The Relationship between Journal Self-citation and Other Scientometric Data for Some Subjects of the Social Sciences

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Abstract
The present study analyzes and compares the journal self-citation (both self-citing rate and self-cited rate) and other scientometric data for journals of economics, psychology and political science from SSCI Journal Citation Reports on the Web 2005. The correlation between each of the nine pairs of two self-citation data and four kinds of scientometric data, i.e. source item, citation count, impact factor and cited half-life is examined based on the Pearson correlation tests. The Fisher's Z-transform is employed to test the significant difference between the Pearson correlation coefficient for each pair of scientometric data from the three subject areas. The significance of mean difference of each scientometric data was examined by the Tukey tests within the ANOVA. The similarities and differences in scientometric data among the three disciplines are identified.

1. Introduction and Literature Review

A citation analysis is considered to be important for evaluating the impact of researcher's works and for the research assessment exercises in many institutions. The journal citation analysis has become a dominant research technique with applications in various disciplines. One of the limitations of using citation to measure the quality or reputation of a journal is the phenomenon of self-citation. The ISI defines the self-citation as "when a journal article cites an article from the same journal". In fact, self-citations often make up a significant portion of the citations a journal gives and receives each year (Thomson Scientific, Web of Knowledge, 2004). Lawani (1982, p.281) classified the self-citation into two types, synchronous and diachronous. Following Lawani's definition, an author's synchronous self-citations are those contained in the references the author gives pointing backwards in time, whereas diachronous ones are those included in the citations an author receives. On the other hand, the ISI has defined the self-citing rate as the ratio between the number of times a journal cites itself and the number of total references it makes; and the self-cited rate as the number of times it is cited by itself over all citations by all journals including itself (Thomson Scientific, SCI JCR CDROM, 2000). According to Lawani's and ISI's definitions, it may be concluded that synchronous self-citation is self-citingness and diachronous one is self-citedness.

Several previous studies analyzed self-citations synchronously. The results of these works have shown that the self-citation rates may be different among various disciplines. The diachronous self-citation rates, on the other hand, may differ from those calculated synchronously. In some bibliometric studies of research performance the percentage of diachronous self-citations has been included as a critical indicator (Aksnes, 2003). Lipetz (1999) examined different aspects of JASIS authorship through five decades. One of his findings was that the percentage of articles containing any journal self-citation increased more or less linearly over the time, from 24% in 1955 to 82% in 1995. Peritz and Bar-Ilan (2002) studied the extent to which the field of bibliometrics and scientometrics makes use of sources outside the field. One of their results shows that when comparing two periods, journal self-citation (i.e., references to the journal *Scientometrics*) increased considerably, from 12.9% (136 journal self-citation) in 1990 to 20.1% (354 journal self-citation) in 2000. Nisonger (2000) investigated the use of the ISI's JCR for journal management in academic libraries. He explored the impact of journal self-citation on JCR rankings of library and information

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science and genetics journals, 1994. His study showed that the overall self-citation rate in 1994 for LIS journals was 27% and 11.7% for genetics journals. Journal rankings by impact factor and total citations received were recalculated with journal self-citations removed and concluded that librarians may use JCR data without correcting for journal self-citation.

Maczelka and Zsindely (1992), based on JCR data for twenty-two new chemistry journals, discovered that the self-citation rate was high immediately following a journal's founding but then decreased during the first two years of the journal's existence and finally stabilized after four or five years. Fassoulaki, et al.(2000) calculated the self-citing rate and self-cited rate for six anaesthesia journals and found that all six journals had a self-citing rate higher than the citing rates they gave to the other journals. They also explored the relationship between journal self-citation and its impact factor and found a significant correlation between self-citing rates and impact factor. In addition, the citation each journal gave to other journals, including itself, and the citations each journal received from the other journals differed significantly among the six journals. Rousseau (1999) clarified the citation structure of journals in terms of self-citing and the self-cited rates and found that self-cited rates reach an earlier peak than external citation. Garfield (1974, p.192) compared both the self-citing and self-cited ratios for twenty-most cited journals of science and observed that, in most cases, leading journals have a smaller self-cited than self-citing ratio. However, Garfield did not perform any statistical test and a major limitation with most previous studies is their small sample size. By applying the Pearson correlation coefficient and Spearman rank order coefficient test for the most productive journals in the domain of semiconductor, Tsay(2006) investigated the self-citations of most productive semiconductor journals by synchronous and diachronous approaches and reveals that journals with higher self-citing rate tend to be more productive and receive more citation than journals with lower self-citing rate. A journal with a high self-citing rate tends to be cited more by itself. Moreover, Tsay found that the journal self-cited rate has no association with the number of articles that a journal published and the citation it received. Above review indicates that the relationship between self-citing rate or self-cited rate and impact factor or cited half-life has not been explored in the literature. Moreover, these previous works focus mostly on journals in science or technology subjects. The citation behaviors for researchers in the social sciences may be significantly different. It is, therefore, of significant interest to study the characteristics of journal self-citations and their relations with other bibliometric properties of the journal.

The objectives of the present study are to investigate the relationship and difference between the self-citation rate of journals and their other scientometric data, in terms of source item, citation count, impact factor and cited half-life in three significantly different subjects of the social sciences, i.e., economics, psychology, and political science, by employing Pearson correlation test, Fisher's Z-transform and ANOVA test. In addition, the relationship and difference of self-citing rate and self-cited rate are also examined. There are about 12 major disciplines in SSCI JCR 2005 edition, including more than 1600 journals. Journals in economics, psychology and political science may be considered as a representation for the more general subject group of business and management, education, sociology, political science and law, respectively. Therefore, they are chosen to be the objects of this study to explore the similarity and difference of self-citation phenomenon among these three disciplines. The results are also compared with those reported in the literature.

The results of the study clarify these relationships and differences and will help librarians to make journal acquisition and cancellation decisions, and to plan subscription budgets, at least for these three particular fields. They may also help information analysts to develop new quantitative indicators of journal performance, and develop various models of scholarly communications processes in the three subject areas under study.

The journal scientometric data, for this study, were drawn from the SSCI Journal Citation Reports on the Web 2005. In the following, definitions for some terms of scientometric data and journal productivity are given [Thomson Scientific, 2004]:

1. Cited Half-life

The cited half-life is "the number of publication years from the current year which account for 50% of current citations received. They basically reflect the timeliness with which articles in a journal are citing other articles, and are cited by other articles. This figure can help one evaluate the age of the majority of cited articles published in a journal."

2. Source Item (journal productivity)

The source item is the number of articles published in the current year.

3. Impact Factor

The journal impact factor is "a measure of the frequency with which the 'average article' in a journal has been cited in a particular year." The JCR impact factor is calculated by dividing the number of current citations to articles published in the two previous years by the total number of articles published in the two previous years.

2. Methodology

In this study, the scientometric data were drawn from the SSCI JCR on the Web 2005. The database, published by the Thomson Scientific (now renamed as Thomson Reuters), is an essential, comprehensive, and unique resource tool for journal evaluation with scientometric data drawn from over 1,650 scholarly and technical journals worldwide. The JCR is the only source of scientometric data on journals, and shows the relationship between citing and cited journals in a clear, easy-to-use framework.

JCR provides a listing of journals ranked by scientometric data, such as source item, impact factor, citing and cited half-life, etc. within a category. Specific descriptions of each of several scientometric parameters are given in the database. Six of these parameters—the self-citing rate, the self-cited rate, the citation count, the source item, the impact factor, the cited half-life—are examined and compared in this study. The Pearson correlations from each pair of scientometric data were calculated to assess the significant relationship between each of the 9 pairs of these scientometric data. The Fisher's Z-transform was used to test the significant difference between the Pearson correlation coefficient for each pair of scientometric data of two subject areas. In this study, SSCI JCR web 2005 lists 170 journals for the subject of economics. The number of journals for economics and political science is 416 and 79, respectively.

The literature review in the above section suggests the following hypotheses for the subject of economics, psychology and political science literature:

1. For journal self-citing rate and self-cited rate, there is an association between each of them and source item and between each of them and citation count.
2. For journal self-citing rate and self-cited rate, there is an association between each of them and impact factor and between each of them and cited half-life..
3. There is an association between journal self-citing rate and journal self-cited rate.
4. There is a significant difference between the Pearson correlation coefficient for self-citing rate and self-cited rate and for each of them and source item, citation count, impact factor and cited half-life.

5. There is a significant difference between the mean of journal self-citing rate and journal self-cited rate and between the mean of source item, citation count, impact factor and cited half-life.

The self-citing and self-cited data were drawn from the Citing Journal Listing and the Cited Journal Listing of the *Journal Citation Reports* (JCR). Self-citing and self-cited rates were determined by the method suggested by the JCR. For example, in 2004 the journal *Scientometrics* was cited 860 times. Of those citations, 366 were self-citations. Its self-cited rate was therefore 366/860=0.4256 or 42.56% for the year 2004. In contrast, in the references of articles published by *Scientometrics* in the same period, there were 2,199 citations. Its self-citing rate therefore was 366/2199=0.166439, or 16.64% for the same period.

This study was a synchronous type comparison between journals of three subject fields. The data collection for all journals was on the basis of the same year of 2005. Although the actual values of citation count for journals vary from one year to another, in general, there is a fair degree of stability in citation rank from year to year. New titles would clearly be at a disadvantage, but for established titles the difference in half-life and ranks of citation would change insignificantly within a few years. While actual values of impact factors and immediacy index shift from year to year, their relative ranking is probably more stable within near years. Although this discrepancy could be acknowledged as a limitation of this study, it is not a serious limitation.

3. Results and discussion

The data of self-citing rate, self-cited rate, source item, citation count, impact factor, and cited half-life, were retrieved and calculated from SSCI JCR on the Web 2005 by the title-by-title search, for the three subjects under study. Statistical tests were conducted to examine the four hypotheses stated previously in the section of Methodology. As stated earlier in the previous section, the Pearson correlation was applied to determine the correlation coefficient between each pair of scientometric data. With the self-citing rate, self-cited rate and the other four scientometric indicators under consideration, there are nine pairs for conducting the test.

3.1 Pearson correlation tests

Table 1 shows the Pearson correlation coefficients of journals in the subjects of economics, psychology and political science for the nine pairs of scientometric indicators together with the p-value and the number of journals for each study pair in the parenthesis. For example, the correlation between self-citing rate and citation count for the journals in the subject (I) economics is 0.384 with a p value of 0.00 and the number of journals for this subject pair is 170. On the other hand, the correlation between self-citing rate and impact factor for the journals in the subject (II) psychology is 0.115 with a p value of 0.02 and the number of journals for this subject pair is 416. Although the correlation is as small as 0.115 with a p value of 0.02, which is smaller than 0.05, the correlation is considered to be significant. Indeed, for the sample size of 416 in this case, the critical correlation value for P = 0.05 is 0.088 (Minium and Clarke 1982, Appendix H, p.A54). In the Table, those pairs with a significant correlation are marked.

Table 1 Pearson correlation coefficient (α=0.05) between each pair of scientometric data

	Self-cited			Source item			Citation count		
Self-citing	I	II	III	I	II	III	I	II	III
	.216** (.00,170)	.381** (.00,416)	.098 (.39,79)	.153* (.05,170)	.232** (.00,412)	.267* (.02,79)	.384** (.00,170)	.315** (.00,416)	.479** (.00,79)
Self-cited				I	II	III	I	II	III
				-.004 (.96, 170)	-.058 (.24,412)	.061 (.59,79)	-.281** (.00, 170)	-.209** (.00,416)	-.256* (.02,79)

	Impact factor			Cited half-life		
Self-citing	I	II	III	I	II	III
	.294** (.00,170)	.115* (.02,416)	.391** (.00,79)	.200* (.01,150)	.208** (.00,399)	.304* (.02,61)
Self-cited	I	II	III	I	II	III
	-.355** (.00,170)	-.256** (.00,416)	-.368** (.00,79)	-.385** (.00,150)	-.225** (.00,399)	-.172 (.19,61)

**α=0.01; *α=0.05
I: Economics; II: Psychology; III: Political Science

The table indicates that there are significant variations in the magnitude of correlation. Table 1 indicates that there is significant correlation between self-citing rate and self-cited rate for both subjects of economics and psychology, while no correlation exists for the subject of political science. This suggests the citation behavior of the researchers in the political science is different from those of economics and psychology. The positive correlation between self-citing rate and self-cited rate agrees with that reported by Tsay (2006) for semiconductor journals. For journal self-citing rate and self-cited rate, the correlations between each of them and citation count and between each of them and impact factor for the three subjects under study are all significant. The positive correlation between self-citing rate and impact factor was also observed by Fassoulaki, et al.(2000) for six anaethesia journals. There is also significant correlation between self-citing rate and source item for the journals in the three subjects, while there is no association between self-cited rate and source item. This is consistent with what reported by Tsay (2006) for semiconductor journals, in which, Tsay revealed that journals with high self-citing rate tend to be more productive and the journal self-cited rate has no association with the number of articles that a journal published.

Interestingly, the correlation between self-citing rate and citation count are all positive for the three subjects under study, while they are all negative between self-cited rate and citation count. This suggests that, for the three subjects, the more the citation count is, the higher the self-citing rate is and the lower the self-cited rate is. Similar situation appears for the correlation between self-citation rates and impact factor for the journals in the three subjects. The positive correlation between self-citing rate and citation count is consistent with that reported by Tsay (2006) for journals in semiconductor.

For the subjects of economics and psychology, there are 8 out of 9 pairs with significant correlation. Among them 5 pairs are positive, which includes the correlation between self-citing rate and self-cited rate, between self-citing rate and source item, between self-citing rate and citation count, between self-citing and impact factor and between self-citing and cited half-life; three pairs are negative, which are between self-cited rate and citation count, between self-cited rate and impact factor and between self-cited rate and cited half-life. The only pair with insignificant correlation is between self-cited rate and source item.

As for the subject of political science, there are only six pairs with significant correlation. In addition to the insignificant correlation between self-cited rate and source item as for the other two subjects, there is no correlation between self-citing rate and self-cited rate, as indicated earlier and between self-cited rate and cited half-life. For those pairs with significant correlation, it is positive between self-citing rate and other scientometric indicators and negative between self-cited rate and other scientometric indicators listed in Table 1.

3.2 Fisher Tests

As indicated earlier, Table 1 illustrates that the correlation coefficient for each pair is quite different for journals in the three subject areas under study. For example, the correlation coefficients between self-citing and citation count are from 0.315 to 0.479. To further clarify the difference of the correlation between each pair for journals in these three subject fields under study, a Fisher test is conducted. Let

$$Z=0.5\log[(1+\rho)/(1-\rho)]$$

be the Fisher's Z-transformation of the sample correlation coefficients ρ. Suppose we have a sample of size n1from one population and a sample of size n2 from the other population, under the null hypothesis H: $\rho_1=\rho_2$, Z_1-Z_2 has normal distribution with mean 0 and variance an asymptotic $1/(n_1-3)+1/(n_2-3)$. A critical region of size 5% is therefore (Anderson 1984, p.122):

$$|Z_1-Z_2|/[1/(n_1-3)+1/(n_2-3)]^{0.5} >1.96 \ (\alpha=0.05),$$

The null hypothesis is rejected if a pair-wise difference between correlation > 1.96. Table 2 illustrates the pair-wise difference between correlation for scientometric data and self-citation rate with significant correlation for the three samples under study, i.e. economics, psychology and political science journals. The table clearly indicates that, except for the subjects of economics and psychology in the correlations between self-citing rate and self-cited rate and between self-citing rate and impact factor, and for the subjects of psychology and political science in correlations between self-citing rate and impact factor, there is no significant difference for the three subjects in the correlation for all the pairs with significant correlation. The fact that there is no significant difference for the three subjects in the correlation for majority of pairs under study indicates that the self-citation behavior for the three subjects under study are quite similar to each other.

Table 2 Pair-wise difference between correlation for Scientometric data

	Self-cited	Source item	Citation count	Impact factor	Cited Half-Life
Self-citing rate	3.190*(I&II)	0.894(I&II) 0.863(I&III)	-0.858(I&II) -1.567(II&III) 0.845(I&III)	-2.044*(I&II) -2.383*(II&III) 0.795(I&III)	0.086(I&II) -0.731(II&III) 0.717 (I&III)
Self-cited rate		NA (I&II) NA(II&III) NA(I&III)	0.836(I&II) 0.398(II&III) 0.195 (I&III)	1.192(I&II) 0.996(II&III) -0.108(I&III)	1.833(I&II) NA(II&III) NA(I&III)

I: Economics; II: Psychology; III: Political Science
NA: Not Applicable;
* α=0.05, pair-wise difference between correlation>1.96, the null hypothesis is rejected.

3.3 Mean difference tests

It is also interesting to explore the mean difference of scientometric data among the three subjects under study, i.e. economics, psychology and political science. Table 3 illustrates the mean values of various scientometric indicators for journals in these subject areas. For the three subjects under study, the mean self-citing rate is from 0.029 to 0.052, which is much smaller than the mean self-cited rate, from 0.13 to 0.166. The mean self-citing rate of psychology journals is significantly higher than that of journals in political science. The very small value of self-citing rate suggests that for the three subjects under study, the self-citing rate is much lower than the self-citing rate of other journals. This is significantly different from that explored by Fassoulaki, et al.(2000) for six anaethesia journals. The table demonstrates that about 7 pairs demonstrate significant difference in scientometric data, while 11 pairs show no significant difference. The mean values of citation count and impact factor for the journals of psychology are significantly larger than those of the economics and political science journals. For cited half-life, the mean value for political science journals is significantly smaller than that for the journals of the other two subjects.

The Tukey tests within the ANOVA are conducted to examine the mean difference between pairs of the three subjects. On average, a psychology journal was cited more than one thousand times than a political science journal, and more than five hundred times than an economics journal. Therefore, it can be understood that the average impact factor for a psychology journal (1.38) is significantly larger than that for an economics (0.83) or political science journal (0.63). A political science journal would be cited shorter, about 1 year, than the other two subject journals.

Table 3 Mean and mean difference of scientometric data among the three subject journals

Scientometric data	Mean	Subject pairs	P value	Mean difference
Self-citing rate	I: 0.046	I & II	0.970	-0.006
	II: 0.052	II&III	0.028*	0.023
	III: 0.029	I &III	0.507	0.016
Self-cited rate	I: 0.147	I & II	0.994	0.013
	II: 0.134	II&III	0.752	-0.032
	III:0.166	I &III	0.997	-0.018
Source item	I: 45.0	I & II	1.000	0.897
	II: 44.1	II&III	0.999	3.838
	III:40.2	I &III	0.997	4.736
Citation count	I:934.9	I & II	0.046*	-508.128
	II:1443.1	II&III	0.000**	1051.72
	III:391.3	I &III	0.400	543.59
Impact factor	I: 0.83	I & II	0.000**	-0.563
	II:1.38	II&III	0.000**	0.763
	III: 0.63	I &III	0.897	0.200
Cited half-life	I: 7.92	I & II	1.000	0.005
	II: 7.92	II&III	0.009**	0.963
	III: 6.96	I &III	0.030*	0.967

**α=0.01; *α=0.05

I: Economics; II: Psychology; III: Political Science

4. Findings and implications

The present study investigates the relationship and difference between the journal self-citation rate and scientometric data for journals in three different subjects of the social sciences, i.e., economics, psychology and political science. The following findings and implications have been drawn based on the results of this study.

1. For the subjects of economics and psychology, there are 8 out of 9 pairs correlation between self-citing (or self-cited) rate with other scientometric indicators are significant. Moreover, six of them show no significant difference using Fisher's test indicating the similarity in self-citation behavior between researches in economics and psychology.
2. For the subject of political science, there are only six pairs with significant correlation between self-citing (or self-cited) rate with scientometric indicators. For this six pairs, all of them show no significant difference from that of economics journals and five of them show no significant difference from that of psychology journals. This also suggests the similarity in self-citation behavior among the three subjects under study.
3. The positive correlation between self-citing rate and self-cited rate agrees with that reported by Tsay (2006) for semiconductor journals. The positive correlation between self-citing rate and source item, while no association between self-cited rate and source item for the three subjects under study in the social sciences, is also consistent with that for journals in semiconductor.
4. The positive correlation between self-citing rate and citation count for the three subjects under study in the social sciences is consistent with that for journals in semiconductor as reported earlier by the author.
5. The positive correlation between self-citing rate and impact factor for the three subjects under study in the social sciences is consistent with that for journals in anaethesia as reported earlier by Fassoulaki, et al.(2000).
6. The interesting findings that for the three subjects under study the correlation between self-citing rate and citation count (or impact factor) are all positive, while they are all negative between self-cited rate and citation count (or impact factor) reflect the different nature of self-citing rate (synchronous approach) and self-cited rate (diachronous approach). This deserves further study.
7. For the three subjects under study, the mean self-citing rate is from 0.029 to 0.052, which is much smaller than the mean self-cited rate. The mean self-citing rate of psychology journals is significantly higher than that of journals in political science.
8. The average self-citing rate (4.23%) for the social science orientation journal, is obviously less than that (9.59%) for science and technology journals as in the subject area of semiconductor (from 9.59%) that reported earlier by the author. However, the average self-cited rate (14.9%) for the journals of these three social science disciplines under study is quite same as that rate (15.03%) for semiconductor journals.
9. On average, a psychology journal was cited more than one thousand times than a political science journal, and more than five hundred times than an economics journal. Therefore, the mean impact factor for a psychology journal (1.38) is significantly higher than that for an economics (0.83) or political science journal (0.63).
10. A political science journal would be cited with a shorter half-life about one year than the other two subject journals.

Self-citation may be regarded as a complicated phenomenon. The number of a journal's self-citation is affected by the age and publication frequency of that journal. The significant correlation between self-citing rates and citation frequency may indicate a significant influence of self-citations on the total citation the journal received. As suggested by Garfield (1974, p.194) that the journal self-citation is nothing to do with good or bad. It says something about the characteristic of a particular journal. The reason why a journal self-citation occurred may include that authors publish a series of their works in the same journal or an author prefers to submit his paper to a journal that has previously published works related to his study. However, further investigations are needed to confirm this point. Lawani (1982, p.282) pointed out that "a high synchronous author self-citation rate does not necessarily imply self-centered, whereas a high diachronous self-citation rate definitely does. A high synchronous self-citation rate coupled with low diachronous self-citation rate may well suggest that the researcher concerned is a productive and key person in his research specialty. Conversely, a researcher may have a low synchronous self-citation rate and yet a high, possibly 100%, diachronous rate. This would be a case of self-centered". Nevertheless, whether or not the above statement could be applicable to journal self-citation requires more studies. Moed & Al. (1999) did a critical examination of the journal impact data in the JCR and found that the impact factor is inaccurate and the cited half-life is an inappropriate measure of decline of journal impact. They developed a normalized impact factor to correct differences of citation characteristics among subfields. They also modified the JCR cited half-life by developing a system with four classes (very fast maturing, fast maturing, slow maturing and very slow maturing) related to rapidity of maturing and four classes (very fast decline, fast decline, slow decline and no decline) with respect to rapidity of impact decline. Wolfgang and Moed (2002) discussed the strengths and flaws of the impact factor and proposed a cross-citation matrix on the basis of transaction of references (citations) among source (citing) and cited journals. According to the matrix they build some new journal citation measures, i.e., immediacy index, consumption factor, adjusted impact factor and influence weight. New journal citation measures have appeared rapidly and what are their impacts on the journal self-citation also deserve more studies.

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