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Impact maturity times and citation time windows: The 2-year maximum journal impact factor

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ABSTRACT

Journal metrics are employed for the assessment of scientific scholar journals from a general bibliometric perspective. In this context, the Thomson Reuters journal impact factors (JIFs) are the citation-based indicators most used. The 2-year journal impact factor (*2-JIF*) counts citations to one and two year old articles, while the 5-year journal impact factor (*5-JIF*) counts citations from one to five year old articles. Nevertheless, these indicators are not comparable among fields of science for two reasons: (i) each field has a different impact maturity time, and (ii) because of systematic differences in publication and citation behavior across disciplines. In fact, the *5-JIF* firstly appeared in the Journal Citation Reports (JCR) in 2007 with the purpose of making more comparable impacts in fields in which impact matures slowly. However, there is not an optimal fixed impact maturity time valid for all the fields. In some of them two years provides a good performance whereas in others three or more years are necessary. Therefore, there is a problem when comparing a journal from a field in which impact matures slowly with a journal from a field in which impact matures rapidly. In this work, we propose the 2-year maximum journal impact factor (*2M-JIF*), a new impact indicator that considers the 2-year rolling citation time window of maximum impact instead of the previous 2-year time window. Finally, an empirical application comparing *2-JIF*, *5-JIF*, and *2M-JIF* shows that the maximum rolling target window reduces the between-group variance with respect to the within-group variance in a random sample of about six hundred journals from eight different fields.

1. Introduction

This work is related to journal metrics and citation-based indicators for the assessment of scientific scholar journals from a general bibliometric perspective. During decades, the *journal impact factor* (JIF) has been an accepted indicator in ranking journals, however, there are increasing arguments against the fairness of using the JIF as the sole ranking criteria (Waltman & Van Eck, in press).

The *2-year impact factor* published by Thomson Reuters in the *Journal Citation Reports* (JCR) is defined as the average number of references to each journal in a current year with respect to 'citable items' published in that journal during the two preceding years (Garfield, 1972). Since its formulation, the JIF has been criticized for some arbitrary decisions involved in its construction. The definition of 'citable items' (including letters and peer reviewed papers – articles, proceedings papers, and

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reviews), the focus on the two preceding years as representation of impact at the research front, etc., have been discussed in the literature (Bensman, 2007; Moed et al., 2012) and have given rise to suggestions of many possible modifications and improvements (Althouse, West, Bergstrom, & Bergstrom, 2009; Bornmann & Daniel, 2008). In response, Thomson Reuters has incorporated the *5-year impact factor*, the *eigenfactor score*, and the *article influence score* (Bergstrom, 2007) to the journals in the online version of the JCR since 2007. These journal indicators are most useful for comparing journals in the same subject category. In this respect, the 2-year and the 5-year impact factor lead statistically to the same ranking (Leydesdorff, 2009; Rousseau, 2009). Yet, it seems that in many cases, but not always, the 5-year impact factor is larger than the 2-year one (Rousseau, 2009).

However, these indicators do not solve the problem when comparing journals from different fields of science. Different scientific fields have different citation practices. Citation-based bibliometric indicators need to be normalized for such differences between fields, in order to allow for meaningful between-field comparisons of citation impact. This problem of field-specific differences in citation impact indicators comes from institutional research evaluation (Leydesdorff & Bornmann, 2011; Van Raan, Van Leeuwen, Visser, Van Eck, & Waltman, 2010). Institutes are populated by scholars with different disciplinary backgrounds and research institutes often have among their missions the objective of integrating interdisciplinary bodies of knowledge (Leydesdorff & Rafols, 2011; Wagner et al., 2011).

There are statistical patterns which are field-specific and allow for the normalization of the JIF. Garfield (1979) proposes the term 'citation potential' for systematic differences among fields of science based on the average number of references. For example, in the biomedical fields long reference lists with more than fifty items are common, but in mathematics short lists with fewer than twenty references are the standard (Dorta-González & Dorta-González, in press). These differences are a consequence of the citation cultures, and can lead to significant differences in the JIF across fields of science because the probability of being cited is affected. In this sense, this is the factor that has most frequently been used in the literature to justify the differences between fields of science, as well as the most employed in source-normalization (Leydesdorff & Bornmann, 2011; Moed, 2010; Zitt & Small, 2008).

However, the variables that to a greater degree explain the variance in the impact factor do not include the average number of references (Dorta-González & Dorta-González, in press) and therefore it is necessary to consider some other sources of variance in the normalization process such as the ratio of references to journals included in the JCR, the field growth, the ratio of JCR references to the target window and the proportion of cited to citing items. Given these large differences in citation practices, the development of bibliometric indicators that allow for meaningful between-field comparisons is clearly a critical issue (Waltman & Van Eck, in press).

Traditionally, normalization for field differences has usually been done based on a field classification system. In this approach, each publication belongs to one or more fields and the citation impact of a publication is calculated relative to the other publications in the same field. Most efforts to classify journals in terms of fields of science have focused on correlations between citation patterns in core groups assumed to represent scientific specialties (Leydesdorff, 2006; Rosvall & Bergstrom, 2008). Indexes such as the *JCR subject category list* accommodate a multitude of perspectives by listing journals under different groups (Pudovkin & Garfield, 2002; Rafols & Leydesdorff, 2009). In this sense, Egghe and Rousseau (2002) propose the *aggregate impact factor* in a similar way as the JIF, taking all journals in a category as a meta-journal. However, the position of individual journals of merging specialties remains difficult to determine with precision and some journals are assigned to more than one category. Moreover, the delineation between fields of science and next-lower level specialties has until now remained an unsolved problem in bibliometrics because these delineations are fuzzy at each moment of time and develop dynamically over time. Therefore, classifying a dynamic system in terms of fixed categories can be expected to lead to error because the classification system is then defined historically while the dynamics of science is evolutionary (Leydesdorff, 2012, p. 359).

Recently, the idea of source normalization was introduced, which offers an alternative approach in normalizing field differences. In this approach, normalization is done by looking at the referencing behavior of citing journals. Journal performance is a complex multi-dimensional concept difficult to be fully captured in one single metric (Moed et al., 2012, p. 368). This resulted in the creation of many other quality metric indices such as the *fractionally counted impact factor* (Leydesdorff & Bornmann, 2011), *audience factor* (Zitt & Small, 2008), *source normalized impact per paper* (Moed, 2010), *scimago journal ranking* (González-Pereira, Guerrero-Bote, & Moya-Anegón, 2009) and *central area index* (Dorta-González & Dorta-González, 2010, 2011) to name a few. All these metrics have their merits, but none include any great degree of normalization in relation to the citation maturity time.

Impact indicators have varying publication and citation periods and the chosen length of these periods enables a distinction between synchronous and diachronous impact indicators. To collect data for calculations of diachronous journal impact factors several volumes of the JCR are needed (Frandsen & Rousseau, 2005). The term diachronous refers to the fact that the data used to calculate is derived from a number of different years with a starting point somewhere in the past and encompassing subsequent years. However, these indicators are not going into the subject of relative impact or normalizations (Frandsen & Rousseau, 2005).

Although journal impact factors can be considered historically as the first way of trying to normalize citation distributions by using averages over 2 years (Leydesdorff, 2009), it has been recognized that citation distributions vary among fields of science and that this needs to be normalized. This is the motivation in considering the two years of maximum citations and variable time windows in providing an alternative to the current journal impact factor.