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Review

A review of the literature on citation impact indicators☆

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ABSTRACT

Citation impact indicators nowadays play an important role in research evaluation, and consequently these indicators have received a lot of attention in the bibliometric and scientometric literature. This paper provides an in-depth review of the literature on citation impact indicators. First, an overview is given of the literature on bibliographic databases that can be used to calculate citation impact indicators (Web of Science, Scopus, and Google Scholar). Next, selected topics in the literature on citation impact indicators are reviewed in detail. The first topic is the selection of publications and citations to be included in the calculation of citation impact indicators. The second topic is the normalization of citation impact indicators, in particular normalization for field differences. Counting methods for dealing with co-authored publications are the third topic, and citation impact indicators for journals are the last topic. The paper concludes by offering some recommendations for future research.

Contents

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1. Introduction

Citation impact indicators are indicators of scientific impact that are based on an analysis of the citations received by scientific publications. Citation impact indicators may provide information on the impact of individual publications, but more often they provide information on the impact of research units such as researchers, research groups, research institutions, countries, or journals. In that case, citation impact indicators are based on an analysis of the citations received by the entire publication oeuvre of a research unit. Well-known examples of citation impact indicators are the journal impact factor (Garfield, 1972) and the *h*-index (Hirsch, 2005).

Citation impact indicators nowadays play a prominent role in the evaluation of scientific research. The importance of citation impact indicators in the context of research evaluation has increased a lot during the past decades, and this is reflected in a rapidly growing body of scientific literature in which citation impact indicators are studied. Most of this literature can be found in journals in the fields of bibliometrics, scientometrics, and research evaluation, although contributions to this literature are also often made by researchers from other fields.

In this paper, I present an in-depth review of the literature on citation impact indicators. This review aims to serve both researchers studying citation impact indicators and practitioners working with these indicators. An overview is provided of different citation impact indicators that have been proposed in the literature and, more generally, of different choices that can be made in the construction of citation impact indicators. In practice, citation impact indicators are calculated based on data obtained from bibliographic databases. The literature on bibliographic databases is therefore reviewed as well, focusing on the three most popular multidisciplinary databases: Web of Science (WoS), Scopus, and Google Scholar.

The literature on citation impact indicators is rather large, and it is not possible to cover the entire literature in this review. Because of this, there are various topics related to citation impact indicators that are not discussed in this review. First of all, no detailed review of the literature on the *h*-index and related indicators is provided. During recent years, a large literature on this topic has emerged, but reviews of this literature can already be found elsewhere (Alonso, Cabrerizo, Herrera-Viedma, & Herrera, 2009; Egghe, 2010; Norris & Oppenheim, 2010; Panaretos & Malesios, 2009). There also is a literature in which citation impact indicators are studied from a purely mathematical point of view. This literature is of less interest to practitioners working with citation impact indicators, and therefore I have chosen not to include it in this review. Furthermore, this review also does not cover literature on the interpretation of citation impact indicators (Bornmann & Daniel, 2008; Nicolaisen, 2007), literature on the practical application of citation impact indicators in the context of research evaluation, and literature on the correlation between citation impact indicators and peer review. I refer to Moed (2005) for an introduction into these topics. Finally, no discussion of the historical development of the literature on citation impact indicators is provided. Such a historical account is offered by De Bellis (2009).

This paper presents the first large-scale review of the literature on citation impact indicators. However, there is some related work to which I would like to draw attention. Vinkler (2010) offers a systematic overview of scientometric indicators for research evaluation. This overview has a broader scope than the literature review provided in the present paper, but its coverage of the recent literature on citation impact indicators is less extensive. Wildgaard, Schneider, and Larsen (2014) present a review of the literature on bibliometric indicators for assessing the performance of individual researchers. A limitation of this review is that it focuses exclusively on individual researchers and does not consider other research units. Finally, Mingers and Leydesdorff (2015) provide a review of the entire scientometric literature. This review has a broad scope and citation impact indicators are just one topic covered in the review.

An earlier version of the literature review presented in this paper appeared in a report prepared for the Higher Education Funding Council for England (HEFCE; Wouters et al., 2015). This report provides an overview of the literature on the following four topics: (1) citation impact indicators, (2) effects of the use of indicators in research evaluation, (3) relation between indicators and peer review, and (4) alternative indicators for research evaluation. The reviews on topics (2) and (4) have also been published separately (De Rijcke, Wouters, Rushforth, Franssen, & Hammarfelt, 2015; Kousha & Thelwall, 2015; Thelwall & Kousha, 2015a, 2015b).

The organization of this paper is as follows. First, the methodology used to collect the literature included in this review is discussed in Section 2. Next, a review of the literature on bibliographic databases is provided in Section 3. An overview of the most basic citation impact indicators is then presented in Section 4. Based on this overview, selected topics in the literature