SOME CONSIDERATIONS ON THE SCIENTIFIC RESEARCH OF THE FACULTY OF SCIENCES AND ARTS IN VALAHIA UNIVERSITY OF TARGOVISTE

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Abstract. *The current paper stems out of the author's concern with the issue of the scientometric parameters used for the evaluation of scientific research productivity. The main point discussed now focuses on the impact of the citations received by published papers on the major scientometric parameters, with special reference to the academic teaching staff in the Faculty of Sciences and Arts of Valahia University of Targoviste (UVT), Romania. Aspects such as ranking, comparison of teaching members and fields as well as university financial endowment are discussed and conclusions are drawn.*

Keywords: *research, Scientometrics, Hirsch index, ranking, number of citations.*

1. INTRODUCTION

The European integration of education and research does not suppose only the thorough knowledge of the internal condition of education and research, the latter's compatibility with the corresponding systems in European developed countries, but mainly the setting of directions and actions that are in alignment with the achievement of quality standards.

The transition to a knowledge – based economy represents an essential strategic option that will have an important impact on mankind's global sustainable development.

Universities play a unique part in the advancement of a knowledge - based society, owing to the fact that they contribute to the production, dissemination and use of knowledge. The university's key role is to train the highly – qualified human resources; this process involves that education and research by blended, and thus the performance of the education system will contribute, to a large extent, to the progress of society.

The increased competitiveness within a knowledge - based economy imposes the dissemination and exploitation of knowledge in economy and society as a whole. Scientometrics intends to characterize science and scientific research on the basis of some quantitative data regarding the output, propagation and employment of scientific research results. A community's scientific output is appreciated by both the number of scientific papers that have been published, and particularly by the number of citations received. A study done by Gregory Webster from the University of Florida in Gainesville analyzed 53,894 papers published in″Science″ Journal between 1901 and 2000 and concluded that the papers with many references are cited more frequently, as shown by the graph in Fig. 1 [1, 2].

The current paper presents the effect of the citations received by the published papers on the main scientometric parameters of the higher - education teaching staff members who hold the highest certification degree in the Faculty of Sciences and Arts from Valahia University of Targoviste. The number of citations clearly indicates the impact of the research outcome. It was Garfield [3] who pointed this out for the first time.
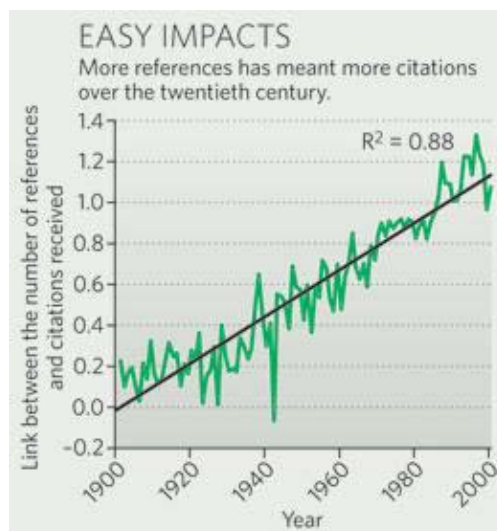

Fig. 1. The effect of a paper's number of references on citations received
(after Gregory Webster [1, 2]).

2. EXPERIMENTAL

The analysis made in this paper was founded on the data collected from the ISI Web of Knowledge site for each member of the academic teaching staff. Thus, the following scientometric parameters have been considered:

- Total number of papers;
- Total number of citations;
- Average citations per paper;
- Total number of citations minus self - citations;
- Average citations per year;
- The Hirsch – index.

Part of the parameters shown above has been compared with the reference data gathered from the site of SC Imago Journal & Country Rank [4]. This site presents the visibility of the scientific journals as well as the indices referring to the countries' scientific development. The site has been developed by SCImago, a Spanish research group.
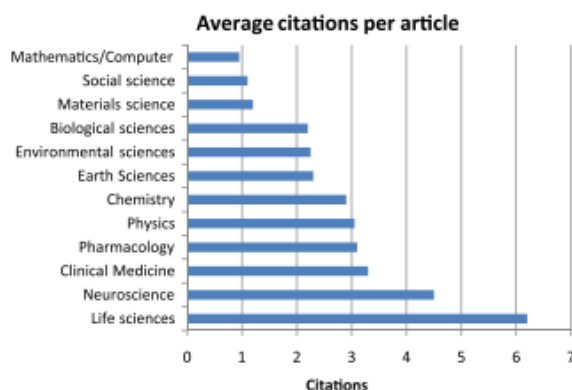
However, all the papers have also been correlated with the cumulative impact factor. The impact factor (IF) of an academic journal is a measure reflecting the average number of citations to the papers published in the journal.

3. RESULTS AND DISCUSSION

The number of scientific papers published since the activity of publishing research began has been enormous. Scientists have been publishing in academic journals for at least 350 years [5, 6] and the number of published papers is obviously tremendous (50 million) [7, 8]. Table 1 shows the values of the scientometric parameters mentioned above for the cases of the academic positions discussed. It is important to analyze the value of the average citations per paper and to compare it with the international standards. The higher the interest in certain problem, the larger the number of those who cite it as a source of information.

Table 1. The main scientometric parameters of UVT Faculty of Science's teaching staff members considered in the analysis [3].

Code	Total number of papers	Total number of citations	Total number of citations minus self-citations	Average number of citations per paper	Average citation per paper
P1	158	727	338	4.60	36.35
P2	99	569	301	5.75	28.45
P3	56	356	275	6.36	17.80
P4	45	87	58	1.93	5.44
P5	14	20	17	1.42	2.86
P6	67	382	92	5.70	42.44
P7	49	19	14	0.39	1.19

Fig. 2. Average citations per paper for different disciplines (according to M. Amin and M. Mabe [9]).

However, it should be mentioned that this parameter objectively presents considerable differences between the three fundamental disciplines of our faculty, as also shown in Fig. 2. And yet, in the very advanced countries, this parameter is higher, both for Chemistry [10], Physics [11] or Mathematics [12]. For instance, as far as Chemistry is concerned, the 2008 statistics shows a maximum number of 15.02 citations per paper (U.S.A.) while the same number is 12.47 for Physics (U.S.A.) and 4.07 for Mathematics (U.S.A.) [10-12]. In 2011, countries such as those shown in Table 2 [13] had a large number of citations per paper in the field of Chemistry.

As Table 1 presents, the number of citations per year can reach 36, while the literature data show a very close situation (44 citations/year). This figure can be inferred from Fig. 3 which presents the accumulation of a number of 700 citations in 16 years [14]. A group of researchers from the Montreal University concluded that the researchers of older ages publish a larger number of papers [15]. Therefore, age seems to raise no barrier to scientific productivity. On the other hand, the papers published in the proceedings of some conferences

are considered to be "with less credits" [16]. The conference proceedings may cause double counting when nearly or completely identical results are first presented at a conference and later published in a journal paper.

Table 2. Citations per paper in the field of Chemistry (2011) [13].

| Item no.	Country	Cites per paper	Item no.	Country	Cites per paper
1	USA	18.26	5	ENGLAND	15.14
2	NETHERLANDS	18.42	6	POLAND	7.05
3	SWITZERLAND	17.63	7	INDIA	6.96
4	SWEDEN	15.27	8	RUSSIA	3.54
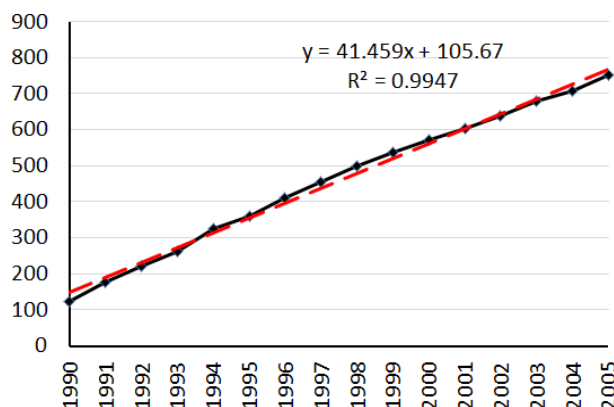
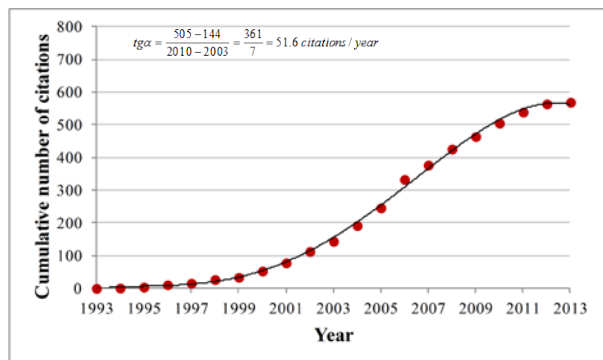**Fig. 3. Cumulative number of citations (1989-2005) [14].**

Bornmann et al. suggest the existence of a correlation between the quality of the paper and the author's reputation but they do not mention any influence regarding the number of authors [17].

A study on the variation of the number of references per paper over 1970 – 2005 reveals that this number increased steadily, from 8.40 in 1970 to 34.63 in 2005, which means that it is 4 times larger [18].

Figs. 4 – 10 show the dependence on time of the cumulative number of citations for all the persons who have been considered in this discussion. The slope of the curve's linear segment indicates the average value of the number of citations per year.
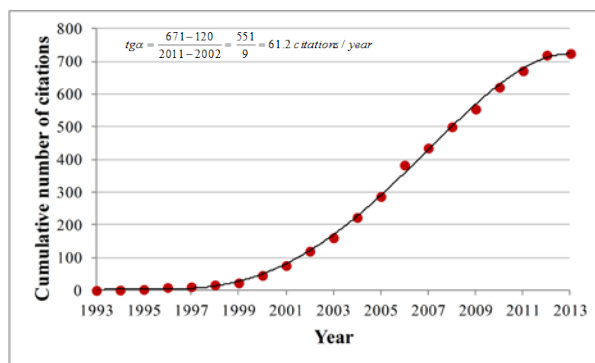
Fig. 4. Cumulative number of citations' dependence on time for P1.

Fig. 5. Cumulative number of citations' dependence on time for P2.
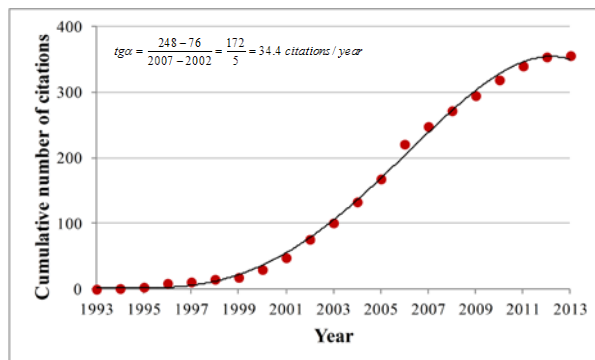
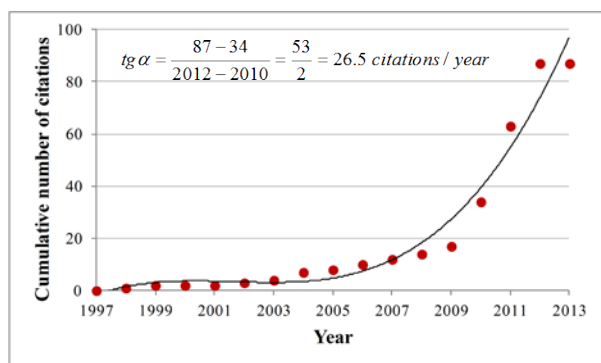**Fig. 6. Cumulative number of citations' dependence on time for P3.**

Fig. 7. Cumulative number of citations' dependence on time for P4.

Fig. 8. Cumulative number of citations' dependence on time for P5.

Fig. 9. Cumulative number of citations' dependence on time for P6.
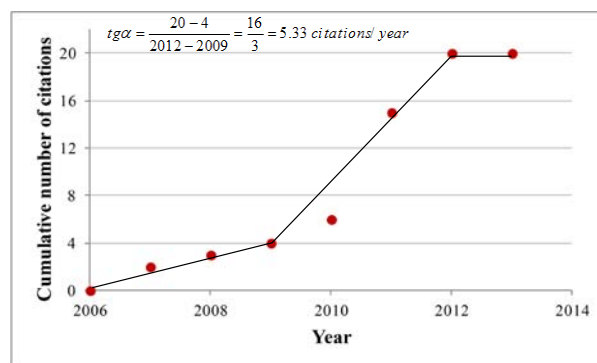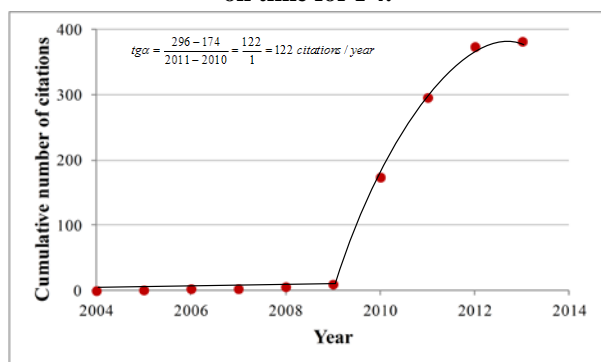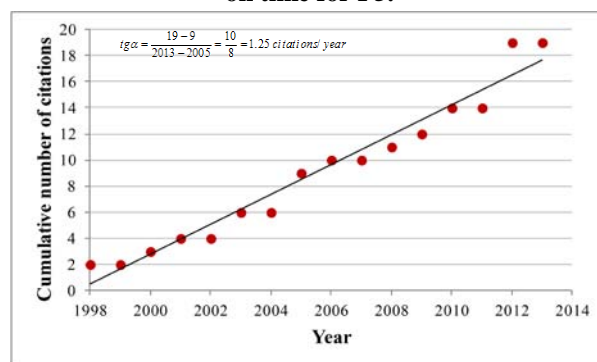

Fig. 10. Cumulative number of citations' dependence on time for P7.

Table 3 presents the slopes in the figures mentioned - those pointing to the efficiency of the respective papers expressed in citations/year.

Table 3. Scientometric parameters showing the efficiency of scientific research.

Code	Slope in dependence of cumulative number of citation vs time	Slope dependence of cumulative impact factor vs time	Hirsch index
P1	61.2	12	13
P2	51.6	8.69	12
P3	34.4	6.98	10
P4	26.5	4.64	5
P5	5.33	1.67	3
P6	122	29.04	11
P7	1.25	1.10	2

The aforementioned table also includes the slopes of the linear lines from another set of figures that represent the dependence of the cumulative impact factors vs. year (Fig. 11), that are another expression for scientific productivity.
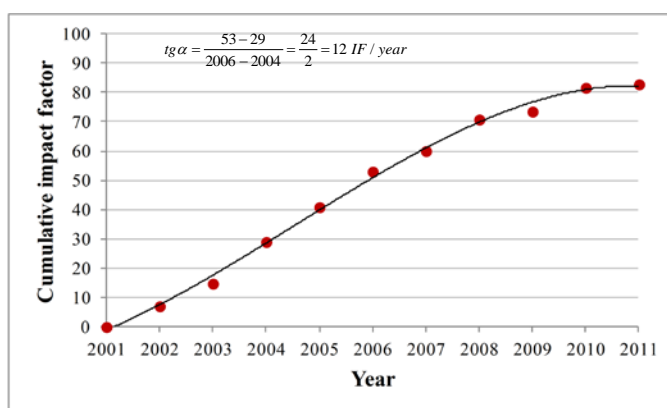

Fig. 11. Cumulative impact factor' dependence on time for P1.

The data in Table 3 highlight the outstanding values of positions P_6, P_1, P_2 and P_3 for all the scientometric parameters mentioned. All these parameters rest on the number of citations. It can be noted that there are two groups of professors – one with higher values of the Hirsch index, the average being 11.5, and the other group with lower values whose corresponding average is 3.33.

And yet, some remarks are necessary [19]. The Hirsch index is a parameter which rises in time, as Fig. 12 shows. It is irrelevant to compare the Hirsch – index of researcher who is in the early part of his career with the one of a senior researcher who is at the end of his career. Also, the different dynamics of each field makes it impossible to do rankings between domains only on the basis of the Hirsch – index. Besides that, some disciplines have more specialized journals that can take more papers and, consequently, attract more citations, while the length of a research may vary from one domain to another. Therefore, the comparison of researchers belonging to different fields is not relevant. In this way, scientometrics can be a useful tool for revealing values and connecting them to the European values, as far as the basic scientific research is concerned.

Some authors resort to an artificial crisscrossed raise of citations in agreement with colleagues from other research centres or sometimes with fellow - researchers from other countries. This type of "scientometric engineering" results in very high values for the Hirsch - indices.
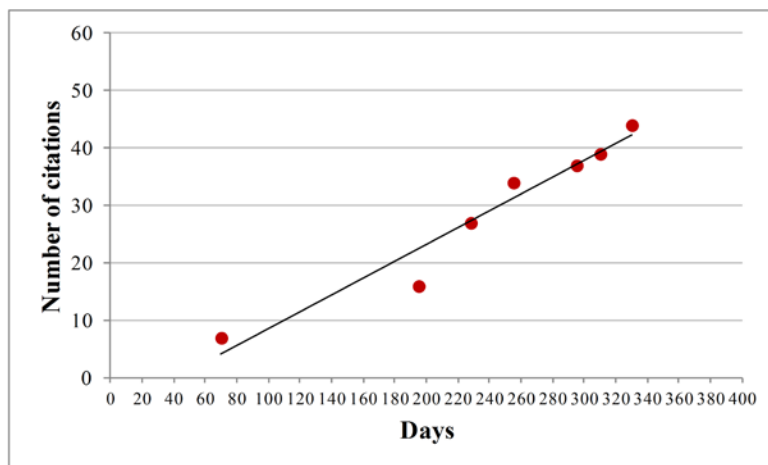

Fig. 12. Hirsch-index in time as a result of the increase in number of citations (case P1) In graphic: Number of citations/days.

The top ranks of Mathematics, Physics and Chemistry professors in Western countries present significantly higher values of the Hirsch – index than those obtained by Romanian researchers, as shown in Table 4.

Table 4. Number of citation and Hirsch- indices of some Mathematics, Physics and Chemistry professors from Western universities [20-22].

Item no.	Name	Affiliation	Number of publications	Number of citations	Hirsch-index
MATHEMATICS					
1	Gene H. Golub	Stanford University	168	30266	87
2	David Donoho	Stanford University	88	27524	83
3	Barry Simon	Calif. Inst. Of Technol.	221	20422	71
4	P. Louis Lions	Paris Dauphine Univ.	194	12378	56
5	Michael Atigah	Univ. of Edinburgh	113	11545	54

(Continued)

Item no.	Name	Affiliation	Number of publications	Number of citations	Hirsch-index
PHYSICS					
1	Edward Witten	Inst. For Adv. Study	337	41013	101
2	Cumrun Vafa	Harvard Univ.	266	19499	70
3	Juan Martin Moldacena	Inst. For Adv. Study	165	17145	65
4	Steven Weinberg	Univ. of Texas Austin	263	12067	55
5	Andrew Strominger	Harvard Univ.	216	10834	52
CHEMISTRY					
1	O. M.Yagi	Univ. of California	90	19870	70
2	C. M. Lieber	Harvard Univ.	74	17776	67
3	A. P. Alivisavor	Univ. Calif. Berkeley	93	14589	60
4	M. O'Keefe	Arizona State Univ.	73	12900	57
5	Honjie Dai	Stanford Univ.	88	12768	56

These differences are generated by the number of citations accumulated by the scientific papers published by the authors of these papers [20-22]. It should be noticed that not all the Hirsch - indices of the academic staff members in the Faculty of Sciences and Arts from Targoviste are low and the comparison values belong to some outstanding persons in the field. One possible explanation lies in the fact that the salaries of Romanian employees range between 35 and 100 USD, a thing which could account for many other things.

On average, the salary of a USA university professor rises to 7,000-7,500 USD/month [23]. There is a direct correlation between a university's financial support and its performances in training students (Fig. 13) or total number of Nobel Laureates in University (Fig. 14).
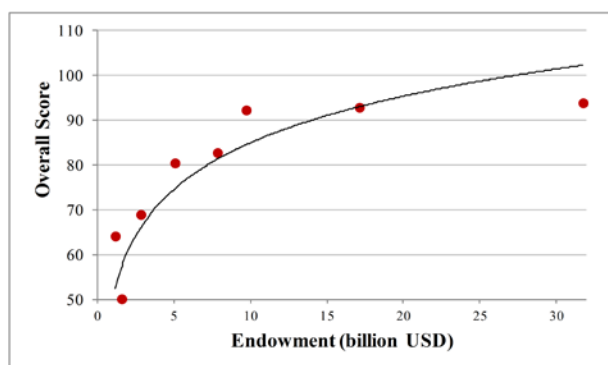

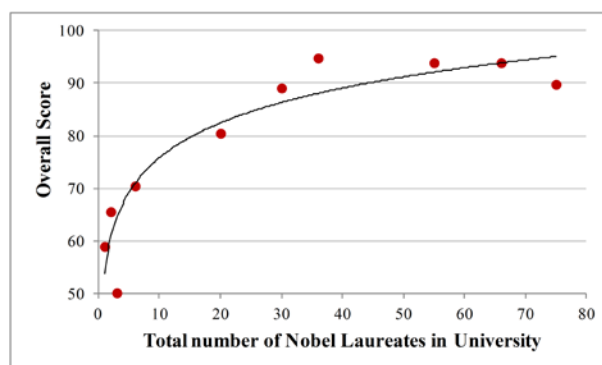**Fig. 13. Increased universities' score relative to increased financial endowment [25].**

Fig. 14. University' overall score vs number of Nobel Laureates in university [25, 26].

Therefore, as Albert Szent - Gyorgi (1893 - 1986) stated, "research means four things: brains with which we think, eyes with which we see, equipment with which we measure and … money". What is more, we are still to expect "the norms of academic evaluation for the universities' teaching staff and the ranking of Universities and National Research Institutes in Romania in compliance with the European standards" [24].

4. CONCLUSIONS

To sum up the main ideas in this paper, we should conclude that:
− The scientometric parameters analyzed lead, in principle, to identical rankings.
− The comparison of university teaching members of very different ages is irrelevant.
− The comparison of university teaching members from different fields is not appropriate due to several reasons.
− The artificial crisscrossed raise of the number of citations between different researchers is a phenomenon that must be prevented.
− A university's yearly financial endowment is directly correlated with the performance level of its students' training.
− The quantification of the scientific research results by scientometric methods represents the major criterion of their evaluation.

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