Journal Self-Citation Study in Semiconductor: Synchronous and Diachronous Approach[1]

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Abstract
The present study investigates the self-citations of the most productive semiconductor journals by synchronous (self-citing) and diachronous (self-cited) approaches. Eighty-seven journals common to INSPEC and Journal Citation Reports (JCR) of SCI in semiconductor were selected as the object of this study and were listed for statistical tests. High self-citing journals are usually older than low self-citing journals. Journals with a short time interval of publication are more possible with high self-citing and self-cited rates. Journals with higher self-citing rate tend to be more productive and receive more citation than journals with lower self-citing rate. The journal self-cited rate has no association with the number of articles that journal published and citation it received. There is significant difference between self-cited and self-citing rate and the former (15.03%) is greater than the latter (9.59%).

Introduction

The journal publication is usually the single most prevalent form of scientific dissemination. 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 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 (ISI Web of Knowledge, 2004). Lawani (1982, p.281) classified self-citation into two types, namely, synchronous self-citation and diachronous self-citation. Following his definition, an author's synchronous self-citations are those contained in the citations the author gives, whereas diachronous self-citations are those included in the citations an author receives. Self-citing rate has been defined, in JCR of Science Citation Index (SCI) CDROM 2000, 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 all journals including itself. According to Lawani and ISI's definitions, synchronous self-citation is self-citingness and diachronous self-citation is self-citedness.

The subject of semiconductor is selected for the present work because the research in the semiconductor science plays a significant role in the development of science and technology due to its interdisciplinary nature. By applying Pearson correlation coefficient and Spearman rank order coefficient test for the most productive journals in the domain of semiconductor, it was found that there is a significant correlation between journal productivity and citation frequency and between journal productivity and impact factor (Tsay, M.Y. and Ma, S.S., 2003). However, it is still not known whether the most productive journals or most cited journals are also journals with the highest self-citing or self-cited rate. This motivation stimulates the orientation of this research.

Several previous studies analyzed journal self-citations (for example, Garfield, 1974; Rousseau, 1999; Fassoulaki, et al., 2000; Aksnes, 2003). However, none of these previous studies can be considered comprehensive. It has not been demonstrated, especially on the basis of examining by a statistical test that less productive or less cited journals in some subject area are necessarily with lower self-citation

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rate; no matter they are measured synchronously or diachronously. The purpose of this study is to measure self-citations of the most productive semiconductor journals by synchronous (self-citing rate) and diachronous (self-cited rate) approaches and to investigate the nature of journal self-citation in terms of journal's age and the journal publication frequency. In addition, the relationship between journal self-citation and journal productivity and journal self-citation and journal citation frequency, respectively, was explored. Moreover, the difference of self-citing rate and self-cited rate was examined by the statistical test.

Methodology

The literature review suggests the following hypotheses for the present study:

1. For a particular subject field, there is an association between journal productivity and journal self-citing and self-cited rate.
2. For a particular subject field, there is an association between journal citation frequency and journal self-citing and self-cited rate.
3. For a particular subject field, there is a significant difference between journal self-citing rate and journal self-cited rate.

Journal's productivity (number of papers published by a journal in a specific subject field during a particular period of time)of 100 most productive semiconductor journals was gathered from INSPEC database, 1978 to 1997 through OVID with search command "semiconductor?.de.". In total, there were 1877 journals published 184,233 semiconductor articles from 1978 to 1997. Among them the first 100 journals cover 80% of literature. Moreover, 50% of the total literature is concentrated in the first 20 journals only. The data of citation frequency was obtained from the Science Citation Index (SCI) JCR 2001 CDROM edition by the title-by-title search. After obtaining the journal productivity and citation data, 87 journals common to INSPEC and JCR in semiconductor were selected as the object of this study and were listed for statistical tests. The self-citing and self-cited data were drawn from the Citing Journal Listing and the Cited Journal Listing of the SCI JCR. Self-citing and self-cited rates were determined by the method that suggested by the JCR. The analysis of the present study was based on the CDROM version of the 1990-2001 JCR. Journal's self-citation rate was calculated yearly. Therefore, each journal possessed 12 self-citation rates and the average self-citation rate was decided. The Pearson correlation was applied to determine the correlation coefficient between journal productivity and self-citations and between journal citation frequency and self-citations. The difference of mean between self-citing and self-cited rate was examined by the T-test.

Journal Self-Citing Data

Table 1 illustrates the journal distribution based on an even self-citing rate interval. The number of journals tends to decrease with increase in self-citing rate.

Table 1 Distribution of journal self-citing rate

Self-citing Rate (%)	<5	5-10	10-15	15-20	20-25	25-30	30-35	Total
No. of Journals	29	23	17	9	5	3	1	87
%	33.3	26.4	19.5	10.3	5.7	3.4	1.1	100

In Table 2, the ten highest and 10 lowest self-citing journals including papers in semiconductor are ranked by self-citing rate in descending order with initiative publication date and frequency of publication, retrieved from JCR on CDROM 2001 Science Edition and Ulrich's on Disc 2001. *IEEE Transactions on Microwave Theory and Techniques* had the highest self-citing rate of 31.4%. The journal with the lowest self-citing rate was *Electronics and Communications in Japan. Pt.2: Electronics* (0.1%). It can be seen from Table 2 that most journals with high self-citing rate published during the period from 1952 to 1958, followed by the period from 1962 to 1966, whereas, most journals with low self-citing rate are published after 1975. It is apparently that high self-citing journals are older than low self-citing journals. This finding is consistent with the comment given by So (1990) as "for younger journals, their self-citing rates appear to be lower". An old journal is usually well-established and known world wide. With more available to be cited, such journals tend to cite themselves more than others.

The self-citing rate is strongly related to the publication frequency. Table 2 shows that the highest self-citing journals (>19.26 and <31.37) are likely to be published weekly, whereas monthly journals tend to be the lowest self-citing ones. Four out of ten highest self-citing journals are published weekly, one published three times per month and one biweekly publication. On the other hand, there are five monthly and two journals each published 15 times yearly with low self-citing rates (>0.08% and <2.28%). This discovery confirms Pichappan's (1995, p.20) proposition that "if a journal revises its policy of increasing the frequency of its publication, its self-citations are likely to increase".

Table 2 Self-citing rate, publication date, and publication frequency of highest and lowest self-citing journals

Rank	Journal name	Self-citing rate (%)	Publication date	Publication frequency, (issue/yr)
1	IEEE Transactions on Microwave Theory and Techniques	31.37	1953	16
2	IEEE Transactions on Nuclear Science	26.79	1954	6
3	IEEE Journal of Solid-State Circuits	26.73	1966	12
4	Physical Review. B, Condensed Matter	26.39	1893	48
5	Nuclear Instruments & Methods in Physics Research Section A	21.93	1957	57
6	Applied Physics Letters	21.79	1962	52
7	IEEE Transactions on Electron Devices	21.75	1952	12
8	Optics Letters	21.03	1977	24
9	Physical Review Letters	20.62	1958	52
10	Applied Optics	19.26	1962	36
78	Il Nuovo Cimento D	2.28	1855	15
79	Superlattices and Microstructures	2.27	1985	12
80	Materials Chemistry and Physics	1.93	1976	15
81	Materials Science Forum	1.88	1984	30
82	IEICE Transactions on Electronics	1.38	1976	12
83	Microelectronics Journal	1.35	1967	12
84	Materials Science and Engineering B	1.11	1988	27
85	Journal De Physique IV	0.96	1991	6-8
86	Acta Physica Sinica	0.18	1992	12
87	Electronics and Communications in Japan Part II	0.08	1963	12

Journal Self-Cited Data

Table 3 indicates the distribution of self-cited rate. The two groups of 5 -10 and 10-15% constitute 52.8% of the total journals considered in the present work.

Table 3 Distribution of journal self-cited rate

Self-cited Rate (%)	<5	5-10	10-15	15-20	20-25	25-30	30-35	>35	Total
No. of Journals	5	19	27	6	6	6	7	1	87
%	5.7	21.8	31	6.9	6.9	6.9	8	1.1	100

Table 4 lists the 10 highest and 10 lowest self-cited journals including paper in semiconductor ranking by self-cited rate in descending order with publication date and publication frequency. In contrast to the self-citing data, the journal self-cited rate is not closely related to the publication year but reflects the characteristics of various journals. Table 4 also shows that there are three highest self-cited journals (>28.31 and <38.85) publishing more than 57 times yearly, whereas no journal with the lowest self-cited rate (>2.05% and <6.02%) has the same publication frequency as the high self-cited journals. A large number of journals with publication frequency equal to12 times yearly belong to low self-cited journals. It is apparent that journals with a short time interval of publication are more possible with high self-cited rates. This is similar to that for the self-citing journals.

Table 4 Self-cited rate, publication date, and publication frequency of highest and lowest self-cited journals

Rank	Journal Name	Self-cited (%)	Publication Date	Publication frequency (issue/year)
1	Nuclear Instruments & Methods in Physics research Section A-Accelerators Spectrometers Detectors and Associated Equipment	38.85	1957	57
2	Nuclear Instruments & Methods in Physics Research Section B	34.67	1957	57
3	IEEE Transactions Nuclear Science	31.69	1954	6
4	IEEE Transactions on Microwave Theory and Techniques	31.46	1953	16
5	IEEE Journal of Solid-State Circuits	30.75	1966	12
6	Diamond and Related Materials	30.65	1991	12
7	Sensors and Actuators A-Physical	30.32	1981	24
8	Soviet Physics : Semiconductors	30.05	1967	12
9	Physical Review. B, Condensed Matter	28.31	1893	48
10	Physica C-Superconductivity and its Applications	28.31	1934	68
78	Zeitschrift fur Physik B: Condensed Matter	6.02	1963	24
79	Solid State Technology	5.74	1958	12
80	Solid State Communications	5.46	1963	48
81	Letters to the Journal of Experimental and Theoretical Physics	5.19	1965	24
82	Applied Physics A-Materials Science & Processing	5.12	1973	12
83	Journal of Physics and Chemistry of Solids	4.33	1956	12
84	Europhysics Letters	4.10	1986	24
85	Material Science Forum	3.92	1984	30
86	Electronics and Communications in Japan Part II-Electronics	3.45	1963	12
87	Canadian Journal of Physics	2.05	1929	12

Statistical Tests for Self-Citing and Self-Cited Journals

Statistical tests were conducted to examine the three hypotheses stated previously in the section of Methodology. The underlying data are presented in Hsia (2001). There is a significant correlation between self-citing rates and journal productivity ($r=0.372$, $p<0.05$) and between self-citing rates and citation frequency ($r=0.449$, $p<0.05$). In other words, journals with a higher self-citing rate tend to be more productive and receive more citation than journals with a lower self-citing rate. On the contrary, journals with lower self-citing rate contribute fewer articles and would be cited less than journals with higher self-citing rate.

There is no significant correlation between self-cited rates and journal productivity for 87 semiconductor journals ($r=0.156$, $p=0.148>0.005$) and between self-cited rates and citation frequency ($r=0.106$, $p=0.329>0.005$). It, therefore, can be concluded that the journal self-cited rate has no association with the number of articles that journal published and citation it received.

For all 87 journal titles of this study, the mean self-cited rate (15.03%) is greater than the mean self-citing rate (9.59%). The T-test shows, as Table 5 demonstrates, that the difference is 5.4% and is highly significant ($t=8.137$, $p<0.05$). This rejects the null hypothesis that there is no significant difference between self-citing and self-cited rate.

Table 5 Mean difference of self-citing and self-cited rate

	Mean	SD	T	P value
Self-citing rate (%)	9.59	7.06	8.137	0.000
Self-cited rate (%)	15.03	8.09		

Conclusions

Self-citation may be considered as a complicated phenomenon. A journal's self-citation is affected by its age, publication frequency, productivity and citation frequency. 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. Moreover, the mean self-cited rate (15.03%) is greater than

the mean self-citing rate (9.59%). This implies that journals in semiconductor are cases of "egotism" (Lawani 1982, p.282). However, this requires more studies.

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