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Applications

A data envelopment analysis approach for ranking journals

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ABSTRACT

We create a data envelopment analysis (DEA) model to rank business journals, using data from the Thomson Reuters *Journal Citation Reports*® (JCR). As opposed to previous models that ranked journals in only one field and mostly relied on survey data, this model is used to rank 358 business journals from five different JCR categories according to such citation-based factors as the number of articles, the number of citations, impact factor, five-year impact factor, immediacy index, eigenfactor score, and article influence score. We compute relative efficiencies of the journals and thereby create plausible journal rankings that largely, but not completely, corroborate three widely used business publication journal ranking lists. In addition, we show how the different characteristics of the JCR data impact the DEA ranking model. Finally, we identify journals that are not on the business publication lists but consistently perform very well relative to those benchmark journals, and should possibly be included in the business publication ranking lists. We also identify journals whose inclusion in widely used business publication rankings cannot be justified by our methodology.

1. Introduction

In recent years, institutions such as universities have become increasingly focused on rankings as a vehicle to publicize and increase their prestige. Within universities, academic departments are also becoming increasingly focused on using rankings, specifically journal rankings, in order to assess scholarly output. This paper proposes a ranking procedure for journals across business disciplines based on data envelopment analysis (DEA), using data from the Thomson Reuters Journal Citation Reports®. One merit of this procedure is its flexibility and usefulness for ranking journals across different academic fields. Another merit is that our procedure relies entirely on readily available article citation data and does not require, like many other rankings, updated opinion surveys.

Article citation data provide the basis for a major category of journal ranking studies, called "revealed preference" rankings by Tahai and Meyer [1] (see also Mingers and Harzing [2]). There is a variety of ways, however, in which article citation data can be used. The Journal Citation Reports® (JCR) published annually by Thomson Reuters display several measures of journal characteristics that are derived from citation data. There has been an ongoing discussion in the literature as to the preeminence or appropriateness of such measures, along with proposals for new measures (Pinski and Narin [3]; Harter and Nisonger [4]; Garfield [5]; Bordons, Fernandez, and Gomez [6]; Glänzel and Moed [7]; Saha, Saint, and Christakis [8]; Hirsch [9]; Garfield [10]; Bollen, Rodriguez, and Van de Sompel [11]; Moed [12]; Brouthers, Mudambi, and Reeb [13].) Rather than add to that discussion, in this paper we will instead rely on the JCR measures as inputs and outputs in the DEA-based analysis that we carry out. Employing DEA analysis to rank business journals is in fact advantageous, since it allows one to compare similar outputs (for example, citations, impact factors, and others), with respect to similar inputs (for example, articles), across different disciplines. More precisely, we feel that the strength of DEA models for ranking journals using citation data is that such rankings are derived directly from input/output *ratios* on identical indices, taken from the JCR citation data; these rankings are thus based purely on the notion of *efficiency* in comparing different journals' various outputs in terms of their article base.

Before we proceed with an analysis, however, we first review relevant journal ranking literature. Following that, we will define and discuss the different citation measures that we use in our DEA model before carrying out our methodology. As we describe in the remainder of Section 1, there are clear gaps in the literature that our work seeks to fill. While previous work has used DEA with objective data to rank journals in a specific academic discipline, none has used DEA with citation-based data to rank journals across academic disciplines, as we do with business journals. And, unlike previous studies, we include the JCR *Eigenfactor Score*

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and *Article Influence Score* as outputs, in addition to the more usual measures like the *Impact Factor*. Finally, ours is the first attempt that we know of to investigate the flexibility of a DEA approach to journal rankings, which we do as follows: by matching rankings obtained from multiple DEA runs to widely accepted business publication rankings, and in doing so, to evaluate which of the JCR factors seem to be more or less congruent with existing subjective (or "stated preference" cf. Mingers and Harzing [2]) rankings. While we believe that subjective comparisons and rankings are very important – and indeed, such rankings provide the benchmarks for us to evaluate our DEA rankings – we also believe that subjective rankings represent opinions that are often slow to change, and therefore it is imperative to develop rankings using citation-based data to complement, combine, compare and contrast with other ones, in the hope of developing a mutually valid approach to journal rankings.

1.1. Rankings literature for OM/OR/MS journals

There have been numerous scholarly attempts to rank journals in operations management (OM) as well as other fields of business, the sciences, and social sciences. For the most part, these works have used either citation-based data or else survey respondents' perceptions of journal quality. Saladin [14] appears to have been the first to study the rankings of OM journals. He surveyed 300 professionals, split between academics and practitioners, and focused on journals' academic quality. Barman, Tersine, and Buckley [15] sent a questionnaire identifying 20 operations management journals to 593 members of the Decision Sciences Institute. The subjects were asked to rank those journals based on relevancy and quality. Barman, Hanna, and LaForge [16] followed up on those findings ten years later.

Vokurka [17] performed a citation analysis to determine the relative importance of OM journals. Starting with a base set of articles appearing in three highly regarded journals (*Decision Sciences*, *Journal of Operations Management*, and *Management Science*), he enumerated all journals cited by articles in the base set and ranked them according to their respective numbers of citations. Olson [18] generated journal rankings through surveys of faculty members at top-25 business schools. Gorman and Kanet [19] ranked operations management-related journals based on the "author affiliation index," which, for a particular journal, is roughly the proportion of their authors that are affiliated with highly-ranked business schools. Relying on the relative prestige of the authors' institutions as an input measure of article or journal quality, as opposed to using citations as an output measure of quality, was first championed by Agrawal [20]. While this concept has merit, it nevertheless depends on the rankings of academic institutions, which is itself problematic. Meredith, Steward, and Lewis [21] evaluate whether university departments recognize research in OM journals in a way that is consistent with their positions in journal ranking studies. Xu et al. [22] employed a PageRank-like procedure to rank a set of 31 operations research/management science journals. They found that their resulting rankings better matched survey opinions from Gorman and Kanet [19] and Olson [18] than do rankings based on impact factor alone.

1.2. Rankings literature for other fields

There have been a number of efforts to rank journals in areas other than operations management. Such articles include Hult, Neese, and Bashaw [23], who surveyed one thousand faculty members in the field of marketing and compiled rankings for marketing journals based on the respondents' subjective assessments of journal importance. Polonsky and Whitelaw [24] also surveyed faculty members in marketing, who evaluated journals in this area on a 1–7 scale across the dimensions of prestige, contribution to theory, contribution to practice, and contribution to teaching. The overall ranking was obtained by using a weighted score (with subjective weights) over these four dimensions. Steward and Lewis [25] compiled an aggregate ranking of marketing journals from a number of previous opinion surveys and citation analyses. DuBois and Reeb [26] used both impact factors and survey results to rank international business journals. Rainer and Miller [27] averaged management information systems journal rankings across nine studies to obtain a composite ranking. Bonner et al. [28] provide a meta-analysis for ranking accounting journals over a twenty-year period. Alexander and Mabry [29] use citation data to rank journals, authors, and articles in finance. Zivney and Reichenstein [30] develop a finance impact factor to rate finance journals, and Chen and Huang [31] use an author affiliation index to rank 41 finance journals. Finally, Templeton and Lewis [32] investigate whether journals across eight primary business disciplines are treated fairly; the findings are that some disciplines have relative advantages or disadvantages in terms of the way that contributions are valued ("recognition fairness") and how much space for articles exists in top journals ("inclusion fairness").

1.3. JCR citation data

In this paper we will consider the following seven JCR citation data categories in our DEA model: *Articles, Total Cites, Impact Factor, 5-Year Impact Factor, Immediacy Index, Eigenfactor Score, and Article Influence Score*. Although there are alternative citation data metrics that have recently gained some attention (which we discuss in Section 1.4 below), we believe that the JCR categories, especially the *Impact Factor*, remain the most widely used and accessible indicators of journal quality. Let us briefly define these different categories. *Articles*, for a particular journal, is the number of articles that were published in that journal in a given year. *Total Cites* for a particular journal counts the total number of citations in a given year to articles published in that journal at any time. The *Impact Factor* (IF) for a particular journal is calculated as the total number of citations to that journal in a given year to articles published in that journal in the previous two years, divided by the total number of articles published in that journal in the previous two years. In other words, the IF for a journal is the average number of citations per article published in that journal in the previous two years. Similarly, the *5-Year Impact Factor* (5-yr. IF), for a particular journal in a given year, is the average number of citations per article published in that journal in the five previous years. The *Immediacy Index*, for a particular journal, is the average number of times that an article published in that journal in a given year has been cited in that year.

Before we present the two remaining JCR measures, the *Eigenfactor Score* and the *Article Influence Score*, we need to review the Google PageRank algorithm (Brin and Page [33]), which gives a measure of the relative importance of different hyperlinked elements, such as websites on the World Wide Web. The idea behind PageRank is to model the probability that a person who is randomly clicking on web links will come across a particular site. It is useful in this context to consider a directed graph in which the nodes are websites and the arcs represent links from one site to another. The relative importance of a site is determined by both the number of other sites that link to it, as well as the relative importance of those other sites. Consider a Markov chain in which transitions are defined by visits from one site to another, according to the arcs in the directed graph. For a given site i, let J be the set of all j such that sites j link to site i and let OUT(j) equal the number of arcs leaving j, for all $j \in J$. If we define the probability $P\{i\} = \sum_{j \in J} P\{j\}/\text{OUT}(j)$ for all i and j, then (under certain conditions) each