A Bibliometric Study of Japanese Science and Social Science Publications

日本の自然科学と社会科学文献のビブリオメトリック的研究

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要　　旨

　日本における学術研究成果の中で，国際的に流通する文献の特性を把握すべく，*Social Sciences Citation Index* と *Science Citation Index* の両 Source Index 誌を用いて，日本で発表された被索引文献について次の諸点に関するデータを抽出した。1)出版タイプ，2)著者所属機関　3)大学別被索引文献発表状況　4)主要国別掲載誌，掲載論文分布，5)主要掲載誌別論文数（日本），6)主要掲載誌別論文数（外国），7) Bradford Distribution Law の適用，8)自然科学，社会科学両分野の論文で使用される言語，9)自然科学論文の主題別論文数を用いた。

　以上の諸データを分析した結果次の諸点が明らかになった。1)大学在籍者の出版物が中心である，2)発表形式は雑誌論文形式が多い，3)使用言語は英語が主である（自然科学で90％，社会科学で83％），4)社会科学では日，米，英，蘭，自然科学では日米，の各国で刊行される雑誌に主に掲載されている，5)分析対象となった論文群には Bradford の分布法則がよく適合する，6) 自然科学の主題別では Biomedical Science の論文の比率が最も高い。

　なお，本研究は上記両索引誌に索引された文献だけを分析したものであり，日本で発表された自然・社会両科学の論文全般について言及するものではない。

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H. Language of Publication

I. Subject Distribution of Science Papers

IV. Conclusion

I. Introduction

Where do Japanese scholars publish their papers? In what languages do they write? With what kinds of institutions are most authors affiliated? Few studies have yet dealt with these questions. The present investigation is based on data from the *Science Citation Index (SCI)*[1] and the *Social Science Citation Index (SSCI)*[2]. This study examines a selection of Japanese science and social science publications compiled in SCI and SSCI, and focuses on the following points as a basis for comparison between publications in the two fields:

1. type of publications
2. type of institutions
3. number of contributions by universities
4. country of publication
5. contributing Japanese journals
6. contributing non-Japanese journals
7. application of the Bradford Distribution Law
8. language of publication
9. subject distribution (science papers)

II. Methods

SCI and *SSCI* are cumulated in different blocks of time, so it is impossible to look at exactly the same sample period. The sample period for the *SSCI* runs January, 1980, to August, 1982, while the sample period for the *SCI* runs from January, 1980 to January, 1982.

For the periods covered in this study, the number of Japanese publications listed in the source indexes of *SCI* and *SSCI* are as follows:

$$SSCI- \quad 2,821$$
$$SCI \ - \ 104,752$$

SCI lists 37 times the number of Japanese publications as does *SSCI*; although overall, *SCI* lists more publications than *SSCI*. Therefore, the samples drawn were quite different in size. Using systematic random sampling, 3378 items were selected from *SCI* and 940

from *SSCI*.

For each item selected, the following information was gathered:

1. name of institution of author
2. type of publication
3. name of journal (for journal articles)
4. language of publication

In addition, for 488 science papers extra information was gathered:

5. title of publications (needed to determine subject)

III. Results

A. Types of Publications

Table 1 illustrates, for both fields, that journal articles account for the majority of publications. However, science publications surpass social sciences publications in terms of abstracts from meetings and technical notes. On the other hand, social science publications appear more frequently in the form of editorial items, books, and book reviews than do science publications.

Table 1   Types of Publications

Type of Publication	Social Sciences Publications		Science Publications	
	#	%	#	%
Journal articles	761	80.9	2530	74.9
Abstracts from meetings	59	6.3	416	12.3
Technical notes	40	4.3	283	8.4
Letters, communications, etc	6	.6	74	2.2
Reviews & bibliographies	8	.9	29	.8
Editorials, etc	15	1.6	3	.1
Books	23	2.4	43	1.3
Book reviews	25	2.7	—	—
Discussions, conference items	3	.3	—	—
Total	940	100.0	3378	100.0

B. Types of Institutions

Table 2 shows the number of publications produced by universities, government agencies and private organizations, including industry. In both the sciences and social sciences, the majority of authors are affiliated with universities. Government agencies publish more frequently than private organizations in the social sciences, while in the sciences, it is private organizations which are by far the active publishers. However, these figures underestimate the actual numbers published, since institutions contributing only one paper in the social sciences and less than four in the sciences are classified as "others".

Table 2 Types of Institutions

Institution	Social Sciences Publications		Science Publications	
	#	%	#	%
Universities	638	67.8	2335	69.1
Government agencies	83	8.8	252	7.5
Private organizations (includes industry)	13	1.4	150	4.4
Other	206	22.0	641	19.0
Total	940	100.0	3378	100.0

C. Number of Contributions by Universities

Contributions from universities are shown in Table 3: the top nineteen universities for the social sciences and the top twenty-three universities for the sciences. Not surprisingly, the University of Tokyo and Kyoto University, the two largest and most prestigious universities in Japan lead in both fields.

However, quite a few universities show themselves to be strong in both fields, The top eight universities in the social sciences are also listed for the sciences, and the top ten in the sciences are also listed for the social sciences. The University of Tokyo contributes equally (11.4% of the totals) to both fields, while Kyoto University has a greater proportion in the sciences.

Table 3 Number of Contributions by Universities

University	Social Sciences Publications (N=638)	
	#	%
1. University of Tokyo	73	11.4
2. Kyoto University	45	7.0
3. Osaka University	29	4.5
4. Tohoku University	29	4.5
5. Tsukuba University	27	4.3
6. Keio University	24	3.8
7. Hiroshima University	23	3.6
8. Kyushu University	19	3.0
9. Hitotsubashi University	18	2.8
10. Nagoya University	15	2.4
11. Hokkaido University	15	2.4
12. Waseda University	12	1.9
13. Tokyo Institute of Technology	12	1.9
14. Tokyo Metropolitan University	12	1.9
15. Kwansei Gakuin University	10	1.6
16. Okayama University	9	1.4
17. Kobe University	9	1.4
18. Sophia University	9	1.4
19. Osaka University of Education	8	1.3
	Science (N=2335)	
1. University of Tokyo	266	11.4
2. Kyoto University	196	8.4
3. Osaka University	185	7.9
4. Tohoku University	118	5.1
5. Kyushu University	109	4.7
6. Nagoya University	108	4.6
7. Hokkaido University	94	4.0
8. Tokyo Institute of Technology	73	3.1
9. Hiroshima University	56	2.4
10. Tsukuba University	48	2.1
11. Okinawa University	39	1.7
12. Keio University	38	1.6
13. Niigata University	31	1.3
14. Kanagawa University	30	1.3
15. Kobe University	29	1.2
16. Chiba University	28	1.2
17. Osaka City University	27	1.1
18. Kumamoto University	26	1.1
19. Shinshu University	25	1.1
20. Tokyo Medical and Dental University	24	1.0
21. Gumma University	24	1.0
22. Nippon University	23	1.0
23 Nagasaki University	23	1.0

Table 4 Country of Publication
Social Sciences

Country	Journals		Papers	
	#	%	#	%
1. Japan	47	16.15	336	44.15
2. U.S.	108	37.11	205	26.94
3. UK	64	22.12	99	13.01
4. Netherlands	31	10.65	49	6.44
5. Switzerland	13	4.47	20	2.63
6. France	5	1.71	16	2.10
7. Germany	12	4.12	15	1.97
8. Italy	2	.69	5	.66
9. Greece	1	.34	5	.66
10. Norway	2	.69	4	.52
11. Denmark	2	.69	2	.26
12. Austria	1	.34	2	.26
13. Sweden	1	.34	1	.13
14. India	1	.34	1	.13
15. Australia	1	.34	1	.13
Total	291		761	

Science

	#	%	#	%
1. Japan	96	13.57	1106	43.71
2. U.S.	289	40.87	726	28.69
3. Netherlands	68	9.61	237	9.36
4. UK	116	16.40	225	8.89
5. Germany	63	8.91	97	3.83
6. Switzerland	27	3.81	56	2.21
7. Denmark	11	1.55	18	.71
8. Italy	5	.70	12	.47
9. Canada	6	.84	8	.31
10. France	7	.99	7	.27
11. Czechoslovakia	4	.56	7	.27
12. Austria	4	.84	6	.23
13. Sweden	4	.56	6	.23
14. Finland	1	.14	6	.23
15. Australia	1	.14	5	.19
16. Belgium	1	.14	3	.11
17. Soviet Union	1	.14	2	.07
18. Hungary	1	.14	1	.04
19. Poland	1	.14	1	.04
20. South Africa	1	.14	1	.04
Total	707		2530	

D. Country of Publication

Table 4 analyzed publication according to the country of publication. A little less than one-half of both science and social science papers are published in Japan, in 96 different Japanese science journals and 47 different Japanese social science journals.

In the social sciences field, 37.11% of the journals are from the United States, composing 26.94% of the total number of articles. In the sciences, on the other hand, while the percentage of articles contributed by United States journals is similar to that in the social sciences (28.69%), the total percentage of all contributing journals from the United States (40.87%) is slightly greater.

Concerning the country of publication, the United States is second to Japan in both fields. In the social sciences, there is a large gap between the number produced by third and fourth contributors: the United Kingdom contributes 99 articles; the Netherlands only 49. In the sciences, however, the Netherlands publish a few more articles (237) than the United Kingdom (225).

E. Most Contributing Japanese Journals

Table 5 lists fourteen social science journals and fifteen Japanese science journals which contribute the greatest number of articles, as well as the number of papers they contributed. No journal is listed for both fields.

In the case of science publications, 1106 papers are found in 96 Japanese journals and the top seven Japanese journals contribute approximately 30% of the total number of articles published in Japan. On the other hand, for social science publications, 336 papers are found in 47 Japanese journals and only the top two Japanese journals contribute approximately 30% of all the articles published in Japan.

F. Most Contributing Non-Japanese Journals

Table 6 lists top sixteen non-Japanese social science journals and the top nineteen non-Japanese journals which contribute the greatest number of articles. In the social sciences, a

Table 5 The Most Contributing Japanese Journals

Social Sciences (N=336)	# of Papers
1. Japanese Journal of Psychology	62
2. Journal of the Anthropological Society of Nippon	45
3. Japanese Psychological Research	28
4. Tohoku Psychologica Folia	20
5. Business Japan	18
6. Japanese Journal of Child and Adolescent Psychiatry	14
7. Library and Information Science	13
8. Psychologica	12
9. Japan Quarterly	11
10. Japanese Economic Studies	9
11. Developing Economics	8
12. Annals of the Institute of Statistical Mathematics	8
13. Hitotsubashi Journal of Economics	7
14. Analytica Chemica Acta-Computer Techniques and Optimization	7

Science (N=1106)	# of Papers
1. Journal of the Physical Society of Japan	57
2. Chemistry Letters	55
3. Bulletin of the Chemical Society of Japan	53
4. Journal of Biochemistry	51
5. Japanese Journal of Applied Physics	48
6. Chemical and Pharmaceutical Bulletin	43
7. Bulletin of the Jsme-Japan Society of Mechanical Engineers	39
8. Progress of Theoretical Physics	38
9. Agricultural and Biological Chemistry	33
10. Heterocycles	30
11. Nippon Kagaku Kaishi	30
12. Journal of the Japanese Institute of Metals	27
13. Bulletin of the Japanese Society of Scientific Fisheries	26
14. Journal of Antibiotics	19
15. Yakugaku Zasshi-Journal of the Pharmaceutical Society of Japan	19

journal from France is the top contributor, followed by journals from the United States, the United Kingdom, the Netherlands, and Greece.

In the sciences, on the other hand, journals from the United States and the Netherlands share the top position. The United Kingdom also contributed, but not France and Greece.

G. Application of the Bradford Distribution Law

Bradford's Law is an important bibliometric phenomenon. Narin and Moll describe it thusly:

" Bradford's Law is expressed in terms of the proportion of papers contained in a given proportion of journals "[3]. The most common procedure is to divide the contributing journals into three zones, each containing approximately the same number of articles. The relationship between the three zones will then be an approximate geometric series.

Lancaster has given an example of a perfect Bradford distribution: " in a particular year 375 articles are published on the same subject, and they are dispersed over 155 journals. If

Table 6 The Most Contributing Non-Japanese Journals

Social Sciences (N=425)	# of Papers
1. Agressologie	12
2. Perceptual and Motor Skills	10
3. Journal of the American Geriatrics Society	9
4. Social Science and Medicine Part D-Medical Geography	9
5. IEEE Transactions on Systems Man and Cybernetics	8
6. Behavioral and Brain Sciences	7
7. IEEE Transactions on Reliability	6
8. Journal of Chemical Information and Computer Sciences	6
9. Personnel Psychology	6
10. Pattern Recognition	5
11. Microelectronics and Reliability	5
12. Journal of Gerontology	5
13. Electroencephalography and Clinical Neurophysiology-Eeg Journal	5
14. American Journal of Physical Anthropology	5
15. Ekistics	5
16. Biometrics	5

Science (N=1424)	# of Papers
1. Biochimica et Biophysica Acta	29
2. Tetrahedron Letters	29
3. Journal of Applied Physics	17
4. Journal of the Chemical Society-Chemical Communications	14
5. Electronics Letters	13
6. Journal of Biological Chemistry	13
7. Biochemical and Biophysical Research Communications	13
8. Applied Physics	11
9. IEEE Transactions on Power Apparatus and Systems	11
10. Journal of Chemical Physics	10
11. Physics Letters A	10
12. Cancer	10
13. Febs Letters	10
14. Solid State Communications	10
15. Physical Review B-Condensed Matter	9
16. Carbohydrate Research	9
17. Journal of Polymer Science	9
18. Nuclear Instruments and Methods	9
19. Physics Letters B	9

the journals are divided into three zones, each contributing 125 articles, the first zone (the nucleus) may be found to contain five journals, the second zone 25, that is 5×5, the third 125, that is 5×5^{2}.[4] The geometric series, then, has the form: $1 : x : x^{2} : \cdots x^{n}$.

Table 7a notes that 761 social science papers are scattered over 291 different journals. First, the number of journals are listed from the most contributing to the least contributing. Bradford's Law is then applied to the data. The zones of division are:

Table 7 a

Bradford Distribution of Social Science Papers

A Number of Journals	B Number of Papers	A×B
1	62	62
1	45	45
1	28	28
1	20	20
1	18	18
1	14	14
1	13	13
2	12	24
1	11	11
1	10	10
3	9	27
3	8	24
3	7	21
7	6	42
7	5	35
10	4	40
19	3	57
42	2	84
186	1	186
291		761

Zone 1 254 papers in 12 journals
Zone 2 253 papers in 59 journals
Zone 3 254 papers in 220 journals

The multiplier between zones is approximately 4.4 and the series is 12: $12 \times 4.4 : 12 \times 4.4^2$.

Table 7b shows that the 2530 science parers selected are scattered over 707 different journals. The data is divided into three zones:

Zone 1 840 papers in 31 journals
Zone 2 848 papers in 128 journals
Zone 3 842 papers in 548 journals

The multiplier between zones is approximately 4.2, and the series is 31: $31 \times 4.2 : 31 \times 4.2^2$.

For both fields, the journals in Zone 1 (the nucleus) account for about 4.1–4.4% of the total journals. Most remarkably, both fields have a similar multiplier. Both the sciences and the social sciences reveal a similar application of Bradford's Law.

Table 7 b

Bradford Distribution of Science Papers

A Number of Journals	B Number of Papers	A×B
1	57	57
1	55	55
1	53	53
1	51	51
1	48	48
1	43	43
1	39	39
1	38	38
1	33	33
2	30	60
2	29	58
1	27	27
1	26	26
2	19	38
4	17	68
3	16	48
2	15	30
3	14	42
5	13	65
7	11	77
14	10	140
7	9	63
9	8	72
13	7	91
20	6	120
26	5	130
39	4	156
69	3	207
126	2	252
343	1	343
707		2530

Table 8 Language of Publication

Languages	Social Sciences		Science	
	#	%	#	%
English	314	83.3	439	90.0
Japanese	62	16.4	45	9.2
German	—	—	3	.6
French	1	.3	1	.2
Total	377	100.0	488	100.0

H. Language of Publication

This analysis was based on random subsets: 337 papers from a total of 761 social science papers and 488 papers from a total of 2530 science papers. Table 8 displays the breakdown by language of publication. In the sciences, about 90% of the papers are in English and 10% in other languages, primarily Japanese. In the social sciences, about 83% of the papers are in English, revealing English to be the prime language of publication in both fields. The results are not so surprising when one takes into account the fact that *SSCI* and *SCI* are more likely to list journals containing English material since they primarily serve an English-speaking population.

I. Subject Distribution of Science Papers

Table 9 shows how 488 papers (randomly selected from the 2530 science papers) are distributed over the 14 subject categories developed by Lancaster and Carvalho[5]. Research in Japan covers a wide range of subject fields. The biomedical sciences rank first, with almost 40% of Japanese papers, followed by chemistry and physics.

IV. Conclusion

The *Social Sciences Citation Index* and the *Science Citation Index*, of course, can not cover all of science and social science literature, but they remain as two of the most comprehensive data bases. Many Japanese journals are not covered, especially journals listing only Japanese language papers. Nevertheless, the data represents publication patterns of Japanese science and social science papers based on the most comprehensive English language data bases.

The data indicates that the academic community is the major contributor of publications, and journal articles are the major form of publication in both the sciences and social sciences fields. The University of Tokyo and Kyoto University are the leading contributors in both fields.

Over 70% of Japanese papers are published either in Japan or in the United States. Japan, the United States, the United Kingdom, and the Netherlands contribute over 90% of the papers. Social science papers are spread over fifteen countries. In the social sciences, Japan seems to publish less internationally than it does in the sciences.

In the sciences, seventeen Japanese journals list 19 papers, while in the social sciences only four Japanese journals list 19 papers. Non-Japanese journals indicate a similar pattern.

In terms of Bradford's Law, both fields have approximately the same multiplier: 4.4 for social sciences; 4.2 for sciences. The core of journals in both fields account for more or less the same percentage of the total number of journals.

Table 9 Subject Distribution (Science Papers)

Subject	# of Papers	%
1. Engineering, applied mechanics, aerodynamics	32	6.6
2. Agriculture, forestry fisheries	13	2.7
3. Plant sciences, phytochemistry	17	3.5
4. Food science, nutrition	9	1.8
5. Astronomy, astrophysics, atmospheric sciences	7	1.4
6. Physics, electronics (excluding biophysics, astrophysics, geophysics)	64	13.1
7. Earth sciences, geophysics	5	1.0
8. Chemistry, crystallography, chemical engineering (excluding biochemistry, plant chemistry)	89	18.2
9. Materials sciences (including metals, ceramics, plastics, polymers)	27	5.5
10. Biomedical sciences (including biochemistry, and preclinical sciences)	191	39.1
11. Zoology, entomology, marine biology	16	3.3
12. Control engineering, cybernetics	4	.8
13. Mathematics	10	2.0
14. Other technical areas like manufacturing, energy, environmental concerns, etc.	1	.2
15. Unclassifiable	3	.6
	488	100.0

The majority of Japanese publications are in English in both science and social science fields. However, social science publications appear slightly more frequently in the Japanese language. As to subject distribution, the biomedical sciences rank first, followed by chemistry and physics.

1) Institute for Scientific Information. "Science Citation Index." Philadelphia, Institute for Scientific Information, 1980–1982.
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