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The 5-year synchronous impact factor for large Journal Citation Reports (JCR) subject areas

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Abstract

Using the largest JCR Thomson Reuters subject areas it is shown that the two-year and the five-year impact factor of journals lead statistically to the same ranking per category. This observation holds for top journals as well as lower level journals. Yet in a majority of cases the 5-year impact factor is larger than the 2-year one. A special case was observed in which one article influenced macro statistics of a whole journal subject category.

Keywords

Synchronous impact factors; journal rankings; Wilcoxon matched-pairs signed-ranks test

Introduction

Since the 2007 edition the Journal Citation Reports of Thomson Reuters' Web of Knowledge include a five-year synchronous impact factor. As it is generally agreed that journal impact is a multidimensional notion (Rousseau, 2002) this addition, together with other ones such as the eigenfactor score and the article influence score, is received favourably by most scientists, see e.g. (Della Sala & Grafman, 2009; Jacsó, 2009). The definition of this impact factor is modelled after that of the standard Garfield-Sher two-year impact factor: for the year Y, and a given journal J, it is defined as:

$$IF_5(Y) = \frac{\sum_{k=1}^{5} CIT(Y-k, Y)}{\sum_{k=1}^{5} PUB(Y-k)}$$

where CIT(Y-k,Y) denotes the number of citations received by journal J in the year Y, referring to publications in J during the years Y-5 to Y-1. The corresponding number of publications (in the year Y-k) is denoted as PUB(Y-k). Several colleagues (Leydesdorff, 2009; Jacsó, 2009; Franceschet, 2010) immediately investigated the relation between this 5-year impact factor and other new and old journal indicators (such as the eigenfactor). Yet, Garfield already published comparisons between long-term (7-year and 15-year) and short-term (2-year) impact factors (Garfield, 1998 a,b). In these articles he observed that most top journals stay top journals, no matter how their impact is measured and, moreover, that rankings within a category did not change significantly. Inspired by an observation made by Leydesdorff (2009) the five-year impact factor has been studied in order to find out if it had something new to offer. Using a random sample of ten JCR categories it was investigated (Rousseau, 2009) if the two-year and the five-year impact factor of journals lead statistically to the same ranking of a JCR subject category. It was found that indeed they do. Yet, it was also found that in a majority of cases the 5-year impact factor is larger than the 2-year one. In this article these investigations are continued, making a distinction between journals with the highest number of total citations and journals with a lower total.

Method

We consider all JCR Thomson Reuters subject categories containing at least 140 journals (2007 edition). In each category journals are ranked according to the total number of received citations. Such a ranking can be considered as a ranking according to visibility. Each ranked category is then divided into four quarters and only the first (the top journals) and the third quarter (the lower middle group) are kept. Next, journals with incomplete data are removed. We did not use the fourth quarter mainly because this section contains too many missing values. We also assume, but did not test, that results would be more erratic. The JCR categories used in our investigation are shown in Table1 (first column), which further shows the number of journals actually used. Not surprisingly, the number of remaining journals in the second group is smaller than in the first. As in our previous study we calculated for each group the Spearman rank coefficients between the ranking according to the 2-year and the 5-year impact factor. We also included the Pearson correlation coefficient.

We further studied the difference in median (and average) between the 2-year impact factor and the 5-year impact factor. As in (Rousseau, 2009) we apply Wilcoxon's matched-pairs signed-ranks test (Sheskin, 2007, Test 18). Its null-hypothesis is that the median of difference scores is zero.

Following (Sheskin, 2007, Test 18) the test is performed by applying the following steps.

1) The differences between the scores of the two dependent samples (here the value of the 2-year and of the 5-year impact factor) are calculated.

2) One considers the absolute values of these differences. Zero values are removed. The number of remaining values is denoted as n.

3) These absolute values are ranked (from smallest to largest).

4) The original sign of the difference is added to the rank.

5) Sums are taken for all positive ranks (R+) and for all negative ranks (R-) separately.

6) The absolute value of the smaller of these two sums is called the Wilcoxon T test statistic, denoted as T.

7) This T-value is compared with the values provided in tables of critical values for Wilcoxon's matched-pairs signed-rank test. For large n there exists a normal approximation. The z-value is:

$$z = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}}$$

This value is always negative, but this plays no role when performing a nondirectional (two-sided) test. When a directional alternative hypothesis is employed the null hypothesis can only be rejected if the directional alternative hypothesis that is consistent with the data is supported.

If the null hypothesis is rejected one concludes that the two dependent samples represent different populations.

Results

Table 1 shows the correlation coefficients between rankings according to the 2-year and the 5-year impact factor. Clearly all values for the Spearman and

for the Pearson coefficient are statistically significant (a table of critical values can be found, e.g. in (Egghe & Rousseau, 1990)). Hence the finding (Rousseau, 2009) that the two-year and the five-year impact factor of journals lead statistically to the same ranking of a JCR subject category is confirmed. This result even holds for large subsets of JCR categories.

Table 1. Correlation coefficients between rankings according to the 2-year and the 5-year impact factor. n: number of journals; r: Pearson correlation coefficient; 'rho': Spearman correlation coefficient

Subject area	First quarter			Third quarter		
	n	r	p	n	r	p
Biochemistry & Molecular Biology	65	,994	,990	63	,920	,922
Cell Biology	39	,995	,993	38	,904	,887
Clinical Neurology	36	,986	,955	33	,920	,938
Engeneering, electric & electronic	55	,916	,870	47	,890	,897
Environmental Sciences	40	,958	,964	35	,924	,854
Material Sciences, multidisciplinary	46	,996	,941	44	,962	,937
Mathematics	52	,965	,968	44	,895	,862
Mathematics, applied	42	,760	,950	35	,843	,806
Neurosciences	53	,993	,990	49	,922	,913
Pharmacology & Pharmacy	52	,987	,976	47	,722	,949
Plant sciences	38	,997	,983	36	,955	,959
Economics	48	,935	,901	41	,870	,830

One result is clearly not in line with the other ones namely the Pearson correlation coefficient for Applied Mathematics, which is only 0,76. If, however we remove the top journal (*SIAM Review*) the Pearson correlation coefficient reaches the 'normal' value of 0,940. The reason of this remarkable difference lies in one article, namely Mark Newman's article "The structure and function of complex networks" published in 2003, which received 2176 citations so far (September 23, 2009). In the year 2007 alone it got 406 citations. This resulted in a five-year impact factor of 8,038, and had no influence anymore on the 2-year impact factor (2,455). This illustrates why a Spearman rank correlation is to be preferred for this type of comparisons. This is another example of how one article can influence macro statistics in journal evaluations. The case of the Pearson correlation coefficient of the category Pharmacology & pharmacy (third quarter) is due to the review journal *Reviews of Physiology Biochemistry and Pharmacology* which publishes very few articles and had in 2003 a few exceptionally highly cited articles.

Figures 1 and 2 show the average impact factors for the two quarters, ranked according to the 2-year impact factor.

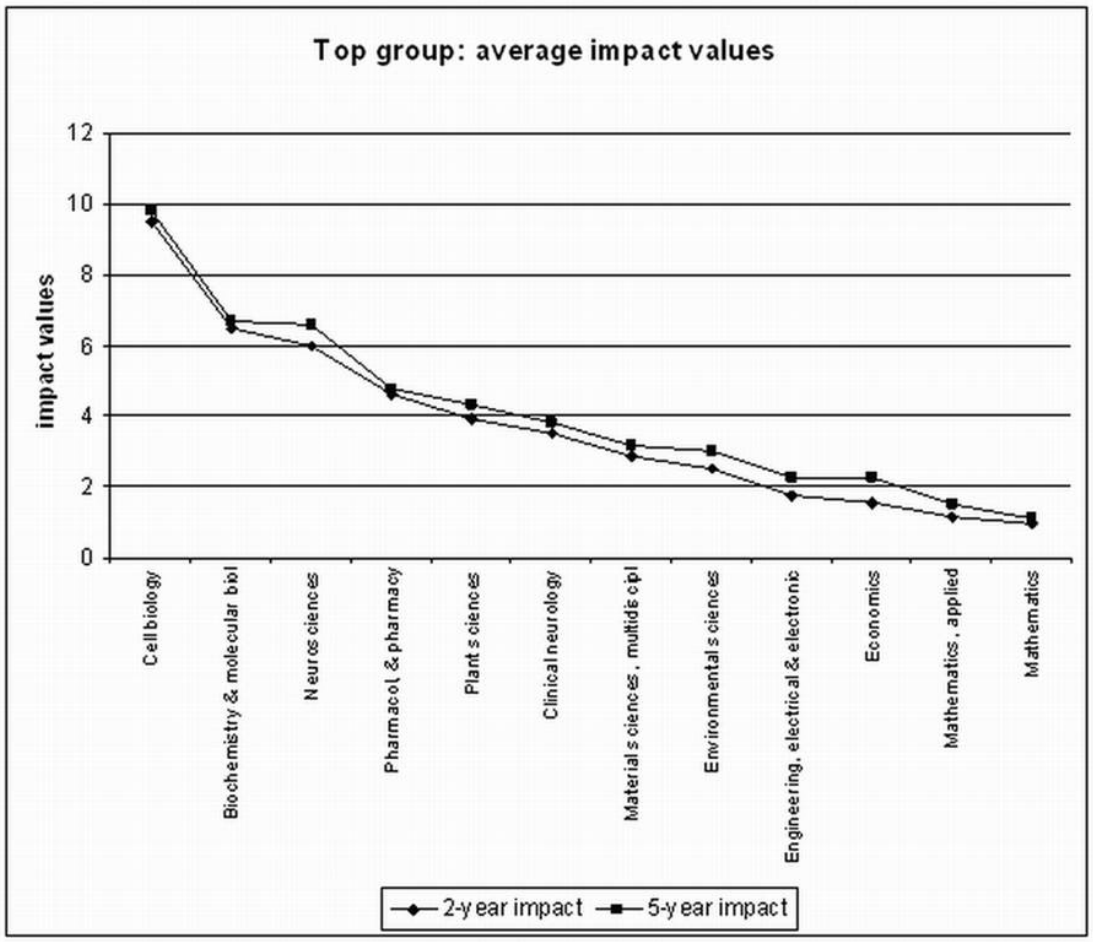

Fig 1. Average impact values for the top quarter

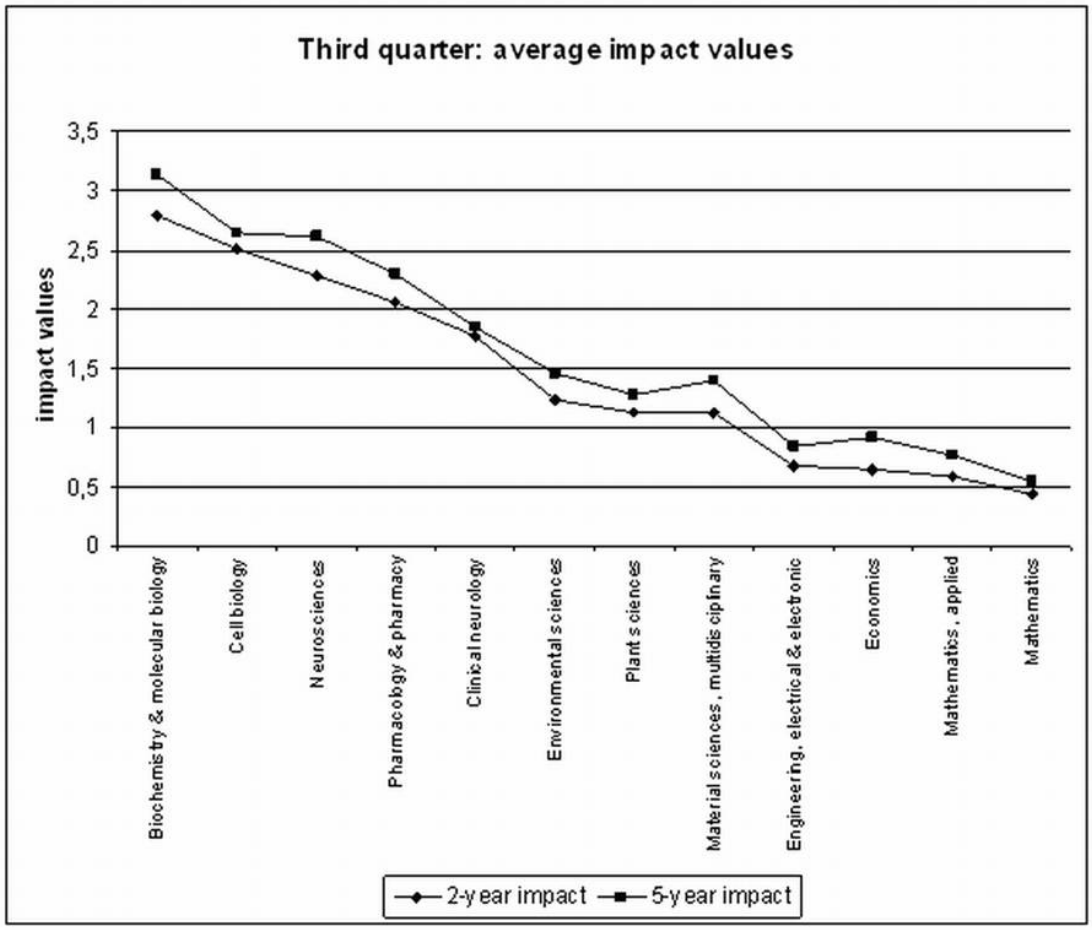

Fig 2. Average impact values for the third quarter.

These figures and Table 2, showing the ratio of the mean 5-year IF over the mean 2-year IF per quarter of a category, confirm that in all cases the average 5-year impact factor is larger than the 2-year impact factor. The largest difference occurs for economics, the smallest ones for Biochemistry & molecular biology, Cell biology and Clinical neurology.

Table 2. Ratios of impact factors

Subject area	Ratio of 5-year IF/2-year IF: first quarter	Ratio of 5-year IF/2-year IF: third quarter
Biochemistry & Molecular Biology	1,029	1,120
Cell Biology	1,031	1,052
Clinical Neurology	1,085	1,048
Engeneering, electric & electronic	1,257	1,263
Environmental Sciences	1,203	1,181
Material Sciences, multidisciplinary	1,115	1,250
Mathematics	1,146	1,214
Mathematics, applied	1,307	1,307
Neurosciences	1,099	1,147
Pharmacology & Pharmacy	1,041	1,112
Plant sciences	1,106	1,141
Economics	1,454	1,428
Average of this column	1,16	1,19

Table 3 contains the z-scores obtained by applying Wilcoxon's matched-pairs signed-rank. The critical value for a one-sided test on the 5% level is 1,96. Consequently, we may say that in the first quarter the null hypothesis of equal values is always rejected and hence the 5-year impact factor is larger than the 2-year impact factor. For the third quarter the null-hypothesis cannot always be rejected. This is the case for the categories Cell biology, Clinical neurology and Pharmacology & pharmacy. According to these z-scores the largest differences between these impact factors occur in the field of Economics. The results of this test confirm the observation made related to average impact factors in Table 2.

Table 3. Absolute values of z-scores for Wilcoxon's matched-pairs signed-rank test

Subject area	First quarter: z-values	Third quarter: z-values
Biochemistry & Molecular Biology	3,01	2,70
Cell Biology	2,76	1,07
Clinical Neurology	4,30	1,49
Engeneering, electric & electronic	5,64	3,74
Environmental Sciences	5,43	3,44
Material Sciences, multidisciplinary	4,39	4,76

Mathematics	4,99	4,72
Mathematics, applied	5,21	4,62
Neurosciences	5,25	4,06
Pharmacology & Pharmacy	2,49	1,11
Plant sciences	5,01	3,61
Economics	6,01	5,35

Note on the relation between the two-year and the five-year impact factor

It seems to be true, see also (Rousseau, 2009), that the five-year impact factor is, on average, larger than the two-year impact factor. In (Rousseau. 2009) we investigated this observation based on the so-called basic model. The term basic model refers to the simple model in which the synchronous citation curve is unimodal and has a mode at year two or year three after publication. This model further assumes that the number of publications a year is not decreasing. These assumptions seem to be too weak to come to a conclusion. We only predicted that for slow moving disciplines it is more likely that the two-year impact factor is smaller than the five-year one.

Conclusion

Using the largest JCR Thomson Reuters subject areas (those containing at least 140 journals) it is shown that the two-year and the five-year impact factor of journals lead statistically to the same ranking per category. This observation holds for top journals as well as for lower ranked journals. On a macro level this finding leads to the conclusion that the five-year impact factor has nothing to add to the two-year one. Yet, for specific journals ranks may change. It has, moreover, been the impression that in many fields a two-year period is too short for evaluating journals. Now that Thomson Reuters has added the five-year impact factor evidence is available to judge in any particular case. In a majority of cases the 5-year impact factor is larger than the 2-year one. We found a special case in which one article, namely Mark Newman's "The structure and function of complex networks" published in SIAM Review 2003 influenced not only the 5-year impact factor of a journal, but also the macro statistics of a whole journal subject category. This is somewhat reminiscent of the influence of Laemmli's article on the journal Nature (Liang & Rousseau, 2008).

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Appendix: About STIMULATE

STIMULATE stands for Scientific and Technological Information Management in Universities and Libraries: an Active Training Environment. It is an international training programme in information management, supported by the Flemish Interuniversity Council (VLIR), aiming at young scientists and professionals from developing countries. The programme has a dual purpose: on the one hand it intends to develop the personal professional skills of all participants, on the other hand participants are actively encouraged to transfer their newly acquired knowledge and skills to their colleagues and other stakeholders in their home country. If feasible STIMULATE students are introduced to the methods of writing articles and international publishing, leading to a nice series of publications (STIMULATE 4 Group, 2005; STIMULATE 6 Group, 2007; STIMULATE 8 Group, 2009; Rousseau & the STIMULATE 8 Group, 2009).

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