Altmetrics for Country-Level Research Assessment

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Abstract. Changes are occurring in scholarly communication and the geography of science. Policy makers and research funding agencies are looking for ways to measure the comprehensive impact of research and benefit from the research experiences of other nations. Recently, altmetrics have been used to measure broader impact of research activities. In this paper, we study altmetrics based on the country-level impact and find that altmetrics can support research evaluation for all countries studied. We compare altmetrics with several traditional metrics and find significant relationships between country-level altmetrics and the number of publications, citations, h-index, and gross domestic expenditure on research and development (GERD). We also find a significant yearly increase in the number of articles published between 2010 and 2014 that received altmetrics.

Keywords: Altmetrics, Research Evaluation, R&D, GDP, H-index.

1 Introduction

Countries collaborate, compete, and compare their scientific production with other countries[1]. The scholarly standing of a country plays a vital role in preparing young researchers, attracting top scientists from around the world, promoting that country's creativity and business, opening doors for international collaboration, creating new jobs, and improving the quality of life for citizens and residents.

Research in general has a range of outcomes including articles, patents, software, data, products, and services. Governments require that their dedicated GERD be utilized effectively and transformed into desirable outcomes [2]. Articles and citations have remained the dominant indicators of scholarly performance for researchers, journals, universities, and countries [3][4].While citations can help measure research impact, they reveal only part of the impact story, as they may not exist for newly published articles, or articles that have local or limited regional benefit.

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An increasing number of researchers are sharing articles on social media sites and discussing their results online. The increase in use of social media for research, is estimated at 5–10% per month [5]. Social-based metrics, known as altmetrics [6][7], have been proposed as a complement to citations. Few studies have examined the relationship between scholarly productivity and altmetrics at the country-level[8]. Moreover, it is not clear whether altmetrics can be considered as a universal measurement tool since Internet access and usage of social media tools vary from one country or region to another. In this paper, we address two research questions:

1. Can altmetrics support research assessment for various countries?
2. How do altmetrics differ at article and country levels?

This paper is structured as follows. In Section 2, we discuss related work. We describe the data collection and methodology in Section 3. In Section 4, we present and discuss our results. In Section 5, we highlight some planned future work.

2 Related Work

Researchers have investigated several factors when measuring and comparing different countries' scholarly outcomes, such as the number of publications, citations, GERD, and gross domestic product (GDP), to evaluate the return on investment and assist with science policy [9]. Moya-Anegónet al. [10] found a correlation (R^2 = 0.687) between the GDP of Latin American countries in 1995 and the number of indexed articles from those countries in 1996. They also found a higher correlation between GERD and the number of articles (R^2 = 0.865).Tasli et al. [11] found that the number of articles in dermatology journals from 1999–2008 correlated with the GDP, population and h-index of OECD countries. Meo et al.[12] found that GERD, number of universities, and number of scientific-indexed journals correlated with publications, citations, and h-index in different science and social science fields.

Research communities are looking for additional approaches to measure both the scientific and social impacts of research [13][14].A number of studies [15][16] found a moderate correlation between citations and Mendeley readerships in various disciplines and journals. Haustein et al. [17] found a low correlation between citations and tweets on the article-level. Zahedi et al. [18] used a sample of 20,000 publications from WoSwith altmetrics from impactstory.org. They found that Mendeley's coverage was the highest among all altmetric sources. Holmberg and Thelwall [19] analyzed tweets from selected researchers across ten disciplines and found some disciplinary differences in how researchers used Twitter, such as type of tweets, retweets, sharing links, or conversations. In [20] we investigated a new social-based journal measure and found several significant correlations with traditional citation-based metrics. We also found that usage and coverage of social media for research activities is high within a few platforms such as Mendeley and Twitter. Most of the previous studies attempted to understand altmetrics using only a few measures and focused on article-level but not on the country-level, which this study has explored.

3 Data and Methods

We selected 35 developed and developing countries that have published 2,000 or fewer indexed articles per year from January 1, 2010 to June 5, 2014.We included articles that were co-authored by researchers from different countries. We downloaded the bibliometric data of those articles from Scopus, including the DOI, citation, and year published. We used only the articles that included a DOI, resulting in a total of 76,517 bibliometric records. For each country studied, we obtained its h-index from SCIMago[1]. We matched Scopus DOIs with data from altmetric.com for each article.We then compared citation-based data with five types of altmetrics data sources: Twitter, Facebook, mainstream news outlets, blogs, and Google Plus.

We downloaded the GDP, GDP per capita, number of Internet users, number of mobile users, and number of researchers per country from the World Bank'sDataBank[2] for the years 2011 and 2012, since publications in 2012 could be funded in 2011 or prior. For the few countries that did not have a GDP documented at the World Bank, we used data from the United Nation's National Accounts Main Aggregates Database[3].We used the latest GERD available for 2011 for each country from the World Bank. Similarly, some countries did not have a GERD, so we used data from *R&D Magazine*[4]. We obtained the data on usage of social networks for countries from the World Economic Forum's Global Information Technology Report[5].We used Spearman's rank correlation coefficient, ρ(rho), to compare different metrics.

4 Results and Discussion

4.1 Article-Level Altmetrics

At the article-level, we found weak correlations between citations and various altmetrics. The highest correlations were between blogs and news ($\rho = 0.32$) and between blogs and citations ($\rho = 0.28$). This shows that article-level altmetrics measure a social impact that is different from scholarly impact. The total number of articles that were cited (citations coverage) washigher than the number of articles that received any type of altmetrics (altmetrics coverage) with significant difference.

However, by considering individual years, we found that altmetrics are increasing significantly as shown in Figure 1. Moreover, articles published in 2014 have more altmetrics (27%) than citations (10%) with significant difference. Among these articles, 22% have only altmetrics and 6% have only citations, which shows that altmetrics can work as an early social impact indicator. Fifteen percent of the articles were shared via Twitter, 4% were posted to Facebook, 2% were blogged, 1% were posted to Google Plus, and 1% reached the mainstream news.

[1] http://www.scimagojr.com/countryrank.php
[2] http://databank.worldbank.org/data/home.aspx
[3] http://unstats.un.org/unsd/snaama/introduction.asp
[4] http://www.rdmag.com/
[5] http://www.weforum.org/reports/global-information-technology-report-2014

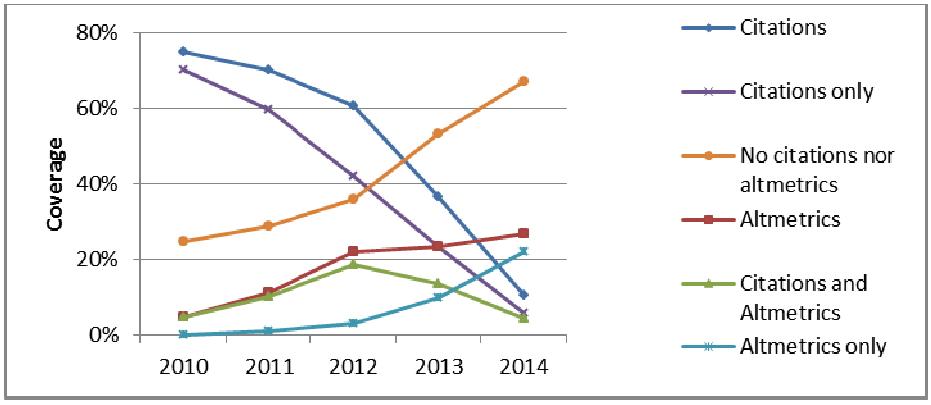

Fig. 1. Coverage of citations and altmetrics from 2010 to 2014

The articles that received citations and altmetrics did not exceed 20% per year, which creates challenges when evaluating or validating the scholarly impact using both types of metrics. Moreover, a huge proportion of the published articles remain without any citation or altmetrics, even years after publication. For example, articles that have neither citations nor altmetrics are 25% in 2010 and 53% in 2013.

4.2 Country-Level Altmetrics

At the country-level, we found that metrics from 2012 had similar correlations to metrics from 2011, so we chose to report correlations based on metrics from 2011 only, as shown in Table 1.

Table 1. Correlations between country-level altmetrics and traditional metrics

	GERD	Total articles	Total citations	H-index	Citations coverage	Altmetrics coverage	Internet users
GERD	1.00	0.75	0.67	0.63	0.72	0.61	0.47
Total articles	0.75	1.00	0.91	0.70	0.98	0.84	0.49
Total citations	0.67	0.91	1.00	0.79	0.95	0.94	0.42
H-index	0.63	0.70	0.79	1.00	0.75	0.83	0.33
Citations coverage	0.72	0.98	0.95	0.75	1.00	0.89	0.49
Altmetrics coverage	0.61	0.84	0.94	0.83	0.89	1.00	0.44
Internet users	0.47	0.49	0.42	0.33	0.49	0.44	1.00

The GERD had higher correlations than the GDP. The GDP per capita and citations per article had low correlations with other metrics; however, the h-index had strong correlations. The number of Internet users, the number of mobile users, and

usage of social networks have low-moderate correlations, which shows that altmetrics are not strongly related to the number of general users.

Individual altmetrics counts (e.g., scholarly tweets count) and altmetrics coverage were strongly correlated with citations and citations coverage. The numbers of researchers were not available for ten countries; however, comparing the available 25 countries showed low correlations between the number of researchers with other metrics. All correlations were significant at ($p < 0.05$).

Figure 2 shows a significant high level of correlation ($\rho = 0.92$) between citations coverage and altmetrics coveragebased on normalized datafor all articles and years, which can help in predicting and validating the scholarly and social impacts.

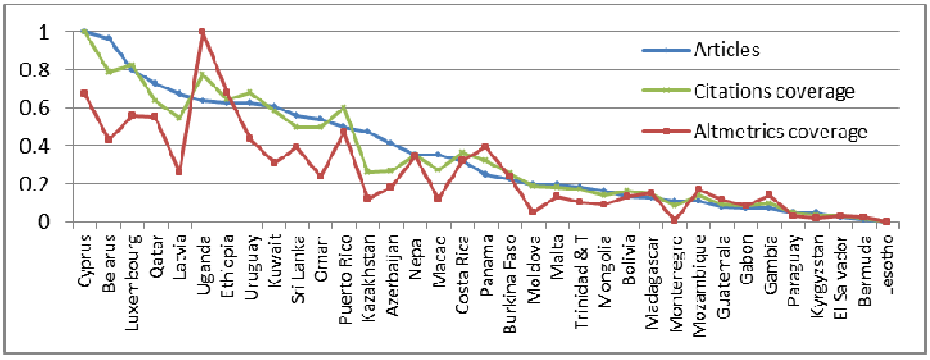

Fig. 2. Countries' scholarly production impact and social impactbased on normalized data

5 Future Work

In the future, we plan to extend the study with more countries and explore if altmetrics can help determine the local social impact of research and emerging research interests across nations. We will investigate why the altmetrics coverage was high for some countries such as Uganda, and whether social attention measures new findings, public interest, gaming of the altmetrics system, or even spam that would target scholarly communities. We also intend to investigate how altmetrics can be used when major social media tools are blocked in some countries.

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References

1. Zhou, P.: The growth momentum of China in producing international scientific publications seems to have slowed down. Information Processing & Management 49, 1049–1051 (2013)
2. Leydesdorff, L., Wagner, C.: Macro-level indicators of the relations between research funding and research output. Journal of Informetrics 3, 353–362 (2009)

3. Bornmann, L., Leydesdorff, L.: Macro-indicators of citation impacts of six prolific countries: InCites data and the statistical significance of trends. PLOS ONE. 8, e56768 (2013)
4. King, D.A.: The scientific impact of nations. Nature 430, 311–316 (2004)
5. Adie, E., Roe, W.: Altmetric: enriching scholarly content with article-level discussion and metrics. Learned Publishing 26, 11–17 (2013)
6. Priem, J., Piwowar, H.A., Hemminger, B.M.: Altmetrics in the wild: Using social media to explore scholarly impact. arXiv:1203.4745 (2012)
7. Alhoori, H., Furuta, R.: Can social reference management systems predict a ranking of scholarly venues? In: Aalberg, T., Papatheodorou, C., Dobreva, M., Tsakonas, G., Farrugia, C.J. (eds.) TPDL 2013. LNCS, vol. 8092, pp. 138–143. Springer, Heidelberg (2013)
8. Thelwall, M., Maflahi, N.: Are scholarly articles disproportionately read in their own country? An analysis of Mendeley readers. Journal of the Association for Information Science and Technology (2014), doi: 10.1002/asi.23252
9. Vinkler, P.: Correlation between the structure of scientific research, scientometric indicators and GDP in EU and non-EU countries. Scientometrics 74, 237–254 (2008)
10. Moya-Anegón, F., Herrero-Solana, V.: Science in America Latina: A comparison of bibliometric and scientific-technical indicators. Scientometrics 46, 299–320 (1999)
11. Tasli, L., Kacar, N., Aydemir, E.H.: Scientific productivity of OECD countries in dermatology journals within the last 10-year period. International Journal of Dermatology 51, 665–671 (2012)
12. Meo, S.A., Al Masri, A.A., Usmani, A.M., Memon, A.N., Zaidi, S.Z.: Impact of GDP, Spending on R&D, Number of Universities and Scientific Journals on Research Publications among Asian Countries. PLOS ONE 8 (2013)
13. Smith, R.: Measuring the social impact of research. BMJ 323, 528 (2001)
14. Alhoori, H., Furuta, R.: Understanding the Dynamic Scholarly Research Needs and Behavior as Applied to Social Reference Management. In: Proceedings of the 15th International Conference on Theory and Practice of Digital Libraries, pp. 169–178 (2011)
15. Bar-Ilan, J., Haustein, S., Peters, I., Priem, J., Shema, H., Terliesner, J.: Beyond citations: Scholars ' visibility on the social Web. In: Proceedings of the 17th International Conference on Science and Technology Indicators, Montréal, Canada, pp. 98–109 (2012)
16. Mohammadi, E., Thelwall, M.: Mendeley readership altmetrics for the social sciences and humanities: Research evaluation and knowledge flows. Journal of the Association for Information Science and Technology 65, 1627–1638 (2014)
17. Haustein, S., Peters, I., Sugimoto, C.R., Thelwall, M., Larivière, V.: Tweeting biomedicine: An analysis of tweets and citations in the biomedical literature. Journal of the Association for Information Science and Technology 65, 656–669 (2014)
18. Zahedi, Z., Costas, R., Wouters, P.: How well developed are altmetrics? A cross-disciplinary analysis of the presence of 'alternative metrics' in scientific publications. Scientometrics (2014), doi:10.1007/s11192-014-1264-0
19. Holmberg, K., Thelwall, M.: Disciplinary differences in Twitter scholarly communication. Scientometrics (2014), doi:10.1007/s11192-014-1229-3
20. Alhoori, H., Furuta, R.: Do Altmetrics Follow the Crowd or Does the Crowd Follow Altmetrics? In: 2014 IEEE/ACM Joint Conference on Digital Libraries (JCDL) (2014)