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National research impact indicators from Mendeley readers

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ABSTRACT

National research impact indicators derived from citation counts are used by governments to help assess their national research performance and to identify the effect of funding or policy changes. Citation counts lag research by several years, however, and so their information is somewhat out of date. Some of this lag can be avoided by using readership counts from the social reference sharing site Mendeley because these accumulate more quickly than citations. This article introduces a method to calculate national research impact indicators from Mendeley, using citation counts from older time periods to partially compensate for international biases in Mendeley readership. A refinement to accommodate recent national changes in Mendeley uptake makes little difference, despite being theoretically more accurate. The Mendeley patterns using the methods broadly reflect the results from similar calculations with citations and seem to reflect impact trends about a year earlier. Nevertheless, the reasons for the differences between the indicators from the two data sources are unclear.

1. Introduction

Governments spend large amounts of money on academic research. For example, the National Science Foundation (NSF) was allocated $7.3 billion for this in 2015 (Rogers, 2014). Although some research supports health and quality of life improvements, the main purpose of the funding is to help enhance national competitiveness, particularly in the long term. Governments periodically change the amount of funding and the way in which it is allocated. For example, the UK has replaced fixed block research grants for universities with a competitive process based upon peer review, the precise nature of which changes every few years (Wilsdon et al., 2015). One way to evaluate the ongoing performance of a nation's research and the effect of any policy changes is to evaluate the scientific impact of its research publications. This is an indirect indicator of success from the perspective of government because it does not directly reflect societal impacts, although these may be derived later, but has the advantage that it is straightforward to estimate in a relatively objective manner and the results can be compared over time to reveal trends in performance. The standard indicator for research impact is field normalised citation counts, often by dividing the mean citation count of a set of articles by the world average for the same field. These allow international comparisons since these figures can be produced for the researchers of any country: a report commissioned by the UK's Department for Business, Innovation & Skills included a graph comparing the relative citation impact of UK publications to those of eight other countries and the world average annually from 2008 to 2012 (Elsevier, 2013, p. 40). A similar approach is used by many other organisations and countries and for other purposes

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(e.g., Leydesdorff, Radicchi, Bornmann, Castellano, & Nooy, 2013; Science-Metrix, 2015; Waltman et al., 2012; Waltman & van Eck, 2013; Zitt, Ramanana-Rahary, & Bassecoulard, 2005).

Whilst citation counts are an accepted indicator of academic impact, especially in the health and natural sciences, citations take time to accrue because of the delay between researchers reading an article and incorporating it into their research, as well as publication and peer review delays. Thus, whilst it would be possible to conduct citation analyses of recently-published articles, the citation counts would be low and even zero for most articles for a very recent analysis. This would make any indicators calculated from the citations more susceptible to outliers, such as sets of articles attracting particularly rapid citations due to being part of a themed special issue with editorial cross-citations, as well as individual articles attracting rapid citations due to being published in Early View by the publisher or self-archived by the author. Perhaps for this reason, early citations are not good predictors of long term citations (Levitt & Thelwall, 2011; Wang, 2013), although after a year the prediction may be reasonable (Adams, 2005).

Researching, peer review and publishing delays do not apply to some alternative indicators, such as counts of tweets, readers, or blog posts about articles. It therefore seems possible, in theory, to use these to develop field-normalised national impact indicators that show trends in advance of those in citation-based indicators, in the sense of more quickly accumulating enough data to be statistically robust. In practice, however, an alternative indicator must also reflect a type of impact reasonably well in order to give meaningful data. From this perspective, the most promising alternative to citation counts is readership counts from the social reference sharing site Mendeley because these have a moderate or high correlation with citation counts (Li, Thelwall, & Giustini, 2012; Li & Thelwall, 2012; Maflahi & Thelwall, in press; Thelwall & Sud, in press), in comparison to all of the alternatives (Haustein, Larivière, Thelwall, Amyot, & Peters, 2014; Thelwall, Haustein, Larivière, & Sugimoto, 2013) and also occur about a year earlier, on average (Maflahi & Thelwall, in press; Thelwall & Sud, in press). Although this makes the case for the value Mendeley for national research impact indicators, a method of constructing them is needed as well as evidence that the results are at least plausible. In response, this article introduces a technique to calculate Mendeley-based national research impact indicators as well as a second method that corrects for national biases in Mendeley uptake. These methods are assessed with an analysis of nine countries over 26 academic fields from 2009 to 2015.

2. Literature review

The research impact of a country's science base can be compared to the impacts of other countries using the average impact per paper, with field normalisation correcting for differing levels of citation (e.g., Elsevier, 2013, p. 40). This has the advantage of being size-independent so that it is easy to compare between countries. Nevertheless, productivity is important for a nation's science and so this information should be presented in conjunction with information about total publication counts (e.g., Albarrán, Crespo, Ortuño, & Ruiz-Castillo, 2010), perhaps normalised by the population, GDP or number of active researchers in each country.

When using citation counts for country comparisons, it is important to use fractional author citation counting (i.e., dividing the citation counts of each contributor by the number of contributors) rather than full citation counting, and to fractionalise based either on the number of affiliations or the number of authors (Aksnes, Schneider, & Gunnarsson, 2012; Huang, Lin, & Chen, 2011; Waltman & van Eck, 2015; Zheng, Zhao, Zhang, Huang, & Chen, 2014). Of these, fractionalising based on the number of authors seems intuitively to be a better approach because it allocates an equal share to each author. More complex approaches that allocate a greater share of credit to the first author, who tends to have made the greatest contribution (within science: Marusic, Bosnjak, & Jeroncic, 2011), are also possible but there is no agreed method for this and some disciplines use alphabetical authorship order instead (Engers, Gans, Grant, & King, 1999; Levitt & Thelwall, 2013). Hence the simple approach of sharing credit equally amongst authors, irrespective of order, seems reasonable although it may be unfair to countries that tend to have first authorships in high impact international collaborative scientific papers.

Another problem is that citation databases have different levels of coverage of the academic outputs of nations. In particular although Scopus seems to be more comprehensive than WoS (Moed & Visser, 2008), WoS and Scopus both seem to have lower coverage of languages other than English (Aghaei Chadegani et al., 2013; Archambault, Vignola-Gagne, Côté, Larivière, & Gingrasb, 2006; Li, Qiao, Li, & Jin, 2014; see also: Albarillo, 2014). This can also result in lower citation counts to non-English publications (Van Leeuwen, Moed, Tijssen, Visser, & Van Raan, 2001, 2011) and so will affect citation impact indicators as well as productivity indicators, particularly in the social sciences and humanities.

Citation counts also have many theoretical limitations for research evaluation purposes. Although citations within science can be created to acknowledge important prior work (Merton, 1973), they can also be created for negative reasons and may be influenced by irrelevant factors (Chubin & Moitra, 1975; MacRoberts & MacRoberts, 1989; Oppenheim & Renn, 1978). Nevertheless, when compared between large enough numbers of publications, non-scientific reasons for citations tend to cancel each other out so that the resulting citation counts are reasonable indicators (but not measures) of overall scientific impact (van Raan, 1998).

2.1. Mendeley reader counts

The limitations of traditional citations, such as their reflection of scholarly impact rather than other types of impact, have led to the pursuit of alternative indicators for the impacts of academic outputs. These have included downloads to