

# Is the Relationship between the Impact Factor and Papers' Citations Really Weakening?

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## Abstract

Recently, certain researches declared a weakening relationship between impact factor (IF) and papers' citations due to the increasingly convenient access to individual papers in the digital age. In this paper, we study the publication distribution of the most cited papers on the most cited journals (i.e., journals with highest IFs) based on three pieces of data, i.e., Science Citation Index Expanded (SCI-EXPANDED), Essential Science Indicators (ESI) and Journal Citation Reports (JCR). The results show that either from the overall or research field perspective, there is no obvious clue to indicate the weakening relationship between IF and papers' citations.

## Conference Topic

The relationship and development of five metrics science concepts, that is, Bibliometrics, Informetrics, Scientometrics, Webometrics and Knowledgeometrics.

## Introduction

Ever since it was proposed, the discussion around Impact Factor (IF) has never stopped (Garfield, 2006; Russell, 2002). The debates always focus on whether IF is an effective way for research evaluation and arouse many variants of IF, e.g., the source normalized impact per paper (Moed, 2010), the Eigenfactor (West & Bergstrom, 2010), and the SCImago Journal Rank (González, 2009), etc. In all those works, IF is treated as an important factor that can influence the potential citations a paper can receive (Waltman, 2016). However, most recently, certain researches declared a weakening relationship between IF and papers' citations due to the increasingly convenient access to individual papers in the digital age (Lozano, 2012). Whereas many others insisted that IF is still one of the most authoritative scientometric indicators for assessing the academic impact of journals and is influential to papers' citations.

Focusing on this debate, in this paper, we study the publication distribution of the most cited papers on the most cited journals (i.e., journals with highest IFs) to analyze the relationship between IF and papers' citations. Rather than ranking papers and journals with self-calculated citations and IFs (Lozano, 2012), we use citations and IFs published by Web of Science (WoS) and Incites. Further, we use IFs for journal ranking and Essential Science Indicators (ESI) baseline for top paper ranking. We believe this way is more objective and effective since WoS/Incites and ESI data is most widely accepted and used by scholars (Archambault, 2008; Meho, 2007). That means, if IF does have certain relationship with paper citation, it is WoS IF (rather than self-calculated IF) that affects scholars' impression to a paper and the willing of citing it. The results show that either from the overall or research field perspective, there is no obvious clue to indicate the weakening relationship between IF and papers' citations.

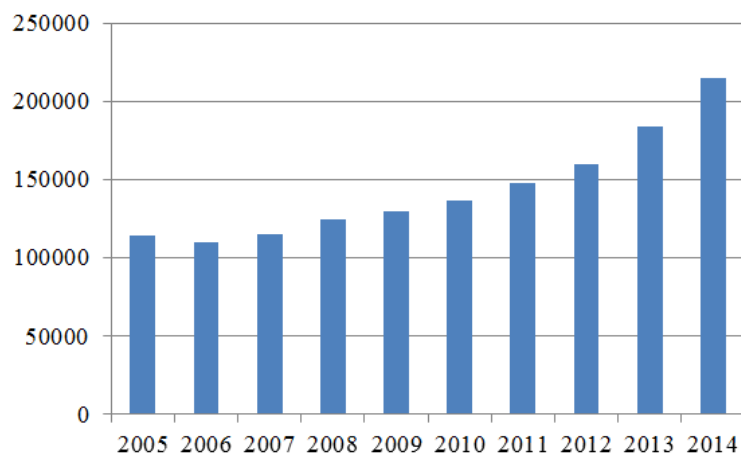
## Method

We made use of three pieces of data in our analysis, i.e., Science Citation Index Expanded (SCI-EXPANDED), Essential Science Indicators (ESI) and Journal Citation Reports (JCR). We first downloaded the bibliography data of papers covering all areas of natural sciences from SCI-EXPANDED in between 2005-2014, and mapped every paper to the corresponding

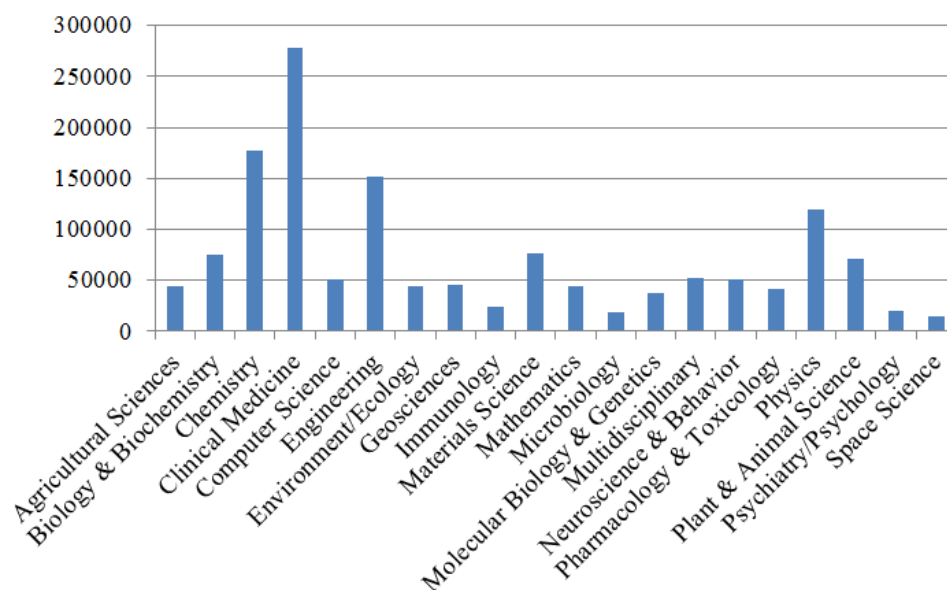
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research field according to the paper's publishing journal based on the ESI category. Then we associated every paper with a top-level (e.g., Top 1%) based on the paper's citation counts and the ESI citation baseline by considering the paper's research field and publishing year, and used the Top 10% papers for statistics, involving 1.44 million papers and 20 research fields. Fig. 1 and Fig. 2 shows the number of papers published in each year and each research field respectively.



**Figure 1 Paper counts vs. Publishing years**



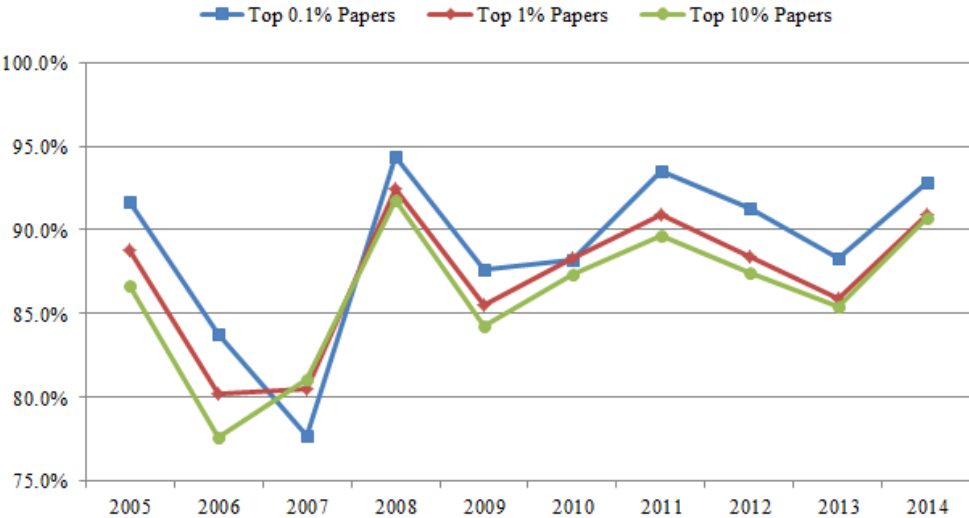
**Figure 2 Paper counts vs. Research field**

Further, for every research field, we ranked its belonging journals according to their Impact Factors (IF) in the decrease order year by year, and calculated the top-level (e.g. Top 5% journals) for every journal in every year. Finally, we calculated the yearly publication distributions of the Top  $m\%$  papers on the Top  $n\%$  journals to assess the overall relationship between IF and papers' citations and its variation trend, for  $m=0.1, 1, 10$  and for  $n=1, 5, 10$ , where Top  $x\%$  papers means papers with citation ranked in the Top  $x\%$  and Top  $x\%$  journals means journals with IF ranked in the Top  $x\%$ . Moreover, we also carried out statistics in a more detailed perspective, i.e., research field, to test whether the overall trend holds in most research fields.

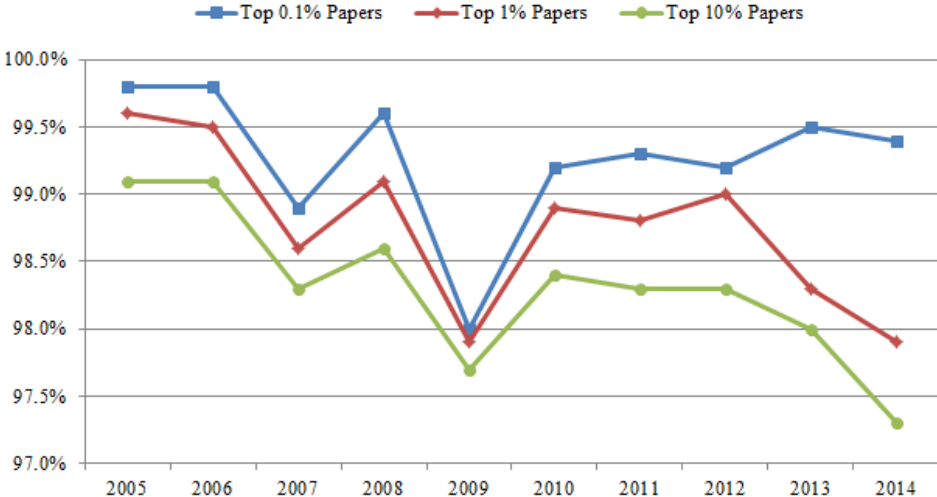
**Results**

*Overall results*

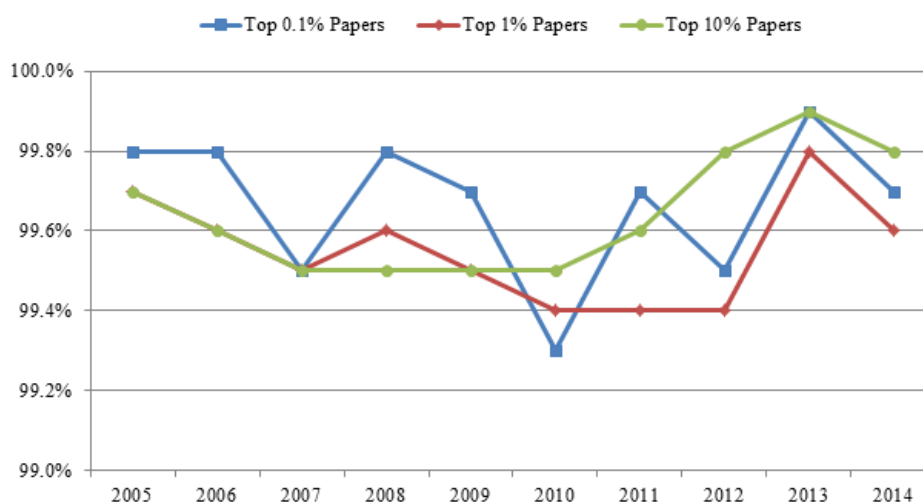
Fig. 3 to Fig. 5 show the percentages of the Top 0.1%, 1% and 10% papers published in the Top 1%, 5% and 10% journals, for all research fields and all countries (regions). From the figures, the following conclusion can easily be drawn: 1) in almost all the years, more than 80% of the Top 0.1%, 1% and 10% papers come from the Top 1% journals, and in average 88.9%, 87.2% and 86.3% of the Top 0.1%, 1% and 10% papers come from the Top 1% journals; 2) despite of small variations, the percentages of the Top 0.1%, 1% and 10% papers published in the Top 5% (10%) journals are all larger than 97% (99%); 3) none of the Figures reflects an obvious declining of the percentages (of top papers published in top journals). That is, in general best papers were still published in best journals, and there is no evidence to indicate the weakening relationship between IF and papers' citations.



**Figure 3 Percentages of the Top 0.1%, 1% and 10% papers published in the Top 1% Journals**



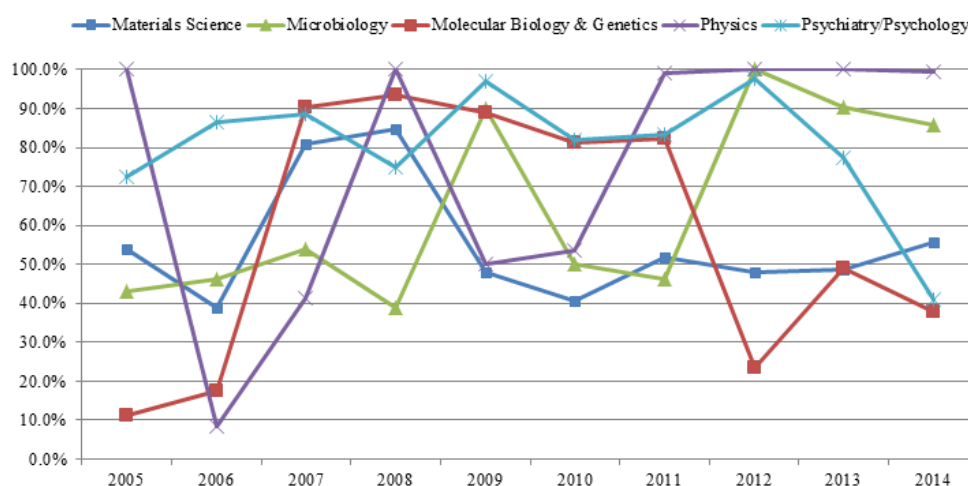
**Figure 4 Percentages of the Top 0.1%, 1% and 10% papers published in the Top 5% Journals**



**Figure 5 Percentages of the Top 0.1%, 1% and 10% papers published in the Top 10% Journals**

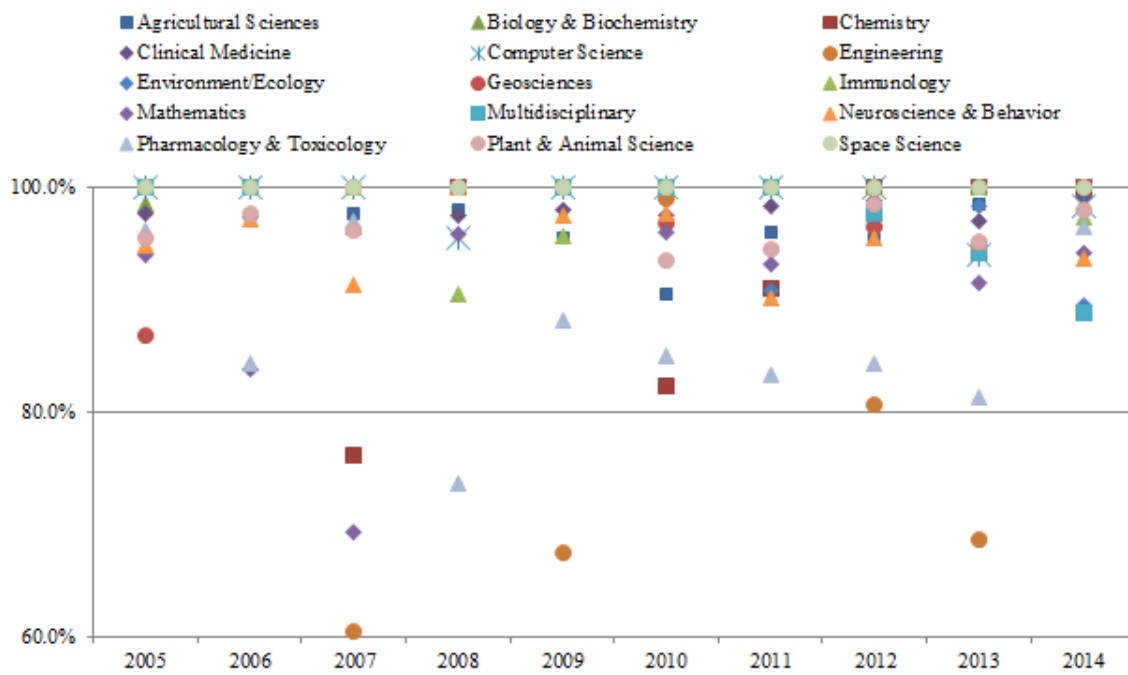
### *Field perspective*

Here we aim to see whether the same relationship (among the top papers and the top journals) holds from the perspective of different research fields. To fully understand the relationship among the *topest* papers and the top journals, here we focus on the Top 0.1% papers for illustration. In addition, the full statistic results including all the research fields and all the Top levels of papers and journals can be found in our supplementary materials<sup>†</sup>. From the results, we see that first, for the Top 1% journals, *a*) the percentages of the top papers published in the top journals are relatively low in certain research fields. As shown in Fig. 6, these fields include Material Science, Microbiology, Molecular Biology & Genetics, Physics and Psychiatry/Psychology. However, *b*) for all the remaining 15 research fields, the percentages of the top papers published in the top journals are approximately the same as the overall situation. As shown in Fig. 7, most of the percentages are larger than 80%, and in average 94.0% of the Top 0.1% papers come from the Top 1% journals.



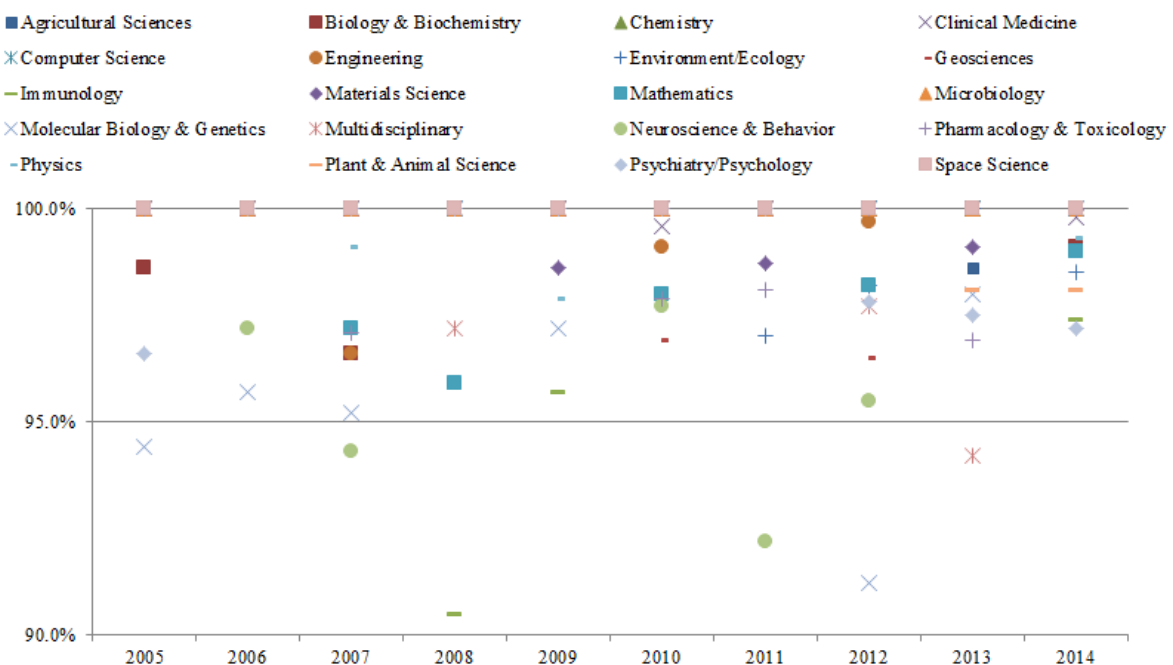
**Figure 6 Percentages of Top 0.1% papers published in the Top 1% Journals: Material Science, Microbiology, Molecular Biology & Genetics, Physics and Psychiatry/Psychology**

<sup>†</sup> The supplementary materials are interactive dashboards formatted as PDF files, please refer to either of the following URLs: Google Drive: <https://drive.google.com/file/d/0BwdzLr3JJ8qcZIJTMXJ3aWd3ZDQ/view?usp=sharing> OR Baidu Cloud: <http://pan.baidu.com/s/1mihsBO0> (Password for Access: zsnj)

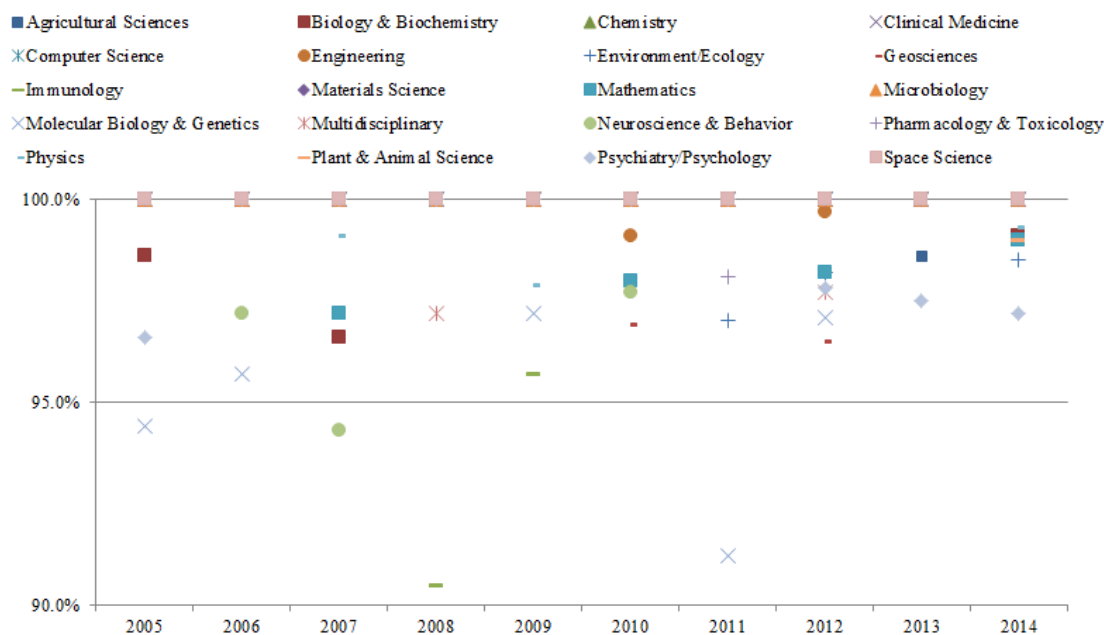


**Figure 7 Percentages of Top 0.1% papers published in the Top 1% Journals: Fields EXCEPT Material Science, Microbiology, Molecular Biology & Genetics, Physics and Psychiatry/Psychology**

Second, for the Top 5% and 10% journals, in almost all the research fields and years, more than 90% (95%) of the Top 0.1% papers come from the Top 5% (10%) journals, as shown in Fig. 8 (for Top 5% journals) and 9 (for Top 10% journals).



**Figure 8 Percentages of Top 0.1% papers published in the Top 5% Journals: All Fields**



**Figure 9 Percentages of Top 0.1% papers published in the Top 10% Journals: All Fields**

From the above analysis, it can be seen that same as the overall situation, there is no obvious evidence to indicate the weakening relationship between IF and papers' citations.

## Conclusion

In this paper, we studied the relationship between IF and papers' citations. The results show that either from the overall or research field perspective, there is no obvious clue to indicate the weakening relationship between IF and papers' citations. That means IF still acts as a very important indicator for the quality of academic journals and can influence the potential citation a research paper can receive. We believe that at least three reasons contribute to this fact. First, higher IF can still attract papers with higher quality for publication. Then, higher IF journals may have scholars with higher academic attainments for peer review. Hence only papers with higher quality may appear on the journals. Those two facts guarantee the papers' potential academic influence. Third, it is exactly because of the increasingly convenient access to individual papers in the digital age, that researchers can easily acquire large amounts of research results. Finding more appropriate references with higher quality becomes an urgent need. And it seems that currently there is no other way more effective and efficient than selecting based on IF and paper citation.

## Acknowledgments

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