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Comparing Journal Impact Factor and H-type Indices in Virology Journals

Zao Liu
zliu@tamu.edu

Gary (Gang) Wan
gwan@tamu.edu

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Zao Liu
Texas A&M University
zliu@tamu.edu
Gary (Gang) Wan
Texas A&M University

Abstract

This paper examines the relationships between the journal impact factor and the h-type indices in virology journals. The virology journals and their 2010 journal impact factors were retrieved from Journal Citation Reports. The h-index and the g-index values of the journals for 2007-2011 were obtained from Web of Science and Google Scholar. The journals were ranked by their journal impact factor and h-indices. The correlation analysis of the measures found a strong relationship between the journal impact factor and the h-type indices, and a stronger tie between the h-indices themselves. Despite the strong correlations between the measures, differences in rankings of the journals with the journal impact factor and the h-type indices were found, and possible explanations for the differences were provided.

Keywords: journal impact factor, journal h indices, citation analysis, correlation analysis, virology journals

Introduction

Citation analysis has frequently been used to evaluate the quality and quantity of academic journals. Traditionally, Web of Science (WoS) of Thomson Institute of Scientific Information (ISI) has been the only source for providing citation data. The journal impact factor, initiated by Garfield (1955) and presented in Thomson ISI Journal Citation Reports (JCR), has been the dominant bibliometric measure for assessing the quality of journals. It measures the average number of citations received by articles from a journal in a given year with a 2-year publication window and more recently, a 5-year publication window. In 2005 Hirsch proposed an alternative impact measure--the h index. Its definition is as follows: "A scientist has index h if h of his or her N_p papers have at least h citations each, and the other ($N_p - h$) papers has no more than h citations each" (Hirsch, 2005). In the following year, Braun, Gl□nzel, and Schubert (2006) suggested that the h index could be used to assess the impact of journals. Since its inception, the h-index has been widely used to evaluate authors, journals, institutions, and other areas. Considering that the h-index ignored the small number of highly cited papers, Egghe developed a new h-type index called the g-index, which gives more weight to highly cited papers. According to him, in a set of articles "if the set is ranked in decreasing order of the number of citations they received, the g-index is the (unique) largest number such that the top g articles receive (together) at g^2 citations" (Egghe, 2006). Therefore, in theory the g-index is always greater than the h-index. Presently, the h-index can be obtained from Web of Science, Scopus, and Google Scholar (GS). As an alternative citation database, Google Scholar provides a wide coverage of content, indexing literature from proprietary databases, publishers, preprint repositories and other sources. Previous studies have noted the importance of Google Scholar as a valuable source for citation

analysis in addition to Web of Science and Scopus (Harzing and van der Wal, 2009; Meho and Yang, 2007). The appearance of the h-index has led to a number of comparative studies of journal impact measures using Web of Science and Google Scholar as their citation sources.

Literature Review

Most of the studies applying the h-type indices to journals have focused on the relationships between the indices and the related impact measures. Using the Web of Science as their source, Braun, Glanzel, and Schubert (2006) compared the h-index and the journal impact factor of top multidisciplinary journals for 2001. They concluded that the h-index as a new bibliometric measure has "promising perspectives" for journal evaluation. Saad (2006) studied the h-index in business-related journals and reported a significant correlation between their h-index and journal impact scores. Another study found a positive relationship between the h-index and the journal impact factor in ecological journals indexed by Web of Science (Olden, 2007). The author indicated that the h-index can be a robust measure for assessing performance of journals. In their study of the h-index of business and management journals, Harzing and van der Wal (2009) used Google Scholar as an alternative source. Likewise, they found a strong correlation between the h-index and the journal impact factor for the journals. They argued that Google Scholar provides a better picture of journal ranking in economics and management than Web of Science. Of special note is the study made by Vanclay (2008) who ranked the forestry journals indexed in Web of Science and Google Scholar with the h-index, the journal impact factor, and an expert ranking. With the h-index showing a high correlation with the journal impact factor, the author reported that the h-index could rank journals objectively as it showed a closer agreement with the expert assessment than the journal impact factor. From a different perspective, Liu, Rao, and Rousseau (2009) studied two series of h-indices in horticulture journals. They found no linear increase in the h-indices in horticulture journals over time, and suggested that the Egghe-Rousseau power law was not applicable to the relation between the number of publications and the h-index. Bornmann, Marx, and Schier (2009) evaluated the organic chemistry journals by the h-type indices and the journal impact factor. They reported a similar high correlation between the h-indices and the journal impact factor. While they cautioned for a redundancy of various bibliometric measures in evaluating scientific literature, they valued the manageability of the h-index compared with the journal impact factor. Using citations of two publication years (2004-2005) for the h-index and 2006 journal impact factor, Bador and Lafouge (2010) examined the pharmacology and psychiatry journals. Their study showed a high correlation between the journal impact factor and the h-index in psychiatry journals but a lower relationship for pharmacology journals. They concluded that the h-index and the journal impact factor can be complementary when evaluating journals of the same scientific discipline. Moussa and Touzani (2010) ranked the marketing journals indexed in Google Scholar using the h-type indices and the journal impact factor. With a special focus on the relationship between the hg-index and the journal impact factor, they found these indicators were correlated well for the marketing journals. In addition, Bar-Ilan (2010) compared the h-type indices and the journal impact factor in the information and library science journals. She noted that, despite the high correlations among the ranked lists of the h-indices and the journal impact factor, the correlation measure was not sensitive enough. On the other hand, the M-measure and Spearman's footrule she used in the study were more sensitive to the differences between the rankings. Hodge and Lacasse (2011) ranked the social work journals with the Google Scholar h-index, the g-index, and the journal

impact factor. Their research showed a high correlation between the ranking measures. They suggested that the Google Scholar h-index may be preferred to the journal impact factor because of its more flexible citation window and wider coverage. Finally, Mingers, Macri, and Petrovici (2012) used the h-index and the journal impact factor to rank the business and management journals indexed in Google Scholar and Web of Science. They concluded that the h-index is preferable to the journal impact factor, and Google Scholar is also preferred to Web of Science as a data source. As little research has been done for the journal h-type indices and the journal impact factor in medical-science related fields, which are generally believed to be well covered by Web of Science, this paper examines virology journals using the citation data from both Web of Science and Google Scholar. It aims to see how different or similar these two citation databases are in terms of producing the h-type indices for the selected journals, and more importantly, how the journal impact factor is related to the h-type indices, and how these journals are ranked by these measures.

Methodology

The study compares the 2010 journal impact factor and the h-type indices in virology journals for 5-year time span (2007-2011). Thirty two journals in the virology category of JCR were selected for the study. The journal *Virologie* was not included because the years indexed for this journal in Web of Science did not match the target period.

The values of the two-year impact factor (JIF_2) for the journals were retrieved from the virology category in JCR for 2010. The WoS h-index was automatically computed from Web of Science whereas the GS h-index and g-index were computed from Harzing's *Publish or Perish* (2007), a free software program that retrieves citation data from Google Scholar. The data was collected on May 2, 2012. In order to avoid inaccurate search results, a journal title was put in quotation marks in a search. If an inaccurate result was suspected in a title search, the journal's ISSN was used instead. The search results of the h-type index values were visually inspected for their accuracy and relevancy. A Spearman correlation analysis of the measures was conducted using SPSS.

Results

Table 1 presents the values of the 2010 JIF_2, the WoS h-index, the GS h and g indices for 2007-2011, and the rank orders of the journals. As expected, the GS g-index values are higher than those of the GS h-index with a mean of 43.25 and 30.84, respectively. It is interesting to note that the GS h-index values are generally higher than the WoS h-index values (mean = 25.37) with the exception of those for *Virology Journal* and *Advances in Virus Research*. On average, the GS h-index values are 30% higher than those of the WoS h-index. *PloS Pathogens* is ranked the first with the JIF_2 and *South African Journal of HIV Medicine* is ranked the last with the metric. In addition, *Journal of Virology* has the highest rankings with the h-indices whereas *Indian Journal of Virology* is ranked the lowest with the h-indices.

Overall, the rank orders between the WoS h-index, the GS h-index, and the GS g-index do not differ too greatly. Nine out of the thirty-two journals have the same ranking positions with these three measures. Fifteen journals have the identical ranking orders with the GS h-index and the

GS g-index whereas seventeen journals are ranked the same with the GS h-index and the WoS h-index. However, it should be noted that among the journals with the identical rank orders with the GS h-index, different values of their GS g-index are found. For instance, *Antiviral Research* and *Journal of Clinical Virology* both have the same GS h-index value (41), but different GS g-index value (53, 60 respectively). On the other hand, some journals exhibit a noticeable difference in the rank orders of the JIF_2 and the H-type indices. For example, *Advances in Virus Research* is ranked sixth with the JIF_2, twenty-third with the WoS h-index, twenty-sixth with the GS h-index, and twenty-third with the GS g-index. Compared with the JIF_2 ranking, *Reviews in Medical Virology* loses twelve places with the WoS h-index ranking and the GS h-index ranking, and ten places with the GS g-index ranking. On the other hand, several journals, such as *Virology*, *Journal of Virological Methods*, *Journal of General Virology*, and *Virus Research*, move up significantly in rank with these measures.

Table 1. Virology journals ranked by the JIF_2 (2010) and the h-indices (2007-2011)

Journal	JIF_2	Rank	WoS_H	Rank	GS_H	Rank	GS_G	Rank
PloS Pathogens	9.079	1	63	2	76	2	104	2
AIDS	6.348	2	57	3	71	3	98	3
Reviews in Medical Virology	5.6	3	25	15	31	15	49	13
Retrovirology	5.236	4	31	9	39	9	55	7
Journal of Virology	5.189	5	74	1	88	1	119	1
Advances in Virus Research	4.833	6	15	23	15	26	27	23
Antiviral Research	4.439	7	33	7	41	6	53	10
Journal of Clinical Virology	4.023	8	34	6	41	6	60	6
Influenza and Other Respiratory Viruses	3.812	9	18	20	21	20	32	20
Antiviral Therapy	3.774	10	32	8	39	9	54	8
Journal of General Virology	3.568	11	38	5	45	5	66	4
Journal of Viral Hepatitis	3.502	12	30	11	38	11	53	10
Virology	3.305	13	40	4	48	4	64	5
Virus Research	2.905	14	31	9	40	8	54	8
Journal of Medical Virology	2.895	15	29	13	34	13	49	13
Microbes and Infection	2.726	16	30	11	35	12	50	12
Virology Journal	2.546	17	23	19	21	20	33	19

International Journal of Medical Microbiology	2.399	18	25	15	30	16	43	16
Journal of Neurovirology	2.243	19	15	23	19	23	23	25
Archives of Virology	2.209	20	25	15	30	16	49	13
Journal of Virological Methods	2.139	21	26	14	32	14	41	17
AIDS Research and Human Retroviruses	2.082	22	24	18	28	18	39	18
Current HIV Research	1.923	23	16	22	22	19	30	21
Viral Immunology	1.871	24	14	25	17	25	23	25
Intervirology	1.756	25	13	26	19	23	25	24
Virus Genes	1.693	26	17	21	21	20	28	22
Food and Environmental Virology	1.381	27	5	30	6	31	8	31
Future Virology	1.2	28	10	27	12	27	15	27
Indian Journal of Virology	1.133	29	2	31	3	32	3	32
Viruses-Basel	1	30	9	28	10	28	13	29
Acta Virologica	.547	31	6	29	7	30	10	30
South African Journal of HIV Medicine	.378	32	2	31	8	29	14	28

The results of the Spearman correlation analysis of the JIF_2, the WoS h-index, the GS h-index, and the GS g-index are displayed in Table 2. As demonstrated, the three h-type indices are highly correlated with one another. It is almost a perfect positive relationship. In addition, there are strong positive relationships between the JIF_2 and the h-type indices. Figures 1-2 further illustrate these relationships. By and large, both diagrams show the similar citation trends for the journals. As the JIF_2 values of the journals increase, so do the values of their WoS h-index and GS h-index. However, several outliers (e.g. *PloS Pathogens* and *Journal of Virology*) are found showing the high h-indices or the JIF_2 values.

Table 2. Correlations between the JIF_2 (2010) and the h-indices (2007-2011)

	JIF-2	WoS_h	GS_h	GS_g
JIF_2	1			
WoS_h	.821*	1		
GS_h	.796*	.992*	1	

GS_g	.830*	.988*	.987*	1

* $p < 0.001$

Figure 1. Scatter plot of the JIF_2 and the WoS h-index

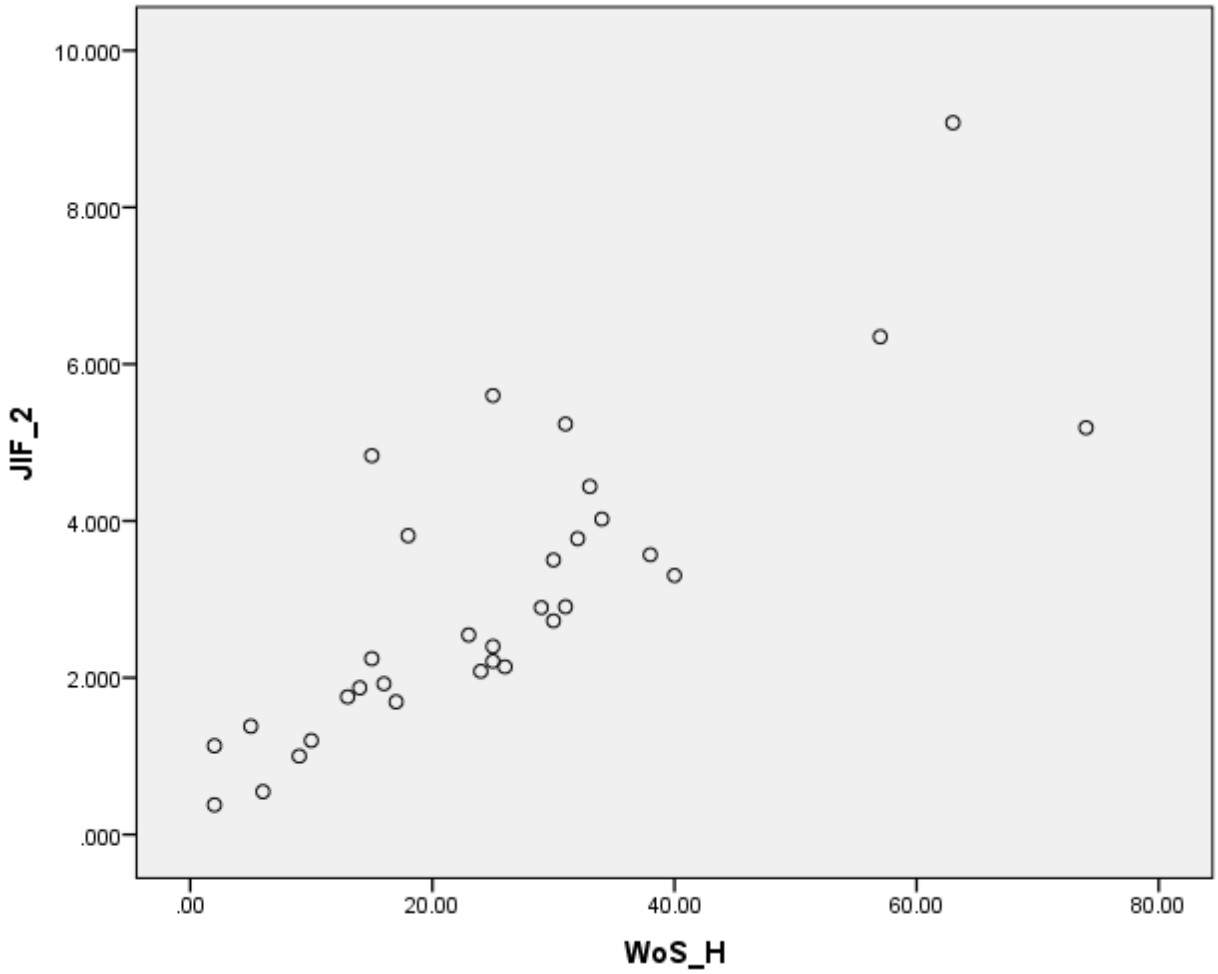
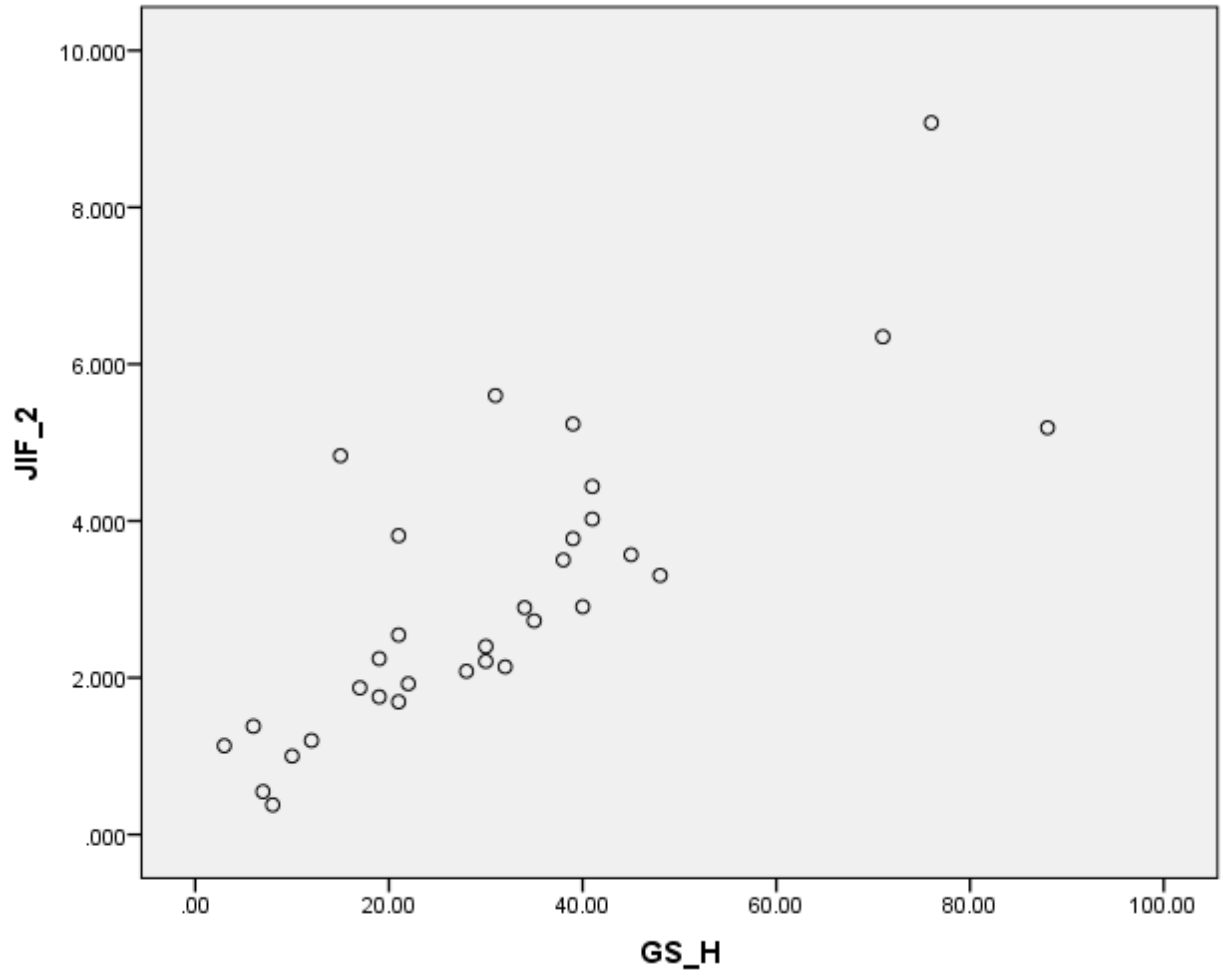


Figure 2. Scatter plot of the JIF_2 and the GS h-index



Discussion and Conclusions

The main purpose of this study is to explore the relationships between the h-index, the g-index, and the journal impact factor obtained from the Web of Science and Google Scholar. The results indicate that they are all significantly correlated. This finding is consistent with those obtained in previous studies in other subject areas, e.g. forestry (Vanclay, 2008), library and information science (Bar-Ilan, 2010), and business and management (Mingers, Macri, & Petrovici, 2012). It is important to note that the correlation coefficients for the h-type indices are higher than those between the h-type indices and the journal impact factors, suggesting a stronger tie between the h-type indices. This is understandable given the fact that the h-type indices are produced following the similar principles.

In general, the GS h-index values are greater than the WoS h-index values for the journals under study. The differences may result from the wider coverage in Google Scholar which includes more formats of materials in its content. This suggests that the advantage of wider coverage in Google Scholar can even apply to a medical-science filed like virology. Further, the GS g-values

are obviously greater than the GS h-index values for some journals with identical GS h-index ranking, indicating that some articles in the former are more frequently cited than those in the latter.

Despite the high correlations among the measures, there are still differences in rank orders in regard to the h-type indices and the journal impact factor. The ranking differences may be due to the fact that journals publishing a limited number of articles per year generally have a low h-index compared with their journal impact factor (Harzing and van der Wal, 2009; Bar-Ilan, 2010). This can partly explain why *Advances in Virus Research* and *Reviews in Medical Virology,* which publish mainly review articles, have lower h-index ranking than their JIF_2 ranking. On the other hand, some journals are ranked higher with the h-indices than with JIF_2 partly because they publish a large number of articles, which increases their chance of generating higher h-indices. For example, *Virology* and *Journal of Virological Methods* are ranked 13th and 21st with the JIF_2, but 4th and 14th with the WoS h-index, respectively. Both journals have published a relatively large number of articles and have some highly cited papers for the study period. Conversely, if their total citations are not high enough, the large number of articles in these journals may also lower their JIF_2, which is based on the average number of citations to articles published in the journals during the two previous years.

The findings of this study have practical implications to professional stakeholders. Publishers and journals editors may benefit from the findings of this study as it informs them of the status of virology journals from different perspectives. The study may also be of interest to academic librarians who need the information for journal subscriptions and fund-allocation in this area. Furthermore, researchers in the field may find rankings of the journals helpful when they submit their papers for publication. Finally, academic administrators may use the information in considering tenure and promotion cases for their institutions.

It should be pointed out that the study is limited in the following ways. First of all, as virology is a very diffuse field, often encompassing medicine, veterinary science, biology, and agriculture science, this study only examined the journals from the virology category in JCR, which has its own criteria for including journals into its categories. Second, citation analysis, though a valid approach to assessing journal quality, is not the only way to do so. Other methods, such as expert judgment, can be used to provide a more comprehensive evaluation of journals.

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