or private, to fuel its field use emissions should be included" (Calvo Buendia et al. 2019), then carbon emissions from electricity or steam are included in the energy activity (which included in the power plant's carbon emissions, Classification number 1A1a in *2006 IPCC Guidelines*), and should not be included in the Solvay soda ash plant in order to avoid double counting. If the source of electricity or gas is a self-owned production plant (i.e., a self-owned power plant), the definition

of a self-owned production plant in *2006 IPCC Guidelines* is: "The emissions generated by a self-supply production plant (an enterprise that, as an activity supporting its main activity, generates electricity/heat wholly or partly for its own use) should be allocated to the sector producing the emissions and not listed under 1A1a. Self-supply plants can be public or private (Calvo Buendia et al. 2019)." All carbon emissions from such electricity or steam should be accounted for in production.

In summary, the main purpose and principle of clarifying the scope of carbon accounting is to avoid double counting between different sectors (industries) and to count carbon emissions only once for the same energy source.

3.2 Calculation of Carbon Emissions

2006 IPCC Guidelines recommend three hierarchical methods for calculating carbon emissions. The calculation method of the first level method is shown in Formula (1) and (2), and the calculation formula of the second and third levels is the same. The main difference of the three levels lies in the value of emission factors.

$$Emission_{GHG,HG} = Fuel\,heat \times Emission\,factor_{GHG,HG} \tag{1}$$

$$Emission_{GHG,HG} = Fuel\,heat \times Emission\,factor_{GHG,HG} \tag{2}$$

$$Total\,emission_{GHG,HG} = \sum_{Fuel} Emission_{GHG,HG}$$

$Emission_{GHG,HG}$: Greenhouse gas emissions by fuel type, kg.

Fuel heat: The heat generated by fuel combustion, TJ.

$Emission\,factor_{GHG,HG}$: GHG emission factors given by fuel type, kg GHG/TJ.

In the first tier approach, default emission factors are used, i.e. the emission factors given by *2006 IPCC Guidelines* for different fuels. In the second tier approach, the value of emission factors is determined by local government departments or authorities depending on the situation in different countries or regions. In the third tier approach, the values of emission factors should be further integrated according to the circumstances of each enterprise, taking into account conditions such as fuel type, combustion technology, operating conditions, control technology, equipment maintenance and equipment life, etc. Emissions can also be measured directly by means of emission monitoring equipment (Calvo Buendia et al. 2019). The computational accuracy of these three stratification methods is increasing in turn, as is the complexity of the input conditions.

Table 1 Carbon emission per unit consumption index (Dalian Chemical Research and Design Institute 2003)

Direct emissions		Indirect emissions		
Calcination/roasting		Whole production process		
Coal oven gas	Coal oven gas	Electricity consumption	High pressure steam consumption	Low pressure steam consumption
Nm^3/t-Na_2CO_3	Nm^3/t-Na_2CO_3	kWh/t-Na_2CO_3	t/t-Na_2CO_3	t/t-Na_2CO_3
X_1	X_2	X_3	X_4	X_5

3.3 Case

Suppose an enterprise accounts for its carbon emissions per tonne of soda ash. The soda ash plant is located in southern China and all system of soda ash production is Solvay soda production, with raw materials of purchased salt (NaCl), all purchased ammonia, a small amount of home-made lime roasting and most purchased lime, roasted in a gas furnace using a mixture of circulating fluidised bed gas and natural gas, and electricity supplied from its own power plant. Assuming full utilisation of CO_2 from Solvay production reactions, the plant's consumption assumptions involving carbon emission accounting per tonne of product are shown in Table 1.

The calcination gas was the circulating fluidized bed gas furnace gas with a calorific value of 5.23 MJ/Nm^3 (1250 kcal/Nm^3) and the calorific value of natural gas was 35.59 MJ/Nm^3 (8500 kcal/Nm^3). The default emission factors, upper and lower limits of emission factors for natural gas recommended by *IPCC Guidelines 2006* are shown in Table 2.

The CO_2 equivalent coefficient of CH_4 is 21 (Department of Climate Change, Ministry of Ecology and Environment, PRC 2018), and that of N_2O is 310 (Department of Climate Change, Ministry of Ecology and Environment, PRC 2018). If the default emission factors are used, the CO_2 equivalent emissions for the production of one tonne of soda ash are:

$$\begin{aligned} &X_1 \times 5.23 \times (44.4 + 0.001 \times 21 + 0.001 \times 310) \div 1000 \\ &\quad + X_2 \times 35.59 \times (56.1 + 0.001 \times 21 + 0.0001 \times 310) \div 1000 \\ &\quad = 0.234X_1 + 1.998X_2 \text{kgCO}_2\text{/t-Na}_2\text{CO}_3 \end{aligned}$$

If calculated according to the lower limit and upper limit of emission factors respectively, the corresponding CO_2 equivalent emissions for the production of one tonne of soda ash are respectively:

$$0.284X_1 + 2.080X_2 \text{kgCO}_2\text{/t-Na}_2\text{CO}_3$$

Table 2 Emission factors (Calvo Buendia et al. 2019)

Fuel	CO_2			CH_4			N_2O		
	Default emission factor	Lower limits	Upper limits	Default emission factor	Lower limits	Upper limits	Default emission factor	Lower limits	Upper limits
Lignite	101	90.9	115	0.001	0.0003	0.003	0.0015	0.0005	0.005
Coal oven gas	44.4	37.3	54.1	0.001	0.0003	0.003	0.0001	0.00003	0.0003
Natural gas	56.1	54.3	58.3	0.001	0.0003	0.003	0.0001	0.00003	0.0003

and

$$0.195X_1 + 1.933X_2\text{kgCO}_2/\text{t-Na}_2\text{CO}_3$$

Indirect emissions from power generation are calculated by emission factors recommended in *the emission Factors of China's Regional Power Grid Base Line of Emission Reduction Projects in 2019* released by the Ministry of Ecology and Environment. The location of the plant belongs to the southern regional power grid, and the marginal emission factor of power consumption of the southern regional power grid is 0.8042 tCO_2/MWh (Department of Climate Change, Ministry of Ecology and Environment, PRC 2020). Tons of soda ash power consumption X_3kWh, corresponding to the CO_2 equivalent emissions of $0.80402X_3\text{kgCO}_2/\text{t-Na}_2\text{CO}_3$.

Indirect emissions from steam consumption first need to convert steam consumption into standard coal. According to *the China Energy Statistical Yearbook 2019*, the coefficient of thermal reduced standard coal is 0.03412 kgce/MJ (Department of Energy Statistics, National Bureau of Statistics 2019). Assuming that the steam return water temperature is calculated at 100 °C, after deducting the return water heat, the net heat of high-pressure steam is 2356 MJ/t (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008), and that of low-pressure steam is 2337 MJ/t (Dalian Chemical Research and Design Institute 2003; Steinhauser 2008). The amount of standard coal consumed per ton of soda ash steam is.

$$\begin{aligned} &X_4 \times 2356 \times 0.03412 + X_5 \times 2337 \times 0.03412 \\ &\quad = 80.39X_4 + 79.74X_5\text{kg standard coal}/t\text{-Na}_2\text{CO}_3 \end{aligned}$$

The standard coal energy consumption of $80.39X_4 + 79.74X_5$kg is $2.36X_4 + 2.34X_5$ GJ. Lignite is used in the soda ash self-provided power plant. The emission factors of lignite are shown in Table 2.

If calculated according to the default emission factor, the CO_2 equivalent emission corresponding to the steam consumption of ton of soda ash is:

$$\begin{aligned} &2.36X_4 + 2.34X_5 \times (101 + 0.001 \times 21 + 0.0015 \times 310) \\ &\quad = 239.51X_4 + 237.48X_5\text{kgCO}_2/t\text{-Na}_2\text{CO}_3 \end{aligned}$$

If the upper and lower limits are calculated respectively, the CO_2 equivalent emissions corresponding to ton of soda ash steam consumption are:

$$275.21X_4 + 272.87X5\,\text{kgCO}_2/\text{t-Na}_2\text{CO}_3$$

and

$$214.90X_4 + 210.74X_5\text{kgCO}_2/\text{t-Na}_2\text{CO}_3$$

According to the default factors of *the 2006 IPCC Guidelines*, the CO_2 equivalent of the Solvay soda ash plant is:

$$0.234X_1 + 1.998X_2 + 0.8X_3 + 239.51X_4 + 237.48X_5 \text{kgCO}_2/\text{t-Na}_2\text{CO}_3$$

If the upper limit and lower limit of emission factors are respectively calculated, the corresponding lower limit and upper limit of CO_2 equivalent emissions are respectively:

$$\begin{aligned}\text{Upper limit: } & 0.284X_1 + 2.080X_2 + 0.8X_3 + 275.21X_4 \\ & + 272.87X_5 \text{kgCO}_2/\text{t-Na}_2\text{CO}_3 \\ \text{Lower limit:} & 0.195X_1 + 1.933X_2 + 0.8X_3 + 214.90X_4 \\ & + 210.74X_5 \text{CO}_2/\text{t-Na}_2\text{CO}_3\end{aligned}$$

4 Conclusion

Accurate accounting of carbon emissions is an important step in understanding whether carbon neutrality has been achieved. This paper combines international literature and guidance documents and Chinese indicators to provide ideas for accounting for carbon emissions in Solvay production. The soda ash industry, as an important part of the chemical industry, faces a very serious task of energy saving and emission reduction in the future. On the one hand, more advanced technologies are needed to reduce consumption, and on the other hand, carbon emissions in the soda ash production process need to be closely calculated according to internationally and nationally accepted accounting methods and accounting scopes, so that no carbon emissions are missed and no double calculations are made; errors in carbon emissions caused by the accounting methods and accounting scopes are avoided.

In addition to this, studying plant-specific emissions in conjunction with statistical methods to establish an accurate link between production and carbon emissions is the next priority.

References

Calvo Buendia E, Tanabe K, Kranjc A, Baasansuren J, Fukuda M, Ngarize S, Osako A, Pyrozhenko Y, Shermanau P, Federici S (eds) (2019) IPCC 2019, 2019 refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. IPCC, Switzerland

Czaplicka N, Konopacka-Łyskawa D, Lewandowska P, Łapiński Marcin, Bray R (2021) Influence of selected CO_2 absorption promoters on the characteristics of calcium carbonate particles produced by carbonation of the post-distillation liquid from the Solvay process. Powder Technol. https://doi.org/10.1016/J.POWTEC.2021.06.042

Dalian Chemical Research and Design Institute, China (2003) Soda ash engineering. Chemical Industry Press

Department of Climate Change, Ministry of Ecology and Environment, PRC (2018) Third national bulletin of the People's Republic of China on climate change. Ministry of Ecology and Environment, Beijing

Department of Climate Change, Ministry of Ecology and Environment, PRC (2020) 2019 Emission reduction project China regional grid baseline emission factor. Ministry of Ecology and Environment, Beijing

Department of Energy Statistics, National Bureau of Statistics (2020) China energy statistical yearbook 2019. China Statistics Press, Beijing

National Bureau of Statistics of China. https://data.stats.gov.cn/search.htm?s=纯碱. Accessed 8 Jul 2022

State Environmental Protection Administration of China (2005) Emission standard of pollutants for soda ash industry

Steinhauser G (2008) Cleaner production in the Solvay process: general strategies and recent developments. https://doi.org/10.1016/j.jclepro.2007.04.005

Xi J (2020) Address at the climate ambition summit. People's Daily, 13 Dec 2020 (02)