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Visualization of ranking data: Geographical signatures in international collaboration, leadership and research impact

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ABSTRACT

In this work we address the comprehensive Scimago Institutions Ranking 2012, proposing a data visualization of the listed bibliometric indicators for the 509 Higher Education Institutions among the 600 largest research institutions ranked according to their outputs. We focus on research impact, internationalization and leadership indicators, which became important benchmarks in a worldwide discussion about research quality and impact policies for universities. Our data visualization reveals a qualitative difference between the behavior of Northern American and Western European Higher Education Institutions concerning International collaboration levels. Chinese universities show still a systematic low international collaboration levels which are positively linked to the low research impact. The data suggests that research impact can be related directly to internationalization only to rather low values for both indicators. Above world average, other determinants may become relevant in fostering further impact. The leadership indicator provides further insights to the collaborative environment of universities in different geographical regions, as well as the optimized collaboration portfolio for enhancing research impact.

1. Introduction

Bibliometric data constitute a primary set of information on which academic research in scientometrics relies, but also provide an important supply for the growing issue of the assessment of the research and development system in different countries. This accountability interests a broader audience, encompassing other academic groups, as well as authorities and policy makers in higher education. The main bibliometric databases are primarily used by all academic circles for bibliographic research, but an increasing offer of search tools within the databases has widened the possibility of an easy gathering of indicators leading to publication and citation rankings often handled without the necessary rigor. Indeed, a widespread familiarity with bibliographic data collections seems to validate such efforts, but concerns were raised against a practice of "use and abuse" of citation based indicators, which progressively influence higher education policies, even without

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proper statistical treatment, as suggested, for instance, in the Citation Statistics report from the International Mathematical Union. The issue here is to contribute in providing frameworks to handle these indicators.

A collateral effect of this situation is well illustrated by the growing importance given to university rankings, still strongly relying on the number of high impact published papers and their citations, as pointed out in the Global University Rankings and their Impact – Report II. Within the context alluded so far, this Report mention an advice by Thomson Reuters (provider of the Web of Science platform) that bibliometric data "should be processed and interpreted competently. Misinterpretation of data may have particularly adverse consequences in cases of the uninformed use of citation impact data, for example, in reliance on average citation data that masks huge differences in numbers counted over several years, or on average journal citation counts that result from just one article collecting thousands of citations in a journal, while others have just a single citation or none whatsoever" (Rauhvargers, 2013). The European report also warns that university strategies may the driven rather than informed by rankings mentioning, as an example, the issue of internationalization with incentives to form international multidisciplinary research teams (Rauhvargers, 2013).

The present paper focuses on the impact, international collaboration and scientific leadership indicators for Higher Education Institutions, objects of a growing number of works, like an analysis of research collaboration effects on university excellence in four world regions, authored by researchers related to SCImago, like (Benavent-Pérez, Gorraiz, Gumpenberger, & de Moya-Anegón, 2012). Also based on SCImago ranking is an analysis of the effect of the research profile of the universities and research institutions on the ranking (Bornmann, de Moya-Anegón, & Mutz, 2013). Considering visualization of data, one of the points addressed here, interesting works based on SCImago institutional rankings, is an analysis of aggregated research impact data for research institutions of different countries (Bornmann & de Moya-Anegón, 2011) and a more recent worldwide mapping of research institutions and universities based on high-impact papers (Bornmann, Stefaner, de Moya-Anegón, & Mutz, 2014). The issue of internationalization of the rapidly growing Chinese science is the object of several investigations in the past few years, as can be appreciated in from the references in the work by Xianwen Wang and collaborators (Xianwen, Shenmeng, Zhi, Lian, & Chuanli, 2013). Other authors focus on intra and extra European Union co-authorship patterns, calling the attention that internationalization is assumed as to have impact on the quality of the scientific output (Mattsson, Laget, Nilsson, & Sundberg, 2008).

Hence, a positive link between research performance and degree of internationalization of research is apparently becoming a hegemonic idea, but this relation has been viewed in both ways: international collaboration as enhancing research impact, as mentioned above, but also the other way around: it is the research productivity (and quality) that foster the degree of international collaboration (Abramo, D'Angelo, & Solazzi, 2011). Considering scientific collaboration, a further issue has to be addressed, namely the effect of the research guarantor on the impact of the output of the collaboration (de Moya-Anegón, Bote, Bornmann, Moed, 2013; de Moya-Anegón, López-Illescas, Moed, 2013).

Mappings of scientific collaboration at different levels (individuals, institutions and countries) has been, therefore, of growing concern and have also been addressed to policy makers and administrators interested in the progression of scientific collaboration (Gazni, Sugimoto, & Didegah, 2012).

In this scenario, providing a common analysis framework for both, scientometricians and policy makers, administrators and the public, is of growing relevance. A bridge between inner academic circles devoted to scientometrics and a broader audience are given by open access data collections provided by the groups responsible for the bibliometric data bases. In some cases, only featured rankings are offered, revealing publication outputs and their impact measured by citations. As an example, one could mention the country profiles and national science rankings released in Sciencewatch from Thomson Reuters since the end of the last century, on which country research profiles can be obtained (Schulz & Manganote, 2012).

More recently, SCImago Journal and Country Rankings, "a portal that includes the journals and country scientific indicators developed from the information contained in the Scopus® database", offers an interesting and interactive indicators platform, which can be used to "assess and analyze scientific domains" (http://www.scimagojr.com/aboutus.php). Another product, also offered by Scimago since 2009, is the SCImago Institutions Ranking (SIR). SIR is a ranking of research institutions, primarily listed by number of outputs, which progressively included more indicators in the successive editions. This rich metadata (Scimago, 2011), in the 2012 edition, assembles 3290 research institutions, discriminated in five sectors – higher education, health, government, private and others – indicating their location (country and region), ranked according to the number of outputs (total number of documents published in scholarly journals indexed in Scopus) covering a period of 2006–2010. The indicators presented for each institution are: international collaboration, normalized impact, high quality publications, specialization index, excellence rate and scientific leadership, according to definitions and proxies to be discussed below. The country of each institution is also assigned and classified into eight geographical regions: Africa (AF), Asia (AS), Eastern Europe (EE), Latin America (LA), Middle East (ME), Northern America (NA), Oceania (OC) and Western Europe (WE).

The purpose of the present work, based on the metadata contained in the 2012 SIR report, is to discuss the limitations, as well as world regional differences, in the relation among proxies for research impact and quality, scientific leadership and international collaboration beyond simply ranking. We propose visualization maps of these indicators at the institutional level, providing benchmarks for institutional strategies, recalling that, as stated in the SIR report, their target audience is formed by policymakers, research managers, researchers, media and general public interested in research performance.