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DEVELOPMENTS IN PUBLICATION METRICS

GEORGE LĂZĂROIU
lazaroiu@addletonacademicpublishers.com
Institute of Interdisciplinary Studies in
Humanities and Social Sciences, New York
Spiru Haret University

ABSTRACT. In the present paper, I focus on citation measures based on indexed journal papers, the use of quality and impact metrics, quantitative indicators of research quality and impact, and the pressure to publish articles in top-tier, peer-reviewed journals. This study is grounded in the considerable body of scholarship examining the actual and future role of citation analysis in research evaluation, the use of sophisticated citation-based indicators as quality markers, the relationship between quantitative metrics of research quality and impact, and citation counts as indicators of research "impact."

Keywords: citation analysis, research evaluation, publication metrics

1. Introduction

Over the past decade, there has been increasing evidence describing the use of citation counts for research performance evaluation, the complex mechanism of the citation process, and the dynamics of knowledge production. In this paper I am particularly interested in exploring the global dynamics of science, changes in the knowledge content, and the increasing political importance gained by citation analysis. The mainstay of the paper is formed by an analysis of the limits of citation analysis, the use of citation analysis in research evaluation, the underlying dimensions of the knowledge production process, and the increasing availability of ready-to-access documentation in electronic format.

2. The Relationship between Quantitative Metrics of Research Quality and Impact

Donovan uses quantitative indicators to evaluate the academic quality and extra-academic impact of publicly funded research: *the impetus to create*

quantitative indicators that capture the extra-academic impact of research within the public realm is a recent development (quantitative indicators are as infused with human values as are qualitative approaches). Research evaluation should no longer aspire to the standardized use of blunt quantitative metrics, many "quality" metrics are underpinned by peer-review processes, and metrics will play a secondary role to qualitative processes. Publication counts are productivity measures that do not gauge research excellence. Donovan holds that the number of peer-reviewed publications produced should not be taken as an indicator of research quality (indicators of research quality are science-friendly). Undetected qualitative social science literature may be viewed as a lower order of knowledge. "Science indicators are imbued with human values masquerading as neutral markers of what science should aspire to be and do, and hence what constitutes scientific excellence in the public arena."[1] Donovan insists that *quantitative and qualitative approaches to research evaluation act as filters that connect the aims of science policy with the perceived value of research outcomes*.[2]

Walbot claims that the majority of scientific progress comes from incremental insights in which the context is provided by the struggle to resolve a number of outstanding questions in a field (maintaining skepticism about current interpretations is essential for progress). "Few of us will ever write a classic paper […] or provide a completely surprising new insight or a significant new technique. The papers that represent great leaps forward are few in number. And we all work to avoid submitting manuscripts with fatal flaws."[3]

Miller et al. shed light on the perceptions of management faculty regarding the pressure to publish imperative, contributing "to a more comprehensive understanding of how pressure to publish affects management faculty in terms of their motivation to publish, choice of publication outlets, research productivity, publication stress, publication burnout, satisfaction related to the publication process, and time and effort devoted to teaching."[4] Miller et al. state that there is particular pressure for management faculty to publish articles in top-tier, peer-reviewed journals (tenure-track faculty feel significantly more pressure than their tenured colleagues). Faculty are compelled to publish their research in peer-reviewed journals intended primarily for academics to attain tenure and promotion. Pressure to publish may marginalize teaching (research and teaching compete for scarce time and faculty effort).

This suggests that "publish or perish" ethos encourages faculty to devote less time to teaching, constraining their efforts to disseminate knowledge. Miller et al. reason that pressure to publish in peer-reviewed journals may have resulted in greater research output, and has had untoward effects on management faculty. The substantial increase in pressure to publish may be attributable, in part, to the growing importance of media rankings.

3. The Effect of the Use of Citation Analysis on Scholars' Publication and Referencing Practices

Moed focuses on the assessment of the contributions scholars make in their research publications to the advancement of valid academic knowledge. Articles published in ISI source journals may cite documents published in other sources than those processed for the Indexes, and the total collection of cited documents constitutes a publication universe that is broader than the universe of ISI sources from which the cited references are drawn. Moed recognizes the crucial importance of scholarly research for global economic and cultural progress: a firm political or social basis can be maintained only by developing a system of internal scholarly quality control and performance enhancement (citation analysis is a useful tool in such a system). Citation analysis aims at obtaining indications of research quality from referencing practices in scholarly publications.[5] Moed reports that better quality science may contribute more effectively to desired social outcomes than science that is of a somewhat lower quality: the future of research evaluation rests with an intelligent combination of advanced metrics and transparent peer review. Metrics may provide tools to keep the peer-review process honest and transparent.

From this, it is evident that measurements of citation impact should be interpreted as a function of the universe of citing publications, and have a comparative nature: the outcomes for a particular entity make sense only if they are in some way related to those of other, similar entities (journal-impact measures are useful tools in journal evaluation). Moed writes that citation analysis is more than generating raw publication and citation counts, and can provide measures of the trans- or interdisciplinary nature of an entity's citation impact. The use of citation analysis in research evaluation should show that citation impact does not fully coincide with notions such as intellectual influence, contribution to scientific progress or research quality.[6]

Kulkarni et al. note that impact factor measures the degree to which articles in a journal are cited by others, and the degree to which authors of the index article publish more, similar works that cite the index article. Removing self-citations from the impact factor would accurately reflect how other researchers perceive the index article. Certain article characteristics should be taken into account when assessing citation counts for individual articles or journal impact factors.[7] The impact factor can be manipulated by boosting journal self citations (self citation is contagious).[8]

Clapham explain that publications are the fertilizer that stimulates ideas in other scientists, and most of the time peer review is a constructive process. "Published knowledge is assimilated by colleagues and leads to more research: hypotheses are modified, rebutted, or confirmed, new paradigms are developed or old ones discarded. In a very real sense, publications *are* the

scientific method."[9] According to Wicherts and Bakker, there are many advantages to publishing the data following publication: (i) the required data archiving ensures that one's data are not lost; (ii) sharing the data is consistent with the universal scientific norms of openness and rigor; (iii) publishing one's data increases citation scores of the papers which first feature the data; (iv) sharing the data encourages more research because it enables secondary (novel) analyses; (v) sharing the data facilitates subsequent reanalyzes, which may have diverse beneficial results; and (vi) many funding agencies have stipulated that grantees should either write a data sharing plan as part of proposals or make the data publically available upon completion of the project.[10]

On Gad-el-Hak's reading, the publish-or-perish emphasis for some institutions has deteriorated into bean counting: counting the publications of individuals should not be used to evaluate them (the impact of the individual's publications should be important), acceptance rate may be an indication of either a shortage or oversupply of journal pages, whereas more papers published means that each researcher may receive more requests for refereeing. The peer review system is essential "to weed out the charlatans, the misguided, and the fools. […] The good referees are inundated with more papers to review than they can possibly handle. Other types of referees typically do not do a thorough job, and mediocre papers make it through the system. […] With the deluge of new journals, enough shoddy work is now being done to fill whole journals."[11] Fowler and Aksnes observe that self-citation improves the visibility of authors' prior works or the authority of their arguments, may be a proxy for the influence or impact of the authors' research, and self-citation advertises the *article* in question and the *author(s)* in question (self-citations appear to influence citations from others): *individuals who do not cite themselves fare considerably worse than those who do (a self-cite may yield more citations to a particular author without yielding more citations to the paper in question)*. Fowler and Aksnes point out that the more one cites oneself the more one is cited by other scholars. Citation analysis should not function as a substitute for an evaluation carried out by peers. Total citation counts may be determined by both quality and visibility.

> Authors have more opportunities for self-citation if they publish more in better journals with many coauthors, and they may be more inclined to cite themselves if their prior work is seen as important by others. […] Authors who publish more have more opportunities to cite previous work, and those who previously published more have more work available to be cited. […] Counts of citations from others are sensitive to strategic manipulation by those who are willing to cite themselves frequently.[12]

4. The Complex Mechanism of the Citation Process

Bellis posits that the connections bibliographic citations establish between documents are the operation of the scientists themselves in the process of exposing and propagandizing their findings to the community of their peers: *bibliographic citations form one visible and traceable channel linking scientific documents, a citation makes visible an intellectual link in the process of transmitting and re-elaborating scientific knowledge, knowledge production is the combined effect of a large number of individual actors' strategies, and all metrics fall short of an ultimate understanding of scientific and technological change*. Bellis stresses that in a quotation the textual transfer is visible, while in a reference it is symbolized by the recording of the cited source's bibliographic data. Both operations provide the cited fragment with a whole array of potentially new meanings. Scanty lists of bibliographic references dominate the backstage of the citation arena. An article citing two documents in its bibliography establishes some kind of association between them. "Any regularity revealed by citation patterns is, to a certain extent, the faded reflection of parallel regularities occurring in the process of generation, validation, and communication of scientific knowledge. […] Scientists pursuing new knowledge cite previous documents from which they drew significant concepts, thereby raising the cognitive and social status of cited authors."[13]

The underlying notion in this paper is that, in a scientific paper, citations must be made to acknowledge intellectual debts, through citations the author debriefs and calls for the support of a host of colleagues and predecessors working in the same research area, whereas citations symbolize the degree of endorsement of the cited texts by the citing authors (their statistical analysis can be employed to build indicators of scientific performance). Bellis argues that a paper may be more and more cited because of the intrinsic quality of its content or due to the social standing and increased visibility of its author. Citations link ideas and arguments (the connections are both internal to each subject area and transversal to multiple areas), reflecting direct genealogical relationships between authors' ideas, and are markers of intellectual influence. Citations' availability depends on the source selection criteria of a proprietary database revolving around journal papers. As Bellis puts it, citation analysis can supply an additional tool *for marking out the perimeter of potentially relevant sources and interpreting the significance of their relationships*, to the degree that citation links reflect the self-perceived dependence of authors on previous work, *they have to be taken into account, both for what they reveal and for what they conceal*, and citations and co-citations cannot be taken at face value as indicators of intellectual cohesiveness *without the support of complementary evidence of a qualitative nature*.

> While citations tend to favor precision at the expense of recall, with a large variability in output quality across different topics, if one performs the same query using alternatively keywords and citations, the two search strategies yield quite different, seemingly complementary results, with a minimal overlap between the two sets. The quality of a citation search, in addition, is strictly dependent on the number, quality, and selection criteria of the seed documents used to trigger the citation cycle. […] Greater increments of recognition and greater bibliographic visibility, along with easier access to research facilities (funds, costly instrumentation, stimulating colleagues, and so on), accrue to scientists already enjoying a good reputation in a sort of spiraling escalation of rewards, bringing about an ever-increasing dispersion of productivity.[14]

Importantly, this means that research activity implements techniques and concepts previously established by other scientists and colleagues in the same research field. Bellis remarks that review articles synthesize the paradigmatic core of concepts and predominantly shared assumptions whereby the state of the art in a particular subject area is established. The core of important scientific literature is published by a small number of journals. Scientific literature grows old and loses its initial power of attractiveness. A scientific author writing an article on a specialized topic enrolls various actants to make the arguments set forth in the article unassailable. Science is a locus of strategic action where new knowledge claims and new social relations are under production and modification.

> Faced with the crisis in traditional peer reviewing, the number of citations accrued to a document has often been welcomed enthusiastically as an unobtrusive indicator of the quality of its author's work, an antidote against funding and academic rewarding criteria governed by obscure logic and personal favoritism. […] The modern scientist cites to pay an intellectual debt in such a way that anyone can realize he or she also has a credit (cognitive, social) to gain, namely the priority claim of a discovery, the intellectual property on a new or purportedly new idea disclosed to the community of qualified peers. […] Published scientific documents are not simply literary artifacts, but nodes of communicative networks where a conventional consensus among individual scientists about the linguistic (and bibliographic) carving of the details in the common landscape they contemplate (or construct) has to be reached.[15]

5. Conclusions

The current study has extended past research by elucidating the pressure to rack up publications in high-impact journals, citation counts received by journal articles, the effect of the use of citation analysis on scholars' publication

and referencing practices, and peer review as an important instrument in quality control in science. The results of the current study converge with prior research on the improper uses of the journal impact factor, conceptual and analytic tools for the handling and interpretation of citation data, and the strategic value of citations in research evaluation. The goal of the present study was to determine if there are relationships between the growth rate of science, the importance of reviews in scientific communication, the cognitive potential of citation indexes, and the explosive growth of scientific literature.

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