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Impact factor as a metric to assess journals where OM research is published

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ABSTRACT

This paper investigates *impact factor* as a metric for ranking the quality of journal outlets for operations management (OM) research. We review all prior studies that assessed journal outlets for OM research and compare all previous OM journal quality rankings to rankings based on impact factors. We find that rankings based on impact factors that use data from different time periods are highly correlated and provide similar rankings of journals using either two-year or five-year assessment periods, either with or without self-citations. However, some individual journals have large rank changes using different impact factor specifications. We also find that OM journal rankings based on impact factors are only moderately correlated with journal quality rankings previously determined using other methods, and the agreement among these other methods in ranking the quality of OM journals is relatively modest. Thus, impact factor rankings alone are not a replacement for the assessment methods used in previous studies, but rather they evaluate OM journals from another perspective.

1. Introduction

This paper investigates *impact factor* (Garfield, 2006) as a metric for ranking the quality of journal outlets for operations management (OM) research and compares journal rankings based on impact factors to those previously determined using other methods. Recent editorials from the *Journal of Operations Management* (Boyer and Swink, 2008; Boyer and Swink, 2009) and *Operations Research* (Simchi-Levi, 2009) highlight the increasing use of impact factors in assessing scholarly contributions of journals where OM research is published. In addition, Nisonger (2004) discusses the increasing use of impact factors for selecting and deselecting journals from a library's collection, and Cameron (Cameron, 2005, pp. 105) notes that impact factors are increasingly being used as a "performance measure by which scientists and faculty are ranked, promoted, and funded." Some editors compare their journal's impact factor to others within a discipline (Boyer and Swink, 2008; Boyer and Swink, 2009), and when its impact factor slips concern may be expressed (Simchi-Levi, 2009). Simchi-Levi (Simchi-Levi, 2009, pp. 2) expresses an ambivalent view towards using impact factor to assess journals: "Clearly, the value of the impact factor as a single measure of quality is fairly limited. Nevertheless, it is used by libraries, funding agencies, and deans of schools and university administrators as a factor in promotion and tenure decision, and therefore cannot be ignored."

Given this increasing use of impact factors, the need to investigate the appropriateness of using this metric to assess the quality of journals where OM research is published is clear. Specifically, we review all 14 prior studies that identified, rated, and/or ranked journals where OM research is published, and compare the assessments of quality in those studies with the results from using impact factors. As Thomson Reuters has expanded the coverage of these journals in its Journal Citation Reports® (JCR), it has become easier to determine and compare impact factors. Therefore, if impact factors provide comprehensive measures of quality, their use could substantially reduce the need for the time-consuming task of manually extracting citation data and/or developing a survey instrument and fielding it to assess journal quality.

The next section provides background on citation analysis and impact factor. Section 3 reviews prior studies that identified, rated, and/or ranked OM journals. Section 4 presents our hypotheses, while Section 5 describes the methods we used to select OM journals, collect impact factor and citation data, determine impact factors, and test the hypotheses. Section 6 describes our results, Section 7 discusses our findings, and Section 8 presents concluding remarks.

2. Background

Citation analysis involves evaluating citations from a set of target or "base" journals (Tahai and Meyer, 1999). Without an automated database, the set of citations must be manually extracted

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from each article in the base journals, and then these citations are counted and summed. Thomson Reuters Web of Science® database has been the standard automated tool to identify article citation counts and conduct citation analysis. Google Scholar and subscription-based Scopus are other citation databases available since 2004. Thomson Reuters' JCR is an annual subscription-based online citation data report for any journal included in its Web of Science® database, which includes the Science Citation Index (SCI) and the Social Science Citation Index (SSCI). The JCR draws on citation data from more than 8000 journals from more than 3300 publishers in over 66 countries (Thomson Reuters, 2010). Citations are compiled annually, and each unique article-to-article link is counted as a citation. *Cited* journal data show how many citations articles in a journal received in a given year. *Citing* journal data show how many citations articles in a journal made to articles in other journals and/or articles in the citing journal (self-citations) in a given year.

Since the impact of a specific article usually cannot be assessed until several years after an article appears in a publication, the quality of a research article is often measured by the perceived quality of the journal in which it is published (Gorman and Kanet, 2005; Olson, 2005). Even recent methods, such as the h-index (Hirsch, 2005) and the g-index (Egghe, 2006), that attempt to measure both the scientific productivity and apparent impact of a researcher depend on the researcher's citation record over time. Also, it is becoming common for schools and departments to generate target journal lists that select or rank journals based on perceived quality (Olson, 2005). In such situations, the mechanisms used to determine quality and establish target lists can have a substantial impact on promotion and tenure processes for faculty.

An outgrowth of citation analysis is the *impact factor*. The impact factor was first introduced in 1955 by Eugene Garfield as a way of "evaluating the relative importance of scientific journals" (Garfield, 1955, pp. 109) and is now used by the JCR to rank, compare, and categorize journals (Garfield, 2006). Impact factors have been the subject of debate since they were introduced. For example, a number of authors have noted that impact factors are not appropriate to use for cross discipline comparisons since different disciplines have different citation expectations and customs (Amin and Mabe, 2000; Glänzel and Moed, 2002; Gorman and Kanet, 2005). Cameron (2005) notes other criticisms; for example, he points out that using a two-year window in calculating the impact factor favors disciplines that have a faster publication lifecycle. Nisonger (2004) observes that a journal with many self-citations could potentially provide a high impact factor ranking and that being cited by other journals has more validity than do self-citations.

These references show that (1) use of impact factor in academia to evaluate and rank journals is increasing, (2) the quality of an article is often measured by the journal in which it was published and (3) this assessment can influence faculty promotion and tenure decisions. Given this increasing role for impact factor, it is important to ascertain whether impact factor is an appropriate measure of quality for OM journals relative to other approaches that are used to assess journal quality. In the next section, we review previous studies that evaluated journal outlets where OM research is published.

3. Previous evaluations of journal outlets for OM research

This section reviews the 14 previous studies of journal outlets for OM research articles published through the end of 2010. Such studies have generally been author-based, behavior-based, citation-based, or empirical-based (Fig. 1).

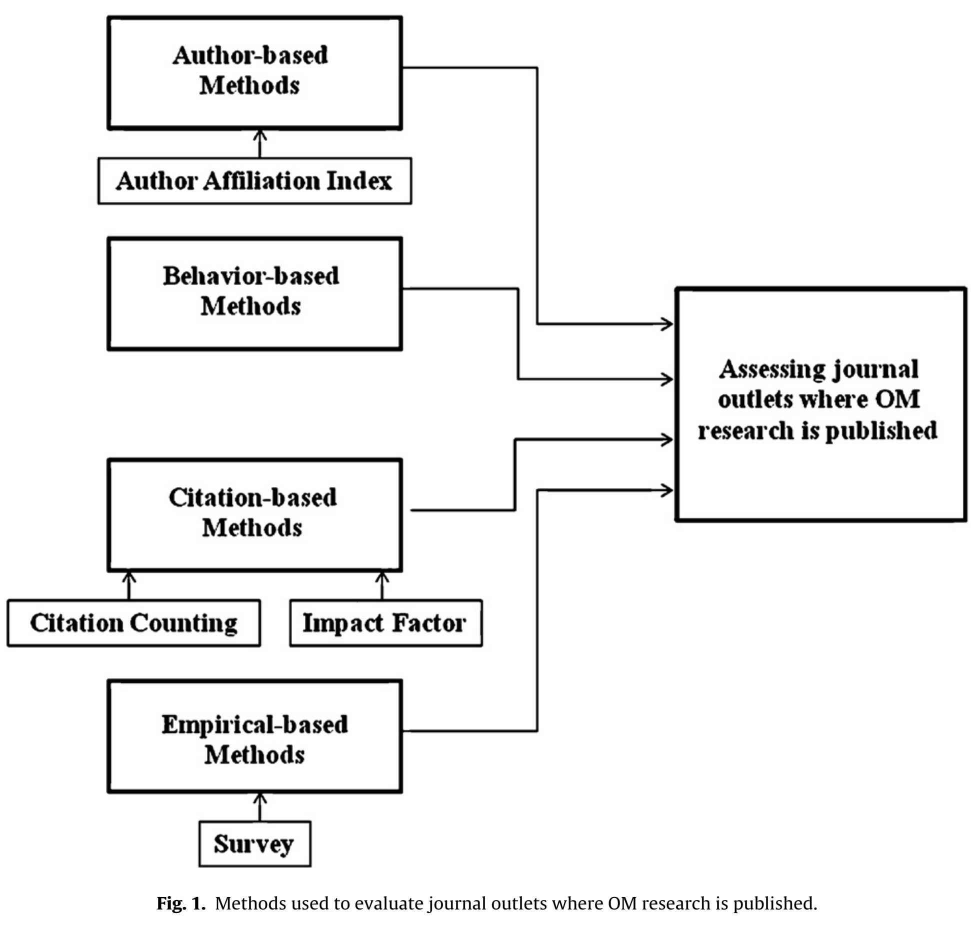

Fig. 1. Methods used to evaluate journal outlets where OM research is published.

3.1. Author-based studies

Author-based methods provide journal ratings based on the affiliation of a journal's authors. Gorman and Kanet (2005, 2007) used the author affiliation index (AAI) to rate the perceived quality of 27 OM-related journals. The AAI is the percent of a journal's US academic authors that are affiliated with top-60 ranked US business research universities. Gorman and Kanet (2005) also used impact factor in their study, but they found that a number of the journals in their study were not included in the JCR.

3.2. Behavior-based studies

Behavior-based methods provide journal ratings based on the actual collective publication behaviors of tenured faculty members. Holsapple and Lee-Post (2010) used a behavior-based method to examine the publication records from 1980 to 2006 of 90 full-time tenured OM researchers at 31 leading public research institutions in the United States. Through this examination, they identified 27 journals and developed three publishing-related metrics to rate the relative importance of these publication outlets for OM research.

3.3. Citation-based studies

Past researchers (Goh et al., 1996; Vokurka, 1996) argued that the SSCI had limited coverage of OM journals at the time of their research so they manually extracted citations of articles from a select number of *base journals*. Vokurka (1996) used three base journals (*Decision Sciences*, *Journal of Operations Management*, and *Management Science*) identified in Saladin (1985) and Barman et al. (1991) to report on the frequency of citations of other journals that appeared in articles of the base journals from 1992 to 1994. This generated 2720 citations across 332 journals and a ranking of the top-25 journals in OM research. Goh et al. (1996) conducted a similar citation analysis from 1989 to 1993 using five base journals (*Journal of Operations Management*, *IIE Transactions*, *International Journal of Production Research*, *International Journal of Operations and Production Management*, and *Journal of Manufacturing and Operations Management* that became *International Journal of Production Economics*) from Barman et al. (1991) resulting in 19,937 citations across 1296 journals and a ranking of the 50 most-cited journals for OM research. Goh et al. (1996) also found that new journals, specialized journals, and journals with small circulations were at a disadvantage with respect to citation counting. Goh et al. (1997) analyzed citations from 1989 to 1993 using three base journals (*Journal of Operations Management*, *International Journal of Production Research*, and *International Journal of Operations and Production Management*) resulting in 13,992 citations across 989 journals. Goh et al. (1997) grouped the top-49 most influential OM journals into four tiers (elite, major, important, and notable). The citation-based studies claim to be more objective than empirical-based studies (Goh et al., 1997; Goh et al., 1996; Vokurka, 1996), but Olson (2005) notes that the act of selecting a limited number of base journals from which to identify and evaluate other journals is not entirely objective. Similarly, the number of journals evaluated in empirical-based survey studies has also been limited since a long list of journals would adversely affect the response rate (Barman et al., 2001).

3.4. Empirical-based studies

Empirical-based methods provide journal ratings by surveying and assessing academic and/or practitioner perceptions of quality (Ansari et al., 1992; Barman et al., 1991; Barman et al., 2001; Saladin, 1985; Soteriou et al., 1999; Theoharakis et al., 2007). Saladin (1985) was the first OM journal evaluation study. Through a survey of academic and practitioner members of the now defunct Operations Management Association, Saladin (1985) identified 13 of the most important journals in which OM academicians publish their work. Barman et al. (1991) surveyed US members of the Decision Sciences Institute who listed OM as their primary area of interest and evaluated perceived quality of 20 OM-related journals. Ansari et al. (1992) reported 110 potential publication outlets for OM academicians and practitioners obtained from Cabell's Directory (Cabell, 1988) and a survey of journal/periodical editors. Since many OM-related journals were not included in any electronically available citation index such as the SSCI at the time of their research, Soteriou et al. (1999) adopted a survey-based approach. They extended the journal list used by Barman et al. (1991) to 35 journals. This study showed that there were differences between European and US researchers' perception of quality of OM-related journals, but the top journals were the same for both groups. In a 10-year follow-up study to Barman et al. (1991), Barman et al. (2001) surveyed US-based academicians of the Production and Operations Management Society and reported that perceptions of quality of 21 OM-related journals remained relatively constant compared to results of their first study. Theoharakis et al. (2007) surveyed OM researchers around the globe on their perceptions of the quality of 11 OM-related journals. They found differences in journal evaluations based on geography, type of researcher (empiricists vs. modelers), professional society membership, and previous publications. They also discovered that researchers who had published in a journal tended to assign higher quality to that journal than researchers who had not published in the journal.

For these empirical-based studies the development of a survey instrument and fielding it was time consuming (Donohue and Fox, 2000; Gorman and Kanet, 2005). Since impact factors are readily available through the JCR, their use could substantially reduce the need for this time-consuming task if impact factors are appropriate replacements for empirical-based assessments of journal quality.

3.5. Combination studies

Combination studies include both empirical and citation-based methods (Donohue and Fox, 2000; Olson, 2005; Vastag and Montabon, 2002). Donohue and Fox (2000) evaluated the perceived quality of 65 journals in the decision and management sciences using a survey of US academic members of the Decision Sciences Institute. For the 65 journals, they also computed the 1994 one-year impact factor (based on citation data for articles published in 1993) for 47 journals, the 1995 five-year impact factor (based on citations for articles published in 1990–1994) for 46 journals and the 1995 10-year impact factor (based on citations for articles published in 1985–1994) for 34 journals. They found that many journals in their study were not included in the SSCI. They showed that perceived quality ratings from the survey were positively correlated with impact factor. Vastag and Montabon (2002) evaluated academic influence of 28 OM-related journals in 1997 and 1998 using the number of references included in each article in a journal and the percentage of articles cited in a journal whose age was less than five years. They also surveyed senior editors of the most influential academic and practitioner journals. Olson (2005) evaluated the perceived quality of 39 OM-related journals through surveys in 2000 and 2002 of faculty members at the top-25 business schools. She also computed the 2003 five-year impact factor (based on citations for articles published in 1998–2002) for 29 of these journals and found that the impact factor results did not have a strong correlation with her survey ratings of perceived quality. Olson also found that her survey-based ratings were more consistent with other studies in the literature than her impact factor ratings.

Donohue and Fox (2000) showed a strong correlation between impact factor and perceived quality whereas Olson (2005) found that the impact factor results did not have a strong correlation with her survey ratings of perceived quality. In response to these conflicting findings, we investigate the relationship between impact factors and results from previous studies that used other methods to evaluate the quality of OM journals. Specifically, we analyze: (1) the consistency of impact factor journal rankings over different time periods and including different sets of citations (two-year window vs. five-year window, and including self-citations vs. without self-citations), and (2) the consistency of our journal rankings based on impact factors to rankings of journal quality from the previous studies.

4. Development of hypotheses

4.1. Time window

Although the most widely used impact factors have been based on two-year data, previous authors have noted that longer time windows may be more representative for OM and related fields (Vokurka, 1996). For example, Olson (2005) used a five-year window when computing impact factor since it seemed more appropriate than a two-year impact factor. Olson concluded this based on Gupta's observation (1997) that most *Interfaces* articles in his study were cited for the first time three years after publication. The length of the time window has also been shown to change the rankings of journals in fields other than OM. For example, Amin and Mabe (2000) showed how changing the time window from two years to five years for 30 chemistry journals caused 24 changes in the rankings by as many as 11 positions. Thus, it is useful to determine whether a five-year time window is more appropriate than a two-year time window for using impact factors to evaluate OM journals. This leads to Hypotheses 1, 2a, and 2b.

Hypothesis 1. The mean impact factors of journal outlets for OM research using five-year impact factors are significantly greater than the corresponding means for two-year impact factors.

Hypothesis 2a. The rankings of journal outlets for OM research using two-year or five-year impact factors are positively correlated.

Hypothesis 2b. The rankings of individual journal outlets for OM research using two-year or five-year impact factors are consistent.

4.2. Self-citations

Journal self-citations can make up a significant portion of the citations a journal gives and receives (Thomson Reuters, 2008). A high-rate of self-citation can lead to different results depending on whether or not they are included in the journal evaluation (Tahai and Meyer, 1999) and can indicate that a journal is relatively closed to authors from other journals (Gupta, 1997). Vokurka (1996) found OM journals leaned toward self-citations. Nisonger (2000) found that self-citations did not substantively influence journal rankings although self-citations had a major effect on the rankings for a small number of journals. For example, out of 59 journals, the average rank change was nearly four with the largest movement being 14 positions. Because of these points, it is useful to identify whether self-citations influence OM journal rankings. This leads to Hypotheses 3a and 3b.

Hypothesis 3a. The rankings of journal outlets for OM research based on impact factors with and without self-citations are positively correlated.

Hypothesis 3b. The rankings of individual journal outlets for OM research based on impact factors with and without self-citations are consistent.

4.3. Relationship to other assessments of journal quality

Donohue and Fox (2000) found that journal ratings based on impact factor were positively correlated with perceived quality ratings. Conversely, Olson (2005) found that there was not a close correlation between impact factors and quality ratings. With an increasing number of OM journals included in the JCR, Olson (2005) concluded that further studies should be conducted to determine how closely impact factor ratings correlate with quality measures from previous studies. This leads to Hypotheses 4a, 4b, and 4c.

Hypothesis 4a. The rankings of journal outlets for OM research based on impact factors are positively correlated with the quality rankings for those journals determined in prior studies.

Hypothesis 4b. The mean correlation coefficients of rankings of journal outlets for OM research based on impact factors with quality rankings for those journals determined in prior studies are the same as the mean correlation coefficients of the quality rankings among the prior studies.

Hypothesis 4c. The rankings of individual journal outlets for OM research based on impact factors and based on quality rankings of individual journal outlets determined in prior studies are consistent.

5. Methodology

We reviewed all periodicals included in the 14 previous studies that identified, rated and/or ranked publication outlets for OM research. We used Ulrich's online directory of periodicals (Ulrich, 2009) to determine which periodicals are still published and whether they are scholarly academic journals vs. professional trade magazines. We also clarified any name/title changes of the periodicals. We then removed journals that were listed only once in the 14 previous studies and also removed those not listed in at least one of the three most recent empirical-based studies that assessed perceived quality of OM journals (Gorman and Kanet, 2005; Olson, 2005; Theoharakis et al., 2007). Those titles that remained are included in our list of academic OM journals.

For each included journal, we obtained annual data on the number of published articles and citations directly from the online JCR (Thomson Reuters, 2004–2009) and used these data to calculate two-year and five-year impact factors with and without self-citations for each of the years 2004–2009. We verified our impact factor calculations using impact factor data that the JCR directly provides for a subset of the impact factors we calculated: (1) two-year impact factors with self-citations for the years 2004–2009 and (2) five-year impact factors with self-citations for the years 2007–2009. (The JCR did not begin providing five-year impact factors until 2007.) The *n*-year impact factor (IF) for a journal, with self-citations in year *t* is defined as:

$$\mathrm{IF_w}(n,t)=\frac{\sum_{i=t-n}^{t-1} C_i}{\sum_{i=t-n}^{t-1} P_i} \qquad (1)$$

and the n-year IF without self-citations in year t is defined as:

$$\mathrm{IF_{w/o}}(n,t)=\frac{\sum_{i=t-n}^{t-1} (C_i-S_i)}{\sum_{i=t-n}^{t-1} P_i}, \qquad (2)$$

where n is the time window, either 2 or 5 years; t is the year 2004, 2005, 2006, 2007, 2008, or 2009; C_i is the number of citations that articles in a journal received in year t for articles published in year i; P_i is the number of articles published by the journal in year i; and S_i is the number of citations that articles in a journal in year t made to articles in the same journal published in year i. For example, the 2007 two-year impact factor with self-citations ($n=2$ and $t=2007$) for *Journal X* is the number of articles published in 2007 in all journals in the JCR that cite articles published in *Journal X* during 2005–2006 divided by the number of published articles in J*ournal X* during 2005–2006.

Based on the data available in the JCR, we determined the *coverage* in the JCR of the academic journals considered in the 14 previous studies. We define coverage as the percent of the academic journals considered in a previous study that are currently included in the JCR (i.e., journals currently having impact factor and citation data in the JCR). We excluded periodicals from previous studies that are professional trade magazines, periodicals that are no longer published, and periodicals that are abstract indexes. We did not double count journals that changed names/titles.

We used the impact factor data for our list of academic OM journals to test our hypotheses. For Hypothesis 1, we used the one-tailed paired t-test to compare the means of impact factors with a two-year window and a five-year window. We also analyzed the trend of impact factor when the time window was increased from two years to five years by comparing each journal's two-year impact factor to its five-year impact factor in the years 2004–2009. For Hypothesis 2a, we used Spearman's Rho rank correlations to examine the relationship between journal rankings using two-year and five-year impact factors. Since the five-year impact factor includes the data for the two-year impact factor (and thus will include innately correlated data), we split the five-year impact factor into two time periods: the first two years (years 1–2) of the five-year impact factor time period and its three last years (years 3–5). We then used Spearman's Rho rank correlations to examine the relationship between the impact factor in years 1–2 (this is also the two-year impact factor) and the impact factor in years 3–5.

To further explore the extent to which the time window impacts OM journal rankings, we determined the minimum, average, and maximum number of rank positions changed by any given journal if a five-year window is used instead of two-year window. For Hypothesis 2b, we used the Mann–Whitney U test to examine the consistency of rankings for each journal based on two-year and five-year impact factors. We also used the one-tailed paired t-test to compare the means of impact factors with and without self-citations. For Hypothesis 3a, we used Spearman's Rho rank correlations to examine the relationship between journal rankings using impact factors with and without self-citations. We also determined the minimum, average, and maximum number of rank positions changed by any given journal if self-citations are excluded instead of being included. For Hypothesis 3b, we used the Mann–Whitney U test to examine the consistency of rankings for each journal based on impact factors with and without self-citations. For Hypothesis 4a, we used Spearman's Rho rank correlations to examine the relationship between journal rankings based on impact factors and rankings determined in previous studies. For Hypothesis 4b, we used the two-tailed t-test to compare the mean rank correlation coefficients of impact factors and previous studies vs. the mean rank correlation coefficients among the previous studies. For Hypothesis 4c, we used the Mann–Whitney U test to examine the consistency of rankings for each journal based on impact factors and rankings from previous studies that used other methods.

6. Results

6.1. Impact factor coverage of journal outlets for OM research

We identified 210 unique periodicals that were included in at least one of the 14 previous studies that identified, rated and/or ranked publication outlets for OM research. These periodicals are shown in Appendix of the online supplement (Appendix) and summarized in Table 1. This table shows, for each of the 14 previous studies, the total number of periodicals studied, and for those periodicals the number no longer published, the number of professional trade magazines, the number of abstract indexes, the number of name/title changes for periodicals that have had multiple different titles, the number of academic journals covered by the JCR at the time of study, the number of those academic journals currently included in the JCR, study coverage as defined above, study type(s) defined above, and the study time period. Across all the previous studies, Ulrich's online directory of periodicals (Ulrich, 2009) was used to identify 10 periodicals no longer published, 26 professional trade magazines, and one abstract index. These 37 periodicals were removed, resulting in 173 academic journals.

Coverage of OM journal outlets has increased from when previous studies were done as more publications are now included in the JCR (Table 1). For example, Donohue and Fox (2000) determined impact factors for 47 of 65 journals from the JCR at the time of their study and now impact factors would be available for 58 journals. Similarly, Gorman and Kanet (2005) determined impact factors for 18 of 27 journals and now 22 would have these data available. Olson (2005) determined impact factors for 29 of 39 journals and now 33 would have these data available. Gorman and Kanet (Gorman and Kanet, 2005, pp. 5) state: "If more OM-related journals were to be catalogued [in the JCR], the impact factor represents a standard for citation analysis that will diminish the value of specialized ad hoc citation-based studies." Moed (2005) has suggested that citation analysis based on the JCR will not play a role, or if it does the role will be limited, in assessing research if its coverage in a field is less than 50%. Our analysis shows that substantially more academic OM journals are now in JCR with coverage ranging from 65 to 100% and averaging 88% for the journals assessed in previous studies (Table 1 "study coverage" column).

6.2. List of academic OM journals

When the selection criteria listed in Section 5 were applied to the 173 journals, 132 were removed, leaving 41 journals. However, as shown in Table 2, 11 of these are former titles for journals that now have different titles. Of the 30 unique journals that meet the criteria, 28 are included in the JCR for the time period covered in our study (labeled as "Yes" in the table). In addition, the *Journal of Supply Chain Management* was recently accepted to appear in the JCR. The *Journal of Business Logistics* is not included in the JCR. Table 2 shows the number of times a journal (including under former names) was included in the 14 previous studies (labeled as *total listings* in the table) and in the three most recent empirical-based studies that assessed perceived quality of journals (Gorman and Kanet, 2005; Olson, 2005; Theoharakis et al., 2007). For example, *IIE Transactions* was included in 13 studies, *AIIE Transactions* was included once, and the *Journal of Industrial Engineering* was included twice and in the same studies that listed the *IIE Transactions*. Combining these without double counting, *IIE Transactions* and its former titles were included in all 14 previous studies. Five other journals were included in all previous studies—*Decision Sciences*, *International Journal of Operations and Production Management*, *International Journal of Production Research*, *Journal of Operations Management*, and *Management Science*.

Table 1
Summary of previous studies that assessed publication outlets for OM research.

	Study	(a) Total number of periodicals	(b) Number of periodicals no longer published	(c) Number of trade magazines	(d) Number of abstract indexes	(e) Number of multiple title changes of periodicals	Number of academic journals covered by the JCR at the time of study	(f) Number of academic journals covered by the JCR now	Study coverage	Study type(s)	Time period of study
1	Ansari et al. (1992)	110	8	23	1	1	NA	50	65%	Empirical	1990
2	Barman et al. (1991)	20	1	0	0	0	NA	18	95%	Empirical	1990
3	Barman et al. (2001)	21	1	0	0	0	NA	19	95%	Empirical	2000
4	Donohue and Fox (2000)	65	1	0	0	1	47	58	92%	Citation Empirical	1985–1994 1996–1997
5	Goh et al. (1996)	50	1	4	0	3	NA	38	90%	Citation	1989–1993
6	Goh et al. (1997)	49	2	5	0	2	NA	35	88%	Citation	1989–1993
7	Gorman and Kanet (2005)	27	1	1	0	0	18	22	88%	Author Citation	2001–2003 2000–2001
8	Holsapple and Lee-Post (2010)	27	1	1	0	0	NA	23	92%	Behavior	1980–2006
9	Olson (2005)	39	1	0	0	0	29	33	87%	Citation Empirical	1998–2002 2000, 2002
10	Saladin (1985)	13	1	0	0	0	NA	12	100%	Empirical	NA
11	Soteriou et al. (1999)	35	1	0	0	1	NA	25	76%	Empirical	1996–1997
12	Theoharakis et al. (2007)	11	1	0	0	0	NA	8	80%	Empirical	2002
13	Vastag & Montabon (2002)	28	1	1	0	0	NA	23	88%	Citation Empirical	1997–1998 1997–1998
14	Vokurka (1996)	25	1	1	0	1	NA	21	95%	Citation	1992–1994

NA, not available. JCR, the Journal Citation Reports® (Thomson Reuters, 2004–2009). Study Coverage = $f/(a - b - c - d - e) \times 100$.

Table 2
List of academic OM journals evaluated in the Journal Citation Reports® (JCR) (Thomson Reuters, 2004–2009).

Journals	JCR	Former titles	Total listings	Recent listings
Annals of Operations Research	Yes		5	2
Computers and Industrial Engineering	Yes		9	1
Computers and Operations Research (Note 1)	Yes	Location Science (Note 1)	10	2
Decision Sciences	Yes		14	3
European Journal of Operational Research	Yes		13	3
IEEE Transactions on Engineering Management	Yes		5	1
IIE Transactions (Notes 2 and 3)	Yes	AIIE Transactions (Note 2) Journal of Industrial Engineering (Note 3)	14	3
INFORMS Journal on Computing (Note 4)	Yes	ORSA Journal on Computing (Note 4)	2	1
Interfaces	Yes		13	2
International Journal of Operations and Production Management	Yes		14	3
International Journal of Production Economics (Notes 5, 6, and 7)	Yes	Engineering Costs and Production Economics (Note 5) Journal of Manufacturing and Operations Management (Note 6) Material Flow (Note 7)	10	2
International Journal of Production Research	Yes		14	3
Journal of Business Logistics	No		4	2
Journal of Manufacturing Systems	Yes		5	1
Journal of Operations Management	Yes		14	3
Journal of Scheduling	Yes		2	2
Journal of Supply Chain Management (Notes 8 and 9)	Note 10	International Journal of Purchasing and Materials Management (Note 8) Journal of Purchasing and Materials Management (Note 9)	13	3
Journal of the American Statistical Association	Yes		4	1
Journal of the Operational Research Society	Yes		12	2
Management Science	Yes		14	3
Manufacturing & Service Operations Management	Yes		4	3
Mathematics of Operations Research	Yes		5	2
Naval Research Logistics (Note 11)	Yes	Naval Research Logistics Quarterly (Note 11)	12	1
Omega-International Journal of Management Science	Yes		11	2
Operations Research	Yes		13	2
Operations Research Letters	Yes		4	1
Production and Operations Management	Yes		8	3
Production Planning and Control	Yes		2	1
Transportation Research Part E: Logistics and Transportation Review (Note 12)	Yes	Logistics and Transportation Review (Note 12)	3	1
Transportation Science	Yes		5	2

Note 1: Location Science was absorbed by Computers and Operations Research. Note 2: AIIE Transactions became the IIE Transactions. Note 3: Journal of Industrial Engineering became IIE Transactions. Note 4: ORSA Journal on Computing became the INFORMS Journal on Computing. Note 5: Engineering Costs and Production Economics became the International Journal of Production Economics. Note 6: Journal of Manufacturing and Operations Management became the International Journal of Production Economics. Note 7: Material Flow became the International Journal of Production Economics. Note 8: International Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 9: Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 10: Journal of Supply Chain Management was recently accepted to appear in the JCR. Note 11: Naval Research Logistics Quarterly became Naval Research Logistics. Note 12: Logistics and Transportation Review became Transportation Research Part E: Logistics and Transportation Review.

6.3. Hypothesis test results

6.3.1. Time window of impact factor

Tables 3a and 3b summarize the 2004–2009 two-year and five-year impact factors that we determined for our list of academic OM journals in Table 2 for which data are available in the JCR. Tables 3a and 3b and Tables 5a and 5b show the number of journals as either 26, 27 or 28 because the *Journal of Scheduling* and *Manufacturing & Service Operations Management* were recently added to the JCR. The *Journal of Scheduling* does not have the necessary data to calculate five-year impact factors for 2004 and 2005, and *Manufacturing & Service Operations Management* has the necessary data to calculate two-year impact factors for only 2008 and 2009.

The first five columns of Tables 3a and 3b show that the mean five-year impact factors are significantly greater than the mean two-year impact factors ($P \leq 0.01$). 100% of the 2004–2009 impact factors for the academic OM journals increase (average increase of 64%) when the time window for the impact factor is increased from two years to five years. There are significantly strong correlations between two-year and five-year impact factors both with self-citations (mean correlation coefficient is 0.908 and is significant at the 0.01 level for all six comparisons) and without self-citations (mean correlation coefficient is 0.911 and is significant at the 0.01 level for all six comparisons).

Since the five-year impact factor includes data for the two-year impact factor, we compared impact factors in years 1–2 with impact factors in years 3–5 to investigate whether removing the data included in both calculations would change the finding of strong correlation. (For the 2007 impact factor, year 1 would be 2006, year 2 would be 2005, year 3 would be 2004, year 4 would be 2003, and year 5 would be 2002.) We found that the mean impact factors in years 3–5 are significantly greater than the mean impact factors in years 1–2 (see the second to last column in Tables 3a and 3b), and the correlations between impact factors in years 1–2 and years 3–5 are significant (see the last column in Tables 3a and 3b). However, these correlations are not as strong as the correlations between years 1–2 (two-year impact factors) and years 1–5 (five-year impact factors). The mean correlation coefficient between impact factors in years 1–2 and impact factors in years 1–5 is 0.910 whereas the mean correlation coefficient between impact factors in years 1–2 and impact factors in years 3–5 is 0.844. This analysis shows that the high correlation between the two-year and five-year impact factors is not being driven by the fact that the five-year data includes the two-year data.

Table 3a
Comparison of the 2004–2009 two-year and five-year impact factors for our list of academic OM journals (with self-citations).

Impact factor with self-citations	N	Time period	Mean	Spearman's Rho rank correlation coefficient	Time period	Mean	Spearman's Rho rank correlation coefficient
2009 two-year	27	2007–2008	1.54[#]	0.933[*]	2007–2008	1.54[#]	0.897[*]
2009 five-year		2004–2008	2.22		2004–2006	2.76	
2008 two-year	27	2006–2007	1.34[#]	0.941[*]	2006–2007	1.34[#]	0.910[*]
2008 five-year		2003–2007	2.00		2003–2005	2.54	
2007 two-year	27	2005–2006	1.04[#]	0.913[*]	2005–2006	1.04[#]	0.873[*]
2007 five-year		2002–2006	1.59		2002–2004	2.02	
2006 two-year	27	2004–2005	0.97[#]	0.940[*]	2004–2005	0.97[#]	0.896[*]
2006 five-year		2001–2005	1.43		2001–2003	1.78	
2005 two-year	26	2003–2004	0.82[#]	0.918[*]	2003–2004	0.82[#]	0.843[*]
2005 five-year		2000–2004	1.18		2000–2002	1.42	
2004 two-year	26	2002–2003	0.78[#]	0.804[*]	2002–2003	0.78[#]	0.671[*]
2004 five-year		1999–2003	1.17		1999–2001	1.42	

N is the number of academic OM journals in the Journal Citation Reports® (Thomson Reuters, 2004–2009) that were compared. Test of means using the one-tailed paired *t*-test for Hypothesis 1: The mean impact factors of journal outlets for OM research using five-year impact factors are significantly greater than the corresponding means for two-year impact factors. Spearman's Rho rank correlation coefficient for Hypothesis 2a: The rankings of journal outlets for OM research using two-year or five-year impact factors are positively correlated.

[*] Significant at the 0.01 level (two-tailed).

[#] Significant at the 0.01 level (one-tailed).

The increased number of citations to articles in our list of academic OM journals for the 2004–2009 impact factors supports a conclusion that using a two-year window to assess OM journals is too short. Years 1–2 account for approximately 31% of these citations whereas years 3–5 account for 69%. Specifically, the number of citations to our list of journals was 13,803 in year 1; 23,236 in year 2; 27,189 in year 3; 28,035 in year 4; and 28,358 in year 5. Thus, the increase in citations is still substantial in year 3 but slowing after that. An analysis of what time window is optimal will need to address a range of windows, probably including windows longer than five years, and this is beyond the scope of this research.

We also compared the changes in ranking position of each journal if a five-year window is used instead of a two-year window. The two-year vs. five-year comparisons involved our list of academic OM journals and their 2004–2009 impact factors, resulting in, for each journal, a total of six comparisons with self-citations and six comparisons without self-citations. We found most journals changed rank positions when the time window was extended from two years to five years. For the 12 comparisons, the number of journals that changed rank position ranged from 17 to 25, and averaged 22.3. The average position change across all journals was 2.4. However, some changed substantially more (Fig. 2). For example, over the 12 comparisons, the average rank-position change for *Omega-International Journal of Management Science* was 5.8 and its minimum and maximum were 2 and 15 positions, respectively.

To further explore these rank-position changes, we examined the consistency of rankings for each individual journal based on two-year and five-year impact factors (Table 4). Out of the 27 journal comparisons, five had significantly different ranks ($P \leq 0.05$) when the time window for impact factor calculations was two years vs. five years: *Computers and Operations Research*, *European Journal of Operations Research*, *IEEE Transactions on Engineering Management*, *Management Science*, and *Transportation Science*. Although *Omega-International Journal of Management Science* had the largest range of ranks (Fig. 2), the Mann–Whitney *U* test did not find significantly different ranks using two-year or five-year impact factors.

In summary, the two-year and five-year impact factors for our list of OM journals are significantly different but highly correlated. For a few journals, changing the time window to five years had substantial effect on their rank. Specifically, five of 27 journals (19%) had significantly different rankings. The five-year window also accounts for more citations than the two-year window. Thus, our results provide strong support for Hypotheses 1 and 2a and support for Hypothesis 2b for a subset of journals, but not all.

Table 3b
Comparison of the 2004–2009 two-year and five-year impact factors for our list of academic OM journals (without self-citations).

Impact factor without self-citations	N	Time period	Mean	Spearman's Rho rank correlation coefficient	Time period	Mean	Spearman's Rho rank correlation coefficient
2009 two-year	27	2007–2008	1.27[#]	0.939[*]	2007–2008	1.27[#]	0.902[*]
2009 five-year		2004–2008	1.94		2004–2006	2.47	
2008 two-year	27	2006–2007	1.10[#]	0.942[*]	2006–2007	1.10[#]	0.883[*]
2008 five-year		2003–2007	1.74		2003–2005	2.27	
2007 two-year	27	2005–2006	0.85[#]	0.943[*]	2005–2006	0.85[#]	0.878[*]
2007 five-year		2002–2006	1.37		2002–2004	1.76	
2006 two-year	27	2004–2005	0.74[#]	0.877[*]	2004–2005	0.74[#]	0.846[*]
2006 five-year		2001–2005	1.19		2001–2003	1.52	
2005 two-year	26	2003–2004	0.69[#]	0.950[*]	2003–2004	0.69[#]	0.871[*]
2005 five-year		2000–2004	1.03		2000–2002	1.25	
2004 two-year	26	2002–2003	0.64[#]	0.814[*]	2002–2003	0.64[#]	0.659[*]
2004 five-year		1999–2003	1.00		1999–2001	1.23	

N is the number of academic OM journals in the Journal Citation Reports® (Thomson Reuters, 2004–2009) that were compared. Test of means using the one-tailed paired *t*-test for Hypothesis 1: The mean impact factors of journal outlets for OM research using five-year impact factors are significantly greater than the corresponding means for two-year impact factors. Spearman's Rho rank correlation coefficient for Hypothesis 2a: The rankings of journal outlets for OM research using two-year or five-year impact factors are positively correlated.

[*] Significant at the 0.01 level (two-tailed).

[#] Significant at the 0.01 level (one-tailed).

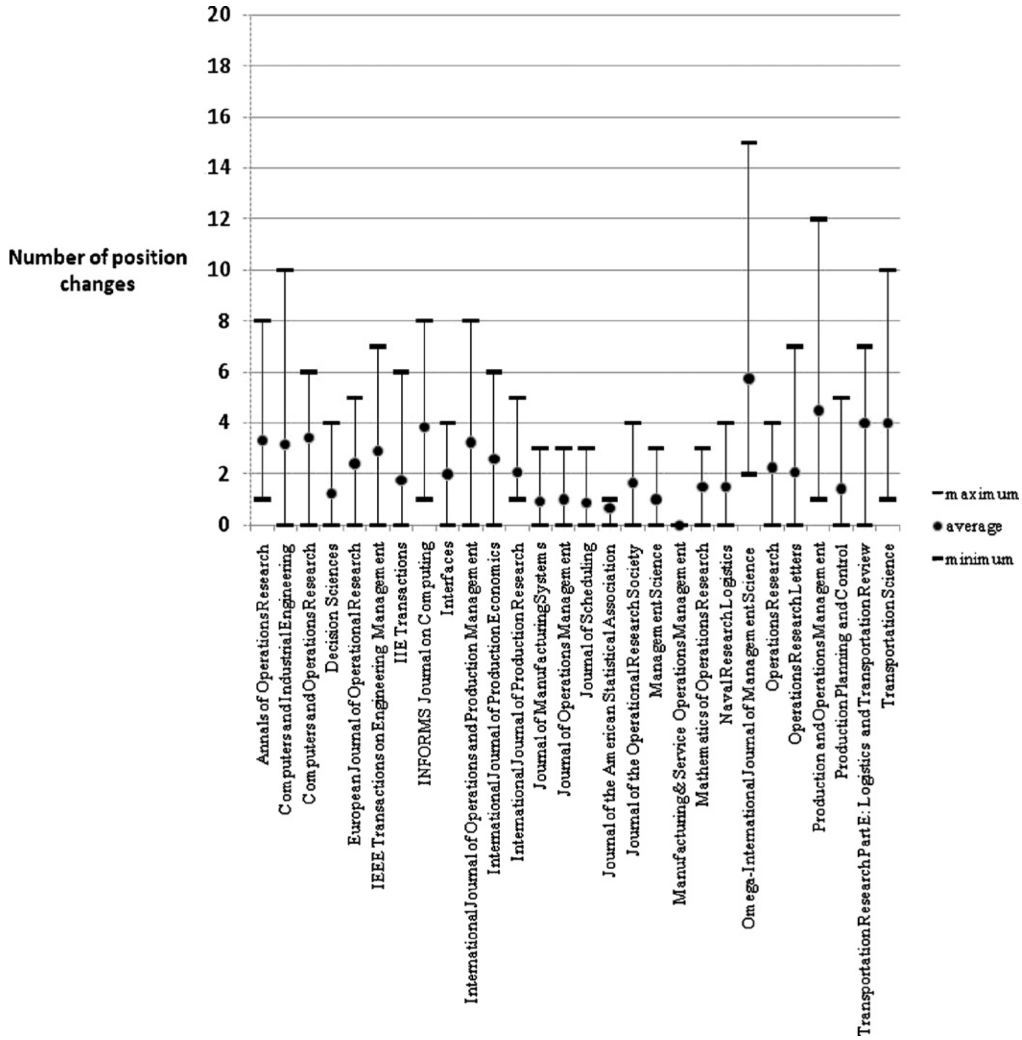

Fig. 2. Number of rank-position changes for our list of academic OM journals when comparing the time window (two years vs. five years) for the 2004–2009 impact factors with and without self-citations.

6.3.2. Impact factor with and without self-citations

Tables 5a and 5b compare the rankings of journals using the 2004–2009 impact factors with and without self-citations for our list of academic OM journals. There are strong correlations between the journal rankings using the 2004–2007 impact factors with or without self-citations for the two-year windows (mean correlation coefficient is 0.912 and is significant at the 0.01 level for all six comparisons) and also for the five-year windows (mean correlation coefficient is 0.954 and is significant at the 0.01 level for all six comparisons). Tables 5a and 5b also show that the mean impact factors with self-citations are significantly greater than the mean impact factors without self-citations ($P \leq 0.01$). The 2004–2009 impact factors for our OM journals increase on average 22% when the impact factor includes self-citations.

We also compared the changes in ranking position of each journal if self-citations are excluded from the impact factor calculation. The "with" vs. "without" self-citations comparisons for our list of academic OM journals and their 2004–2009 impact factors results in, for each journal, a total of six comparisons for the two-year window and six comparisons for the five-year window. We found that most journals changed rank position when self-citations are excluded. For the 12 comparisons, the number of journals that changed rank position ranged from 19 to 25, and averaged 21.4. The average position change across all journals was 1.9. However, some changed substantially more (Fig. 3). For example, over the 12 comparisons, the average rank-position change for *Production and Operations Management* was 7.3 and its minimum and maximum were 1 and 20 positions, respectively. Of the total citations for our list of academic OM journals, 14% were journal self-citations. However, some journals self-cite more than others. For example, *Production and Operations Management* had the largest percent of self-citations (34.8% of its citations were self-citations) whereas the *Annals of Operations Research* had the smallest percent of self-citations (4.1% of its citations were self-citations).

To further explore these rank-position changes, we examined the consistency of rankings for each individual journal based on impact factors with and without self-citations (Table 6). Out of the 28 journal comparisons, eight journals had significantly different rankings ($P \leq 0.05$) for impact factor calculations with, vs. without, self-citations: *Annals of Operations Research*, *IIE Transactions*, *International Journal of Operations and Production Management*, *International Journal of Production Economics*, *Journal of the American Statistical Association*, *Journal of the Operational Research Society*, *Production and Operations Management*, and *Production Planning and Control*.

In summary, the impact factors with self-citations and impact factors without self-citations are significantly different (with impact factors that include self-citations being significantly greater) but highly correlated. For some journals, excluding self-citations had a substantial effect on the rank of the journal.

Table 4
Rank consistency of individual journal outlets for OM research based on impact factor calculation methods (two-year vs. five-year time windows).

Journals	*n* (two-year)	*m* (five-year)	Mann–Whitney *U*	Sig. (2-tailed)
Annals of Operations Research	12	12	58.5	0.443
Computers and Industrial Engineering	12	12	71.5	0.977
Computers and Operations Research	12	12	33.5	0.024*
Decision Sciences	12	12	46.5	0.143
European Journal of Operational Research	12	12	27.0	0.008*
IEEE Transactions on Engineering Management	12	12	33.5	0.024*
IIE Transactions	12	12	50.0	0.219
INFORMS Journal on Computing	12	12	70.5	0.932
Interfaces	12	12	52.0	0.266
International Journal of Operations and Production Management	12	12	47.0	0.160
International Journal of Production Economics	12	12	57.0	0.410
International Journal of Production Research	12	12	54.5	0.319
Journal of Manufacturing Systems	12	12	38.0	0.052
Journal of Operations Management	12	12	54.0	0.319
Journal of Scheduling	12	8	45.5	0.851
Journal of the American Statistical Association	12	12	70.0	0.932
Journal of the Operational Research Society	12	12	48.5	0.178
Management Science	12	12	33.5	0.024*
Manufacturing & Service Operations Management	4	0	NA	NA
Mathematics of Operations Research	12	12	67.5	0.799
Naval Research Logistics	12	12	62.5	0.590
Omega-International Journal of Management Science	12	12	70.5	0.932
Operations Research	12	12	64.0	0.671
Operations Research Letters	12	12	60.5	0.514
Production and Operations Management	12	12	57.0	0.410
Production Planning and Control	12	12	69.0	0.887
Transportation Research Part E: Logistics and Transportation Review	12	12	52.5	0.266
Transportation Science	12	12	25.5	0.006*

NA, not available (sample size is too small). Mann–Whitney *U* test for Hypothesis 2b: The rankings of individual journal outlets for OM research using two-year or five-year impact factors are consistent (n, m are sample sizes for two-year and five-year time windows).
* Significant at the 0.05 level (two-tailed).

Table 5a
Comparison of journal rankings using 2004–2009 impact factors with and without self-citations for our list of academic OM journals (two years).

Two-year impact factor	*N*	Time period	Mean	Spearman's Rho rank correlation coefficient
2009 with	28	2007–2008	1.56#	0.967*
2009 without		2007–2008	1.29	
2008 with	28	2006–2007	1.34#	0.899*
2008 without		2006–2007	1.10	
2007 with	27	2005–2006	1.04#	0.894*
2007 without		2005–2006	0.85	
2006 with	27	2004–2005	0.97#	0.817*
2006 without		2004–2005	0.74	
2005 with	27	2003–2004	0.82#	0.933*
2005 without		2003–2004	0.69	
2004 with	27	2002–2003	0.77#	0.959*
2004 without		2002–2003	0.64	

N is the number of academic OM journals in the Journal Citation Reports® (Thomson Reuters, 2004–2009) that were compared. Spearman's Rho rank correlation coefficient for Hypothesis 3a: The rankings of journal outlets for OM research based on impact factors with and without self-citations are positively correlated.
* Significant at the 0.01 level (two-tailed).
\# Significant at the 0.01 level (one-tailed).

Table 5b
Comparison of journal rankings using 2004–2009 impact factors with and without self-citations for our list of academic OM journals (five years).

Five-year impact factor	*N*	Time period	Mean	Spearman's Rho rank correlation coefficient
2009 with	27	2004–2008	2.22#	0.975*
2009 without		2004–2008	1.94	
2008 with	27	2003–2007	2.00#	0.975*
2008 without		2003–2007	1.74	
2007 with	27	2002–2006	1.59#	0.945*
2007 without		2002–2006	1.37	
2006 with	27	2001–2005	1.43#	0.907*
2006 without		2001–2005	1.19	
2005 with	26	2000–2004	1.18#	0.966*
2005 without		2000–2004	1.03	
2004 with	26	1999–2003	1.17#	0.954*
2004 without		1999–2003	1.00	

N is the number of academic OM journals in the Journal Citation Reports® (Thomson Reuters, 2004–2009) that were compared. Spearman's Rho rank correlation coefficient for Hypothesis 3a: The rankings of journal outlets for OM research based on impact factors with and without self-citations are positively correlated.
* Significant at the 0.01 level (two-tailed).
\# Significant at the 0.01 level (one-tailed).

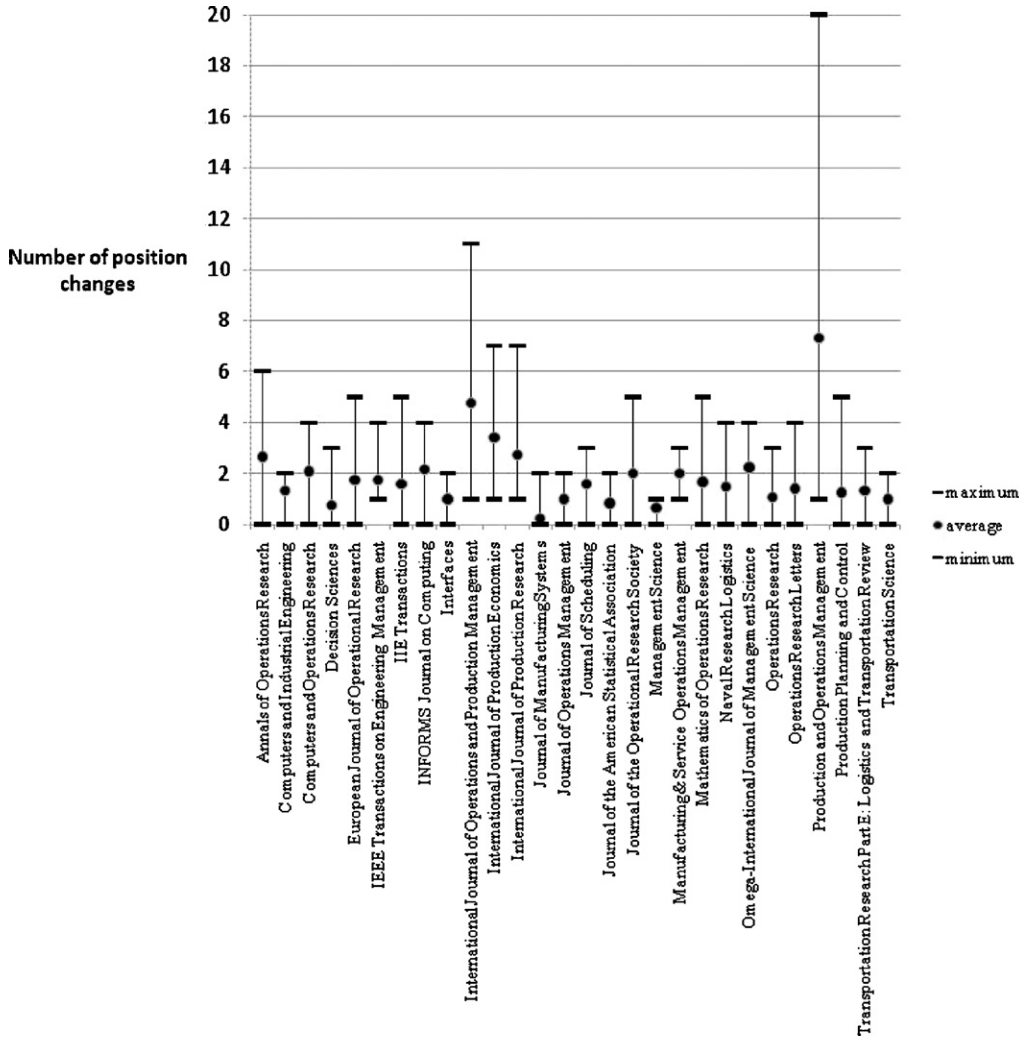

Fig. 3. Number of rank-position changes for our list of academic OM journals when comparing with vs. without self-citations for the 2004–2009 two-year and five-year impact factors.

Eight of 28 journals (29%) had significantly different rankings. Our results provide strong support for Hypotheses 3a and support for Hypothesis 3b for a subset of journals, but not all. This supports the case for considering impact factors without self-citations in journal rankings.

6.3.3. *Comparisons of impact factor to the quality assessments from previous published studies of journal outlets for OM research*

Table 7 summarizes the five-year impact factors with self-citations that we calculated and the assessments for each previous study that evaluated the journal quality of our list of academic OM journals. (The legend for this table is at the bottom of the table.) Journals that have changed title are shown under the title that was used in the previous study. For example, *AIIE Transactions* was identified in Saladin (1985) and later became the *IIE Transactions*. (There are no data shown in Table 7 for *AIIE Transactions* since Saladin (1985) did not provide complete ratings or rankings of journals.) Five-year impact factors with self-citations were used for the analysis in this table because Olson (2005) and Donohue and Fox (2000) both used five-year impact factors with self-citations. In addition, the results just presented show five-year impact factors are highly correlated with two-year impact factors and include significantly more citations.

Nine of the 14 previous studies provided either rating or ranking assessments of journal quality (Barman et al., 1991; Barman et al., 2001; Donohue and Fox, 2000; Goh et al., 1996; Gorman and Kanet, 2005; Olson, 2005; Soteriou et al., 1999; Theoharakis et al., 2007; Vokurka, 1996) and five did not provide complete ratings or rankings of journal quality (Ansari et al., 1992; Goh et al., 1997; Holsapple and Lee-Post, 2010; Saladin, 1985; Vastag and Montabon, 2002). In Table 7, the columns labeled IF1–IF6 show the 2004–2009 five-year impact factors with self-citations from our study. IF7 and IF8 show the 2003 and 1995 five-year impact factors with self-citations from Olson (2005) and Donohue and Fox (2000), respectively. These older impact factors (IF7 and IF8) provide a useful comparison to IF1–IF6 as well as to the previous studies that were conducted during a similar time period. Although Gorman and Kanet (2005) used impact factor in their research, their impact factor results are excluded since they used a two-year window which cannot be directly compared to the five-year impact factors, IF1–IF8. We included the six empirical-based survey studies that assessed perceived quality of OM journals; these are labeled in Table 7 as Q1 (Barman et al., 1991), Q2 (Barman et al., 2001), Q3 (Donohue and Fox, 2000), Q4 (Olson, 2005), Q5 (Soteriou et al., 1999), and Q6 (Theoharakis et al., 2007). There are three other studies that assessed journal quality; these included one author-based study (Gorman and Kanet, 2005) that is labeled as A1 in Table 7, and two citation-based studies that are labeled as C1 (Goh et al., 1996) and C2 (Vokurka, 1996).

Table 6
Rank consistency of individual journal outlets for OM research based on impact factor calculation methods with vs. without self-citations.

Journals	*n* (with)	*m* (without)	Mann–Whitney *U*	Sig. (2-tailed)
Annals of Operations Research	12	12	34.0	0.028*
Computers and Industrial Engineering	12	12	68.0	0.843
Computers and Operations Research	12	12	42.5	0.089
Decision Sciences	12	12	53.0	0.291
European Journal of Operational Research	12	12	61.0	0.551
IEEE Transactions on Engineering Management	12	12	65.5	0.713
IIE Transactions	12	12	34.5	0.028*
INFORMS Journal on Computing	12	12	56.0	0.378
Interfaces	12	12	69.0	0.887
International Journal of Operations and Production Management	12	12	27.5	0.008*
International Journal of Production Economics	12	12	29.5	0.012*
International Journal of Production Research	12	12	39.5	0.060
Journal of Manufacturing Systems	12	12	66.5	0.755
Journal of Operations Management	12	12	43.0	0.101
Journal of Scheduling	10	10	30.5	0.143
Journal of the American Statistical Association	12	12	32.5	0.020*
Journal of the Operational Research Society	12	12	23.0	0.004*
Management Science	12	12	53.0	0.291
Manufacturing & Service Operations Management	2	2	2.0	1.000
Mathematics of Operations Research	12	12	56.5	0.378
Naval Research Logistics	12	12	38.0	0.052
Omega-International Journal of Management Science	12	12	55.5	0.347
Operations Research	12	12	49.5	0.198
Operations Research Letters	12	12	58.5	0.443
Production and Operations Management	12	12	27.0	0.008*
Production Planning and Control	12	12	36.0	0.039*
Transportation Research Part E: Logistics and Transportation Review	12	12	63.5	0.630
Transportation Science	12	12	69.0	0.887

Mann–Whitney *U* test for Hypothesis 3b: The rankings of individual journal outlets for OM research based on impact factors with and without self-citations are consistent (n, m are sample sizes for with and without self-citations).
* Significant at the 0.05 level (two-tailed).

Table 8 shows the rankings derived from Table 7. *Management Science* was the top-ranked journal using the criterion of the highest number of #1 rankings. *Management Science* ranked first nine times out of the 17 studies shown in Table 8 although only once for the impact factor studies (IF2). *Journal of Operations Management* ranked first four times, *Journal of the American Statistical Association* ranked first three times, *Transportation Science* ranked first once, and no other journal was ranked first in any of the 17 studies.

Management Science also had the lowest (that is, best) average ranking across the studies in which it was ranked. The average ranking for *Management Science* was 1.9. Even though it was not ranked #1 in any of the previous studies, *Manufacturing and Services Operations Management*, which began publication after most of the previous studies, had the second best average ranking of 3.7. Of those journals that received at least one #1 ranking in a previous study, *Journal of the American Statistical Association* had the next best average ranking of 3.8, followed by *Journal of Operations Management* with 4.4, and *Transportation Science* with 5.4. Although it did not rank number one in any of the previous studies *Operations Research* had an average ranking of 4.8, which places it above *Transportation Science* based on average ranking. Except for *Manufacturing and Services Operations Management* and *Operations Research*, no journals that were not ranked #1 in at least one previous study had an average ranking as low (good) as any of the journals that were ranked #1 in at least one previous study.

Table 9 provides Spearman's Rho rank correlations between the rankings based on our impact factor analysis and rankings from previous studies that provided assessments of journal quality. The correlations between our 2004–2009 impact factors (IF1–IF6) are significantly strong (mean correlation coefficient is 0.871 and is significant at the 0.01 level for all 15 correlations). The correlations between rankings using the 2004–2009 impact factors and rankings based on the 2003 impact factors determined by Olson (2005) are also significantly strong (mean correlation coefficient is 0.803 and is significant at the 0.01 level for all six correlations). The correlations between rankings for our 2004–2009 impact factors and for the 1995 impact factors (Donohue and Fox, 2000) are moderate (mean correlation coefficient is 0.611 and is significant at the 0.05 level for four of six correlations). In general, the closer the time period for which the impact factors were determined the stronger the correlation. For example, the correlation for rankings based on the 2003 impact factors determined by Olson (2005) is strongest with the rankings based on our 2004 impact factors.

Table 10 summarizes Spearman's Rho rank correlations in Table 9 into categories based on the assessment method that was used to evaluate journal quality as follows: studies using impact factors, studies using methods other than impact factors (shown in the table as "non-impact factors"), and empirical-based survey studies that assessed perceived quality. (Note that these categories overlap so that some previous studies appear in more than one category, as shown in the table legend.) We compared each impact factor study (IF1–IF8) to the non-impact factor studies and to the empirical-based survey studies that assessed perceived quality. For each comparison in Table 10, we determined the mean correlation coefficient using the data in Table 9, the number of significant (positive) correlations (at the 0.05 level), the number of positive correlations, and the percent of significant correlations. In the last two columns of Table 10, we also show the statistical significance of differences for mean correlation coefficients between impact factors and previous studies that used methods other than impact factors and mean correlation coefficients among these previous studies.

The mean correlation coefficient for rankings among studies using impact factors (IF1–IF8) is the highest of any comparisons in Table 10. The mean correlation coefficient between rankings in the impact factor studies (IF vs. IF) is 0.794 and is significant at the 0.05 level for 26 of 28 correlations. The mean correlation coefficient between rankings for impact factor and the non-impact factor studies (IF vs. NonIF) is 0.450 and is significant at the 0.05 level for 27 of 72 correlations. The mean correlation coefficient between rank-

Table 7
Five-year impact factors with self-citations and assessments from the previous studies for our list of academic OM journals.

Journal	IF1	IF2	IF3	IF4	IF5	IF6	IF7	IF8	Q1	Q2	Q3	Q4	Q5	Q6	A1	C1	C2
AIIE Transactions (Note 1)																	
Annals of Operations Research	1.57	1.16	0.91	0.66	0.74	0.54	0.47					2.97			0.515	0.025465	
Computers and Industrial Engineering	2.05	1.64	1.06	1.08	0.73	0.67		0.06	5.09	5.46	63.8	4.46	4.71			0.025724	13
Computers and Operations Research (Note 2)	2.44	1.79	1.43	1.18	0.99	0.82	0.79	0.29	4.85	5.14	80.5	4.05	5.54		0.325	0.016150	21
Decision Sciences	3.28	3.13	2.41	1.99	1.38	1.14	1.45	0.49	2.58	2.81	100.0	3.27	6.35	5.10	0.361	0.138154	201
Engineering Costs and Production Economics (Note 3)																0.053113	
European Journal of Operational Research	2.60	2.08	1.57	1.30	1.08	1.14	0.90	0.28	3.74	3.60	99.5	2.83	6.61	5.31	0.501	0.100464	64
IEEE Transactions on Engineering Management	1.96	2.15	1.54	1.37	1.13	0.89									0.429	0.015096	
IIE Transactions (Notes 1 and 6)	1.71	1.37	1.15	0.91	0.84	0.76	0.75		2.87	3.18	106.0	2.44	6.13	5.38	0.671	0.244999	125
INFORMS Journal on Computing (Note 4)	1.50	1.78	1.71	1.65	1.94	1.80						2.63					
Interfaces	1.27	0.82	0.96	0.75	0.82	0.82	0.72	0.38	3.87	3.67	85.5	2.53	5.75		0.574	0.062627	45
International Journal of Operations and Production Management	1.95	2.02	1.46	1.12	1.10	0.97			3.94	4.43	75.1	4.10	6.79	4.46	0.190	0.115555	36
International Journal of Production Economics (Notes 3, 7, and 10)	2.74	2.77	1.49	1.40	1.05	1.01	0.58			4.51		4.06	6.17		0.232		
International Journal of Production Research	1.36	1.38	0.97	1.06	0.75	0.83	0.87	0.30	2.94	3.82	88.1	3.88	6.74	4.90	0.451	0.520203	229
International Journal of Purchasing and Materials Management (Note 5)											63.3						28
Journal of Business Logistics											77.9	3.71			0.370		
Journal of Industrial Engineering (Note 6)																0.039529	15
Journal of Manufacturing and Operations Management (Note 7)									3.25		93.1					0.013224	
Journal of Manufacturing Systems	0.42	0.49	0.29	0.52	0.36	0.56	0.71	0.24			69.8	4.36				0.066795	17
Journal of Operations Management	4.18	3.81	3.80	3.33	2.62	3.03	2.45		2.60	2.66	95.9	3.02	6.86	5.36	0.523	0.157547	152
Journal of Purchasing and Materials Management (Note 8)									5.27	5.38			4.77			0.024861	
Journal of Scheduling	1.83	1.61	1.53	1.23								3.75			0.599		
Journal of Supply Chain Management (Notes 5 and 8)												3.90		3.82	0.500		
Journal of the American Statistical Association	3.75	3.46	3.38	3.19	2.70	2.73	2.46	1.33			126.7	1.68				0.019459	
Journal of the Operational Research Society	1.57	1.14	0.99	0.83	0.74	0.68	0.67	0.38	4.30	4.19	99.6	3.27	6.27		0.339	0.098827	32
Location Science (Note 2)													5.00				
Logistics and Transportation Review (Note 9)								0.11			80.2				0.522		
Management Science	4.13	4.07	3.41	2.83	2.62	2.72	2.24	0.94	2.34	2.09	136.2	1.10	7.67	6.32	0.778	0.544483	554
Manufacturing & Service Operations Management												1.75		5.54	0.835		
Material Flow (Note 10)																0.018258	
Mathematics of Operations Research	1.61	1.56	1.42	1.17	1.24	1.26	1.33	0.83			123.8	1.41			0.847		27
Naval Research Logistics (Note 11)	1.25	0.99	0.78	0.67	0.61	0.66	0.68	0.33	3.23	3.26	109.1	2.38	6.19		0.488		66
Naval Research Logistics Quarterly (Note 11)																0.071731	
Omega-International Journal of Management Science	3.24	2.37	1.45	1.20	1.04	1.05	0.87	0.29	4.40	4.33	88.0	4.37	5.94		0.209	0.053486	35
Operations Research	2.67	2.55	1.96	1.74	1.38	1.33	1.15	0.74	3.16	2.58	128.5	1.12	7.56		0.836	0.236935	225
Operations Research Letters	1.05	1.13	0.79	0.88	0.78	0.82	0.71					2.65	6.04			0.013047	
ORSA Journal on Computing (Note 4)											108.7						
Production and Operations Management	2.81	2.36	2.30	2.90	1.01	1.12				2.84	91.3	2.99	6.62	5.10	0.619		
Production Planning and Control	1.15	1.05	0.73	0.74	0.58	0.49									0.354		
Transportation Research Part E: Logistics and Transportation Review (Note 9)	2.30	2.47	1.39	1.26	1.22	0.78											
Transportation Science	3.60	2.82	2.10	1.69	1.23	1.82	1.23	0.38			111.1	2.42			0.867		

IF1: Our Study—2009 five-year impact factor with self-cites, time period: 2004–2008. IF2: Our Study—2008 five-year impact factor with self-cites, time period: 2003–2007. IF3: Our Study—2007 five-year impact factor with self-cites, time period: 2002–2006. IF4: Our Study—2006 five-year impact factor with self-cites, time period: 2001–2005. IF5: Our Study—2005 five-year impact factor with self-cites, time period: 2000–2004. IF6: Our Study—2004 five-year impact factor with self-cites, time period: 1999–2003. IF7: Olson (2005)—2003 five-year impact factor with self-cites (Table 2, pp. 327–328), time period: 1998–2002. IF8: Donohue and Fox (2000)—1995 five-year impact factor with self-cites (Table 2, pp. 24–25), time period: 1990–1994. Q1: Barman et al. (1991)—Survey: Quality ("less is better" scale, Table 2, pp. 199), time period: 1990. Q2: Barman et al. (2001)—Survey: Quality ("less is better" scale, Table 4, pp. 374), time period: 2000. Q3: Donohue and Fox (2000)—Survey: Quality (Table 1, pp. 24–25), time period: 1996–1997. Q4: Olson (2005)—Survey: Quality ("less is better" scale, Table 2, pp. 327–328), time period: 2000 and 2002. Q5: Soteriou et al. (1999)—Survey: Quality (Table 4, pp. 231), time period: 1996–1997. Q6: Theoharakis et al. (2007)—Survey: Quality (Table 4, pp. 939), time period: 2002. A1: Gorman and Kanet (2005)—Author Affiliation Index (Table 2, pp. 9), time period: 2001–2003. C1: Goh et al. (1996)—Normalized citations (Table 4, pp. 341), time period: 1989–1993. C2: Vokurka (1996)—Total Citations (Table 4, pp. 351), time period: 1992–1994. Note 1: AIIE Transactions became the IIE Transactions, AIIE Transactions was identified (no ratings/rankings) in Saladin (1985). Note 2: Location Science was absorbed by Computers and Operations Research. Note 3: Engineering Costs and Production Economics became the International Journal of Production Economics. Note 4: ORSA Journal on Computing became the INFORMS Journal on Computing. Note 5: International Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 6: Journal of Industrial Engineering became IIE Transactions. Note 7: Journal of Manufacturing and Operations Management became the International Journal of Production Economics. Note 8: Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 9: Logistics and Transportation Review became Transportation Research Part E: Logistics and Transportation Review. Note 10: Material Flow became the International Journal of Production Economics. Note 11: Naval Research Logistics Quarterly became the Naval Research Logistics.

Table 8
Rankings using five-year impact factors with self-citations and assessments from the previous studies that provided assessments of journal quality for our list of academic OM journals.

Journal	IF1	IF2	IF3	IF4	IF5	IF6	IF7	IF8	Q1	Q2	Q3	Q4	Q5	Q6	A1	C1	C2
AIIE Transactions (Note 1)																	
Annals of Operations Research	19	21	23	26	22	25	19					13			12	17	
Computers and Industrial Engineering	13	16	19	18	23	22		16	15	17	23	27	19			16	18
Computers and Operations Research (Note 2)	11	14	15	15	16	17	11	11	14	15	18	22	16		22	21	15
Decision Sciences	5	4	4	5	5	8	4	5	2	4	9	16	8	6	19	6	4
Engineering Costs and Production Economics (Note 3)																14	
European Journal of Operational Research	10	12	9	11	12	9	8	13	9	8	11	12	7	5	13	8	8
IEEE Transactions on Engineering Management	14	11	10	10	10	14									17	22	
IIE Transactions (Notes 1 and 6)	17	20	18	20	17	20	12		4	6	8	8	12	3	6	3	6
INFORMS Journal on Computing (Note 4)	21	15	8	8	4	5						10					
Interfaces	23	26	22	23	18	18	13	6	10	9	17	9	15		9	12	9
International Journal of Operations and Production Management	15	13	13	17	11	13			11	13	21	24	4	9	25	7	10
International Journal of Production Economics (Notes 3, 7, and 10)	8	6	12	9	13	12	18			14		23	11		23		
International Journal of Production Research	22	19	21	19	20	15	9	10	5	10	15	20	5	8	16	2	2
International Journal of Purchasing and Materials Management (Note 5)											24						13
Journal of Business Logistics											20	18			18		
Journal of Industrial Engineering (Note 6)																15	17
Journal of Manufacturing and Operations Management (Note 7)									8		13					23	
Journal of Manufacturing Systems	27	27	27	27	26	24	14	14			22	25				11	16
Journal of Operations Management	1	2	1	1	2	1	2		3	3	12	15	3	4	10	5	5
Journal of Purchasing and Materials Management (Note 8)									16	16			18			18	
Journal of Scheduling	16	17	11	13								19			8		
Journal of Supply Chain Management (Notes 5 and 8)												21		10	14		
Journal of the American Statistical Association	3	3	3	2	1	2	1	1			3	4				19	
Journal of the Operational Research Society	20	22	20	22	21	21	17	6	12	11	10	16	9		21	9	12
Location Science (Note 2)													17				
Logistics and Transportation Review (Note 9)								15			19				11		
Management Science	2	1	2	4	3	3	3	2	1	1	1	1	1	1	5	1	1
Manufacturing & Service Operations Management												5		2	4		
Material Flow (Note 10)																20	
Mathematics of Operations Research	18	18	16	16	7	7	5	3			4	3			2		14
Naval Research Logistics (Note 11)	24	25	25	25	24	23	16	9	7	7	6	6	10		15		7
Naval Research Logistics Quarterly (Note 11)																10	
Omega-International Journal of Management Science	6	9	14	14	14	11	10	11	13	12	16	26	14		24	13	11
Operations Research	9	7	7	6	6	6	7	4	6	2	2	2	2		3	4	3
Operations Research Letters	26	23	24	21	19	16	15					11	13			24	
ORSA Journal on Computing (Note 4)											7						
Production and Operations Management	7	10	5	3	15	10				5	14	14	6	6	7		
Production Planning and Control	25	24	26	24	25	26									20		
Transportation Research Part E: Logistics and Transportation Review (Note 9)	12	8	17	12	9	19											
Transportation Science	4	5	6	7	8	4	6	6			5	7			1		

IF1: Our Study—2009 five-year impact factor with self-cites, time period: 2004–2008. IF2: Our Study—2008 five-year impact factor with self-cites, time period: 2003–2007. IF3: Our Study—2007 five-year impact factor with self-cites, time period: 2002–2006. IF4: Our Study—2006 five-year impact factor with self-cites, time period: 2001–2005. IF5: Our Study – 2005 five-year impact factor with self-cites, time period: 2000–2004. IF6: Our Study—2004 five-year impact factor with self-cites, time period: 1999–2003. IF7: Olson (2005)—2003 five-year impact factor with self-cites (Table 2, pp. 327–328), time period: 1998–2002. IF8: Donohue and Fox (2000)—1995 five-year impact factor with self-cites (Table 2, pp. 24–25), time period: 1990–1994. Q1: Barman et al. (1991)—Survey:Quality (Table 2, pp. 199), time period: 1990. Q2: Barman et al. (2001)—Survey:Quality (Table 4, pp. 374), time period: 2000. Q3: Donohue and Fox (2000)—Survey:Quality (Table 1, pp. 24–25), time period: 1996–1997. Q4: Olson (2005)—Survey:Quality (Table 2, pp. 327–328), time period: 2000 and 2002. Q5: Soteriou et al. (1999)—Survey:Quality (Table 4, p. 231), time period: 1996–1997. Q6: Theoharakis et al. (2007)—Survey: Quality (Table 4, pp. 939), time period: 2002. A1: Gorman and Kanet (2005)—Author Affiliation Index (Table 2, pp. 9), time period: 2001–2003. C1: Goh et al. (1996)—Normalized citations (Table 4, pp. 341), time period: 1989–1993. C2: Vokurka (1996)—Total Citations (Table 4, pp. 351), time period: 1992–1994. Note 1: AIIE Transactions became the IIE Transactions, AIIE Transactions was identified (no ratings/rankings) in Saladin (1985). Note 2: Location Science was absorbed by Computers and Operations Research. Note 3: Engineering Costs and Production Economics became the International Journal of Production Economics. Note 4: ORSA Journal on Computing became the INFORMS Journal on Computing. Note 5: International Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 6: Journal of Industrial Engineering became IIE Transactions. Note 7: Journal of Manufacturing and Operations Management became the International Journal of Production Economics. Note 8: Journal of Purchasing and Materials Management became the Journal of Supply Chain Management. Note 9: Logistics and Transportation Review became Transportation Research Part E: Logistics and Transportation Review. Note 10: Material Flow became the International Journal of Production Economics. Note 11: Naval Research Logistics Quarterly became the Naval Research Logistics.

Table 9

Spearman's Rho rank correlation for impact factors and previous studies that provided assessments of journal quality for our list of academic OM journals.

		IF2	IF3	IF4	IF5	IF6	IF7	IF8	Q1	Q2	Q3	Q4	Q5	Q6	A1	C1	C2
IF1	Rho	0.950**	0.874**	0.864**	0.731**	0.735**	0.714**	0.497	0.345	0.400	0.393	0.093	0.414	0.467	0.155	0.247	0.382
	sig.	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.23	0.13	0.10	0.66	0.10	0.24	0.50	0.32	0.14
	N	27	27	27	26	26	19	15	14	16	19	24	17	8	21	18	16
IF2	Rho		0.904**	0.925**	0.839**	0.801**	0.749**	0.513	0.442	0.424	0.449	0.126	0.551*	0.395	0.125	0.300	0.474
	sig.		0.00	0.00	0.00	0.00	0.00	0.05	0.11	0.10	0.05	0.56	0.02	0.33	0.59	0.23	0.06
	N		27	27	26	26	19	15	14	16	19	24	17	8	21	18	16
IF3	Rho			0.968**	0.893**	0.902**	0.795**	0.569*	0.473	0.550*	0.456*	0.256	0.610**	0.467	0.287	0.354	0.465
	sig.			0.00	0.00	0.00	0.00	0.03	0.09	0.03	0.05	0.23	0.01	0.24	0.21	0.15	0.07
	N			27	26	26	19	15	14	16	19	24	17	8	21	18	16
IF4	Rho				0.878**	0.890**	0.811**	0.572*	0.429	0.476	0.423	0.238	0.549*	0.240	0.266	0.232	0.453
	sig.				0.00	0.00	0.00	0.03	0.13	0.06	0.07	0.26	0.02	0.57	0.24	0.35	0.08
	N				26	26	19	15	14	16	19	24	17	8	21	18	16
IF5	Rho					0.914**	0.861**	0.770**	0.556*	0.532*	0.582**	0.416*	0.620**	0.347	0.322	0.243	0.524*
	sig.					0.00	0.00	0.00	0.04	0.03	0.01	0.05	0.01	0.40	0.17	0.33	0.04
	N					26	19	15	14	16	19	23	17	8	20	18	16
IF6	Rho						0.886**	0.743**	0.565*	0.621*	0.598**	0.428*	0.696**	0.383	0.429	0.331	0.562*
	sig.						0.00	0.00	0.04	0.01	0.01	0.04	0.00	0.35	0.06	0.18	0.02
	N						19	15	14	16	19	23	17	8	20	18	16
IF7	Rho							0.676**	0.657*	0.687**	0.515*	0.405	0.626*	0.257	0.450	0.411	0.552*
	sig.							0.01	0.02	0.01	0.04	0.09	0.02	0.62	0.08	0.13	0.04
	N							14	12	13	16	19	14	6	16	15	14
IF8	Rho								0.731*	0.790**	0.892**	0.837**	0.626*	0.400	0.506	0.333	0.592*
	sig.								0.01	0.00	0.00	0.00	0.04	0.60	0.08	0.29	0.03
	N								11	11	16	15	11	4	13	12	13
Q1	Rho									0.914**	0.732**	0.669**	0.746**	0.679	0.637*	0.782**	0.930**
	sig.									0.00	0.00	0.01	0.00	0.09	0.02	0.00	0.00
	N									15	15	14	15	7	13	15	14
Q2	Rho										0.821**	0.820**	0.745**	0.731*	0.832**	0.802**	0.855**
	sig.										0.00	0.00	0.00	0.04	0.00	0.00	0.00
	N										15	16	17	8	15	14	14
Q3	Rho											0.902**	0.504	0.874**	0.674**	0.488	0.647**
	sig.											0.00	0.06	0.01	0.00	0.06	0.01
	N											20	15	8	18	16	17
Q4	Rho												0.384	0.942**	0.839**	0.269	0.592*
	sig.												0.13	0.00	0.00	0.30	0.02
	N												17	10	22	17	16
Q5	Rho													0.072	0.393	0.807**	0.763**
	sig.													0.87	0.15	0.00	0.00
	N													8	15	15	14
Q6	Rho														0.839**	0.500	0.393
	sig.														0.00	0.25	0.38
	N														10	7	7
A1	Rho															0.521	0.380
	sig.															0.06	0.18
	N															14	14
C1	Rho																0.900**
	sig.																0.00
	N																15

Spearman's Rho rank correlation for Hypothesis 4a: The rankings of journal outlets for OM research based on impact factors are positively correlated with the quality rankings for those journals determined in prior studies. IF1: Our Study—2009 five-year impact factor with self-cites, time period: 2004–2008. IF2: Our Study—2008 five-year impact factor with self-cites, time period: 2003–2007. IF3: Our Study—2007 five-year impact factor with self-cites, time period: 2002–2006. IF4: Our Study—2006 five-year impact factor with self-cites, time period: 2001–2005. IF5: Our Study—2005 five-year impact factor with self-cites, time period: 2000–2004. IF6: Our Study—2004 five-year impact factor with self-cites, time period: 1999–2003. IF7: Olson (2005)—2003 five-year impact factor with self-cites (Table 2, pp. 327–328), time period: 1998–2002. IF8: Donohue and Fox (2000)—1995 five-year impact factor with self-cites (Table 2, pp. 24–25), time period: 1990–1994. Q1: Barman et al. (1991)—Survey:Quality (Table 2, pp. 199), time period: 1990. Q2: Barman et al. (2001)—Survey:Quality (Table 4, pp. 374), time period: 2000. Q3: Donohue and Fox (2000)—Survey:Quality (Table 1, pp. 24–25), time period: 1996–1997. Q4: Olson (2005)—Survey:Quality (Table 2, pp. 327–328), time period: 2000 and 2002. Q5: Soteriou et al. (1999)—Survey:Quality (Table 4, pp. 231), time period: 1996–1997. Q6: Theoharakis et al. (2007)—Survey:Quality (Table 4, pp. 939), time period: 2002. A1: Gorman and Kanet (2005)—Author Affiliation Index (Table 2, pp. 9), time period: 2001–2003. C1: Goh et al. (1996)—Normalized citations (Table 4, pp. 341), time period: 1989–1993. C2: Vokurka (1996)—Total Citations (Table 4, pp. 351), time period: 1992–1994.

* Significant at the 0.05 level (two-tailed).

** Significant at the 0.01 level (two-tailed).

Table 10
Spearman's Rho rank correlation for our list of academic OM journals between impact factors and previous studies that provided assessments of journal quality using methods other than impact factors (or non-impact factors), and previous empirical-based survey studies that assessed perceived quality.

Correlation	Mean correlation coefficient	Number of significant* correlations	Number of positive correlations	Percent of significant correlations	Test of Means between Column 1 and NonIF vs. NonIF Sig. (2-tailed)	Test of Means between Column 1 and Q vs. Q Sig. (2-tailed)
Impact factors vs. impact factors (IF vs. IF)	0.794	26	28	93%	NA	NA
Impact factors vs. non-impact factors (IF vs. NonIF)	0.450	27	72	38%	0.000*	NA
IF1 vs. non-impact factors (IF1 vs. NonIF)	0.322	0	9	0%	0.000*	NA
IF2 vs. non-impact factors (IF2 vs. NonIF)	0.365	1	9	11%	0.000*	NA
IF3 vs. non-impact factors (IF3 vs. NonIF)	0.435	2	9	22%	0.000*	NA
IF4 vs. non-impact factors (IF4 vs. NonIF)	0.367	1	9	11%	0.000*	NA
IF5 vs. non-impact factors (IF5 vs. NonIF)	0.460	6	9	67%	0.001*	NA
IF6 vs. non-impact factors (IF6 vs. NonIF)	0.513	6	9	67%	0.006*	NA
IF7 vs. non-impact factors (IF7 vs. NonIF)	0.507	5	9	56%	0.009*	NA
IF8 vs. non-impact factors (IF8 vs. NonIF)	0.634	6	9	67%	0.570	NA
Non-impact factors vs. non-impact factors (NonIF vs. NonIF)	0.677	25	36	69%	NA	NA
Impact Factors vs. Perceived Quality (IF vs. Q)	0.488	23	48	48%	NA	0.004*
IF1 vs. Perceived Quality (IF1 vs. Q)	0.352	0	6	0%	NA	0.000*
IF2 vs. Perceived Quality (IF2 vs. Q)	0.398	1	6	17%	NA	0.002*
IF3 vs. Perceived Quality (IF3 vs. Q)	0.469	2	6	33%	NA	0.008*
IF4 vs. Perceived Quality (IF4 vs. Q)	0.393	1	6	17%	NA	0.001*
IF5 vs. Perceived Quality (IF5 vs. Q)	0.509	5	6	83%	NA	0.017*
IF6 vs. Perceived Quality (IF6 vs. Q)	0.549	5	6	83%	NA	0.062
IF7 vs. Perceived Quality (IF7 vs. Q)	0.525	4	6	67%	NA	0.072
IF8 vs. Perceived Quality (IF8 vs. Q)	0.713	5	6	83%	NA	0.914
Perceived Quality vs. Perceived Quality (Q vs. Q)	0.702	11	15	73%	NA	NA

NA, not applicable. Test of Means uses the two-tailed *t*-test for Hypothesis 4b: The mean correlation coefficients of rankings of journal outlets for OM research based on impact factors with quality rankings for those journals determined in prior studies are the same as the mean correlation coefficients of the quality rankings among the prior studies. Impact Factors (IF): IF1, IF2, IF3, IF4, IF5, IF6, IF7, IF8. Non-impact factors (NonIF) are previous studies that provided assessments of journal quality using non-impact factors: Q1, Q2, Q3, Q4, Q5, Q6, A1, C1, and C2. Perceived Quality (Q) is the previous empirical-based survey studies that assessed perceived quality: Q1, Q2, Q3, Q4, Q5, and Q6. IF1: Our Study—2009 five-year impact factor with self-cites, time period: 2004–2008. IF2: Our Study—2008 five-year impact factor with self-cites, time period: 2003–2007. IF3: Our Study—2007 five-year impact factor with self-cites, time period: 2002–2006. IF4: Our Study—2006 five-year impact factor with self-cites, time period: 2001–2005. IF5: Our Study—2005 five-year impact factor with self-cites, time period: 2000–2004. IF6: Our Study—2004 five-year impact factor with self-cites, time period: 1999–2003. IF7: Olson (2005)—2003 five-year impact factor with self-cites (Table 2, pp. 327–328), time period: 1998–2002. IF8: Donohue and Fox (2000)—1995 five-year impact factor with self-cites (Table 2, pp. 24–25), time period: 1990–1994. Q1: Barman et al. (1991)—Survey:Quality (Table 2, pp. 199), time period: 1990. Q2: Barman et al. (2001)—Survey:Quality (Table 4, pp. 374), time period: 2000. Q3: Donohue and Fox (2000)—Survey:Quality (Table 1, pp. 24–25), time period: 1996–1997. Q4: Olson (2005)—Survey:Quality (Table 2, pp. 327–328), time period: 2000 and 2002. Q5: Soteriou et al. (1999)—Survey:Quality (Table 4, pp. 231), time period: 1996–1997. Q6: Theoharakis et al. (2007) – Survey: Quality (Table 4, pp. 939), time period: 2002. A1: Gorman and Kanet (2005)—Author Affiliation Index (Table 2, pp. 9), time period: 2001–2003. C1: Goh et al. (1996)—Normalized citations (Table 4, pp. 341), time period: 1989–1993. C2: Vokurka (1996)—Total Citations (Table 4, pp. 351), time period: 1992–1994.

* Significant at the 0.05 level (two-tailed).

ings in the non-impact factor studies (NonIF vs. NonIF) is 0.677 and is significant at the 0.05 level for 25 of 36 correlations. The mean correlation coefficient between rankings for impact factor and non-impact factor studies (IF vs. NonIF) is significantly different ($P = 0.000$) than the mean correlation coefficient for the rankings among non-impact factor studies (NonIF vs. NonIF). The mean correlation coefficient between rankings for impact factors and the empirical-based survey studies (IF vs. Q) is 0.488 and is significant at the 0.05 level for 23 of 48 correlations. The mean correlation coefficient between rankings in the empirical-based survey studies that assessed perceived quality (Q vs. Q) is 0.702 and is significant at the 0.05 level for 11 of 15 correlations. The mean correlation coefficient between rankings for impact factors and the empirical-based survey studies (IF vs. Q) is significantly different ($P = 0.004$) than the mean correlation coefficient for the rankings among the empirical-based survey studies (Q vs. Q).

We also compared the correlations of each impact factor study (IF1–IF8) with the non-impact factor studies and the empirical-based survey studies that assessed perceived quality, and these results are also shown in Table 10. The results were the same as presented in the previous paragraph for the impact factor studies taken together vs. non-impact factor studies with the exception of IF8 for the non-impact factor studies and IF6-IF8 for the empirical-based survey studies. For example, there is no significant difference ($P = 0.570$) for the mean correlation coefficient between rankings for IF8 and the non-impact factor studies (IF8 vs. NonIF) (mean correlation coefficient of 0.634) and the mean correlation coefficient for the rankings among non-impact factor studies (NonIF vs. NonIF) (mean correlation coefficient of 0.677). There is also no significant difference ($P = 0.914$) for the mean correlation coefficient between rankings for IF8 and the empirical-based survey studies that assessed perceived quality (IF8 vs. Q) (mean correlation coefficient of 0.713) and the mean correlation coefficient for the rankings among empirical-based survey studies (Q vs. Q) (mean correlation coefficient of 0.702).

We examined the consistency of rankings for each individual journal based on five-year impact factors with self-citations and previous studies (Table 11). Out of the 26 journal comparisons of impact factors vs. non-impact factor studies, 11 journals had significantly different rankings ($P \leq 0.05$): *Annals of Operations Research*, *Computers and Operations Research*, *IIE Transactions*, *Interfaces*, *International Journal of Production Research*, *Journal of Operations Management*, *Journal of the American Statistical Association*, *Journal of the Operational Research Society*, *Management Science*, *Naval Research Logistics*, and *Operations Research*. Out of 24 journal comparisons of impact factors vs. empirical-based survey studies that assessed perceived quality, six journals had significantly different rankings ($P \leq 0.05$): *IIE Transactions*, *Journal of Operations Management*, *Journal of the Operational Research Society*, *Management Science*, *Naval Research Logistics*, and *Operations Research*.

In summary, the results shown in Tables 9 and 10, as presented in this section, provide support for Hypothesis 4a. However, in con-

Table 11
Rank consistency of individual journals for OM research based on impact factor calculation methods vs. previous study ranking methods.

Journals	n (IF1–IF8)	m (Q1–Q6, A1, C1, C2)	Mann–Whitney U	Sig. (2-tailed)	n (IF1–IF8)	m (Q1–Q6)	Mann–Whitney U	Sig. (2-tailed)
Annals of Operations Research	7	3	0.0	0.017*	7	1	0.0	0.250
Computers and Industrial Engineering	7	7	21.5	0.710	7	5	13.0	0.530
Computers and Operations Research	8	8	12.0	0.038*	8	5	9.0	0.127
Decision Sciences	8	9	23.5	0.236	8	6	16.0	0.345
European Journal of Operational Research	8	9	21.5	0.167	8	6	13.0	0.181
IEEE Transactions on Engineering Management	6	2	0.0	0.071	6	0	NA	NA
IIE Transactions	7	9	0.5	0.000*	7	6	0.5	0.001*
INFORMS Journal on Computing	6	1	2.0	0.857	6	1	2.0	0.857
Interfaces	8	8	10.0	0.021*	8	5	7.0	0.065
International Journal of Operations and Production Management	6	9	21.0	0.529	6	6	15.0	0.699
International Journal of Production Economics	7	4	5.0	0.109	7	3	5.0	0.267
International Journal of Production Research	8	9	12.5	0.021*	8	6	9.5	0.059
Journal of Manufacturing Systems	8	4	7.0	0.154	8	2	5.0	0.533
Journal of Operations Management	7	9	0.0	0.000*	7	6	0.0	0.001*
Journal of Scheduling	4	2	4.0	1.000	4	1	0.0	0.400
Journal of the American Statistical Association	8	3	1.5	0.024*	8	2	1.5	0.089
Journal of the Operational Research Society	8	8	12.0	0.038*	8	5	5.0	0.030*
Management Science	8	9	12.0	0.021*	8	6	3.0	0.005*
Manufacturing & Service Operations Management	0	3	NA	NA	0	2	NA	NA
Mathematics of Operations Research	8	4	5.5	0.073	8	2	1.5	0.089
Naval Research Logistics	8	7	2.0	0.001*	8	5	1.0	0.003*
Omega-International Journal of Management Science	8	8	14.5	0.065	8	5	7.5	0.065
Operations Research	8	8	3.0	0.001*	8	5	2.5	0.006*
Operations Research Letters	7	3	5.5	0.267	7	2	0.0	0.056
Production and Operations Management	6	6	18.0	1.000	6	5	14.5	0.931
Production Planning and Control	6	1	0.0	0.286	6	0	NA	NA
Transportation Research Part E: Logistics and Transportation Review	6	0	NA	NA	6	0	NA	NA
Transportation Science	8	3	9.0	0.630	8	2	7.0	0.889

n, *m* are sample sizes for the impact factor studies and non-impact factor studies. NA, not available (sample size too small).Mann–Whitney *U* test for Hypothesis 4c: The rankings of individual journal outlets for OM research based on impact factors and based on quality rankings of individual journal outlets determined in prior studies are consistent. Impact factors (IF): IF1, IF2, IF3, IF4, IF5, IF6, IF7, IF8. Non-impact factors (NonIF) are previous studies that provided assessments of journal quality using non-impact factors: Q1, Q2, Q3, Q4, Q5, Q6, A1, C1, and C2. Perceived Quality (Q) is the previous empirical-based survey studies that assessed perceived quality: Q1, Q2, Q3, Q4, Q5, and Q6. IF1: Our study—2009 five-year impact factor with self-cites, time period: 2004–2008. IF2: Our study—2008 five-year impact factor with self-cites, time period: 2003–2007. IF3: Our study—2007 five-year impact factor with self-cites, time period: 2002–2006. IF4: Our study—2006 five-year impact factor with self-cites, time period: 2001–2005. IF5: Our study—2005 five-year impact factor with self-cites, time period: 2000–2004. IF6: Our study—2004 five-year impact factor with self-cites, time period: 1999–2003. IF7: Olson (2005)—2003 five-year impact factor with self-cites (Table 2, pp. 327–328), time period: 1998–2002. IF8: Donohue and Fox (2000)—1995 five-year impact factor with self-cites (Table 2, pp. 24–25), time period: 1990–1994. Q1: Barman et al. (1991)—Survey:Quality (Table 2, pp. 199), time period: 1990. Q2: Barman et al. (2001)—Survey:Quality (Table 4, pp. 374), time period: 2000. Q3: Donohue and Fox (2000)—Survey:Quality (Table 1, pp. 24–25), time period: 1996–1997. Q4: Olson (2005)—Survey:Quality (Table 2, pp. 327–328), time period: 2000 and 2002. Q5: Soteriou et al. (1999)—Survey:Quality (Table 4, pp. 231), time period: 1996–1997. Q6: Theoharakis et al. (2007)—Survey: Quality (Table 4, pp. 939), time period: 2002. A1: Gorman and Kanet (2005)—Author Affiliation Index (Table 2, pp. 9), time period: 2001–2003. C1: Goh et al. (1996)—Normalized citations (Table 4, pp. 341), time period: 1989–1993. C2: Vokurka (1996)—Total Citations (Table 4, pp. 351), time period: 1992–1994.

* Significant at the 0.05 level (two-tailed).

trast to the strong correlations between studies that used impact factors, Table 10 shows that the correlations between rankings based on impact factors and assessments from previous studies that used methods other than impact factors are only moderately correlated. While correlations between impact factor rankings and rankings using other methods are positive, these positive correlations are often not significantly different from zero at the 0.05 level. The mean correlation coefficients for rankings based on impact factors and other ranking methods from previous studies are often significantly different providing little support for Hypothesis 4b. The rankings of individual journals across impact factors and previous studies were consistent for 15 of 26 journals (58%) in the non-impact factor studies and consistent for 18 of 24 journals (75%) in the empirical-based survey studies that assessed perceived quality. These results provide support for Hypothesis 4c for a subset of journals, but not support across all journals.

7. Discussion

We propose and test eight hypotheses concerning the *internal* consistency of different impact factor calculation methods to rank journals (two-year window vs. five-year window, and self-citations vs. without self-citations over different time periods) and the *external* consistency of impact factor rankings as a metric to assess the quality of journal outlets for OM research when compared to the rankings from previous studies that assessed journal quality.

7.1. Internal consistency of impact factors for two-year window vs. five-year window

Although the most widely used impact factors have been based on two-years, intuitively it seems that a longer time period might be more appropriate for OM journals because of the nature of OM research. Our results show that the mean journal ratings for two-year and five-year impact factors are significantly different but the rankings are highly correlated although some individual journals have substantial rank changes when the a five-year window is used instead of a two-year window. Journal review and publication lead-time may be an explanatory factor associated with this outcome.

The impact factor benefits journals that publish research in OM when the time window is changed from two years to five years because five-year impact factors are higher than the two-year impact factors. This situation is analogous to what has been found in the field of statistics. Van Nierop (2010) showed that using a five-year window to calculate impact factors for statistics journals increases them from their traditionally low two-year impact factors. Van Nierop (2009) demonstrated that two-year impact factors for statistics journals are low compared with impact factors in other disciplines because the citations of articles in statistics journals start off slower. Van Nierop (2010) also showed the statistics discipline had a stronger average increase in impact factor compared to other disciplines when the time window was increased from two years to five years, with the increase in ranking being the 14th largest among the 171 science disciplines in the JCR. Similarly, when the time window was increased from two years to five years, the operations research and management science discipline in the JCR had the 23rd largest increase in ranking among the 171 disciplines (personal communication with Van Nierop, 2010). That is, there were only 22 disciplines that experienced a stronger average increase in impact factor when the time window was increased from two years to five years.

Our analysis of academic OM journals also shows a similar increase for five-year impact factors as compared to two-year impact factors. In fact, 100% of the impact factors for the OM journals increased when the time window increased from two to five years. In addition, the impact factors in years 3–5 are significantly more than the impact factors in years 1–2. Note that this type of increase does not always happen for other fields. For example, the top-three rated medical journals—*New England Journal of Medicine*, *JAMA*, and *Lancet* – each with two-year impact factors over 20 – show a decrease of their impact factors when the time window is extended from two years to five years (Thomson Reuters, 2004–2009).

In summary, we conclude that the five-year impact factor is a better metric for the long-run impact of OM journal articles than the two-year impact factor. While we have not studied the specific reasons for this, we speculate that it is because of the inherently longer publication lifecycle of OM articles which leads to slower citation diffusion of OM research as compared to some other fields.

7.2. Internal consistency of impact factors with self-citations vs. without self-citations

We do not reach a definitive conclusion about whether self-citations should be included or not in evaluating OM journals. Self-citations are sometimes viewed as less valid than citations received from other journals. However, in general, it seems that there should be at least a modest level of journal self-citations, especially for top journals. If one is publishing in a top journal then one would expect to cite work in that journal since, as Goh et al. (1997) note, presumably influential articles on the subject are appearing in that journal. However, as Boyer and Swink (2008) note, one would expect a top journal to be widely cited by journals other than itself, both in OM and other fields.

McVeigh (2002) determined that journal self-citation rates less than 20% characterized the majority of journals in the JCR. She also showed that the removal of self-citations from impact factor calculations had little effect on the ranking of the higher impact factor journals across the various science disciplines in the JCR, and only a small proportion of the lower impact factor journals in a discipline showed a significant change in rankings. Linderman and Chandrasekaran (2010) showed the OM discipline tends to have a higher level of self-citations than other business disciplines in management, finance, and marketing. However, the majority of the journals we analyzed self-cited below the general tendency found by McVeigh, with only seven journals exceeding the 20% self-citation rate: *Production and Operations Management* (34.8%), *International Journal of Operations and Production Management* (27.2%), *International Journal of Production Economics* (26.0%), *International Journal of Production Research* (22.6%), *Production Planning and Control* (21.3%), *Journal of Operations Management* (20.3%), and *Journal of the Operational Research Society* (20.0%).

The question of whether to include self-citations when ranking OM journals may be a value judgment that cannot be resolved using data. Perhaps using five-year impact factors both with and without self-citations would be a prudent approach in ranking the quality of OM journals. The information systems (IS) discipline has suggested such an approach. To reduce the possibility of "gaming" the system by journal editors, Straub and Anderson (2009) proposed that impact factors with and without self-citations should both be made available to make the practice of *forced journal self-citation* more transparent to the IS community. Straub and Anderson (Straub and Anderson, 2009, pp. 58) defined forced journal self-citation as "when an editor either requires or strongly requests that an author cite articles that have appeared in the editor's journal."

Our analysis also shows that the journal rankings will generally be similar with or without self-citations, but that a number of OM journals show substantially different results for the two cases. Specifically, approximately 30% of the journals had significantly different rankings when impact factor calculations excluded self-citations. These results show that caution should be applied in using a single impact factor to rank journal quality, since the ranking for some journals will be significantly different depending on the specific impact factor calculation procedure.

7.3. Consistency of impact factor journal assessment vs. previous studies

In contrast to the strong correlations between rankings using different impact factors, correlations are more mixed between rankings using impact factors and rankings from previous studies that used other methods. The mean correlation coefficient between rankings using impact factors and rankings from non-impact factor studies is significantly different than the mean correlation coefficient between rankings for the non-impact factor studies, but both are relatively modest. Similarly, the mean correlation coefficient between rankings based on impact factors and rankings from empirical-based survey studies that assessed perceived quality is significantly different than the mean correlation coefficient between rankings for the empirical-based survey studies. These results support the findings from Olson (2005) that rankings from empirical-based survey studies are more consistent with rankings from other previous studies than with rankings based on impact factors. Specifically, the correlations between rankings in previous studies that assessed journal quality were higher than the correlations between rankings using impact factors and the rankings in those quality studies. In addition, Olson (2005) proposed that a more thorough analysis of impact factors to determine how well rankings based on them correlate with other methods for ranking journals could be undertaken when the JCR covered OM journals extensively. We have shown that extensive OM journal coverage is now the case, and have thus carried out this evaluation and presented it here.

It is not clear what previous empirical-based surveys of journal quality measured since quality was not defined in those surveys. Not defining quality when assessing the perception of researchers for journals is common across business disciplines. For example, Katerattanakul et al. (2005) showed that perception-based rankings of the quality for IS journals were consistent among themselves but only moderately consistent with journal rankings using impact factors. We found similar results.

Even though quality was not defined in the empirical-based survey studies (Q1–Q6 in Tables 7 and 8) and left to the survey respondent's judgment (Barman et al., 2001; Olson, 2005;

Theoharakis et al., 2007), the rankings for those studies were relatively consistent among themselves and more highly correlated than the comparison between the impact factor studies (IF1–IF8) and the empirical-based survey studies (Q1–Q6). When assessing the quality of a journal, opinion surveys are likely capturing general impressions about the journal's reputation, such as respondent experiences or direct knowledge of the rigor of the review process of the journal as an author and/or referee (Holsapple and Lee-Post, 2010; Straub and Anderson, 2010). On the other hand, a journal impact factor, regardless of exactly which variant is used, measures how frequently articles in that journal are cited by scholars in other articles. This metric does not directly address the degree of rigor in the journal's reviewing process or the quality of the articles that appear in the journal.

Researchers in other business fields have also noted differences between impact factor assessments of journals and other approaches to assessing journal quality. Specifically, Straub and Anderson (2010) suggest that rankings of IS journals based on impact factors differ from rankings based on perception-based surveys because impact factors only indirectly measure the opinions of IS scholars through the citations that the scholars make to other articles. They note that scholars may cite articles in what they believe to be top journals more often and therefore what scholars believe to be top journals becomes reinforced through the reviewing process. Katerattanakul et al. (2005) view IS journal quality as a multifaceted concept that can only be captured by multiple measures, including impact factors. In addition, Lewis et al. (2007) concluded that opinion surveys and impact factors are both metrics for the relative quality of IS journals. Similarly, Steward and Lewis (2010) concluded that opinion surveys and impact factors are both reliable ways to measure the quality of marketing journals.

The strong correlations between IF8 (Donohue and Fox, 2000) and the results for the empirical-based survey studies (Q1–Q6) may indicate that impact factors can influence survey respondents over time when assessing the perceived quality of OM journals. The time period for IF8 pre-dates all but one of the empirical-based survey studies that assessed perceived quality (Q1–Q6), and Table 10 shows no significant difference for the mean correlation coefficient between rankings for IF8 and the perceived quality studies (Q1–Q6) vs. the mean correlation coefficient for the rankings among the perceived quality studies. Similarly, Tahai and Meyer (1999) in their study of management journals suggested that citation analysis may be a leading indicator of future perceptions of journal quality.

7.4. Possible influence of modeling vs. empirical articles on impact factors

While not addressed by our analysis, another characteristic of OM journals that may influence impact factors within our set of OM journals is the relative number of modeling articles vs. empirical articles in each journal. Since 1980, there has been an increase in the number of survey/empirical articles in OM publication outlets (Rungtusanatham et al., 2003). For the six OM journals Rungtusanatham et al. (2003) studied from 1992 to 2000, the *Journal of Operations Management* had the highest percentage of empirical articles (27.9%), followed by *International Journal of Operations and Production Management* (11.4%), *Production and Operations Management* (8.6%), *Decision Sciences* (5.1%), *International Journal of Production Research* (2.6%), and *Management Science* (1.7%). While their study does not provide sufficient basis for a detailed analysis of the relationship between number of empirical articles in a journal and the journal's impact factor, we note that the percentage of empirical articles in a journal tends to be associated with an increase in impact factor for this small sample. For example, we first compared the percentages of empirical articles for the six journals to their impact factors during a similar time period (i.e., IF6) and found that the correlation coefficient was 0.512 and not significant ($P = 0.299$). Then we removed *Management Science*, the journal with lowest percentage of empirical articles, and re-calculated the correlation coefficient between percentage of empirical articles and impact factors. The resulting correlation coefficient was 0.948 and significant ($P = 0.014$).

Theoharakis et al. (2007) also found that OM modelers rated the quality of *Management Science* significantly higher than OM empiricists. On the other hand, empiricists rated the quality of *Decision Sciences*, *International Journal of Operations and Production Management*, *International Journal of Production Research*, and *Journal of Operations Management* significantly higher than modelers. This result indicates that empirical researchers and modelers in the OM field have different views on journal quality. Since Theoharakis et al. (2007) included substantially more modelers in their survey than empiricists (approximately 3 to 1), this could explain the low correlations of impact factors with Q6 (Theoharakis et al., 2007) and may suggest a reason for the low correlations of impact factors with the other empirical-based survey studies that assessed perceived quality of journals (Q1–Q5).

Some of the higher-ranked journals, e.g., *Management Science* and *Operations Research*, in the empirical-based survey studies (Q1–Q6) in Table 8 publish a higher proportion of modeling articles. The brief analysis just presented supports the anecdotal wisdom that modeling articles tend to have fewer citations than comparable empirical articles. If this is correct, journals with a large number of modeling articles would tend to rank lower using impact factors than using perceived quality measures. The question of whether modeling articles tend to have fewer citations than empirical articles has been studied in the marketing field. Bettencourt and Houston (2001) investigated the impact of an article's method type (lab experiment vs. mathematical modeling) for the *Journal of Marketing*, *Journal of Marketing Research*, and *Journal of Consumer Research* and found that empirical-based papers were more likely to be cited than modeling papers.

8. Concluding remarks

Our results raise questions without easy answers for how we should consider impact factors in assessing quality of journals that publish OM research. In most universities, faculty evaluations for promotion or tenure include review and assessment by faculty outside of our field, and as presented at the beginning of this paper there is some perception of an increasing tendency to use impact factors as a measure of journal quality for such reviews. Our results show that impact factors, particularly those based on a five-year time window, can provide valuable insights about OM journals, but these impact factors do not replicate OM journal assessments that have been conducted using other methods. Our results raise questions about how to deal with the increasing use of impact factors for assessing the perceived quality of journals in faculty evaluations if the OM journal rankings from using impact factor differ from other assessments of OM journals.

The implications of our results for faculty development and promotion are significant. Our findings suggest impact factors provide useful information about journals, but that a balanced approach which also considers such other factors as an individual's academic progress and focus is appropriate for OM. As Table 10 shows, the agreement among different OM journal ranking studies is relatively modest, regardless of what method is used to rank journals. In fact, many of the previous OM journal ranking studies (Gorman and Kanet, 2005; Olson, 2005; Theoharakis et al., 2007; Holsapple and Lee-Post, 2010) conclude that there is no single measure or sole method for judging quality of OM journals, and we concur with this useful advice.

Our overall conclusion is that impact factors are useful metrics to rank OM journals, but impact factors do not replace other methods that are used to rank journal quality. Based on our comparison of impact factor results with those from other ranking approaches, impact factors are not a replacement for surveys used to assess perceived quality of OM journals or citation-based or author-based methods. Rather impact factors address journal quality from another perspective and can be usefully applied along with these other methods to rank OM journals and to develop journal target lists for promotion and tenure committees. With their ease of use and ever-increasing presence in academia, impact factors are likely to shape and influence the future perception of OM journal quality. Like it or not, the impact factor is here to stay, and we need to learn to use it wisely.

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Appendix A. Supplementary data

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