

Bibliometric Analysis of Scientific Research Collaboration between Japan and China

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Abstract

Nowadays international collaboration is promoted in various areas by various ways. In this study we take a look at collaboration in scientific research between Japan and China from a viewpoint of international co-authorship of academic publications. The analysis is based on data retrieved from a specific database produced by Thomson Scientific as the National Citation Report for Japan (NCR-J) during 1981-2004. The situation, trends and characteristics of scientific collaboration between the two countries are investigated and discussed in the paper. The most productive research organizations and subject fields in the collaboration will be revealed as well.

1. Data and Methods

The analysis is based on data retrieved from a specific database produced by Thomson Scientific as the National Citation Report for Japan (NCR-J) during 1981-2004. The NCR-J is the database, which is made from the ISI's three citation index databases (Science Citation Index, Social Science Citation Index, and Art & Humanities Citation Index), in which at least one author is affiliated with an organization located in Japan. The database contains 1,453,888 papers overall, but we only count documents of Article, Letter, Note and take 1,277,823 papers as research papers in this study. Subject classification of publication is based on field assignment (NCR-J's original more than 100 categories) of journals according to ISI's National Science Indicators (Standard version) of 26 fields.

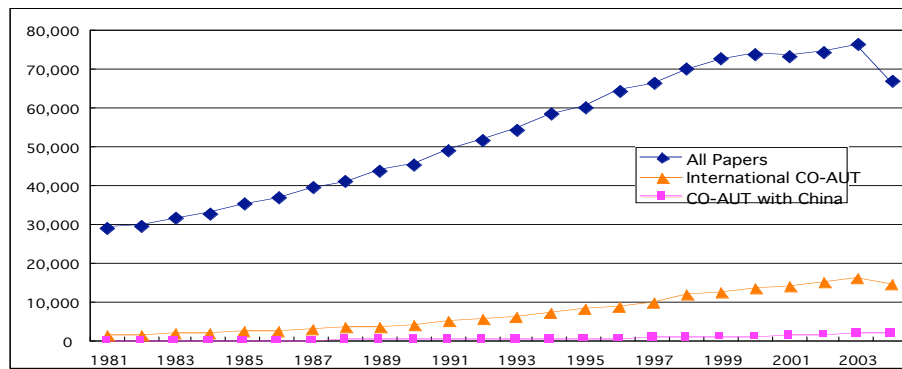
To look at the situation and characteristics of each research organizations, we identify each organization to which an author of a paper is affiliated, then create a running tally for each organization. Considering of variations in notation of organization: for example, the University of Tokyo could be noted not only as "UNIV TOKYO", but also as "TOKYO UNIV", "TOKYO UNIV HONGO", or "TOKYO UNIV HOSP", etc, we have made a collation table to unify the name of organizations first.

Results

Outlines of international coauthorship of Japanese papers

According to NCRJ 1981-2004, total number of Japanese papers is increasing steadily from around 30,000 in early 80's to 2.5 times that figure at more than 75,000 papers in 2003 (Fig.1). This indicates that more and more Japanese papers are published in international academic journals (source journals of ISI's databases). Together with the growth of total publication, the portion of papers co-authored internationally is growing as well, which went from 4.8% in 1981 to 22.2% in 2004 (Table1).

Fig. 1: Time trend of Japanese papers in total and its international coauthored papers



At the same time, Table 1 also shows an increasing scientific collaboration with China. The portion of co-authored papers with China in the international co-authored papers has been increasing from only 1.1% to 12.8% over the period.

Table 1: Japanese papers and ratios of papers co-authored internationally and with China

Year	All Papers (N)	International CO-AUT		CO-AUT with China	
		Papers (I)	Ratio (I/N)	Papers (C)	Ratio (C/I)
1981	29,144	1,411	4.84%	16	1.13%
1982	29,780	1,673	5.62%	26	1.55%
1983	31,497	1,854	5.89%	39	2.10%
1984	32,989	2,206	6.69%	62	2.81%
1985	35,299	2,449	6.94%	83	3.39%
1986	36,860	2,608	7.08%	98	3.76%
1987	39,444	2,901	7.35%	104	3.58%
1988	41,074	3,326	8.10%	154	4.63%
1989	43,863	3,687	8.41%	213	5.78%
1990	45,634	4,229	9.27%	206	4.87%
1991	49,212	4,915	9.99%	251	5.11%
1992	51,805	5,678	10.96%	297	5.23%
1993	54,487	6,401	11.75%	333	5.20%
1994	58,389	7,348	12.58%	376	5.12%
1995	60,300	8,107	13.44%	451	5.56%
1996	64,392	8,860	13.76%	522	5.89%
1997	66,258	10,057	15.18%	721	7.17%
1998	69,963	11,819	16.89%	789	6.68%
1999	72,501	12,732	17.56%	1,004	7.89%
2000	73,952	13,709	18.54%	1,151	8.40%
2001	73,338	14,319	19.52%	1,423	9.94%
2002	74,407	15,086	20.27%	1,627	10.78%
2003	76,391	16,205	21.21%	1,849	11.41%
2004	66,844	14,855	22.22%	1,908	12.84%

Figure 2 reveals great differences among fields in coauthorship between Japan and China. Among 26 fields, Physics (PHYS), Chemistry (CHEM), Engineering (ENGN), Clinical medicine (CLIN) and Material (MATR) fields showed a large number of coauthored papers. It seems that the number grows more rapidly in the latest decades than in the 1980's in any of the fields. However, it is not necessarily true as we look at the percent change over corresponding period of previous year in Table2.

Fig. 2: Papers coauthored with China by fields, 1981-2004

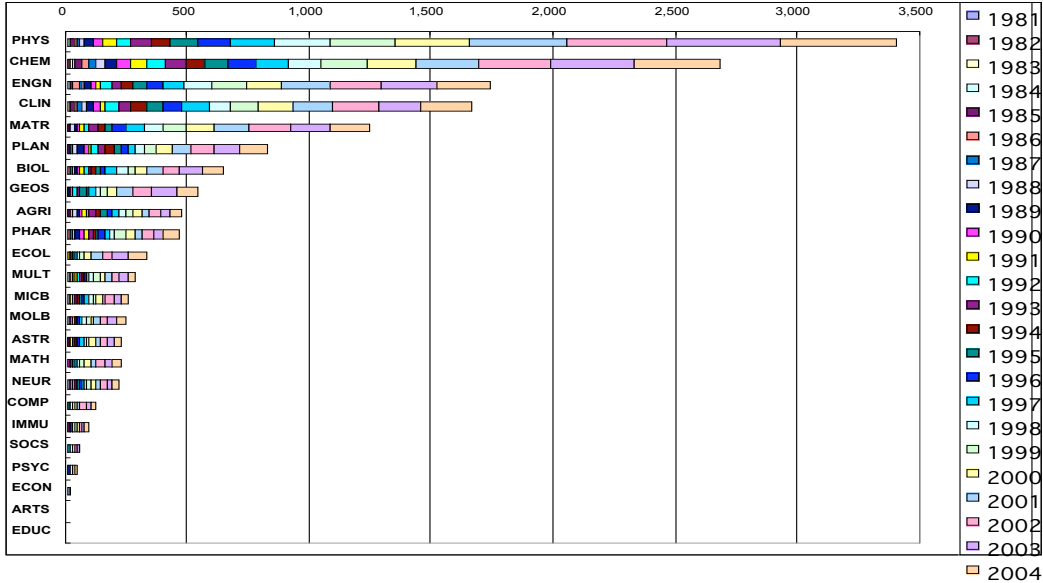
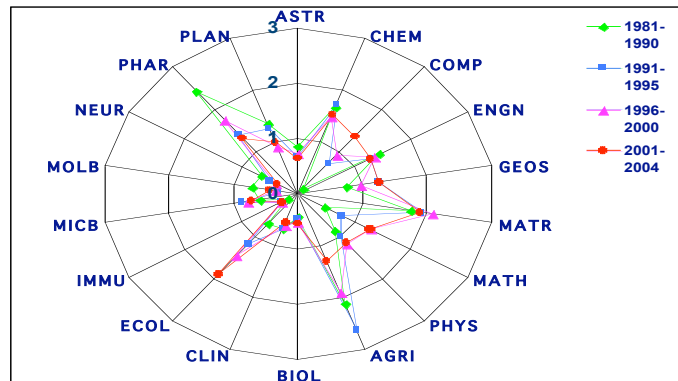


Table 2: Yearly growth of Japanese papers co-authored internationally and with China among, 1981-2004

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
International	118	109	120	111	110	110	115	110	116	118	114	114	115	109	109	113	118	107	107	106	104	106	92
With China	194	140	153	127	125	102	156	132	95	130	122	114	104	119	117	134	110	124	117	124	112	111	105

Table 2 reveals that Japanese-Chinese coauthorship almost shows larger growth comparing with the whole Japanese-international collaboration, with 1989 (131.7%), 1997 (133.9%), 1983 (140%), 1984 (153.1%), and 1982 (194.4%) growing the most. It indicates that share of Japanese-Chinese coauthored paper is steadily increasing, however the growth rate in 1980's was larger than that in the recent years.

Fig. 3: Publication profile of Japan-China research collaboration by subject fields



In order to look at the characteristic and trends of share of Japanese-Chinese coauthored paper with respect to subject fields, we define an indicator as follows, which is closely

related to the so-called Activity Index (AI) very long used in bibliometrics (Frame, 1977).

$$PI(1) = \frac{\text{share of the given field in the publications of the Japan - China coauthorship}}{\text{share of the given field in the publication of total Japanese - international coauthorship}}$$

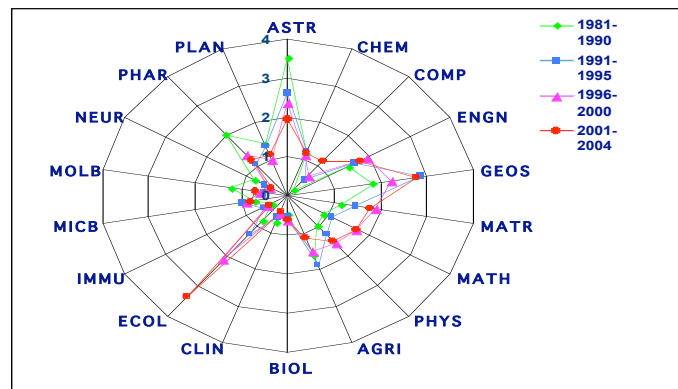
Figure 3 shows Profile Index (PI) of Japan-China coauthorship to total Japanese-international coauthorship in the four periods of 1981-1990, 1991-1995, 1996-2000 and 2001-2004 based on 18 major fields of science, as Astrophysics (ASTR), Chemistry (CHEM), Computer Sciences (COMP), Engineering (ENGN), Geosciences (GEOS), Mathematics (MATH), Materials Science (MATR), Physics (PHYS), Agricultural Sciences (AGRI), Biology & Biochemistry (BIOL), Clinical Medicine (CLIN), Ecology / Environment (ECOL), Immunology (IMMU), Microbiology (MICB), Molecular Biology & Genetics (MOLB), Neurosciences (NEUR), Pharmacology (PHAR), Plant & Animal Sciences (PLAN). It reveals that:

- the share in PHAR and AGRI which were the fields with largest coauthorship between Japan and China, is decreasing toward to the average,
- the share in MATR, CHEM and ENGN fields remains almost steady at a relatively high level during the period,
- the share in GEOS, COMP and ECOL fields is increasing steadily. Among them, especially ECOL is growing to the top field with highest share in Japan-China coauthorship papers,
- the share in NEUR, MOLB, IMMU and BIO fields stays at a relatively low level.

On the other hand, as comparing to the whole Japanese publications in each subject fields, we have some different view for publication profile in Japan-China research collaboration (Fig.4). The rise is dramatic in Geosciences(GEOS), especially Ecology/Environment (ECOL).

$$PI(2) = \frac{\text{share of the given field in the publications of the Japan - China coauthorship}}{\text{share of the given field in the whole Japanese publications}}$$

Fig. 4: Profile of Japan-China research collaboration to the whole Japanese papers by subject fields



International coauthorship by Japanese universities

In order to look at the characteristics of individual university in terms of its international collaborations, we chose the top ten coauthored paper-producing universities from the period of the study. Except RIKEN, all the rest nine are national universities and all of the so-called “seven Imperial Universities” are included. Figure 5 shows the top 10 Japanese university collaborations with china and total foreign countries, respectively. UNIV TOKYO and KYOTO UNIV is always ranking the first and the second in the whole international collaborations, while focusing on the collaborations with China among, TOHOKU UNIV is rising rapidly and has exceeded KYOTO UNIV and OSAKA UNIV to rank the second in recent years.

Fig. 5: Top 10 coauthored paper-producing universities, 1981-2004 (left: collaborations with China; right: collaborations with total foreign countries)

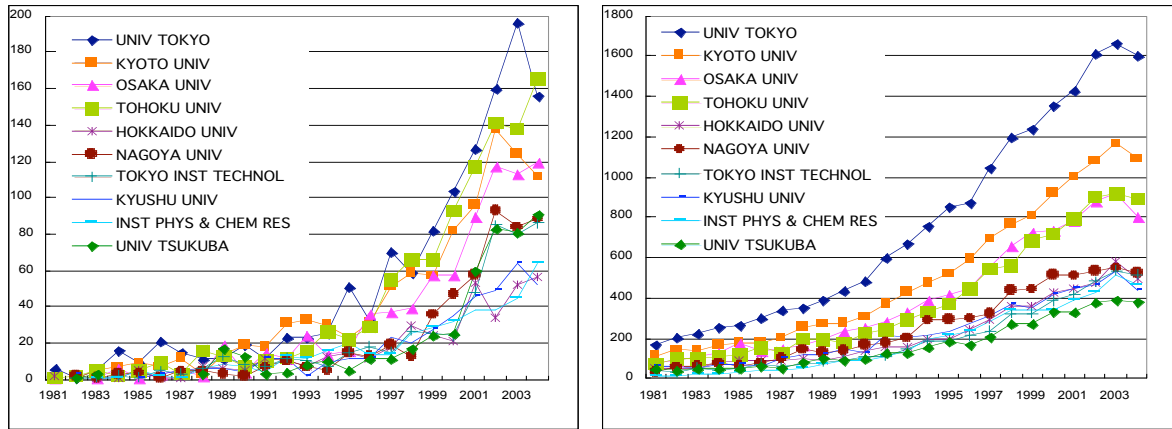


Fig. 6: The University of Tokyo

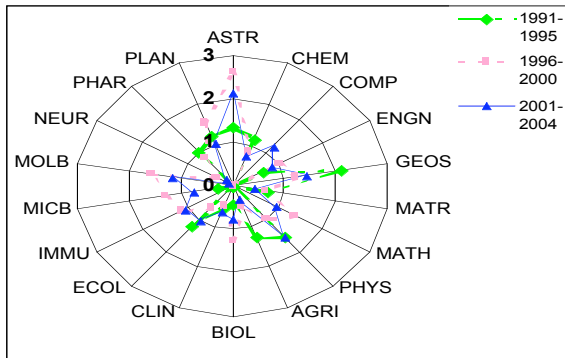


Fig.7: Tohoku University

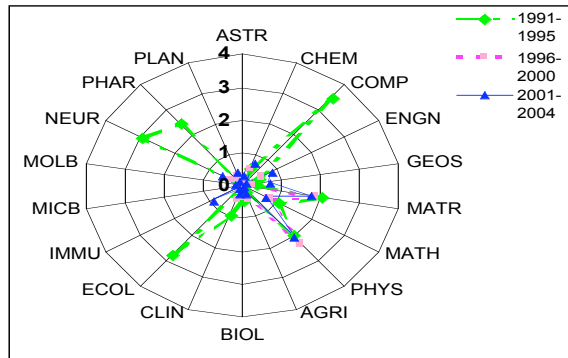
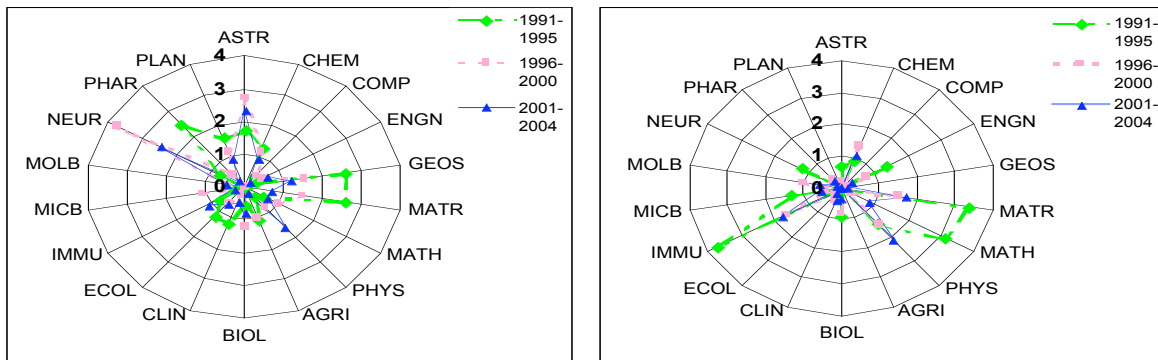


Fig. 8: Kyoto University

Fig.9: Osaka University

Figure 6 to Figure 9 are breakdown of the top four universities in terms of profile of their coauthorship with China to the whole Japanese-Chinese coauthored publications in each subject fields during three subperiods of 1991-1995, 1996-2000 and 2001-2004, respectively. Obviously, the universities have different advantage or enhancing trends on subject fields concerning international collaborations. Astrophysics (ASTR) in the university of Tokyo, Materials Science (MATR) in Tohoku university, Neurosciences (NEUR) in Kyoto university, Immunology (IMMU) in Osaka university shows relatively strong links with China.



Conclusion

The international collaborations reflect spectacular changes in academic research in Japan, and become more and more important. Traditional cultural and geographical ties will be expected to continuously play a great role in their academic cooperation between Japan and China in various fields.

Nowadays international collaboration is highly promoted and financially supported by research grants. The analysis of the share of international co-publications, of their publication profiles and specific coauthorship affinities will be useful in a reorientation in research policy as well. Selection of the research fields or research institutes in particular fields to foster, effectively assisting according to priority policies might be necessary to enforce further. We expect more improvement of polices fostering and financially supporting international cooperation by the government of each country.

To assess the international collaborative activity of Japanese universities comprehensively, we consider it essential to Citation Database for Japanese Papers (CJP) produced by National Institute of Informatics, Japan, as well (Negishi etc (2003) [2]; Sun etc (2005) [3]). CJP contains 916,735 papers, which were in approximately 1590 titles of Japanese academic society journal covering four science fields of Engineering, Science,

Agriculture and Medical Science during 1995-2004. Now we are on the way to investigate and discuss the situation, trends and characteristics of Japanese international collaboration linkages from both international and national perspective.

References

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