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ACADEMIC PERFORMANCE: MEASUREMENT METHODS USED IN SOCIO - ECONOMIC SCIENCES

Abstract

Evaluation of scientific research is crucial, however, although numerous studies have been conducted in this area, it is not easy to measure academic productivity/ performance. The most important perspective in measuring the productivity/ performance comes from the economic field, where it is the ratio between outputs and inputs for a particular product. This article aims to address the most important elements to be considered in the measurement of scientific research: types of indicators, qualitative/ quantitative respectively simple/ composite, level of measurement, micro, respectively macro indicators and the limits of those indicators. Also, this paper presents evidences regarding academic performance for Romanian university professors in economics and business administration from North – East Romania.

Key words: *ranking, measurement methods, academic performance, biliometrics, peer review*

1. Introduction

Evaluation of scientific research is crucial (van Raan, 2003), however, although numerous studies have been conducted in this area, it is not easy to measure academic productivity/ performance. The most important perspective in measuring the productivity/ performance comes from the economic field, where it is the ratio between outputs and inputs for a particular product.

In addition, in higher education an important issue is to divide the resources between input and output (Hassan, Tymms and Ismail, 2008). According to Farnham the key variables in defining input for higher education are: funding sources (including taxes/ tuitions) and the number of students (Farnham, 1999). On the other hand, there are a number of indicators associated to output: the number of graduates (students who have completed studies) and the number of publications (Virtanen, 1999). These indicators refer to the measurement of productivity at the macro level (institutional level).

At the micro level, measuring the output of a researcher is becoming increasingly important to justify the acceptance of projects, grants or offering scientific prizes (Alonso, Cabrerizo, Herrera-Viedma and Herrera, 2010). For measurement, there is a whole series of indicators that allow quantification of both the productivity and the impact of academic publications. Usually it is desirable to use a combination of these indicators (Alonso, Cabrerizo, Herrera-Viedma and Herrera, 2010; Martin, 1996).

Academic productivity/ performance is generally measured in terms of both quantity and quality. The quantity can be measured by the number of articles published. Quality is often measured by the reputation of the journal in which the article was published. Also an important element taken into account is the number of citations (Manley, 1998). Citations show that a person's work has been read, or at least someone referred to it, and thus had an impact in that field (Hancock et. al., 1992).

Further analysis of the quality of research is carried out by peer-review method. Peer-review represents a qualitative analysis of research performance, while bibliometric indicators represents a quantative analysis (van Raan, 2003). Peer-review is undoubtedly the main

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procedure of judging academic research in qualitative terms (Juznic et. al., 2010; van Raan, 2003). However, expert opinion may be influenced by subjective elements (Juznic et. al., 2010; Schmoch and Schubert, 2009; van Raan, 2003), limited horizons (van Raan, 2003), conflicts of interest (Juznic et. al., 2010; Schmoch and Schubert, 2009) and evaluator's incompetence (Schmoch and Schubert, 2009). This is why bibliometric studies are increasingly used to measure research performance (Franceschet, 2009; Schmoch and Schubert, 2009; Wallin, 2005). While bibliometric methods are by nature quantitative methods, they are used to characterize the qualitative elements. This is actually the purpose of the bibliometric methods: to transform something intangible (scientific quality) into something measurable. Compared to peer-review, which has a small area of investigation, bibliometric methods can easily be used to examine a high number of publications. Thus, the bibliometrics provides a tool that can be easily used from micro level (individual, institution) to macro level (countries, international) (Wallin, 2005; Moed, 2000).

Bibliometric analysis is the application of mathematical and statistical methods to publications (from "*biblos*" = book and "metron" = measurement). In the narrow sense, a bibliometric indicator is "a measure, an index or a statistic (preferably objective) of the impact or the number of publications as documentary products" (Vinkler, 1988). Scientometric indicators are bibliometric indicators that relate to science. Since 1999, Braun has made a suggestive analysis of the weaknesses and strengths of the two types of analysis, peer-reviewed and scientometric/ bibliometric indicators, as can be seen in figure no.1.

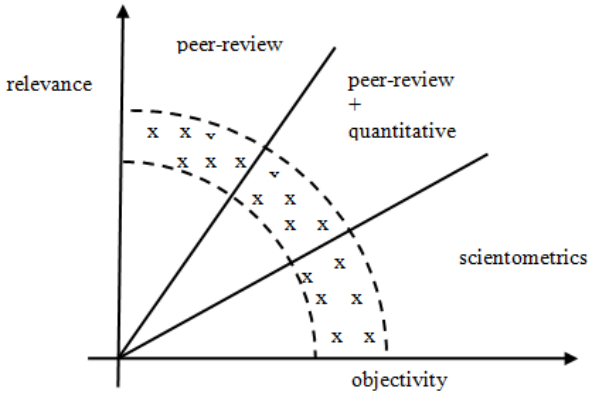

Figure 1. The reliability of peer-review and scientometric methods (Source: Braun, 1999)

Peer-review has a high reliability in comparison with bibliometric indicators, but have a low objectivity. Specialists not plead for the removing of peer-review method, but believes it would be desirable to use parallel both types of evaluation: based on peer-reviewed and on bibliometric indicators (van Raan, 2003; Schmoch and Schubert, 2009; Aksnes and Taxt, 2004). Bibliometric indicators can not replace peer-review system to support the final decisions, but calculating scores, they can show the weaknesses of peer-review and lead to minimize conflicts of interest (Juznic et. al., 2010). However, the "conflict" between quantitative assessment methods (bibliometric indicators) and qualitative methods (peer-reviewed) seems to be exaggerated. Quantitative elements are always present in peer-reviewed, and citations (often used bibliometric indicators) offered to a paper can be seen as a judgment or a "vote" of peer researchers for the citated paper. Biliometrice approaches are, in fact, a indirectly peer-review: they based on data about publications, however, papers are selected for publication based on experts' opinions and decisions (Juznic et. al., 2010).

2. Measuring academic performance at macro and micor level

The next section briefly describes the most important indicators used for ranks at macro level (countries, institutions, departments) respectively to the micro level (individuals).

2.1. Measuring academic performance at the macro level

The concept of productivity in higher education is closely related to the ranking. Both productivity and rankings can be calculated on individual or institutional level. Generally, productivity is only one of the factors taken into account when a rank is calculated, especially if we speak about the institutions. When it comes to calculate an individual rank, the rank is often based just on productivity.

Making rankings of universities is a difficult task, but very important for different audiences (Sadlak, Merisotis and Liu, 2008). According to Dill and Soo, exactly the request of these audiences regarding information on academic quality of universities led to the development of ranking systems (Dill and Soo, 2005). Such audiences interested in ranking systems are (Alaşehir, 2010): students who wish to choose a proper university to study, academics who want to work for prestigious universities, university administrators which face the defining of governing policies, national authorities that define long-term goals for education, media that wish to inform the society about the quality of the university system, companies that want to provide jobs for college graduates etc.

First ranking system was developed in 1983 by Bob Morse, a representative of the U.S. News and World Report. He published "American Colleges" Ranking, which became an annual publication since 1987 (Mahnung, 1998). Due to the huge impact this ranking had, many ranking systems have been developed at national and international level. They were made by different organizations such as government agencies, magazines and newspapers, professional associations (Dill and Soo, 2005).

Initially, ranking systems were developed mainly at national level, given the complexity and the difficulty of identifying indicators that can be applied to an extensive number of universities. For example, the most popular national and regional systems of ranking are (Alaşehir, 2010 and Ranking Resources, 2011): UK (Guardian University Guide, The Complete University Guide, The Times Good University Guide), Asia (Asia's Best Universities), Australia (The Melbourne Institute‘s International Standing of Australian Universities, Good Universities Guides), Canada (Maclean‘s Ranking of Canadian Universities, Canadian Psychological Association Graduate Guide), China (Netbig‘s Chinese University Ranking, Academic Ranking of World Universities, China Academic Degrees and Graduate Education Development Center, Rankings by the Research Centre for China Science Evaluation, Wuhan University, Ranking of Universities in Hong Kong), Germany (Center for Higher Education Development, Humboldt Ranking, The DFG Funding Ranking, Wirtschaftswoche Uniranking, Karriere University Rankings, Focus University Ranking), Hong-Kong (Education18.com & the Public Opinion Program), India (JAM College Ranking, India‘s Best Colleges; National Assessment and Accreditation Council), Italy (Universidad de la República), Japan (Kawaijuku Rankings, Asahi Shimbun Newspaper Ranking, Recruit Ltd. Ranking, Sunday Mainichi Newspaper Ranking), Pakistan (Pakistan Higher Education Commission Ranking of Universities), Slovacia (The Independent Slovak Academic Ranking and Rating Agency), Spain (National Graduation Rate Ranking), Switzerland (Swiss Centre for Science and Technology Studies‘ Champions league‘), Romania (National Council of Scientific Research in Higher Education, AdAstra, UEFISCDI), USA (OEDb‘s Online College Rankings, The Princeton Review College Rankings, The Washington Monthly Rankings, The Top American Research), Ukraine (Compass National University Ranking).

Information provided by national ranking systems are useful for implementing government policies and for university administration, but they say nothing about visibility, attractiveness and quality at international level. For this reason the interest in development of ranking systems that can be applied internationally increased. Table no.1. provides information about the most known international ranking systems.

Table 1

International ranking systems

System	Geographic area		Level			Field			Indicator	
	National	Global	Department	Faculty	University	Field	Subject	General	Simple	Composite
ARWU (Academic Ranking of World Universities, known as Shanghai System)	X	X			X	X	X	X		X
CHE (Centre for Higher Education Development)	X	X			X		X		X	X
Financial Times Business School Rankings		X			X	X				X
HEEACT	X	X			X	X		X		X
SCIMAGO		X			X			X	X	X
The Leiden Ranking		X			X			X	X	
The New Global Ranking of World Universities		X			X			X		X
THE-QS World University Rankings		X			X		X	X		X
U.S.News & World Report	X	X			X		X	X		X
Webometrics	X	X			X			X		X

Source: adapted after Alaşehir, 2010

As can be seen from the analysis in table no. 1, these systems differ in terms of area, coverage and number of indicators used. Regarding the level at which they are applied, all systems performed global analysis and institution level analysis.

2.2. Measuring academic performance at the micro level

Bibliometric indicators can be used for different levels of analysis (countries, regions, institutes and centers) and they are described extensively in the literature (Costas and Bordons, 2005; Wallin, 2005; Moed, 2000). Instead, indicators to measure individual performance (micro-level) are less studied because they are considered a challenge. This is due to the need of collecting a complete and accurate database (Costas and Bordons, 2005). Studies that have examined individual performance used different data sources: curriculum vitae (Gaughan and Bozeman, 2002; Dietz et. Al., 2000), institutional reports (Carayol and Matt, 2004), questionnaires and surveys (Prpic, 2000) bibliographic databases (Krapf, 2011; Ursprung and Zimmer, 2007). It is understood that the indicators and indices that can be calculated at the micro level can be used at the macro level analysis by adding results of all employees of the unit to be considered: department, institution, country (Ursachi (Horodnic) and Ursachi, 2010).

There are many classification of individual indicators designed by differnet specialists (Sen, 1999; Alonso, Cabrerizo, Herrera-Viedma and Herrera, 2010; Costas and Bordons, 2007; Hirsch, 2005; Franceschet, 2010; Franceschet, 2009) .

Given the large number of bibliometric indicators identified in the literature, for their brief presentation we propose the following classification:

1) *Simple bibliometric indicators* - take into account only one variable: papers, citations, authors, patents or journal impact*:*

- indicators based on the number of *papers – Papers* (Franceschet, 2010; Costas, van Leeuwen and Bordons, 2010; The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; Moed and Visser, 2007; van Raan, 2006b; Okubo, 1997), *ISI Papers* (Rehn, Kronman and Wadskog, 2007), *Paper Top Journals* (The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007), *Papers per year* (Franceschet, 2010), *Papers per autor* (Franceschet, 2010; The Karolinska Institutet, 2008), *CEST field-based world share of publications* (Rehn, Kronman and Wadskog, 2007)
- indicators based on the number of *citation – Citations* (Franceschet, 2010, Costas, van Leeuwen and Bordons, 2010; The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; van Raan, 2006b; Okubo, 1997), *Citations per year* (Franceschet, 2010), *Citations per author* (Franceschet, 2010; The Karolinska Institutet, 2008), *Citations per paper* (Franceschet, 2010; Costas, van Leeuwen, and Bordons, 2010; Jarwal, Brion and King, 2009; Rehn, Kronman and Wadskog, 2007; Moed and Visser, 2007; van Raan, 2006b), *Cited Papers* (Franceschet, 2010), *Percentage of publications non-cited* (The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; Moed and Visser, 2007; van Raan, 2006b), *Number of patent citations* (Okubo, 1997), *Self citedness* (The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; Moed and Visser, 2007), *"Crown" indicator* (The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007).
- indicators based on the number of *co-authors - Co-authors* (The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; Okubo, 1997);
- indicators based on the number of *patents - Patents* (Okubo, 1997);
- indicators based on the *journal impact factor - ISI Journal Impact Factor* (Jarwal, Brion and King, 2009; The Karolinska Institutet, 2008; Rehn, Kronman and Wadskog, 2007; Garfield, 2006), *Normalized Factor Impact/ field citations score* (Costas, van Leeuwen and Bordons, 2010; Rehn, Kronman and Wadskog, 2007; Moed and Visser, 2007).

2) *Composite bibliometric indicators* - take into account at least two of the variables: the number of papers, number of citations and journal impact.

- indicators based on the *number of papers* and *number of citations - h-index* and its development. The best known index focused on the number of papers and the number of citations is H index (Hirsch, 2005). Its development it has revolutionized the researchers vision on measuring academic productivity. As a result, over 40 other indicators and indicators were developed from the H index.
- indicators based on the *number of papers* and journal *impact factor - CLpn* and its development. CLpn index was proposed by Combes and Linnemer in 2003. The index was developed especially for economic field and encompasses all EconLit journals (Combes and Linnemer, 2003). The index was further developed by institutes such as Handelsblatt (Krapf, 2011). For example, in a recent study, Krapf and Schläpfer (2012) used the Handesblatt methodology to check whether the overall rating scores of the Nobel Laureates in economics are indicative of their high achievements.

Based on individual indicators, many studies on measuring research productivity go on to identify factors that influence individual research performance. The most common factors influencing academic performance (productivity) include: parenthood and number of children (Krapf et al., 2014), gender (Mauleón et al. 2014; Danell and Hjerm, 2013), the researcher's historic age (Costas et al., 2010), the academic program he or she graduated in (Brusa et al., 2010), the field of specialization, academic pedigree, academic environment (Long et al. 2009), personal circumstances, career age (Rauber and Ursprung, 2008a), cohort effects (Rauber and Ursprung, 2008b), financial rewards (Backes-Gellner and Schlinghoff, 2008), the size of the laboratory (research group), the number of a researcher's foreign postdoctoral students (Carayol and Matt, 2006) and promotion (Backes-Gellner and Schlinghoff, 2004).

3. The bibliometric indicators limits

In 2009, Todd performed an analysis of the errors that can occur when bibliometric indicators are used to measure academic productivity/ performance. He identifies several levels at which these errors can occur, as can be seen from fig. no. 2.

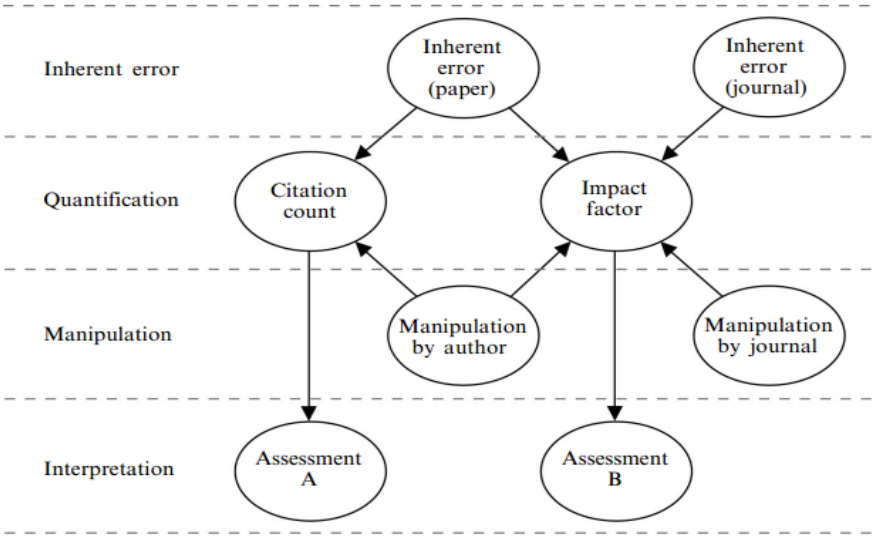

Figure 2. Levels errors "behind" bibliometric indices and indicators for measuring performance (Source: Todd, 2009)

- *Inherent errors*

A citation of a paper is considered as an objective measurement of the impact of the paper, or at least of its usefulness, however, this assumption may be wrong (Todd, 2009). The decision to publish a paper is not always based on its academic merits (Bornmann and Daniel, 2008), social network playing a major role in who cites who (GFO Echological Society, 2009). In addition, the number of citations may be positively correlated with the length of the paper, the number of authors and the open accessibility (Ball, 2008; Leimu and Koriecheva, 2005). Also, the language, the affiliation and the authors position, the significance of the results and the paper position in journal influences the likelihood of being cited (Garcis-Ruiz, 2008; Leimu and Koriecheva, 2005). On the other hand, a paper may be cited because it is "wrong" and citations represent the opposition to what they are supposed to represent (Todd and Ladle, 2008).

Considering the impact factor of a journal is calculated as the number of citations obtained by the articles published in the last two years, divided by the total number of articles published in the journal in the past two years, some areas may be disadvantaged (Garfield, 1997). An author may be lucky to publish article in a journal with a good image and coverage and also a journal may be lucky to publish an article that will become the "superhot" (star) which will increase its impact (Todd, 2009).

This type of error does not refer to the fact that the number obtained is wrong, but that there are a number of factors that can influence the number of citations and therefore the impact factor of a journal. As can be seen, the inherent errors are very difficult to detected and impossible to be controled.

- *Quantification errors*

Measurement problems may be due to the author or the journal. The author errors may appear due to misspelling of names or due to usage of an inadequate database (Todd, 2009; GFO Echological Society, 2009; van Raan 2005a; van Raan, 2005b). For example, in 2007, Meho and Yang found differences between the results provided by three of the most popular search

engines used for counting citations: Google Scholar, Web of Science and Scopus (Meho and Yang, 2007).

The Impact Factor calculated by ISI Web of Knowledge is the standard indicator for classifying journals (Todd, 2009). However, there are discussions regarding the correctness of calculation. For example, it can generate basic mistakes such as wrong counting or failing to identify articles. (Monastersky, 2005).

- *Manipulation errors*

Errors due to manipulation concerns those errors due to the desire of an author or a journal to increase impact. Prior to exploit the inherent errors mentioned above (long publications, published in English for higher visibility, co-authored, positive results etc.) authors must go through the selection process of the journal. For this, some authors use the "fancy" words in manuscripts, ask not to be reviewed by some demanding evaluators, nominate potential evaluators for awards or cite them, meets with editors at conferences or similar events etc. (Lawrence, 2007).

In the same manner there are ways to improve the impact factor of a journal. Editors publish "hot papers", editorial, or other materials that are citable but are not included in calculating the ISI denominator (Monastersky, 2005). It is unlikely that these tactics will improve the quality of the journal, but it can significantly increase its impact (Todd, 2009).

Another method used is "open access" politic which increase the number of citations of an article, and, therefore, improve the impact factor of the journal in which the article was published. This approach can be carried out by the author, the journal or by both (Chew, Villaneuva and Van Der Weidon, 2007).

- *Interpretation errors*

Given the above errors, it is important to consider these when making an interpretation. For example, when taking into account the number of citations (assessment A), can be taken into account some other indicators such as average number of citations per paper, h-index, g-index etc. (Todd, 2009; Egghe, 2006a, 2006b; Hrisch, 2005). When taking into account the impact factor (assessment B) it can be taken into account factors such as: area, the most prestigious journals in a particular field etc. (Todd, 2009).

4. Academic performance of Romanian university professors in economics and business administration – evidence for the North – East Romania

From the composite indicators mentioned above we choose to measure research performance with the the CLpn index which was developed by Combes and Linnemer (2003) especially for the economics profession. The index is a weighted sum of all journal publications indexed in the database EconLit of the American Economic Association. Three kinds of weights are used for each article: a journal quality weight, the number of coauthors, and the length of the article. The sum runs from some year ***t*** to year ***T***. Researcher i's CLpn index thus has the following appearance:

$$CLpn_i(T) = \sum_k \frac{p_{k(i)} w_{k(i)}}{n_{k(i)}} \quad (1)$$

where, ***k*** indexes researcher i's publications, $p_{k(i)}$ denotes the number of pages of the article *k*, $n_{k(i)}$ the number of authors of the article ***k***, and $w_{k(i)}$ the quality weight (impact) of the journal in which article ***k*** was published. In this study, the original index is adapted to the Romanian academic environment. We did not use the original journal quality weights because only few Romanian professors publish in EconLit-indexed journals, implying that this

weighting scheme would lead to close to zero performance measures in our study. Instead we assigned quality weights to the category of article as classified by the Executive Unit for Financing Higher Education, Research, Innovation and Development (UEFISCDI) [2]: *ISI (Thomson) indexed journals* with an impact factor (a); *ISI indexed Science and social science journals* without impact factor (b); *ISI indexed arts and humanities journals (c)*; *ISI indexed* Proceedings (d); *BDI*[3] *indexed articles and working papers* and articles published in B+ journals according to the CNCSIS [4] classification; articles published in national journals recognized by CNCSIS (B category). The following weights were used: *ISI indexed papers (a)* – 0,8; *ISI indexed papers (b)* – 0,6; *ISI indexed papers (c)* – 0,6; *ISI indexed papers (d)* – 0,4; *BDI indexed papers* – 0,2; *CNCSIS (B)* articles – 0,05.

The bibliometric data were available from 2006 to 2010 in university's reports of public universities[5]. We collected the publication data for a period of five years (2006-2010) for all university professors in economics and business administration from North – East Romania which have a public e-mail address on their university's site. We identified a number of 224 professors affiliated to the following universities: "Alexandru Ioan Cuza" University of Iasi, "George Bacovia" University of Bacau and "Stefan cel Mare" University of Suceava. We obtained a database with 1,894 records (professors and their publications, respectively). Nevertheless some 25 professors did not publish any paper in the analyzed period (2006-2010). The main results regarding the academic performance are reported in the figures no. 3, 4 and 5.

As figure no. 3 shows, a university professor in economics and business administration from North – East Romania has an average of the performance index of 7,64. Almost a half of the professors have though a performance index close to zero, which is alarming. Just a few of the professors have an index greater than 20, and one of them has an index above 100.

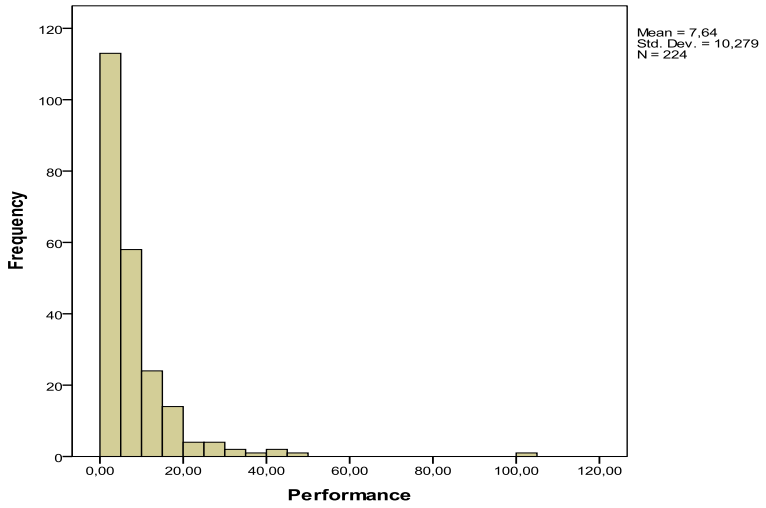

Figure 3. Academic performance of Romanian university professors in economics and business administration – evidence for the North – East Romania, mean for 2006-2010

Turning the analysis to gender distribution, we can see in figure no. 4 that man publish more compared with their women peer. A man have an average performance index of 8,01 since a

[2] UEFISCDI - public institution with legal personality under the Ministry of National Education (MEN) which operate under the subordination of MEN Advisory Councils with responsibilities in higher education, scientific research, development and innovation.

[3] BDI = Indexed database

[4] CNCSIS - National Council of Scientific Research in Higher Education

[5] We should mention that those data are the only public data available on the individual level that we are aware. The other recently reports made available for public use compress only institutional data, therefore are useless for the present study.

woman have an average of 7,32. The most performant man has a performance index of 102,59 since the most performant woman has a less than a half, respectively 49,87. Those results regarding gender differences are in line with previous studies.

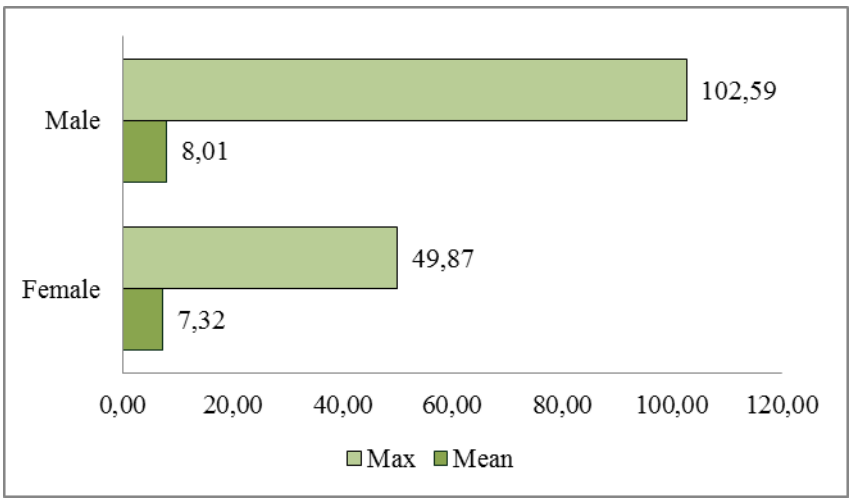

Figure 4. Academic performance of Romanian university professors in economics and business administration – evidence for the North – East Romania, mean and max for 2006-2010, by gender

For a better understanding of the real situation of the Romanian academic enviroment, figure no. 5 reports the number of the papers published, by categories. As figure no.5 shows, Romanian university professors in economics and business administration prefer to publish database-indexed articles (70 per cent of the total number of publications). A further 15 per cent is represented by ISI (d) published papers, 8 per cent is represented by CNCSIS (B) papers and, 3 percent is represented by ISI (a), ISI (b), respectively. Less than 1 per cent nevertheless, is represented by ISI(c).

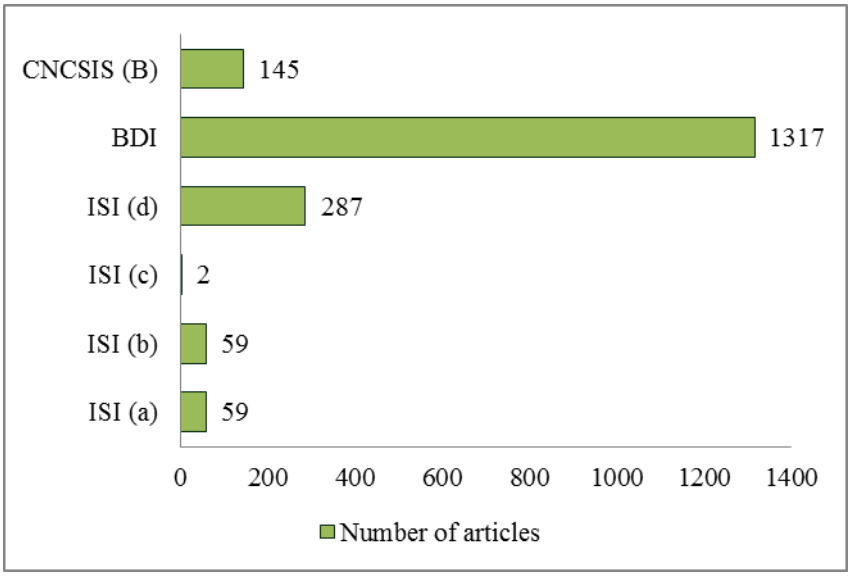

Figure 5. Number of papers published by Romanian university professors in economics and business administration – evidence for the North – East Romania, 2006-2010

These evidence with academic performance of Romanian university professors in economics and business administration depicts us a country undergoing transition. Academic professors just start to publish high listed journals (only 21 per cent of their papers are published in ISI journals or conferences volumes).

Conclusion

As it can be seen after a review of the literature there are several ways to develop rankings between countries, institutions and individuals in terms of academic performance. For this reason a high number of different indicators have been developed. There are different indicators in respect with the level of the analysis (macro and micro) and their nature (qualitative and quantitative). No one can say that a qualitative analysis is better than the quantitative, or the reverse but lately the quantitative ones are mainly used. It is the case because they include qualitative aspects and have a higher coverage. Quantitative indicators with a higher degree of trust are those composite. After analyzing the composite indices measuring academic performance, it can be seen that the choice of one of them depends on the purpose for which the investigation is carried out. Currently it can not be said that a certain indicator or index is perfect because each of them have a certain degree of error. However, the current direction is in favor of using indices that take into account the impact factor of the journal (although is based on the number of citations is less influenced by social networks). In this study, in line with the trend form the literature, we used the CLpn index for assessing the academic performance of the Romanian university professors in economics and business administration. The results reveals us a relatively weak academic enviroment, with a preference for low ranked journals. This is not unusual for a country undergoing transition.

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