The influence of co-authorship on article impact in OR/MS/OM and exchange of knowledge with Finance in the 21st Century

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Abstract

The article is motivated by two related research questions about research activity in the Operations Research / Management Science / Operations Management (OR/MS/OM) and Finance disciplines. First, we investigate the influence of co-authorship on article impact in OR/MS/OM. Second, we develop a number of citation metrics to explore the nature of scholarly exchange between top OR/MS/OM and top Finance journals. We work with a large sample of articles published across 2001-2008 for twenty OR/MS/OM journals and nineteen Finance journals and corresponding citations up to and including year 2012. Key findings for the first research question indicate a higher impact for articles with multiple authors but the marginal gain brought by an additional author is not significant for articles with three or more authors. Key findings for the second research question indicate that the Finance discipline borrows less from OR/MS/OM than vice versa. This finding highlights the potential for a wider collaboration among researchers, particularly Finance academics exploring how various OR/MS/OM techniques can be adopted or adapted. We discover that the ranking of OR/MS/OM journals is determined more by the extent they are cited in other disciplines, and observe a gradual rise in self-perpetuating behavior in OR/MS/OM.

***JEL* classification:** C00; G00

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1. Introduction

The origins of *Operations Research* or *Operational Research* (OR) are often traced to the application of mathematical or statistical methods to manufacturing and logistics problems during World War II. Post-war, as scientists turned their attention to applying OR to more traditional management studies, *Management Science* (MS) emerged as an offshoot that appears to have stood the test of time. Chase, Jacobs and Aquilano (2006) describe the overlapping fields of OR/MS as application of quantitative methods in all fields, whereas *Operations Management* (OM) is argued to use decision-making tools developed in OR/MS for line management. Bertrand and Fransoo (2002) also consider OR part of the quantitative research found in OM. Thus, in this article, we study the influence of author collaboration or co-authorship on article impact (or quality of research) in Operations Research / Management Science / Operations Management (OR/MS/OM) without attempting to distinguish these closely linked fields as separate disciplines. Published studies on this topic in other disciplines indicate that multiple authors can raise the chances of an article being cited. For example, see Beaver (1986) on Physics; Lawani (1986) on Cancer Research; Katz and Hicks (1997) on Life Sciences, Natural Sciences, Engineering and Materials, and Multidisciplinary fields; and Avkiran (2013) on Finance.

Data used to explore the influence of collaboration on article impact can also be used to explore the nature of scholarly exchange between top OR/MS/OM journals and top Finance journals. Historically, inter-disciplinary citations of Finance articles have been highest in the closely related discipline of Economics, and vice-versa (Pieters and Baumgartner 2002). Linderman and Chandrasekaran (2010), who examine the most influential journals in several business disciplines, conclude that OM and Finance are *not* exchanging ideas as frequently as other disciplines. Lack of cross-pollination can hinder development of knowledge in the form of missed opportunities where, for example, ideas from OM or OR/MS are not introduced to the discipline of Finance. Given the complexity of the financial system, there is a need to better understand and manage it, for example, regarding systemic risk; a forceful reminder of this need was the global financial crisis of 2007-09 that led to wide scale ramifications throughout the real economy. Linderman and Chandrasekaran (2010) report OM as a discipline more readily accepting of ideas from other disciplines.

In the applied fields of OR/MS/OM one would intuitively expect to find a higher citation rate of publications from fields outside the discipline. Overall, the expectation is that higher citation numbers would lead to greater dissemination of knowledge, although the process can be asymmetrical between disciplines. We are interested in finding out to what extent such assertions

hold true between OR/MS/OM and Finance because a more in-depth exchange between these disciplines could lead to better solutions to multi-faceted problems faced by management and policy-makers. Furthermore, due to the more applied nature of OR/MS/OM, methods used in this discipline could be an important source of practical solutions to problems in Finance. The two classic examples of Finance reaching out to another discipline are the Markowitz quadratic portfolio selection model (Markowitz 1952) borrowing from OR, and the development of the famous Black and Scholes option formula in early 1970s which was inspired by the heat transfer equation from Physics (Black 1989). More recently, Kuhnen and Chiao (2009) have researched the genetic determinants of financial risk taking. Exchange of knowledge is also evidenced in the top OR/MS/OM journal *Management Science,* which has established a solid intersection with Finance by creating a Finance editorial department as indicated on their website (http://pubsonline.informs.org/page/mnsc/editorial-statements).

The importance of collaboration in research can be further highlighted by the findings reported in Wuchty, Jones and Uzzi (2007) where the authors define a team as having more than one listed author. In a comprehensive study covering five decades, Wuchty, Jones and Uzzi (2007) calculate that in 1955 only 17.5% of articles in the field of social sciences were written by teams, rising to 51.5% by the year 2000, where the trend is towards larger teams (with a similar increase in science and engineering). Similarly, a consultation document by the LSE Public Policy Group (2011) maintains that collaborative publications produce more citations due to networking between authors. Sonnenwald (2007, p.672) contributes to this discussion with the words, "Scientific collaboration continues to increase in importance because it can uniquely address complex, critical problems." Therefore, it is important to study the influence of collaboration on the impact or quality of research produced – an area of research that has recently been closely examined in Finance (Avkiran 2013) but has not been sufficiently explored in OR/MS/OM despite many studies on journal ranking primarily under the heading of OM. We initially focus on the impact of collaboration in OR/MS/OM and later extend the investigation to exchange of knowledge between OR/MS/OM and Finance – with the motivation to understand the potential for knowledge creation.

The scope of this study is limited to an investigation of publications in the 21st Century. That is, analyses related to the impact of co-authorship in OR/MS/OM follow citations of articles published across 2001 – 2008 up to and including year 2012. Investigation of the broader second research question examines the exchange of knowledge between OR/MS/OM and Finance disciplines uses data from the top journals in both disciplines over the same timeframe. To better understand the exchange of knowledge between these disciplines, we examine changes in inter- and

intra-disciplinary citation flows across sampled journals and over time. Better understanding of this exchange of knowledge between OR/MS/OM and Finance could lay the foundation for wider cross-disciplinary collaboration.

Main findings of this study support the importance of collaboration in publishing high impact articles in OR/MS/OM (a finding recently also established for Finance by Avkiran 2013). However, the marginal gain enjoyed by introducing another author to articles with three or more authors is insignificant. We also find an asymmetric exchange of knowledge between OR/MS/OM and Finance where the latter discipline is less likely to borrow from the former, thus underlining the potential for wider interdisciplinary collaboration. Such insight could facilitate different types of research collaborations, as well as help develop a more in-depth understanding of dissemination of knowledge. Possible benefits include adoption of new applications across disciplines and editorial strategies, such as giving more journal space to Finance papers that borrow from OR/MS/OM. Other findings include (i) the ranking of OR/MS/OM journals is determined more by citation rates outside the discipline, (ii) there is a gradual rise in self-perpetuating behavior in OR/MS/OM, (iii) we observe a steady rise in collaborative OR/MS/OM articles across 2001-08, (iv) Finance articles cite two author OR/MS/OM articles more frequently than one author articles, and (v) higher ranked Finance journals are less likely to borrow knowledge from other disciplines.

The next section discusses the types of data required, data collection, and methodology. This is followed by results of analysis in section 3 as we investigate the two research questions, and section 4 offers concluding remarks.

2. Data and methodology

In measuring impact and dissemination of knowledge we rely on citation metrics. Pieters and Baumgartner (2002) consider citation an indication of the significance of a study as citations imply that the knowledge contained in the article is worth bringing to the attention of others. Citation count is a robust approach to assessing academic quality and performance (Furnham, 1990). In various studies, citation rates have been shown to be associated with indicators of quality such as number of scientific awards and expert panel memberships (Cole and Cole 1973; Lawani 1977; Lawani and Bayer 1983), as well as journal quality (Judge et al. 2007).

In investigating the first research question, annual mean citation counts are complemented by a four-year citation count where articles are followed over four years after publication. The four-year citation count is a more stable citation measure because it removes the variations likely to be

introduced in the annual mean citation count due to different periods in publication. We also note that, as this study was drafted in 2013, a five-year window would have removed the 2008 publications, and a three-year window would have been too short to capture most of the knowledge dissemination. Therefore, our choice of four-year citation count is the optimal approach for investigating publications to emerge in the period 2001-2008. Further support for this choice can be found in Stonebraker et al. (2012) who conclude that in Operations Management a larger number of citations emerge in years 3-5 (our choice is the mid-point of this range). Equally relevant, two key articles on influence of collaboration in Finance on article impact also use a four-year citation count (see Avkiran 1997, 2013).[1]

We download article records covering eight years of publications (2001-2008) that include data fields such as authors, publication name, publication year, keywords, and cited references, as well as corresponding citations across 2002-2012. Web of Science (WoS) by Thomson Reuters provides access to a large number of journals, and we prefer to work with this older data base rather than Scopus because of its more comprehensive, practical and reliable features (see Avkiran 2013, p.914, for a discussion of known issues with Scopus).

2.1 Selection and ranking of OR/MS/OM journals (preparing to address the first research question)

The starting point for identifying journals is the OR/MS Subject Category in ISI Web of Knowledge Journal Citation Reports (JCR), Science Edition. Journals that consistently appear across 2001 – 2008 are noted. The initial count of 49 OR/MS journals drops to 47 when WoS is scrutinized for consistent presence across the study period, which we treat as the initial shortlist. We then check this initial shortlist against journal lists in various recently published academic articles to make sure that there are no major oversights or missing journals of potential interest not listed due to JCR's approach to categorizing (see Denizel, Usdiken and Tuncalp 2003 on OR/MS, Meredith et al 2011 on OM, Petersen, Aase and Heiser 2011 on OM, Xu et al 2011 on OR/MS and Stonebraker et al 2012 on OM). For example, we notice that *Decision Sciences* is missing from the OR/MS category of JCR and return this journal to our list (it can in fact be found in JCR, Social Sciences Edition, under the Management subject category instead). Overall, this cross-checking exercise adds nine more journals to the initial shortlist – resulting in 56 journals.

[1] Avkiran (2013) finds no statistically significant difference between results based on a four-year citation count against a five-year citation count.

Studies that attempt to assess journal quality or impact are often grouped into two main categories, namely, opinion-based surveys (stated preference studies) and citation analyses (revealed preference studies). According to Tahai and Meyer (1999, p.282) citation analysis can be construed as a leading indicator of future changes in perceptions. We also include two more categories, namely, behavior-based analysis (see Holsapple and Lee-Post 2010) and author affiliation index (see Gorman and Kanet 2005). However, approaches within these categories can vary substantially both in research design and results. For example, perceptions of journal quality under the category of *stated preference studies* commonly follow a longer timeframe whereas *revealed preference studies* that rely on citation metrics capture more recent changes in quality. We refer the readers to Holsapple and Lee-Post (2010) and Xu et al. (2011) for a discussion of pros and cons of opinion-based, citation-based, behavior-based and author affiliation index approaches.

We prefer to account for the variety of different approaches published more recently, rather than subscribe to one approach at the expense of others, or try to account for all the studies published on this topic. To implement this study's method-inclusive strategy effectively, we use the averaging method demonstrated by Rainer and Miller (2005) and rank OR/MS/OM journals according to a composite score. Rainer and Miller's intuitive scoring method has been used by Sidiropoulos and Manolopoulos (2006), Petersen et al. (2011) and Pratt et al. (2012) to eliminate bias from individual ranking schemes by collapsing different rankings from different length journal lists into composite scores. As Pratt et al. (2012, p.282) point out, integrating results from multiple ranking methods using Rainer and Miller's average composite score offsets weaknesses found in each method. Lowry et al. (2013, A3) state, "more accepted approach is to simply average all previous journal rankings into one index (Rainer and Miller 2005). We believe this can be useful for highly stable fields."

We design an averaging system that incorporates various published ranking exercises which use data from the 21st Century. Adopting the scoring method illustrated by Rainer and Miller (2005), the OR/MS/OM journals are ranked in descending order. This flexible approach allows for different numbers of journals in various ranked lists by dividing each journal's rank by the total number of journals ranked in a given study. Scores for a given journal across multiple studies are then averaged to arrive at the *average composite score* (ACS) where a lower score indicates a higher rank. According to Rainer and Miller (2005) average composite scores smooth out differences found both in selecting journals and ranking them. A further argument can be made for the use of composite scores when we consider that opinion surveys often reflect general impressions about a journal's reputation, and impact factors may not directly capture the rigor exercised in review processes.

2.2 Developing average composite scores (ACS) for OR/MS/OM journals

In constructing the average composite scores, we consolidate seven ranked lists from six tables found across five publications. For example, Gorman and Kanet (2005, p.10, Table 3) rank 27 journals available in 2003 on author affiliation index by analyzing articles by US professors from the top 60 universities. That is, author affiliation index is defined as the proportion of a journal's US-based academic authors that come from top research universities. Table 5 in Olson's (2005, p.331) opinion-based study carried out in 2002 reports ranking of 33 journals by OM and OR academics from the top 25 US business schools. On the other hand, the behavior-based analysis of Holsapple and Lee-Post (2010) considers the concentration of experienced US researchers in peer reviewed journals without relying on opinion surveys, citation analyses or author affiliation index. This approach identifies the 31 highest rated US public research universities in 2005 and 90 tenured faculty. Collective publication activities of these faculty members across 1980 – 2006 provide the data base. Holsapple and Lee-Post (2010) use three metrics of journal importance, namely, publishing breadth (i.e. proportion of benchmark faculty members publishing in a given journal), publishing intensity (i.e. number of articles published by benchmark faculty members in a given journal), and publishing mode. In this study we make use of rankings based on publishing breadth and intensity reported in Table 3 (22 journals) and Table 4 (26 journals) of Holsapple and Lee-Post (2010, pp.172-173).

Meredith, Steward and Lewis (2011) use internal journal lists maintained by AACSB (Association to Advance Collegiate Schools of Business) accredited business schools in 2006. Although a study with a more international flavor, North America dominates 206 respondents by a proportion of approximately 91%. Table 8 in Meredith, Steward and Lewis (2011, p.443) ranks 30 focal journals from AACSB school lists. Finally, we also include the rankings reported in Xu et al. (2011), who rely on Google's PageRank and weighted citations to rank 31 OR/MS journals that appear in JCR in year 2004 and in Olson (2005). We utilize the second column of ranks in Table 2 of Xu et al. (2011, p.381) where all relevant citations are accounted for.

In further refining the initial shortlist of 56 journals developed earlier, we exclude any journal that does not appear in *at least three out of five ranking studies* cited above. This selection criterion results in 20 journals ranked on average composite scores that accommodate multiple approaches already subjected to peer review (see Table 1). The ranked list reveals the two generally agreed tier 1 journals of *Management Science* and *Operations Research* ranked first and second, respectively, thus bringing additional confidence to the use of average composite scores; we also observe that the jump

in ACS from the second to the third ranked journal is more substantial, thus placing greater distance between these top two journals and the rest.

[Insert Table 1 about here]

2.3 Profiling OR/MS/OM articles and setting up hypotheses

We now further detail the method to be used to search for an answer to the first research question that probes the influence of collaboration on article impact in OR/MS/OM. We profile the sample of OR/MS/OM articles found in the twenty shortlisted top journals in order to determine discrete categories of collaboration for testing. Based on article reports extracted from WoS, we construct some additional variables such as number of authors per article, age of an article (2012 minus year of publication), and annual mean citations per article that includes 2012 but ignores the year of the writing of this article, 2013. Panel A in Table 2 shows both citation counts for collaborative articles to be *higher* than for one-author articles. The majority of articles are found in the *two-* and *three-author* collaboration categories where the articles with two authors dominate the large sample of 17862 articles (see the first three columns in Panel A of Table 2). The five categories of collaboration identified in Table 2 lead to the main null hypothesis to be tested that there is no statistically significant difference among the distribution of citations for one-author and multiple author articles. We also test for the marginal value of collaboration by comparing the impact of two authors to three, three authors to four, and so on.

[Insert Table 2 about here]

In this study we do not attempt to control for author self-citations for a number of reasons. For example, most journal submission guidelines and refereeing processes actively discourage self-citing for the purpose of self-promotion, which could also make difficult implementation of double-blind reviews. Therefore, self-citations, when they do occur, are more likely to be legitimate citations of an author's existing work in the field relevant to the article being drafted (Katz and Hicks 1997). We also note that identifying and controlling for self-citations by authors is not a practical proposition when working with large numbers of articles that are bound to have same or similar author names. Furthermore, as recently reported in Avkiran (2013), who examines the impact of collaboration in Finance, self-citation counts are not necessarily reliable when Web of Science is compared with Scopus. Avkiran (2013) also proceeds with his study without accounting for author self-citations. We do however measure self-citations within a discipline or a journal when we address the second research question, i.e. an article citing others in the same discipline or journal

2.4 Designing a cross-citation analysis (preparing to address the second research question)

The second research question investigates the exchange of knowledge between top OR/MS/OM and Finance journals. For this we use the list of nineteen ranked Finance journals used by Currie and Pandher (2011, Table 5), as also used by Avkiran (2013, Table 1). Currie and Pandher's approach generates a numerical estimate of quality that determines the rank ordering. Table 3 shows their ranking of journals between Tiers A+ and B- (tiers not shown) based on a survey of active scholars and nested regression. In this study, journals not listed consistently throughout the study period or not listed in Web of Science are omitted.

[Insert Table 3 about here]

We collect citation data for the total sample of thirty-nine journals across OR/MS/OM and Finance listed in Tables 1 and 3.We then construct various cross-pollination indices based on citations in order to investigate inter-disciplinary and intra-disciplinary exchange of knowledge between OR/MS/OM and Finance. That is, to what extent are authors from each journal reaching out to publications in journals outside their discipline as opposed to referring to journals within their discipline or even within the same journal? Such an investigation can shed light on the dissemination of OR/MS/OM in Finance and help identify existing gaps.

According to Lockett and McWilliams (2005), when journal *X* cites journal *Y*, the former is importing and the latter is exporting knowledge. Thus, various citation exchange measures employed here are designed to capture knowledge dissemination and creation (McFadyen and Cannella 2004). Initially, we adapt the range of citation metrics discussed in Linderman and Chandrasekaran (2010), Lockett and McWilliams (2005) and Tahai and Meyer (1999). Primarily, we keep the focus of citation metrics on capturing the extent OR/MS/OM is establishing a foothold in Finance. For example, the balance of trade (BoT) measures citation exchange at the aggregate level (see Lockett and McWilliams 2005), or in the context of this study, the overall propensity of OR/MS/OM and Finance disciplines to cite one another. In a standardized manner designed to account for different total citations in each discipline, BoT can be defined as

> **BoT** $_{(2001\text{-}2012)}$ = [proportion of citations in Finance journals of articles from OR/MS/OM journals] / [proportion of citations in OR/MS/OM journals of articles from Finance journals]

More generally:

$$BoT_{(2001-2012)} = \frac{\left(\frac{\sum_{yr=2001}^{2012} [\text{citations of OR/MS/OM journals by Finance journals}]}{\sum_{yr=2001}^{2012} [\text{total citations in Finance journals}]} \right)}{\left(\frac{\sum_{yr=2001}^{2012} [\text{citations of Finance journals by OR/MS/OM journals}]}{\sum_{yr=2001}^{2012} [\text{total citations in OR/MS/OM journals}]} \right)} \quad (1)$$

The above formula for BoT can be rephrased as the ratio of knowledge *imported* by Finance from OR/MS/OM to the knowledge *exported* by Finance to OR/MS/OM.

For the period 2001-2012, the computed BoT ratio of 0.424 indicates a knowledge exchange *surplus* for Finance; similarly, the unstandardized BoT where citations are not divided by 'total citations' is 0.212. A BoT ratio substantially *less* than 1 highlights an export of knowledge from Finance that substantially exceeds what is imported from OR/MS/OM. This finding is in line with the discussion in the introduction to this article, and guides the formulation of the next set of citation metrics.

The forward-looking citation proportion (FCP) is a metric that also measures the diffusion of knowledge from one discipline into another. Yearly computation of FCP provides a longitudinal perspective on citations of articles published across 2001-2008. For example, standardizing with a four-year window and starting with the year 2001,

> **FCP_{2001}** = [total citations of 2001-dated OR/MS/OM journal articles by Finance journals published across 2002-2005] / [total citations of 2001-dated OR/MS/OM journal articles across 2002-2005 in all disciplines]

This definition can be generalized as,

$$FCP_t = \frac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ OR/MS/OM journal articles in year } i \text{ Finance journals}]}{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ OR/MS/OM journal articles in year } i \text{ across all disciplines}]} \quad (2)$$

FCP_{2001} measures the diffusion of 2001-dated OR/MS/OM articles into Finance over four years following publication, or to what extent Finance is utilizing knowledge generated in OR/MS/OM compared to use of OR/MS/OM by all disciplines. Alternatively, the forward-looking citation proportion can be calculated at the collaboration category levels identified in Table 2 as

FCP_{2001} (one author) = [total citations of 2001-dated one-author OR/MS/OM journal articles by Finance journals published across 2002-2005] / [total citations of 2001-dated OR/MS/OM journal articles across 2002-2005 in all disciplines]

where the total citations in the numerator is divided by number of one-author OR/MS/OM articles published in 2001, and the total citations in the denominator is divided by the number of OR/MS/OM articles published in 2001. The above definition measures the diffusion of 'one-author OR/MS/OM articles' into Finance. We use similar measures for the other collaboration categories and it can be generalized as,

$$FCP_{t,k} = \frac{\left(\frac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ OR/MS/OM journal articles (collaboration category } k) \text{ in year } i \text{ Finance journals}]}{[\text{number of year } t \text{ OR/MS/OM journal articles (collaboration category } k)]} \right)}{\left(\frac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ OR/MS/OM journal articles in year } i \text{ across all disciplines}]}{[\text{number of year } t \text{ OR/MS/OM journal articles}]} \right)} \quad (3)$$

We are also interested in discovering whether mean citation rates for sub-groups of articles with multiple authors are different when compared to the mean citation rate of one author articles. This can be observed in the numerator of FCP.

On the other hand, the forward-looking intra-disciplinary exchange (FIDE) measures the knowledge contribution of journals to the discipline to which they belong. For example, FIDE for the Journal of Operations Management (JOM) in the year 2001 would be defined as,

$FIDE_{JOM,\ 2001}$ = [total citations of articles in JOM 2001 by OR/MS/OM journal articles published across 2002-2005] / [total citations of 2001-dated OR/MS/OM journal articles by OR/MS/OM journals across 2002-2005]

Alternatively, in a generalized format,

$$FIDE_{j,t} = \frac{\left(\frac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ articles from journal } j \text{ in year } i \text{ OR/MS/OM journal articles }]}{[\text{number of year } t \text{ articles in journal } j]} \right)}{\left(\frac{\sum_{i=t+1}^{t+4} [\text{citations of all year } t \text{ OR/MS/OM articles in year } i \text{ OR/MS/OM journals}]}{[\text{number of year } t \text{ OR/MS/OM articles}]} \right)} \quad (4)$$

The above metric captures the proportion of within-discipline citations received by each OR/MS/OM journal, standardized by number of articles published in that journal. Similarly, for the Journal of Finance (JF),

> **FIDE$_{\text{JF, 2001}}$** = [total citations of articles in JF 2001 by Finance journal articles published across 2002-2005] / [total citations of 2001-dated Finance journal articles by Finance journals across 2002-2005]

Generalizing,

$$FIDE_{j,t} = \frac{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ articles from journal } j \text{ in year } i \text{ Finance journal articles}]}{[\text{number of year } t \text{ articles in journal } j]} \right)}{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of all year } t \text{ Finance articles in year } i \text{ Finance journals}]}{[\text{number of year } t \text{ Finance articles}]} \right)} \quad (5)$$

Replicating the FIDE metric for each year in the study provides an opportunity to observe such behavior across journals averaged over eight years.

Further narrowing the focus of analysis, the forward-looking journal self-citation (FJSC) metric is defined as the proportion of citations a journal's articles published in a given year receive in the same journal over a four-year period. Compared to FIDE, the FJSC metric which shares the same denominator, is more limited in scope and measures the extent a journal is self-perpetuating in relation to the discipline. Once again, starting with the Journal of Operations Management in 2001,

> **FJSC$_{\text{JOM, 2001}}$** = [total citations of articles in JOM 2001 by JOM across 2002-2005] / [total citations of 2001-dated OR/MS/OM journal articles by OR/MS/OM journals across 2002-2005]

Generalizing the FJSC metric,

$$FJSC_{j,t} = \frac{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ articles from journal } j \text{ in year } i \text{ articles in journal } j]}{[\text{number of year } t \text{ articles in journal } j]} \right)}{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of all year } t \text{ OR/MS/OM articles in year } i \text{ OR/MS/OM journals}]}{[\text{number of year } t \text{ OR/MS/OM articles}]} \right)} \quad (6)$$

The numerator represents the self-citations enjoyed by JOM and the denominator represents the discipline-wide self-citations over four years following publication. Similarly, for the Journal of Finance (JF),

> **FJSC$_{\text{JF, 2001}}$** = [total citations of articles in JF 2001 by JF across 2002-2005] / [total citations of 2001-dated Finance journal articles by Finance journals across 2002-2005]

Once again, in a generalized format,

$$FJSC_{j,t} = \frac{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of year } t \text{ articles from journal } j \text{ in year } i \text{ articles in journal } j]}{[\text{number of year } t \text{ articles in journal } j]} \right)}{\left(\dfrac{\sum_{i=t+1}^{t+4} [\text{citations of all year } t \text{ Finance articles in year } i \text{ Finance journals}]}{[\text{number of year } t \text{ Finance articles}]} \right)} \quad (7)$$

A higher journal self-citation rate would suggest isolation of a journal from its related peers, thus handicapping a wider exchange of knowledge. That is, an FJSC score greater than 1 would indicate a journal that is more self-referential than its discipline. We are keen to observe if a higher ranked journal would generally have a higher or a lower FJSC score.

3. Analysis and findings

3.1 Testing for the distribution of citations among OR/MS/OM collaboration categories (answering the first research question)

The null hypothesis states that citation counts across different categories of collaboration originate from the same distribution. If the null hypothesis is statistically rejected where the annual mean citation and/or the four-year citation counts for collaborative articles are higher (as can be clearly seen in Panel A of Table 2), this would then imply that collaborative research in OR/MS/OM is likely to lead to higher impact articles. Comparing means to medians in Panel A of Table 2 indicates skewness, and skewness values for the annual mean citation count and the four-year citation count are 4.45 and 4.10, respectively (skewness values for different categories of collaboration are also positive and high). In the presence of skewed data, we can use non-parametric tests such as the Mann-Whitney U or the Kruskal-Wallis test to compare samples because these tests do not make assumptions about distributions. We proceed with the Kruskal-Wallis test which compares a nominal variable (i.e., collaboration category) against a measurement variable (i.e., citation count) in a multivariate setting (Conover 1999; McDonald 2008). Independent samples Kruskal-Wallis test

rejects the null hypothesis that citation counts do not differ by number of authors (H=227.86, p<0.01). Post testing, reported in Panel B of Table 2, shows the significance of pair-wise differences in citation rates by number of authors. In summary, the differences in citation counts first observed in Panel A of Table 2 are statistically significant and support the contention that *collaboration enhances article impact.*

We re-test for differences between one-author and multiple author articles through Tobit regression similar to the approach in Borokhovich, Bricker and Simkins (2000) and Avkiran (2013). A Tobit model is appropriate because we have a cluster of zeros, where approximately 11.76% of the sample has four-year citation counts equal to zero (see Greene 2012 regarding Tobit regression). The regression model is set up as follows:

$$y_i^* = \alpha + \beta_1 \mathbf{x}_1 + \beta_2 \mathbf{x}_2 + \beta_3 \mathbf{x}_3 + \beta_4 \mathbf{x}_4 + \varepsilon_i$$

where y_i^* is a latent variable that is observed for values greater than 0 and censored otherwise, x_i represents classification variables or collaboration categories with multiple authors, and $\varepsilon_i \sim N(0 ; \sigma^2)$. A classification variable equals 1 or 0 depending on the presence or absence of a collaboration category, where one-author articles represent the intercept or the constant set to 1.

Results are shown in Table 4 where the Tobit model is censored at zero and the parameters are estimated in LIMDEP. Results indicate a statistically significant higher prediction of the four-year citation count by all collaboration categories compared to one-author articles. Thus, the findings already reported using Kruskal-Wallis tests are supported by Tobit regression. Table 4 indicates that the highest parameter estimate of the citation count (2.84) is found with four-author articles – an observation also made in Panel A of Table 2 under the four-year citation count for the same category.

[Insert Table 4 about here]

We now extend testing to examine the *marginal value of collaboration* based on the annual mean citation and the four-year citation counts. That is, with additional cooperation-related difficulties likely to be experienced as more authors collaborate, is there a marginal gain in terms of increased citation in moving from two author collaboration to three author collaboration, and so on? Comparing two-author articles with three-author and four-author articles, Kruskal-Wallis post test results reported in Panel B of Table 2 reject the null hypothesis at the p<0.01 level. That is, adding one or two authors to a two-author team may improve the chances of publishing a higher impact article. However, comparing three with four authors or five or more authors, or comparing four authors with five or more authors retains the null, suggesting that once a team has three authors

involving an additional author is unlikely to have a significant marginal value on the impact of a published article. Avkiran (2013) reports a similar finding for collaboration in Finance.

Finally, we explore whether OR/MS/OM articles with greater four-year citation counts are generally found in journals that are ranked higher under the average composite score in Table 1. After sorting articles in the sample in descending order by the four-year citation count, we examine the distribution of the corresponding ACS journal ranks. In relation to the top 5% (893 articles), the median journal rank is 4 and the rank for the rest of the sample is 12. This finding further underlines the expected correspondence between higher impact articles and journals ranked higher using the average composite score.

3.2 Testing for the nature of scholarly exchange between OR/MS/OM and Finance (answering the second research question)

Data collected in the process of answering the first research question provides the OR/MS/OM data needed to answer the second research question. Before we report on the analysis based on the specific citation metrics designed in this article, we revisit the aggregate citation metric, the *balance of trade*. The overall finding regarding scholarly exchange signaled by a BoT of 0.424 is one where the Finance discipline is more inclined to export to OR/MS/OM than import from it. Panel A of Table 5 shows the evolution of BoT over time. While there is no clear trend, OR/MS/OM imports more knowledge from Finance than it exports to Finance in every year of the study. This is an intuitive observation given the more applied nature of OR/MS/OM. When we look only at citations in the top three journals of each discipline in Panel B of Table 5, the imbalance is even more pronounced, with an aggregate BoT of 0.093. Looking at the components of BoT, the top three Finance journals import a smaller proportion of OR/MS/OM than the full sample of Finance journals, while the top three OR/MS/OM journals import a larger proportion of Finance than the full sample of OR/MS/OM journals. Thus, it would appear that the exchange of knowledge between these two disciplines is greatest in the top three OR/MS/OM journals but lowest in the top three Finance journals, implying a more inward looking Finance discipline.

[Insert Table 5 about here]

FCP ratios are measured in per cent (see Panel A in Table 6). For example, the rate at which 2001 OR/MS/OM articles are cited in Finance over the four years following publication is 0.069% of the rate at which 2001 OR/MS/OM articles were cited in all disciplines over the same period. On the other hand, the rate at which four-author OR/MS/OM articles published in 2002 are cited in Finance

over 2003-2006 is 0.260% of the rate that all OR/MS/OM articles published in 2002 were cited in the same period across all disciplines. The underlying citations of OR/MS/OM articles in Finance are low or non-existent for some categories, particularly earlier in the study period, and there is no clear trend among the rather small FCP values in Table 6.

[Insert Table 6 about here]

Nevertheless, when we examine some of the other components of FCP ratios we gain a better insight to the extent Finance is utilizing knowledge generated in OR/MS/OM. For example, the mean citation rates in the last column of Panel B of Table 6 indicate a substantial rise when we add a second author to an OR/MS/OM article. This is an expected finding given the results reported earlier on collaboration in OR/MS/OM enhancing article impact. That is, Finance articles are citing two author (higher impact) OR/MS/OM articles more than one author articles. Finally, mean values in the last column in Panel C of Table 6 indicate that the majority of OR/MS/OM articles are in the two author category, followed by three author and one author categories – an observation also made in Panel A of Table 2. An additional observation we can make based on Panel C (looking left to right) includes the steady rise across 2001-2008 in the numbers of OR/MS/OM articles published among the collaboration categories two, three and four authors.

Table 7 maps the within-discipline citation patterns. By far the greatest mean FIDE across eight years is held by the Journal of Operations Management, followed by the Productions and Operations Management. Insignificant Spearman's rank correlation of 0.182 suggests a weak association between OR/MS/OM journal ranks based on the average composite scores and rankings on the extent of knowledge contribution to the discipline, i.e. FIDE. This implies that OR/MS/OM contributes to a wide selection of other disciplines, i.e. the impact and thus ranking of OR/MS/OM journals is determined more by the extent they are cited in other disciplines than within the discipline itself. Similarly, in Table 8, the Journal of Finance, the Journal of Financial Economics and the Review of Financial Studies lead their peers in contributing knowledge to the discipline of Finance. However, contrary to the earlier observation on OR/MS/OM journals, significant Spearman's rank correlation of 0.796 (0.01) indicates a substantial association between journal rank as per Currie and Pandher (2011) and rankings on FIDE. That is, the extent of knowledge contribution within the discipline is more prevalent among the higher ranked Finance journals.

[Insert Tables 7 and 8 about here]

FJSC values depicted in Table 9 (last row) indicate a gradual rise in the sample means across 2001-2007 for OR/MS/OM (i.e. a rise in self-perpetuating behavior); in Table 10, there is no clear trend in sample mean FJSC across the study period for Finance. The top two OR/MS/OM and Finance journals in Tables 9 and 10, respectively, ranked on journal mean FJSC are identical to what was observed in the corresponding Tables 7 and 8 using FIDE. Within-table Spearman rank correlations are insignificant for Tables 9 and 10. Therefore, we are unable to say that a higher ranked journal would generally have a higher or a lower FJSC. When we compare Tables 8 and 10, and Tables 7 and 9, we notice that FJSC proportions are substantially lower than FIDE proportions. While this relationship is anticipated because the FJSC citation metric is a subset of FIDE, the large difference suggests limited self-perpetuating behavior where ideas from other journals would not be used. The rank correlation between FIDE and FJSC is significant at 0.835 (0.01) for OR/MS/OM but insignificant for Finance. The first three journals in Tables 9 and 10 stand out from their peers in self-perpetuating behavior.

[Insert Tables 9 and 10 about here]

4. Concluding remarks

We set out to study two related research questions, namely, the extent collaboration in OR/MS/OM leads to higher impact articles, and the nature of scholarly exchange between top OR/MS/OM and top Finance journals. Insight gained in investigating the first research question highlights the importance of collaboration in publishing high impact articles in OR/MS/OM. Examining the marginal value of collaboration reveals that bringing on board a third or fourth author to a two-author team is likely to enhance the impact of the resulting publication. On the other hand, expanding a three-author research team is unlikely to have a significant marginal value. We also find a correspondence between higher impact OR/MS/OM articles and journals ranked higher using the average composite score.

Overall, findings from exploring the second research question indicate an asymmetrical exchange of knowledge between OR/MS/OM and Finance where the latter discipline is less likely to borrow from the former, i.e. there is a surplus balance of trade for Finance. This highlights the potential for a wider collaboration among researchers, particularly in the context of Finance academics reaching out to their OR/MS/OM colleagues to explore how various techniques can be adopted or adapted. It is also comforting to see certain findings from the second research question follow the findings from the first research question. For example, when we dissect the ‘forward-looking citation proportion’ (FCP) we discover that mean citation rates rise when a second author

joins an OR/MS/OM article - a finding that follows from the main insight gained from the first research question on the positive impact of co-authorship. That is, Finance articles cite two author OR/MS/OM articles more often than one author articles. We also observe a steady rise in collaborative OR/MS/OM articles across 2001 – 2008.

When we use the citation metric 'forward-looking intra-disciplinary exchange' (FIDE), we find that there is a strong correlation between Finance journal rankings and rankings based on within-discipline citations captured by FIDE. In other words, citing articles from the Finance discipline is more common among higher ranked Finance journals. An alternative way of interpreting this finding is to say that higher ranked Finance journals are less likely to borrow knowledge from other disciplines. No such association is observed among the OR/MS/OM journals. The Journal of Operations Management and the Journal of Finance lead their peers on the FIDE metric by a substantial margin. Finally, the citation metric 'forward-looking journal self-citations' (FJSC) - essentially a narrower definition of FIDE - indicates limited self-perpetuating behavior among the journals studied. Nevertheless, we also observe a gradual rise in self-perpetuating behavior among OR/MS/OM journals across the study period, while there is no clear trend in Finance.

Findings of this study could assist decision-making in a variety of situations such as setting up research collaborations including grant applications, recruitment and promotions, as well as developing a better understanding of dissemination of knowledge with a view to identifying the potential for new applications across disciplines and devising editorial strategies. For example, both in OR/MS/OM and Finance, we are now aware that expanding a team of collaborators beyond three people does not add marginal value in terms of impact. Looking at the same finding from a different perspective, we can argue that researchers who collaborate with one or two people are likely to enhance the reputation of the institution that employs them. Similarly, the rather asymmetrical exchange of knowledge between the two disciplines studied highlights the potential for greater use of OR/MS/OM in Finance. Finally, journal editorial strategies can lead to a stronger exchange of knowledge by actively encouraging Finance papers that borrow from OR/MS/OM. A possible extension of this article would be to identify examples of OR/MS/OM-based techniques that may lend themselves to applications in Finance. Another future direction for research would be to re-run tests using a five-year citation count when more data become available.

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Table 1: Ranked OR/MS/OM journals in the study

Rank and journal	Average composite score (ACS) [a]
1. Management Science	0.068
2. Operations Research	0.109
3. IIE Transactions	0.251
4. European Journal of Operational Research	0.264
5. Transportation Science	0.265
6. Journal of Scheduling	0.272
7. Interfaces	0.284
8. Journal of Operations Management	0.288
9. Naval Research Logistics	0.352
10. Operations Research Letters	0.362
11. Production and Operations Management	0.410
12. Annals of Operations Research	0.421
13. Decision Sciences	0.456
14. Journal of the Operational Research Society	0.504
15. International Journal of Production Research	0.508
16. Computers & Industrial Engineering	0.518
17. International Journal of Production Economics	0.639
18. Computers & Operations Research	0.644
19. OMEGA-International Journal of Management Science	0.670
20. International Journal of Operations & Production Management	0.686

[a] A lower ACS indicates a higher rank.

Table 2: Categories of collaboration among OR/MS/OM articles, corresponding citation counts [a] and -*p*-values [b]

Panel A: Article numbers and citation counts

Categories of collaboration	Article count	Proportion in sample (%)	*Annual mean citation count*	*Four-year citation count*
One author	3035	16.99	1.74 [1.00]	5.42 [3.00]
Two authors	7466	41.80	2.15 [1.25]	6.80 [4.00]
Three authors	5241	29.34	2.26 [1.43]	7.40 [5.00]
Four authors	1590	8.90	2.27 [1.43]	7.72 [5.00]
Five or more authors	530	2.97	2.10 [1.33]	6.97 [4.00]
Total	17862	100.00		

Panel B: Results (*p*-values) from the multivariate Kruskal-Wallis test

Categories of collaboration	*vs*. Two authors	*vs*. Three authors	*vs.* Four authors	*vs*. Five or more authors
One author	<0.01 [<0.01]	<0.01 [<0.01]	<0.01 [<0.01]	<0.01 [<0.01]
Two authors		<0.01 [<0.01]	<0.01 [<0.01]	*0.26 [0.62]*
Three authors			*0.20 [0.79]*	*0.17 [0.15]*
Four authors				*0.05 [0.14]*

[a] The annual mean citation count equals total citations including year 2012, divided by the number of years between year 2012 and the year of publication. The four-year citation count covers citations over four years following the year of publication. Corresponding median counts are in square brackets.

[b] *P*-values correspond to parameter estimates to emerge from the Kruskal-Wallis test used to examine the statistical significance of the citation differences observed in *Panel A*. Those outside the square brackets are *p*-values where the measurement variable is the *four-year citation count*, whereas the numbers in brackets correspond to *p*-values based on the *annual mean citation count*. Statistically insignificant *p*-values are in italics.

Table 3: Ranked Finance journals in the study [a]

Rank and journal
1. Journal of Finance
2. Review of Financial Studies
3. Journal of Financial Economics
4. Journal of Financial and Quantitative Analysis
5. Journal of Money Credit and Banking
6. Journal of Banking & Finance
7. Mathematical Finance
8. Journal of Financial Intermediation
9. Journal of Corporate Finance
10. Financial Management
11. Journal of International Money and Finance
12. Journal of Financial Markets
13. Financial Analysts Journal
14. Journal of Risk and Insurance
15. Journal of Futures Markets
16. Journal of Portfolio Management
17. Journal of Business Finance & Accounting
18. Journal of Real Estate Finance and Economics
19. National Tax Journal

[a] See Table 5 in Currie and Pandher, 2011, p.18.

Table 4: Tobit regression on citation count and categories of collaboration in OR/MS/OM

Independent Variables	Parameter estimates (p-values)
Intercept (one author)	4.35 (<0.01)
Two authors	1.73 (<0.01)
Three authors	2.49 (<0.01)
Four authors	2.84 (<0.01)
Five or more authors	2.05 (<0.01)
Log likelihood (model fit)	-60,301
N	17862

Table 5: Balance of Trade (BoT) 2001 – 2012 (see equation 1)

Panel A: Aggregate Balance of Trade by Year

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
(a) Citations of OR/MS/OM journals by Finance journals	63	89	87	120	86	131	172	180	145	282	238	252	1,845
(b) Total Citations in Finance journals	21,567	22,956	25,738	27,432	29,591	32,506	35,580	39,022	43,765	47,686	53,394	50,831	430,068
(c) BoT Numerator (a)/(b)	*0.292%*	*0.388%*	*0.338%*	*0.437%*	*0.291%*	*0.403%*	*0.483%*	*0.461%*	*0.331%*	*0.591%*	*0.446%*	*0.496%*	*0.429%*
(d) Citations of Finance journals by OR/MS/OM journals	300	318	388	391	573	549	666	741	1,015	1,340	972	1,433	8,686
(e) Total citations in OR/MS/OM journals	46,716	46,684	46,956	51,265	55,546	66,530	76,768	81,220	90,660	93,745	91,293	111,580	858,963
(f) BoT Denominator (d)/(e)	*0.642%*	*0.681%*	*0.826%*	*0.763%*	*1.032%*	*0.825%*	*0.868%*	*0.912%*	*1.120%*	*1.429%*	*1.065%*	*1.284%*	*1.011%*
BoT *(c)/(f)*	**0.455**	**0.569**	**0.409**	**0.574**	**0.282**	**0.488**	**0.557**	**0.506**	**0.296**	**0.414**	**0.419**	**0.386**	**0.424**
Unstandardized BoT	0.210	0.280	0.224	0.307	0.150	0.239	0.258	0.243	0.143	0.210	0.245	0.176	0.212

Panel B: Balance of Trade by Year in the top 3 journals

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
(a) Citations of OR/MS/OM journals by top 3 Finance journals	15	15	22	26	20	11	29	31	31	45	57	43	345
(b) Total Citations in top 3 Finance journals	6,420	6,918	7,132	7,598	8,200	8,810	9,681	10,979	13,994	13,429	14,666	13,157	120,984
(c) BoT Numerator (a)/(b)	*0.234%*	*0.217%*	*0.308%*	*0.342%*	*0.244%*	*0.125%*	*0.300%*	*0.282%*	*0.222%*	*0.335%*	*0.389%*	*0.327%*	*0.285%*
(d) Citations of Finance journals by top 3 OR/MS/OM journals	126	176	116	202	188	296	179	250	499	383	404	747	3,566
(e) Total citations in top 3 OR/MS/OM journals	7,600	7,612	8,049	8,205	8,665	9,793	9,653	10,964	11,062	11,815	10,985	11,617	116,020
(f) BoT Denominator (d)/(e)	*1.658%*	*2.312%*	*1.441%*	*2.462%*	*2.170%*	*3.023%*	*1.854%*	*2.280%*	*4.511%*	*3.242%*	*3.678%*	*6.430%*	*3.074%*
BoT *(c)/(f)*	**0.141**	**0.094**	**0.214**	**0.139**	**0.112**	**0.041**	**0.162**	**0.124**	**0.049**	**0.103**	**0.106**	**0.051**	**0.093**
Unstandardized BoT	0.119	0.085	0.190	0.129	0.106	0.037	0.162	0.124	0.062	0.117	0.141	0.058	0.097

Table 6: Forward-looking Citation proportion (FCP) across 2001-2008 and collaboration categories [a]

	2001	2002	2003	2004	2005	2006	2007	2008	Mean
Panel A: FCP Ratios (%)									
FCP	0.069	0.246	0.296	0.314	0.248	0.272	0.190	0.304	0.242
FCP (one author)	*nil*	0.223	0.103	0.384	0.377	0.140	0.206	0.382	0.227
FCP (two authors)	0.123	0.191	0.521	0.348	0.222	0.417	0.192	0.467	0.310
FCP (three authors)	0.055	0.384	0.166	0.213	0.288	0.233	0.173	0.153	0.208
FCP (four authors)	*nil*	0.260	*nil*	0.180	0.068	0.103	0.043	0.041	0.087
FCP (five or more authors)	*nil*	*nil*	*nil*	0.994	*nil*	*nil*	0.824	0.252	0.259
Panel B: Numerator values in FCP (citation rate, %) [b]									
FCP	0.259	1.140	1.745	2.157	1.950	2.129	1.582	2.409	1.671
FCP (one author)	*nil*	1.031	0.606	2.639	2.965	1.093	1.711	3.030	1.634
FCP (two authors)	0.461	0.885	3.075	2.387	1.742	3.255	1.600	3.707	2.139
FCP (three authors)	0.207	1.779	0.982	1.459	2.262	1.818	1.441	1.217	1.395
FCP (four authors)	*nil*	1.205	*nil*	1.235	0.538	0.803	0.360	0.323	0.558
FCP (five or more authors)	*nil*	*nil*	*nil*	6.818	*nil*	*nil*	6.849	2.000	1.958
Panel C: Numbers of published OR/MS/OM articles used to standardize the numerator and denominator of FCP									
FCP	1931	1929	1834	2040	2103	2443	2718	2864	2233
FCP (one author)	429	388	330	379	371	366	409	363	379
FCP (two authors)	868	791	813	838	861	983	1125	1187	933
FCP (three authors)	483	506	509	617	619	770	833	904	655
FCP (four authors)	115	166	124	162	186	249	278	310	199
FCP (five or more authors)	36	78	58	44	66	75	73	100	66

[a] FCP measures the extent Finance is utilizing knowledge generated in OR/MS/OM compared to all disciplines. Refer to equations (2) and (3). '*nil*' indicates no citations.

[b] The numerator of FCP for collaboration categories is defined as 'citations of a given collaboration category OR/MS/OM articles from a given year in Finance articles published over four years following that year *divided by* the number of OR/MS/OM articles of the selected collaboration category published in the given year'.

Table 7: Forward-looking Intra-disciplinary Exchange (FIDE) across 2001-2008 and OR/MS/OM journals sorted on mean FIDE in descending order [a]

ACS rank and journal [b]	2001	2002	2003	2004	2005	2006	2007	2008	Journal mean FIDE
8. Journal of Operations Management	4.114	3.173	3.608	2.941	2.511	2.530	2.936	4.683	3.312
11. Production and Operations Management	2.027	1.681	1.940	2.461	2.403	2.481	2.428	1.484	2.113
1. Management Science	2.215	1.558	1.492	1.585	1.720	1.151	1.212	1.150	1.510
2. Operations Research	1.567	0.898	1.710	1.699	1.243	1.346	1.416	1.211	1.386
13. Decision Sciences	0.638	1.321	0.718	1.370	1.793	1.683	2.543	0.800	1.358
17. International Journal of Production Economics	0.965	1.310	1.383	1.515	1.364	1.535	1.222	1.572	1.358
5. Transportation Science	0.867	1.681	1.241	1.709	1.697	1.283	1.023	0.794	1.287
19. OMEGA-International Journal of Management Science	1.103	0.578	0.754	0.642	0.965	1.433	1.654	1.611	1.092
20. International Journal of Operations & Production Management	0.976	1.250	0.955	0.999	1.109	1.302	1.099	0.981	1.084
4. European Journal of Operational Research	0.880	0.953	1.074	0.945	0.954	1.017	0.996	0.982	0.975
6. Journal of Scheduling	0.949	1.121	0.987	1.134	0.658	1.036	1.016	0.729	0.954
18. Computers & Operations Research	0.864	1.047	0.840	0.941	0.932	0.927	1.045	0.857	0.932
3. IIE Transactions	0.939	1.105	0.654	0.888	0.783	0.963	0.711	0.854	0.862
15. International Journal of Production Research	0.879	0.880	0.848	0.743	0.774	0.632	0.630	0.810	0.775
14. Journal of the Operational Research Society	0.763	0.901	0.760	0.645	0.748	0.827	0.714	0.727	0.761
9. Naval Research Logistics	0.859	0.726	0.596	0.559	0.644	0.747	0.692	0.613	0.680
16. Computers & Industrial Engineering	0.585	0.628	0.626	0.524	0.856	0.585	0.585	0.883	0.659
7. Interfaces	0.922	0.683	0.947	0.493	0.502	0.548	0.427	0.397	0.615
12. Annals of Operations Research	0.251	0.367	0.335	0.761	0.530	0.348	0.469	0.284	0.418
10. Operations Research Letters	0.512	0.382	0.452	0.434	0.414	0.411	0.366	0.282	0.407
Annual Sample Mean	*1.144*	*1.112*	*1.096*	*1.149*	*1.130*	*1.139*	*1.159*	*1.085*	*1.127*

[a] FIDE in Table 7 measures the extent OR/MS/OM journals contribute knowledge to the discipline to which they belong. Refer to equation (4).

[b] ACS: average composite score

Table 8: Forward-looking Intra-disciplinary Exchange (FIDE) across 2001-2008 and Finance journals sorted on mean FIDE in descending order [a]

Currie and Pandher rank and journal [b]	2001	2002	2003	2004	2005	2006	2007	2008	Journal mean FIDE
1. Journal of Finance	3.166	3.320	2.703	2.833	3.182	3.564	2.858	2.644	3.034
3. Journal of Financial Economics	2.280	2.700	2.915	2.365	2.954	2.360	2.529	2.511	2.577
2. Review of Financial Studies	2.295	1.675	1.998	1.952	1.905	2.216	2.396	2.276	2.089
4. Journal of Financial and Quantitative Analysis	1.360	0.957	1.687	1.109	1.277	1.188	0.868	1.096	1.193
10. Financial Management	0.859	0.693	0.532	2.006	1.031	0.927	0.665	0.750	0.933
8. Journal of Financial Intermediation	0.429	1.103	1.091	1.320	0.626	0.436	1.322	0.787	0.889
12. Journal of Financial Markets	0.687	1.616	1.158	0.894	0.633	0.557	0.698	0.670	0.864
6. Journal of Banking & Finance	0.640	0.526	0.453	0.605	0.647	0.637	0.917	1.117	0.693
9. Journal of Corporate Finance	0.687	0.258	0.561	0.792	0.626	1.041	0.854	0.721	0.693
13. Financial Analysts Journal	0.566	0.614	0.665	0.464	0.607	0.512	0.347	0.405	0.522
5. Journal of Money Credit and Banking	0.398	0.237	0.530	0.878	0.388	0.493	0.291	0.261	0.434
17. Journal of Portfolio Management	0.421	0.369	0.574	0.438	0.228	0.186	0.307	0.221	0.343
16. Journal of Futures Markets	0.385	0.290	0.323	0.385	0.261	0.401	0.316	0.233	0.324
18. Journal of Business Finance & Accounting	0.243	0.137	0.349	0.230	0.469	0.449	0.350	0.346	0.322
7. Mathematical Finance	0.309	0.388	0.293	0.380	0.307	0.360	0.301	0.204	0.318
11. Journal of International Money and Finance	0.380	0.376	0.185	0.253	0.344	0.438	0.330	0.188	0.312
14. Journal of Risk and Insurance	0.238	0.161	0.330	0.238	0.376	0.424	0.284	0.267	0.290
21. Journal of Real Estate Finance and Economics	0.226	0.222	0.298	0.174	0.219	0.275	0.301	0.301	0.252
22. National Tax Journal	0.232	0.235	0.245	0.216	0.119	0.157	0.143	0.124	0.184
Annual Sample Mean	*0.832*	*0.836*	*0.889*	*0.923*	*0.853*	*0.875*	*0.846*	*0.796*	*0.856*

[a] FIDE in Table 8 measures the extent Finance journals contribute knowledge to the discipline to which they belong. Refer to equation (5).

[b] Currie and Pandher (2011)

Table 9: Forward-looking Journal Self-Citation (FJSC) across 2001-2008 and OR/MS/OM journals sorted on mean FJSC in descending order [a]

ACS rank and journal [b]	2001	2002	2003	2004	2005	2006	2007	2008	Journal mean FJSC
8. Journal of Operations Management	1.323	1.140	1.164	0.907	0.615	0.932	0.977	1.945	1.125
11. Production and Operations Management	0.939	0.611	1.074	0.925	1.026	1.073	1.178	0.759	0.948
17. International Journal of Production Economics	0.342	0.646	0.780	0.918	0.744	0.776	0.727	0.944	0.735
20. International Journal of Operations & Production Management	0.447	0.629	0.449	0.537	0.677	0.662	0.579	0.498	0.560
13. Decision Sciences	0.189	0.318	0.194	0.439	0.777	0.842	1.017	0.267	0.505
15. International Journal of Production Research	0.611	0.531	0.527	0.433	0.422	0.374	0.427	0.560	0.486
1. Management Science	0.673	0.511	0.588	0.453	0.409	0.359	0.388	0.344	0.466
5. Transportation Science	0.319	0.611	0.272	0.427	0.488	0.400	0.259	0.176	0.369
4. European Journal of Operational Research	0.319	0.345	0.361	0.354	0.347	0.377	0.369	0.377	0.356
2. Operations Research	0.392	0.197	0.321	0.452	0.332	0.371	0.348	0.273	0.336
19. OMEGA-International Journal of Management Science	0.132	0.099	0.097	0.118	0.324	0.374	0.733	0.767	0.330
14. Journal of the Operational Research Society	0.319	0.344	0.327	0.284	0.277	0.323	0.293	0.275	0.305
18. Computers & Operations Research	0.241	0.267	0.210	0.226	0.273	0.245	0.267	0.246	0.246
16. Computers & Industrial Engineering	0.115	0.139	0.135	0.127	0.331	0.275	0.307	0.396	0.228
6. Journal of Scheduling	0.115	0.306	0.134	0.219	0.105	0.148	0.201	0.172	0.175
3. IIE Transactions	0.245	0.133	0.142	0.163	0.136	0.241	0.129	0.127	0.164
7. Interfaces	0.130	0.142	0.300	0.139	0.108	0.149	0.148	0.139	0.157
10. Operations Research Letters	0.192	0.087	0.100	0.129	0.068	0.091	0.072	0.059	0.100
9. Naval Research Logistics	0.113	0.089	0.111	0.092	0.077	0.126	0.095	0.071	0.097
12. Annals of Operations Research	0.029	0.143	0.078	0.126	0.069	0.054	0.041	0.053	0.074
Annual Sample Mean	*0.359*	*0.364*	*0.368*	*0.373*	*0.380*	*0.410*	*0.428*	*0.422*	*0.388*

[a] FJSC in Table 9 measures the extent an OR/MS/OM journal is self-perpetuating in relation to its discipline. Refer to equation (6).

[b] ACS: average composite score

Table 10: Forward-looking Journal Self-Citation (FJSC) across 2001-2008 and Finance journals sorted on mean FJSC in descending order [a]

Currie and Pandher rank and journal	2001	2002	2003	2004	2005	2006	2007	2008	Journal mean FJSC
1. Journal of Finance	0.941	0.885	0.627	0.587	0.586	0.610	0.393	0.360	0.624
3. Journal of Financial Economics	0.552	0.683	0.739	0.553	0.593	0.526	0.506	0.545	0.587
6. Journal of Banking & Finance	0.361	0.294	0.223	0.372	0.394	0.515	0.726	0.959	0.480
2. Review of Financial Studies	0.361	0.212	0.349	0.342	0.415	0.504	0.577	0.441	0.400
10. Financial Management	0.286	0.326	0.100	0.618	0.516	0.534	0.371	0.428	0.397
9. Journal of Corporate Finance	0.191	0.081	0.150	0.277	0.257	0.538	0.381	0.425	0.288
18. Journal of Business Finance & Accounting	0.193	0.085	0.253	0.187	0.378	0.348	0.258	0.296	0.250
14. Journal of Risk and Insurance	0.211	0.149	0.262	0.192	0.331	0.350	0.218	0.217	0.241
16. Journal of Futures Markets	0.282	0.232	0.257	0.248	0.243	0.313	0.202	0.148	0.241
21. Journal of Real Estate Finance and Economics	0.226	0.211	0.246	0.143	0.184	0.248	0.267	0.220	0.218
17. Journal of Portfolio Management	0.249	0.202	0.380	0.248	0.141	0.109	0.176	0.149	0.207
7. Mathematical Finance	0.155	0.319	0.168	0.275	0.194	0.194	0.175	0.164	0.205
13. Financial Analysts Journal	0.131	0.168	0.266	0.170	0.189	0.179	0.124	0.105	0.166
22. National Tax Journal	0.224	0.226	0.215	0.155	0.119	0.151	0.131	0.107	0.166
5. Journal of Money Credit and Banking	0.101	0.103	0.228	0.224	0.189	0.179	0.151	0.125	0.163
8. Journal of Financial Intermediation	0.000	0.133	0.240	0.440	0.132	0.051	0.183	0.097	0.160
11. Journal of International Money and Finance	0.153	0.201	0.086	0.114	0.174	0.230	0.189	0.120	0.158
12. Journal of Financial Markets	0.183	0.158	0.175	0.112	0.138	0.115	0.122	0.153	0.145
4. Journal of Financial and Quantitative Analysis	0.220	0.112	0.194	0.100	0.132	0.159	0.083	0.096	0.137
Annual Sample Mean	*0.264*	*0.252*	*0.271*	*0.282*	*0.279*	*0.308*	*0.275*	*0.271*	*0.275*

[a] FJSC in Table 10 measures the extent a Finance journal is self-perpetuating in relation to its discipline. Refer to equation (7).

[b] Currie and Pandher (2011)