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Providing impact: The distribution of JCR journals according to references they contribute to the 2-year and 5-year journal impact factors

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ABSTRACT

In general, scientometrics studies tend to focus on citations received *from* journals (incoming citations) and usually neglect references *to* journals (outgoing citations). The aim of this study is to suggest a new approach to the journal impact factor on a wider scale, i.e., from the viewpoint of citing journals. I studied how citations (references) given by JCR journals contribute to the 2-year and 5-year journal impact factors (JIF). To do so, data were obtained from the 2011 edition of JCR (Science Edition) available for universities in Spain, and the citing journal matrix for each journal was used. This matrix records the number of times articles published in other journals (cited journals) were cited in a given journal (citing journal) in 2011. The results showed that a set of 50 journals produced about 15% of all references that contributed to the 2-year JIF. Similarly, a set of 50 journals produced about 13% of all references that contributed to the 5-year JIF. A Bradford-like plot was obtained by plotting the cumulative number of references that contributed to the 2-year and 5-year JIF against the cumulative number of citing journals. The distribution of journals according to the number and percentage of references they contributed to the 2-year and 5-year JIF showed peaks. A rank-order distribution of references that contributed to the 2-year and 5-year JIF was obtained with a previously described empirical two-exponent equation. Based on the maximum contribution to the 2-year JIF of different 2-year rolling reference windows, the second rolling window (references to articles published 2 and 3 years before 2011) made the greatest contribution to impact in 41% of journals.

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1. Introduction

Most methods used to study the relative influence of different journals are based on journal-to-journal citation transaction frequencies [Tijssen & Van Raan, 1990]. The journal impact factor (JIF) has become one of the most widely used scientometric indicators. This indicator is computed by Thomson–Reuters for each year (Y) according to the following equation [Glänzel & Moed, 2002]:

$$\text{JIF}(Y) = \frac{\text{Citations_in_Y_to_documents_published_in_Y1_and_Y2}}{\text{Citable_items_published_in_Y1_and_Y2}}$$

In the previous equation, Y1 and Y2 are the two years before Y.

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There is a vast literature on the JIF, reviewed recently by Braun (2007), Bensman (2007) and Archambault and Larivière (2009). In 2012 the journal *Scientometrics* devoted an issue to the problems of JIFs and alternatives to this important indicator (*Scientometrics*, Vol. 92, issue 2, August: Special Discussion Issue on Journal Impact Factors). Below I summarize only research on the JIF that is relevant to the present study.

Since 2007, ISI-Thomson–Reuters published, in addition to the classical JIF computed with a 2-year citation window, a new JIF with a 5-year window. This new version of the older indicator addresses some of the criticisms against the short citation window [Jacso, 2009; Campanario, 2011]. However, the 5-year impact factor does not solve the problems that arise when journals from different fields of science are compared, because different fields have different citation practices. To address this problem, Dorta-González and Dorta-González (2013) proposed a clever idea: the 2-year maximum journal impact factor. This new kind of journal impact factor considers a 2-year rolling citation window to capture maximum impact, instead of a chronologically fixed 2-year window.

Some interesting properties of the distribution of JIF were discovered by Mansilla et al. These authors studied the rank-order distribution of JIFs and proposed the following empirical two-exponent equation for the rank-order behavior of JIFs:

$$\text{JIF}(r) = K \frac{(N + 1 - r)^b}{r^a}$$

In the above equation, N is the number of cases, r is the rank position of a given JIF value, and K , b and a are the parameters to be obtained. Mansilla and colleagues found a very good fit to this equation [Mansilla, Köppen, Cocho, & Miramontes, 2007]. This empirical law also worked well for changes in JIF from one year to the following year [Campanario, 2010].

As Albarrán et al. acknowledge, most studies of citation analysis deal with citations received, i.e., incoming citations [Albarrán, Crespo, Ortuño, & Ruiz-Castillo, 2011]. Citations given (references, outgoing citations) are, in general, neglected in scientometrics studies. Below I review the scarce literature found on this topic.

Many years ago, Eugene Garfield noted that a small group of 250 journals provided almost half of the 3.85 million references processed for the SCI in 1969. This was one of the reasons why the JCR has been very selective [Garfield, 1972]. Albarrán and Ruiz-Castillo (2011) studied reference distributions with the characteristic scores and scales (CSS) technique, and estimated power laws with maximum likelihood techniques [Albarrán & Ruiz-Castillo, 2011]. In a follow-up study, Albarrán et al. studied reference and citation distributions in journals, and discovered that their characteristics differed considerably across sub-fields. However, when analyzed with the CCS technique, the shape of these distributions in three broad categories of articles was similar. Reference distributions were mildly skewed [Albarrán et al., 2011].

Didegah et al. undertook an international comparison of journal publishing and citing behaviors. They studied documents and their references indexed in Web of Science (WoS) in the period 2000–2009, and compared journal publishing behaviors against journal citing behaviors by scientists from different countries [Didegah, Thelwall, & Gazni, 2012]. In a sample of economics journals, Frandsen presented a method of citation analysis based on multiple linear regression for both cited and citing journals. He found that for the set of journals studied, citations were to a large extent self-supplied. However, his analysis included only a subset of journals in the field of economics [Frandsen, 2005].

Liang and Rousseau proposed an indicator framework based on references instead of citations. They suggested the use of a reference factor and even a reference-based h-index [Liang & Rousseau, 2010a]. Similarly, Nicolaisen and Frandsen, based on a previous study by [Yanovsky, 1981], introduced the reference return ratio. This new journal impact measure is based on references as bibliographic investments and citations as returns. They studied the relationship between the reference return ratio and the JIF, and found that the two measures were strongly related [Nicolaisen & Frandsen, 2008].

Using an area of astrophysics research as the data source, Bakdi applied logistic regression to examine the extent to which the characteristics of both potentially citing and potentially cited papers influenced the probability that a citation existed between the papers [Baldi, 1998]. As in other examples noted here, this study used data from only a single field of research. In a recent study, Bornmann and Marx suggested a new perspective in evaluative bibliometrics using references as source of a cited reference analysis. This approach starts by selecting all papers dealing with a given topic or field. Next, all cited references from the selected papers are extracted. Then, they analyze which papers, scientists, and journals have been cited most often [Bornmann & Marx, 2013].

Other authors have also used references in scientometrics studies, or suggested different ways in which references could be used [Evans, Hopkins, & Kaube, 2012; Huang, Andrews, & Tang, 2012; Liang & Rousseau, 2010b; Moed, 2010; Ruiz-Castillo, 2012; Tijssen & Van Raan, 1990; Zitt & Small, 2008; Zitt, 2011].

Despite the research summarized above, there appear to be no large-scale studies of the JIF that have focused on citing journals. Researchers tend to study the JIF from the viewpoint of cited journals (i.e., the journals that receive citations, and thus receive impact). However, most JCR journals cite other journals. These references contribute (when the window is the appropriate) to the journals' JIF. For example, as seen in the Table 1 below, the journal *Hormone Research in Paediatrics* contributed to other journals' 2011 JIF with 214 references to items published in 2010 and 335 references to items published in 2009. These references represent the impact “provided” by *Hormone Research in Paediatrics* and merit a more in-depth analysis. This study was designed in an attempt to shift the focus of research on JIFs from cited to citing journals.

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