Defining triadic patent families as a measure of technological strength

CHRISTIAN STERNITZKE[1,2]

[1]Technische Universität Ilmenau, PATON – Patentzentrum Thüringen, Ilmenau (Germany)

[2]Universität Bremen, Forschungsgruppe Innovation und Kompetenztransfer, Bremen (Germany)

Abstract:

A frequently used indicator for assessing technological strengths of nations are patents registered in the triad region, i.e. in North America, Europe, and Asia. Currently these so-called triadic patents are defined as filed at the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO), and the Japanese Patent Office (JPO). Recent developments suggested that this definition might lack adequacy regarding the offices in Europe and Asia. Our findings propose that in particular Germany and China should be added to this triad definition since in some technology fields patents registered in these countries show the same citation impact as patents registered at the EPO or JPO. Our results also underline that the number of triadic patent families per country is a function of technological specialization and (national) patenting strategies.

This is the accepted version of the paper. The final version is available under https://doi.org/10.1007/s11192-009-1836-6

Address for correspondence:
CHRISTIAN STERNITZKE
Technische Universität Ilmenau
PATON – Patentzentrum Thüringen
PF 100 565, D-98684 Ilmenau, Germany
E-mail: christian.sternitzke@tu-ilmenau.de

1. Introduction

A frequently used method to assess the technological strengths of nations is counting patents registered in the economically most important world regions, in North America, Europe, and East Asia (EUROPEAN COMMISSION, 2003, pp. 333-334; LEGLER & GEHRKE, 2005, pp. 55-56). Patents registered therein are labeled "triadic patent families" and cover these inventions which the applicant expects to be of high economic value since they are worth the costly application process on the world's most important markets. Counting triadic patents has one fundamental advantage in comparison to counting only inventions at one major domestic office: many domestic applicants file many patents of minor importance at their domestic office. Hence, in cross-country comparisons the country wherein the major domestic reference patent office is located would always benefit. This phenomenon has been described as the so-called home country advantage (BASBERG, 1987; SCHMOCH ET AL., 1988, p. 54-57; WATANABE ET AL., 2001). Triadic patent families reduce this bias since patents from each country are counted at least at three different (important) patent offices, so all applications are expected to be of particular value since it was worth applying at these three offices.

The currently most prominent approach for defining triadic patent families is to take the European Patent Office (EPO), the US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO) as reference authorities (GEHRKE & GRUPP, 1994, p. 48; GRUPP, 1998, pp. 156-157; GRUPP & SCHMOCH, 1999). In the last years two reasons have emerged rising doubts about the current practice of taking only these countries into

consideration. First of all, the steep economic growth of Asian countries, in particular China and South Korea, should shift the patenting focus in this triad region. Second, several studies have shown that for filing a patent in Europe, national patent offices (still) play an important role besides the EPO.

So far, only one study (DERNIS & KHAN, 2004) exists which deals with the selection of patent offices for the triadic concept. DERNIS & KHAN (2004) focus on Europe, more specifically on patents filed in the United Kingdom, France, and Germany in comparison to the EPO. The authors analyze to which extend the share of triadic patent families among OECD members varies when (some of) these three national offices mentioned above are included. It could be shown that when, in addition to the EPO, the national offices of France, Germany, and the United Kingdom were taken into account, the OECD member states Japan, Korea and Germany would possess a clearly higher share of triadic patent families.

In this paper we investigate several combinations of regional and national offices which can be defined as a basis for triadic patent families. First, we explore how the share of triadic patent families - among all patents filed - varies over time. Such a trend analysis offers insights for determining if a specific definition would deliver more adequate results than another. Second, we analyze if the importance of the triadic patent family definitions differs, measured through patent citation analysis. Such an investigation can verify the results from the first analysis: only those alternative definitions are worth being discussed in order to replace the current triad definition that consist of patents with similar impact. Third, as an example, we calculate

the position of the G-7 countries plus Sweden and Finland based on triadic patent families per million inhabitants as found in BMBF (2004, p. 774) but for two different triad definitions: the current EPO-US-JPO definition and a further one including also Germany, France, the United Kingdom, and China.

The paper is organized as follows. The second section presents developments with impact on the triad definition. Section three explains the data retrieval approach, section four outlines different definitions of the triad regions. Section five presents our findings and discussion, followed by the conclusions in section six.

2. Background of the analysis

2.1 Asian perspective

Asia's position in the world's economy is increasing steadily. For example, firms from South Korea such as Samsung and LG Electronics now belong to the leading electronic firms in the world. Patent figures underline this tendency: the number of foreign patent applications in Korea alone climbed from approximately 25,000 in 1998 to 34,000 in 2004. However, at the same time, the number of foreign patents granted fell from 17,000 to about 14,000 (EPO, 2006). Next to South Korea, the People's Republic of China steadily increases its economic weight. During the last decades, the Chinese economy grew on average with double-digit rates (NATIONAL BUREAU OF STATISTICS OF CHINA, 2005). This growth rate made the country first choice among foreign investors (UNCTAD, 2005, p. 34). Simultaneously, the Chinese government fosters the country's development from the world's

workbench towards a high-tech powerhouse, following the footpaths of Japan and South Korea. In 2002, China had the sixth largest research and development (R&D) budget and in 2004, it occupied the third rank as recipient of foreign R&D investments in the world. The latter position will likely to turn into the first in the near future (UNCTAD, 2005, pp. 105-106, 133, 153). Economic growth in China is accompanied by a surge in patenting. Even though there is an ongoing discussion of the effectiveness of intellectual property rights in China (see e.g. YANG, 2003), the number of patent applications increases dramatically: while in 1997 only 20,000 foreign patent applications were filed in China, this number rose to about 65,000 in 2004 and, according to the SIPO website, to about 88,000 in 2006. Simultaneously, the number of patents granted to foreigners in China increased from approximately 2,000 in 1997 to 31,000 in 2004 (EPO, 2006). Thus, the numbers for China already surpassed those for Korea. Looking at the JPO, the current Asian triad office, in 2004 about 55,000 foreign patent applications were filed, of which about 12,500 were granted (EPO, 2006). To sum up, China already overtook Japan as leading country for foreign patent applications in Asia while Korea is (still) lagging behind both countries.

2.2 European perspective

Almost every year in a row, the EPO reports a new record in patent applications received. One could assume that, over time, the EPO would cannibalize the applications filed at the national offices in Europe. This is, however, not the case. EATON ET AL. (2004) cannot find any evidence for such an assumption. Our computation for the priority years 1999-2003 in

{insert Figure 1 about here}

Figure 1 illustrates this for the EPO and the German Patent and Trademark Office (DPMA). These numbers indicate that, across technology fields as defined by the Department of Trade and Industry (DTI) and the Office of Science and Technology (OST) of the United Kingdom who provide a definition of technology classes linked to classifications of the International Patent Classification (IPC) (DTI/OST), no general effect of cannibalization can be observed. In two fields, consumer goods and equipment as well as civil engineering, building and mining, effects of cannibalization can be recognized. The contrary, however, can be seen in organic fine chemicals, biotechnology, and basic chemical processes/petrol.

Furthermore, EATON ET AL. (2004) and DERNIS & KHAN (2004) provide evidence that some countries follow the strategy to frequently bypass the EPO and file their applications directly at, for instance, the DPMA. The reason might be high filing costs at the EPO. A European patent is only then economically feasible in comparison to separate filings at national offices when protection is sought in more than three or four countries (SCHMOCH ET AL., 1988, p. 40; TÄGER, 1989, p. 19; REBEL, 1993, p. 42; GRUPP & SCHMOCH 1999, S. 385). Instead of choosing the EPO for seeking costly protection in several European states, firms may try to "cover" the European market through filing a patent in only one or two large and important national markets. By this, they may hope to gain sufficient protection of the underlying product, making it not feasible for competitors to imitate and sell it in other European countries. Such a strategy would in particular be beneficial in industries where economies of scale play a crucial role.

As mentioned earlier in the introduction of the present paper, DERNIS & KHAN (2004) also investigated the effect of different definitions of triadic patent families by taking into account various national patent offices in Europe. Even though they find that extending the triad definition from the EPO towards a combination of various national offices would increase the share of triadic patent families for a whole range of countries significantly, they reject such a measure. Their arguments against the inclusion of national patent offices in Europe into the triad definition as alternatives to the EPO are that this would lead to a home country advantage for patents originating from these countries. They furthermore expect negative effects from bilateral trade flows and market size in Europe on the triad definition.

However, these objections disregard some important aspects. First, taking into account national offices besides the EPO would ceteris paribus have the same undesirable effects mentioned above as the *national* patent offices from the United States and Japan would have. Second, the home country advantage disappears for triadic patent families per definitionem (see BASBERG, 1987; SCHMOCH ET AL., 1988, p. 54-57; WATANABE ET AL., 2001) because at least two further (important) offices serve as filters for patents originating from one national office. Third, trade flows and national market size in general clearly affect international patenting activities (SLAMA, 1981). According to the OECD trade statistics (HS 1988 data file, own calculation), the United States largest trading partners are the European Union (first 15 member states), with Japan and Germany ranking fourth and fifth, respectively. For Japan, the situation is similar: the United States comes first, followed by the European Union (15), with Germany coming

fifth. A similar order can be found for large European countries, China, and many other states. Hence, the argumentation that trade flows and market size lead to a bias when selecting national patent offices in Europe as alternatives for the EPO is somewhat blurred.

Nevertheless, as mentioned in section one, our analysis of the inclusion of national patent offices in Europe includes citation analysis in order to reveal any differences in impact between patent applications registered at the EPO and national patent offices. Effects such as a home-country advantage, measurable through patent applications of minor impact, should therefore be detected. If this phenomenon should be observed, the inclusion of national into the triad definition would not be recommendable.

3. The data

Our analysis focuses on four different technological fields. Mechanical engineering as one field covers more traditional industries. In contrast, telecommunications, chemicals, and pharmaceuticals relate to more science-based ones. The definitions of the fields were adopted from DTI/OST, as was done for the computations of technology fields in Figure 1. For details on the IPC subclasses see Table 1.

The time frame of the analysis was nine years between 1994 and 2002, referring to the patent application's priority date, i.e. the date when the invention was filed the first time at one patent office. Integrating newer data was not feasible as there is a considerable time-lag from the priority date to the date when the patent documents are published in several countries. The analysis regarding triadic patents was performed using the World Patents

{insert Table 1 about here}

Index (WPINDEX) database from Derwent via STN International, comprising “patent family” records for the world’s major patent offices, including those under consideration. A “patent family” and thus a family record usually refers to all patent documents that are published in various countries but relate to the same invention. It frequently occurred that some patent families were based on more than one priority patent, resulting in different priority years. In this case patent families were counted more than once since parts of the underlying invention were patentable on their own, even though they were later grouped to one single patent family. Patent citation data was obtained from the Derwent Patent Citations Index (DPCI) database, containing unfortunately only a subset of all patents from WPINDEX, partially due to the fact that citation data is only included if already a search report exists from the DPMA, EPO, JPO, the Patent Office of the UK (UKPTO), USPTO, or the World Intellectual Property Organization (WIPO). Consequently, citation rates were calculated based on the data subset. For estimating national patenting activity levels, we tracked the origin of patent families. Since applicants might file a patent, for instance, at the EPO first, we cannot take the “priority country” (the country were the invention was filed for the first time) as the country of origin for the corresponding patent family, since this would imply that in some cases there is a country such as the EPO. Therefore we count the inventors’ residence as country of origin as contained in WPINDEX. This implies multiple-counting of patent families if they originate from cross-border cooperation. Data on population statistics was retrieved from (OECD, 2005, p. 5).

4. Defining the triad

It is necessary to clarify some definitions that serve as the basis for our analysis. First, there exist ambiguous views on how a patent family is defined. Since these different definitions have a high impact on search results of several definitions of the triad region, they deserve attention. Second, a number of triadic definitions is introduced as the basis for our subsequent analyses.

4.1 Patent family definitions

There are three different definitions on how the size of a "patent family" can be defined:

- When patent applicants file regional patent applications at, for instance, the EPO or via the Patent Cooperation Treaty (PCT), designated states have to be named. The patent family size can therefore equal the number of the designated states named in this regional patent application.

- When a patent was filed at a national or regional office, the corresponding fees have to be paid, and as a consequence, the patent application is published. Therefore, the number of published patent applications can be taken as the patent family size.

- Only granted patents at the designated patent office are counted for the patent family size.

We will subsequently refer to the second definition.[1] In the case of the first, the applicant will not necessarily proceed with the patent application procedure in all designated states (EPO, 2002, table 7.4). The reason is that naming designated states is free of charge and for PCT applications now occurs automatically. Paying patent application and translation fees as in the second case signals that the invention is of particular economic value. The third case imposes a limit with respect to the scope of patents: there is a considerable time-lag between filing an application and finally its granting by the patent office. In particular, many European and Asian countries examine the application only upon request, with a grace period of several years, even extending the time-lag that the office needs in order to perform the examination. Until 2001, at the United States Patent and Trademark Office (USPTO) only granted patents were published, so the latter point is only relevant for Europe and Asia.

4.2 Triad definitions

In Europe, we focus on the European, the German, French (INPI) as well as the British Patent Office (UKPTO) similar to DERNIS & KHAN (2004) to determine possible combinations of patent offices for the definition of triadic patent families. In Asia, in addition to the Japanese Patent Office, the Chinese State Intellectual Property Office (SIPO) is the other authority under consideration. As the overview in section one about patent applications and grants at the Korean Patent Office demonstrated, this office

[1] In the case the applicant filed an accelerated examination no patent application might be published. Therefore we count applications OR grants.

rather plays a minor role in comparison to the JPO and SIPO, with foreign patent applications only increasing marginally.

The analysis by DERNIS & KHAN (2004) covered the following three (Boolean) combinations, using country codes according to the World Intellectual Property Organization (WIPO):

(a) EP AND US AND JP;
(b) (EP OR (DE AND FR AND GB)) AND US AND JP
(c) (EP OR DE OR FR OR GB) AND US AND JP

It was shown by DERNIS & KHAN (2004) that the transition from (a) to (b) increased the number of triadic patent families among OECD countries by 3.2 percent. However, moving from (a) to (c) raised the total number of triadic patent families by 19 percent, with countries like Korea, Japan and Germany increasing their share by 212 percent, 34 percent and 15 percent, respectively. Based on these findings, we limit the scope of our analysis for Europe on the EPO, the EPO or the DPMA since it could be identified as Europe's most important national office (DERNIS & KHAN, 2004) and finally the EPO, DPMA, INPI or UKPTO. Looking far east, we focus on the JPO as single office in Asia according to the current definition of triadic patent families, the SIPO as single office since foreign patent applications in China already surpassed those in Japan in 2004, and the JPO or the SIPO. This leads us to the following definitions of triadic patent families:

(1) EP AND US AND JP
(2) (EP OR DE) AND US AND JP
(3) (EP OR DE OR GB OR FR) AND US AND JP
(4) EP AND US AND CN

(5) EP AND US AND (JP OR CN)

(6) (EP OR DE) AND US AND CN

(7) (EP OR DE) AND US AND (JP OR CN)

(8) (EP OR DE OR GB OR FR) AND US AND CN

(9) (EP OR DE OR GB OR FR) AND US AND (JP OR CN)

5. Results and Discussions

5.1 Trend analysis of patent activities

The first analysis aims to identify whether the importance of filing patents in the countries discussed above has changed in the course of time, which could indicate that some of the newly proposed triadic definitions from section 4.2 might have become more adequate than the current definition. Such a trend analysis also allows to investigate if the surge in patenting worldwide, including the increase of the overall patent family size (BLIND ET AL., 2003), leads to an inflation of the triadic patent family size as for instance is mentioned by SCHRAMM (1995).

{insert Figures 2-5 about here}

We thus plotted the ratio of the different definition of triadic patent families to total patent families for the four technology fields over time. The total number of patent families is defined as all patents from the priority year and in the technology field under consideration that were identified in WPINDEX.

Figure 2-5 present our findings. These figures reveal that inflationary tendencies are only existent in mechanical engineering. A slight overall increase in patenting activities for the years 2000ff. should result from the fact that since then also US patent applications, not only granted patents, were considered.

The figures also provide us with more information on patenting strategies and the fit of several triad definitions:

- First, comparing the different technology fields, it becomes obvious that in some of them a worldwide protection of inventions is more important than in other. While in telecommunications about twelve percent of all patents worldwide are registered at the first triadic definition (EP AND US AND JP) patent offices. In chemicals it is about 40 percent, in pharmaceuticals about 33 percent, while there is an increase in mechanical engineering from eight to ten percent in 1996 to about ten to twelve percent in 2001. Therefore, nations with strong patenting activities in fields such as pharmaceuticals and chemicals should ceteris paribus possess more triadic patents than nations with activities primarily in mechanical engineering.

- Second, it can be seen that all definitions taking solely China - but not Japan - into account result in significantly lower shares of triadic patent families. The reason is that the number of international applications registered in Europe, the United States, and China, but not Japan, was very low in the pre-2002 era. Presumably, the Chinese market, in combination with a patent system that only theoretically provides a high level of patent protection (YANG, 2003), seemed less attractive for patenting. Another important reason should be that triadic patent applications from Japan, according to the EPO-JPO-USPTO definition, are accountable for about a quarter of all triadic patent families (GRUPP & SCHMOCH, 1999). However,

for Japanese applicants it does not make much sense filing their patents in China instead of in Japan. Hence, the high weight of Japanese applications within the triad leads to lower patent rates in China. In parallel to many applicants from various countries, Japanese applicants have begun to file a higher share of their applications also in China. As Figures 2 and 5 furthermore demonstrate for telecommunications and mechanical engineering, the gap between triadic applications filed solely in China and triadic applications filed (also) at the JPO is narrowing considerably. Looking at detailed figures for the triadic patents filed in Asia, these numbers reveal that in 1994 two-thirds of the patents in telecommunications were only registered in Japan, while in 2002 this number fell to about one quarter, underlying the strategic importance of the Chinese market for the telecommunications industry. For mechanical engineering the numbers are similar, but the growing importance of the Chinese market was less predominant. A further analysis (not presented in this paper) shows that the number of triadic patent applications filed only in China increases faster than the number of patent applications registered at both the Chinese and Japanese patent office. If these trends pertain, it can be expected that for the priority years 2004ff. in telecommunications and mechanical engineering – two technology fields with particular importance for China's exports – China as a triadic patent country might reach or even surpass the role of Japan.

- Third, the analysis reveals that for chemicals and pharmaceuticals there is not much variance regarding the share of the different triadic patent family definitions. Obviously, patents are generally filed here in numerous countries. However, in comparison to the other triadic definitions, the established definition of EP, US and JP fits quite well. This is, however, not the case for telecommunications and mechanical engineering. Taking into account German applications in addition to European ones, the total share of triadic patent families in telecommunications would rise by about ten percent. Adding furthermore France and the United Kingdom only increases the share of triadic patent families marginally, but adding China as a triadic patent county leads to an increase in the overall share of triadic patent families by another ten percent. Even more substantial are these changes in the case of mechanical engineering. Including France and the United Kingdom also represents a marginal influence, but including Germany raises the share of triadic patent families worldwide by slightly more than 25 percent. The increase by including China is in the same order of magnitude as in the case of telecommunications, but growing slightly over time.

5.2. Trend analysis of citation frequency

Before conclusions should be drawn from results found in section 5.1, it is of interest if these findings can be supported by citation analysis. If for instance the rise of patent families registered in China is based mainly on patents that are clearly less highly cited than the patent families registered in

Japan, including China as a triadic patent country would undermine the meaning of the triad definition and rather support objections raised by DERNIS & KHAN (2004).

We therefore compared the importance of the patent families captured by the different definitions of the triad by means of patent citation frequency analysis. The frequency with which a patent is cited by later inventions is a widely used indicator for the cited patents' importance (NUNN & OPPENHEIM, 1980; CARPENTER ET AL., 1981; ALBERT ET AL., 1991). Most citations occur shortly after the patent was published (BACCHIOCCHI & MONTOBBIO, 2004), the amplitude and the time when the peak of cumulative citations received per year is reached varies considerably with the technology field (HALL ET AL., 2000). Since a yearly comparison of the triadic patent families per technology field is performed, the bias due to the unequal time windows for citation counts is minimized.

Because we found only minor differences among different triadic definitions in chemicals and pharmaceuticals (see Figure 3 and 4), it was not surprising that also differences in patent citations received per triadic definition were rather small. We therefore focused only on telecommunications and mechanical engineering. Furthermore, as a result of our findings in the previous analysis, we only compared the citation frequency of EPO vs. DPMA as well as JPO vs. SIPO patent families. In the trend analysis of patent activities triad countries were "connected" via Boolean OR-operations that actually comprise of three different subsets of patent families with individual citation frequencies: one subset consists of patents registered, for instance, only at the EPO, another of patents registered only

at the DPMA, and finally a subset of the combination of patents registered at both the EPO AND DPMA. Especially the latter case consisted of applications filed in both countries and was associated with a larger family size, which might result in a higher citation frequency. We thus take into account all four measures per technology field.

{insert Figures 6-9 about here}

Figures 6 and 7 reveal that in telecommunications the difference between those patent families registered only in China and only in Japan is rather small over the observation period. Patents registered at both offices receive about 20 percent more citations. There was a larger gap in mechanical engineering regarding patents filed exclusively in China and exclusively in Japan, of which the latter were clearly more highly cited. However, this gap has diminished over time. Interestingly, patent families from recent years filed at both offices receive fewer citations than those filed exclusively in Japan. Looking at EP and DE, Figures 8 and 9 show that in telecommunications there used to be a gap between the triadic patent families only registered at the DPMA and those only filed at the EPO. This gap has closed as well. At the same time, triadic patent families registered at both offices received considerably more citations. This leads to the conclusion that the DPMA serves as an alternative for the EPO, while only very important patent applications are registered at both offices.[2] For mechanical engineering there is no clear difference among the citation frequency of triadic patent families registered at the DPMA, EPO and/or both offices. To sum up, the current triad definition does not appropriately capture all important patent families in Europe and Asia since a

[2] We did not distinguish between patents registered at both offices and EP applications granted in DE.

considerable amount of equally important inventions is registered in countries within the triad region but that are currently not considered for defining triadic patent families. The findings also prove that there is no home country advantage for triadic patents registered at the DPMA instead of at the EPO. Therefore, it is more appropriate to move from the triadic definition (1) to (7), or even from (1) to (9) by including at least the DPMA in Europe as alternative to the EPO, and the SIPO as alternative to the JPO in Asia.

5.3 Benchmarking technological strength with the triad definitions

To test the impact of the suggested triad definition in practice as measures of the nations' technological position and productivity, we chose the current definition (1) as well as (9) and investigated the number of triadic patent families per million inhabitants for the G-7 countries plus Sweden and Finland and the year 2002. Such an analysis was conducted in BMBF (2004, p. 774) for triadic family definition (1). Our results are presented in Figure 10.

{insert Figure 10 about here}

It can be recognized that there are considerable differences in the number of triadic patent families per country, depending on the definition.[3] As Table 2 reveals, when moving from definition (1) to (9), with 60 percent more triadic patent families the largest increase can be found in Finland, while the

[3] There might be an overestimation for the number of triadic patent families originating from Japan, rooted in the definition of what a patent family is. Since in Derwent World Patent Index a family record is based on the first entry into the database, it is possible that there exist multiple records originating from Japanese priority applications that subsequently were "grouped" for one single application in Europe or the US. Should the records be counted separately as is done in WPINDEX, or should they better considered one single invention since they for instance relate to the same priority date and several aspects of one "big" technical solution?

United States “only” received about seven percent more triadic patent families. The reasons for this observation depend on two aspects: First, we uncover national patenting strategies. As O'KEEFFE (2005) discovered, large multinational corporations from the US are particularly reluctant to file patents in China; instead, they prefer filing in Japan. European and Japanese firms, on the other hand, are more open to file in China, even though enforcing their property rights is still regarded as a major hurdle. Second, Figure 9 also reveals technological strengths of nations. Finland and Japan are both well-known for their strengths in telecommunications or electronics in general, while Germany is known for its strength in mechanical engineering. As our analyses on the technology field-level demonstrated, these fields are highly affected by the triadic definitions. Therefore, not surprisingly, countries with strengths therein show significant changes in the number of their triadic patent families when moving from definition (1) to (9).

6. Conclusion

Countries with a high share of patenting activities in technology fields where a wide geographical scope of protection is rather common, such as in pharmaceuticals or chemicals, ceteris paribus show a higher share of triadic patent families. As a consequence, there is always a technology specialization bias in statistics on national technological strengths based on triadic patent families, independent from the chosen definition. In some technological fields, the importance of national markets is clearly underestimated with the current US-EP-JP triad definition. Our analysis shows that, for example, patent families in mechanical engineering,

registered exclusively in Germany are not necessarily less cited than those filed at the EPO. Especially the growing importance of the Chinese market results in steadily increasing national and international patent activities. The importance (measured through citations) of those patents filed in China, at least in telecommunications and mechanical engineering, in recent years equals those filed only in Japan. To take these findings into account, it is recommendable to perform triadic patent statistics by taking into account at least the patents filed at the JPO or SIPO in Asia and the EPO or DPMA in Europe, maybe even adding the UKPTO and INPI as further offices here. In particular, the fact that the number of foreign patent applications in China already surpassed foreign patent applications in Japan in 2004 underlines the importance of including China as an alternative to Japan in Asia. In addition, the existence of inflationary tendencies in the share of triadic patent families as was anticipated in the literature cannot be confirmed in general, it rather seems to be a phenomenon limited to certain technology fields.

Acknowledgements

The author would like to thank Adam Bartkowski and Elke Thomä for helping him with data processing and discussions on patent search strategies, as well as Anja Schmiele, Jana Thiel and two anonymous referees for helpful comments.

References:

ALBERT, M. B., AVERY, D., NARIN, F. AND MCALLISTER, P. (1991), Direct Validation of citation counts as indicators of industrially important patents, *Research Policy,* 20 : 251-259.

BMBF (2004), *Bundesbericht Forschung 2004,* Bundesministerium für Forschung und Technologie, Bonn.

BACCHIOCCHI, E. AND MONTOBBIO, F. (2004), EPO vs USPTO Citation Lags, CESPRI Working Paper No. 161, *ftp://ftp.unibocconi.it/pub/RePEc/cri/papers/WP161Montobbio.pdf* (23-Aug-2005).

BASBERG, B. L. (1987), Patents and the measurement of technological change: a survey of the literature, *Research Policy,* 16 : 131-141.

BLIND, K., EDLER, J., FRIETSCH, R. AND SCHMOCH, U. (2003), *Erfindungen kontra Patente: Schwerpunktstudie 'zur technologischen Leistungsfähigkeit Deutschlands' : Endbericht,* FhG-ISI, Karlsruhe.

CARPENTER, M. P., NARIN, F. AND WOOLF, P. (1981), Citation rates to technologically important patents, *World Patent Information,* 3 : 160-163.

DTI/OST DTI/OST Technology group & IPC Subclass mapping *http://www.ipaustralia.gov.au/pdfs/statistics/Technology%20Groups.doc* (June 27, 2006).

DERNIS, H. AND KHAN, M. (2004), Triadic patent families methodology, STI Working Paper 2004/2, OECD, *http://www.oecd.org* (15-Apr-2005).

EATON, J., KORTUM, S. AND LERNER, J. (2004), International Patenting and the European Patent Office: A Quantitative Assessment, Patents, Innovation, and Economic Performance: OECD Conference *http://www.nber.org/CRIW/papers/eaton.pdf* (Apr 16, 2007).

EPO (2002), Annual Report 2002, European Patent Office, München,.

EPO European Patent Office Website: FAQ on Far East - China: Facts & Figures *http://patentinfo.european-patent-office.org/prod_serv/far_east/index.en.php* (05-Jul-2006).

EUROPEAN COMMISSION (2003), Third European report on science & technology indicators, Directorate-General for Research, Brussels.

GEHRKE, B. AND GRUPP, H. (1994), *Innovationspotential und Hochtechnologie: technologische Position Deutschlands im internationalen Wettbewerb,* Physica, Heidelberg.

GRUPP, H. AND SCHMOCH, U. (1999), Patent statistics in the age of globalisation: new legal procedures, new analytical methods, new economic interpretation, *Research Policy,* 28 : 377-396.

GRUPP, H. (1998), *Foundations of the economics of innovation: theory, measurement and practice*, Elgar, Cheltenham.

HALL, B. H., JAFFE, A. B. AND TRAJTENBERG, M. (2000), Market value and patent citations: a first look, NBER Working Paper No. 7741, Cambridge, Mass.

LEGLER, H. AND GEHRKE, B. (2005), *Zur technologischen Leistungsfähigkeit Deutschlands 2005,* Bundesministerium für Bildung und Forschung, Berlin.

NATIONAL BUREAU OF STATISTICS OF CHINA (2005), *Chinese Statistical Yearbook.*

NUNN, H. AND OPPENHEIM, C. (1980), A patent-journal citation network on prostaglandin, *World Patent Information,* 2 : 57-60.

O'KEEFFE, M. (2005), Cross comparison of US, EU, JP and Korean companies patenting activity in Japan and in the Peoples Republic of China, *World Patent Information,* 27 : 125-134.

OECD (2005), *Labour Force Statistics 1984-2004.*

REBEL, D. (1993), *Handbuch gewerbliche Schutzrechte: Übersichten und Strategien,* Gabler, Wiesbaden.

SCHMOCH, U. ET AL., (1988), *Technikprognosen mit Patentindikatoren: zur Einschätzung zukünftiger industrieller Entwicklungen bei Industrierobotern, Lasern, Solargeneratoren und immobilisierten Enzymen,* TÜV Rheinland, Köln.

SCHRAMM, R. (1995), *Patentinformationen mittels Science Citation Index,* Proceedings 17. DGD-Online-Tagung, Frankfurt, pp. 295-307.

SLAMA, J. (1981), Analysis by Means of a Gravitation Model of International Flows of Patent Applications in the Period 1967-1978, *World Patent Information,* 3 : 2-8.

TÄGER, U. C. (1989), *Probleme des deutschen Patentwesens im Hinblick auf die Innovationsaktivitäten der Wirtschaft: (insbesondere kleiner und mittlerer Unternehmen) und Vorschläge zu deren Lösung,* Ifo-Inst. für Wirtschaftsforschung, München.

UNCTAD (2005), World Investment Report 2005, United Nations Conference on Trade and Development *http://www.unctad.org/en/docs/wir2005_en.pdf* (03-Jul-2006).

WATANABE, C., TSUJI, Y. S. AND GRIFFY-BROWN, C. (2001), Patent statistics: deciphering a 'real' versus a 'pseudo' proxy of innovation, *Technovation,* 21 : 783-790.

YANG, D. (2003), The development of intellectual property in China, *World Patent Information,* 25 : 131-142.

Table 1: Technology fields of the investigation.

OST code	Description of technology field: Abbreviation (full name)	IPC classification (4 digits)
2, 3	Telecommunications (telecommunications and audiovisual technology)	G08C, H01P, H01Q, H03B, H03C, H03D, H03H, H03K, H03L, H03M, H04B, H04H, H04J, H04K, H04L, H04M, H04N, H04Q, G09F, G09G, G11B, H03F, H03G, H03J, H04R, H04S
9	Chemicals (organic fine chemicals)	C07C, C07D, C07F, C07H, C07J, C07K
11, 12	Pharmaceuticals (pharmaceuticals, cosmetics, biotechnology)	A61K, C07G, C12M, C12N, C12P, C12Q, C12R, C12S
21, 22	Mechanical Engineering (mechanical tools, engines, pumps, turbines)	B21, B23, B24, B26, B27, B30, F01B, F01C, F01D, F01K, F01L, F01M, F01P, F02, F03, F04, F23R

Table 2: Triadic patent families per G-7 country including Sweden and Finland.

Country	Inhabitants [Mio]*	Triadic patent families§ according to definition:		Triadic patents per inhabitant		Percentage increase
		(1)	(2)	(1)	(2)	
Canada	31.373	1,709	1,880	54,5	59,9	10,0%
Finland	5.201	486	777	93,4	149,4	59,9%
France	59.678	3,903	4,363	65,4	73,1	11,8%
Germany	82.456	9,417	11,578	114,2	140,4	22,9%
Italy	57.474	1,334	1,593	23,2	27,7	19,4%
Japan	127.435	25,138	29,522	197,3	231,7	17,4%
Sweden	8.925	1,208	1,356	135,4	151,9	12,3%
UK	59.322	3,755	4,148	63,3	69,9	10,5%
USA	287.941	35,902	38,338	124,7	133,1	6,8%
Sum of triadic patent families G-7 + FI/SE		82,852	93,555			
Total triadic patent families		84,595	102,241			

* OECD (2005), p. 5.

§ Multiple counting possible if inventors from more than one country.

Figure 1: Patent families by technology field as defined by DTI/OST. Numbers are computed as differences between applications filed at the EPO minus applications filed not at the EPO but at the German Office (DPMA).

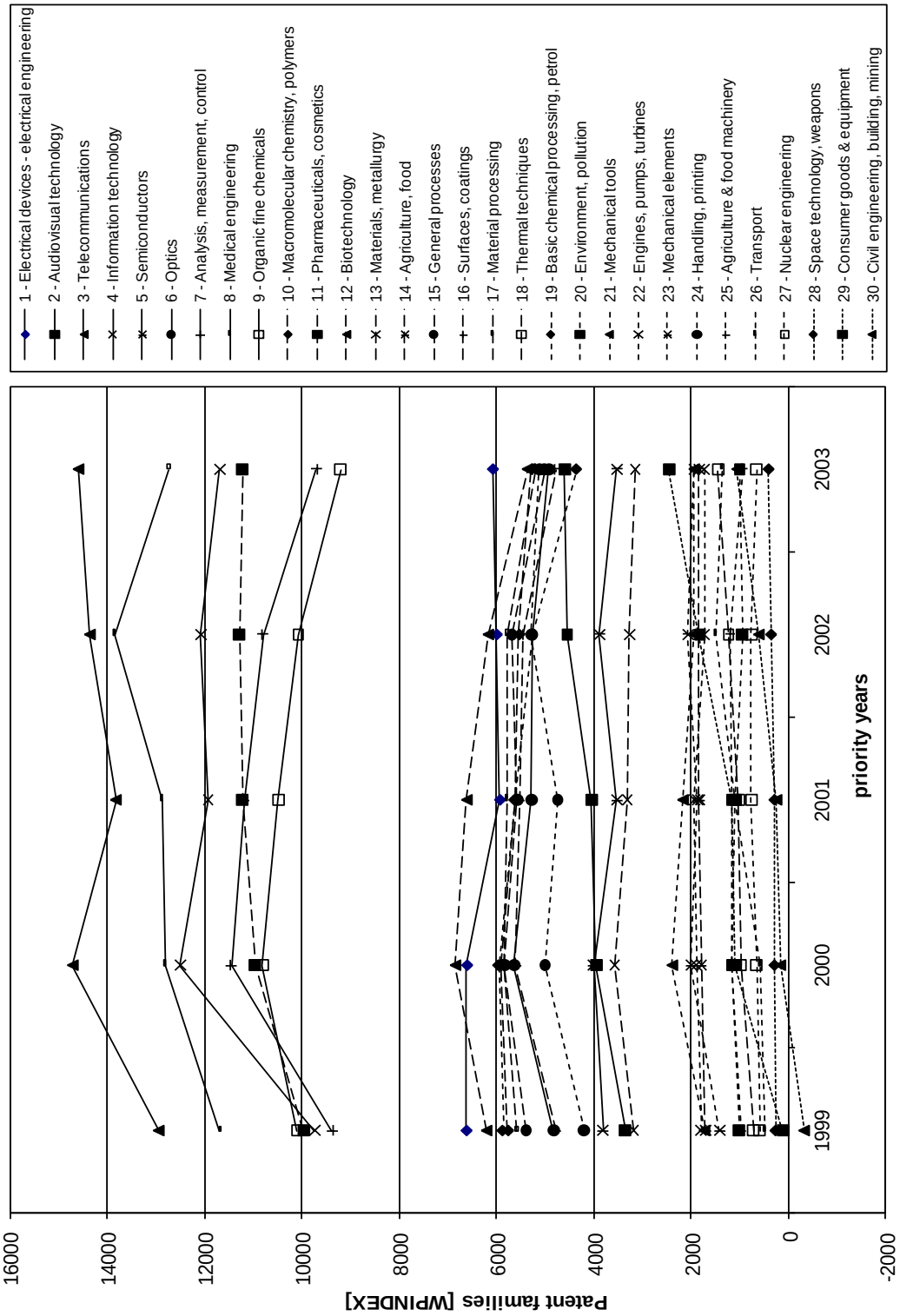

Figure 2: Triadic patent families in telecommunications

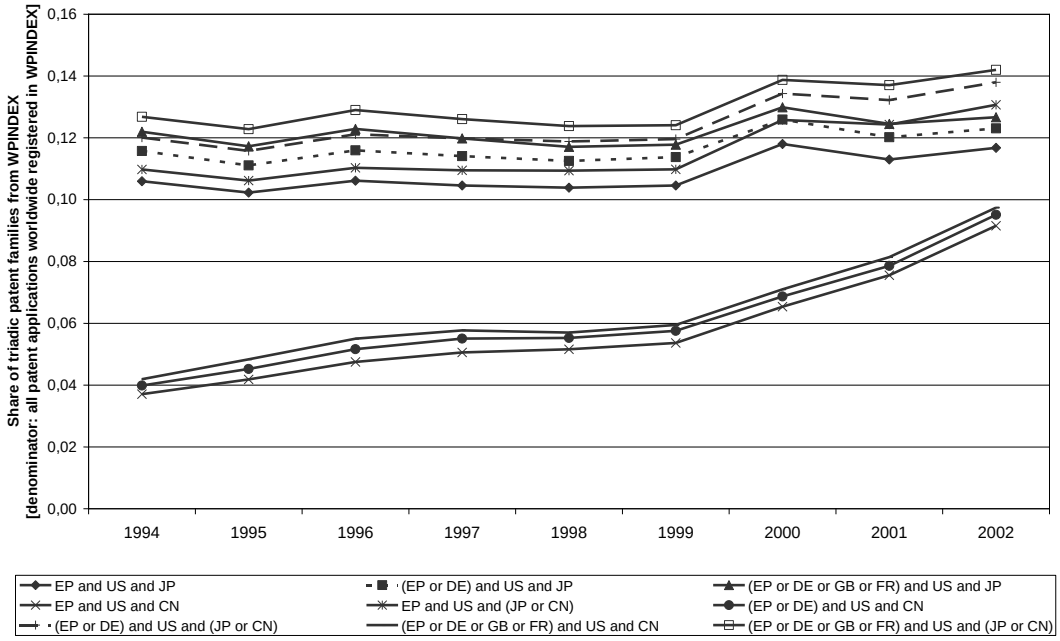

Figure 3: Triadic patent families in chemicals

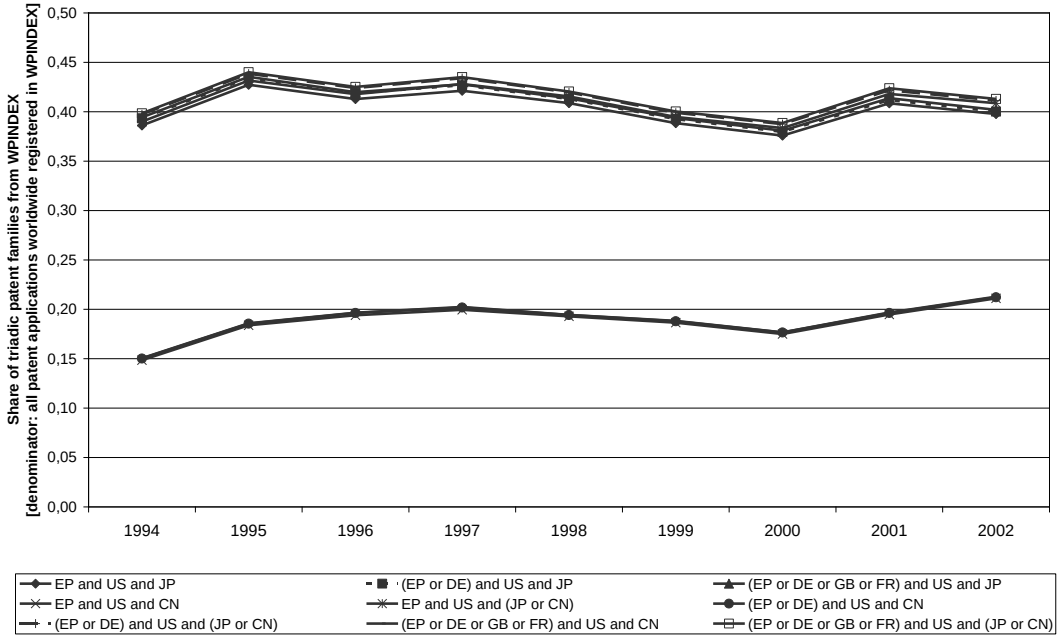

Figure 4: Triadic patent families in pharmaceuticals

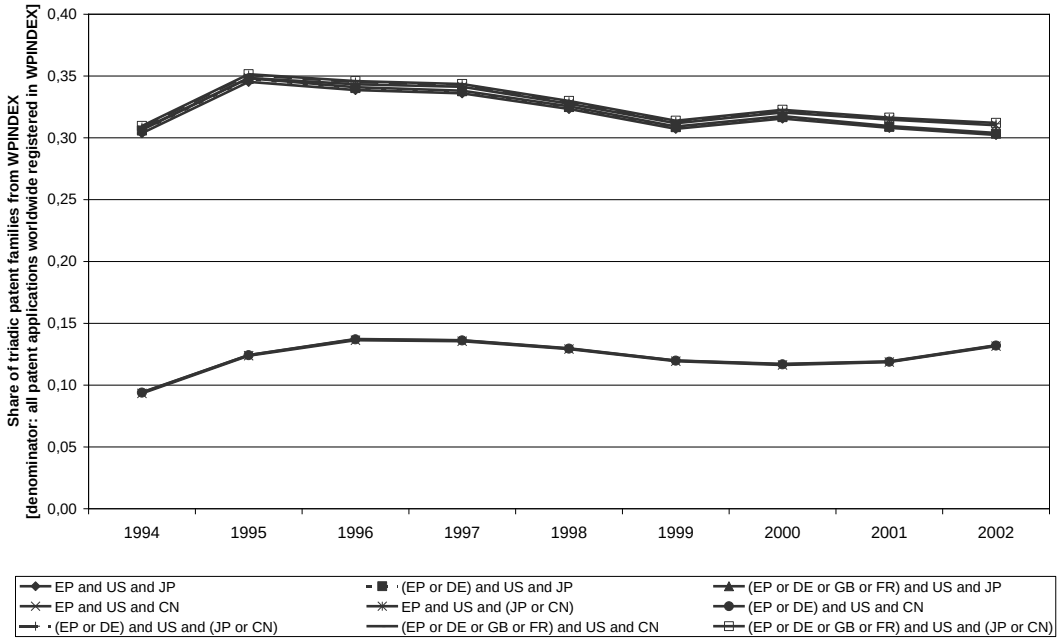

Figure 5: Triadic patent families in mechanical engineering

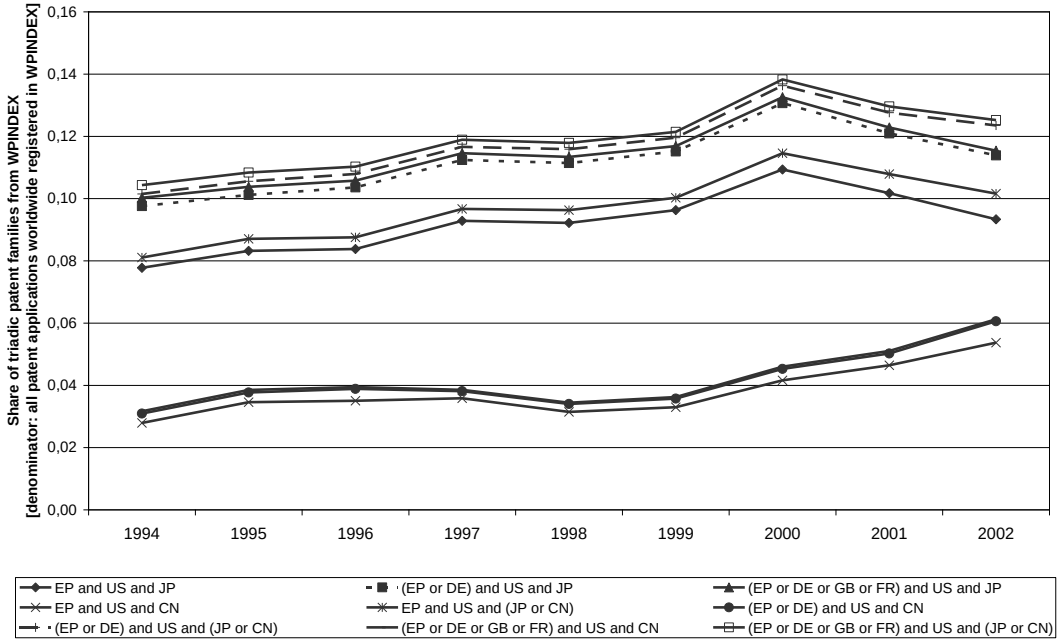

Figure 6: Citation frequency of triadic patent families registered in Japan, China, (Japan AND China) and (Japan OR China) in telecommunications

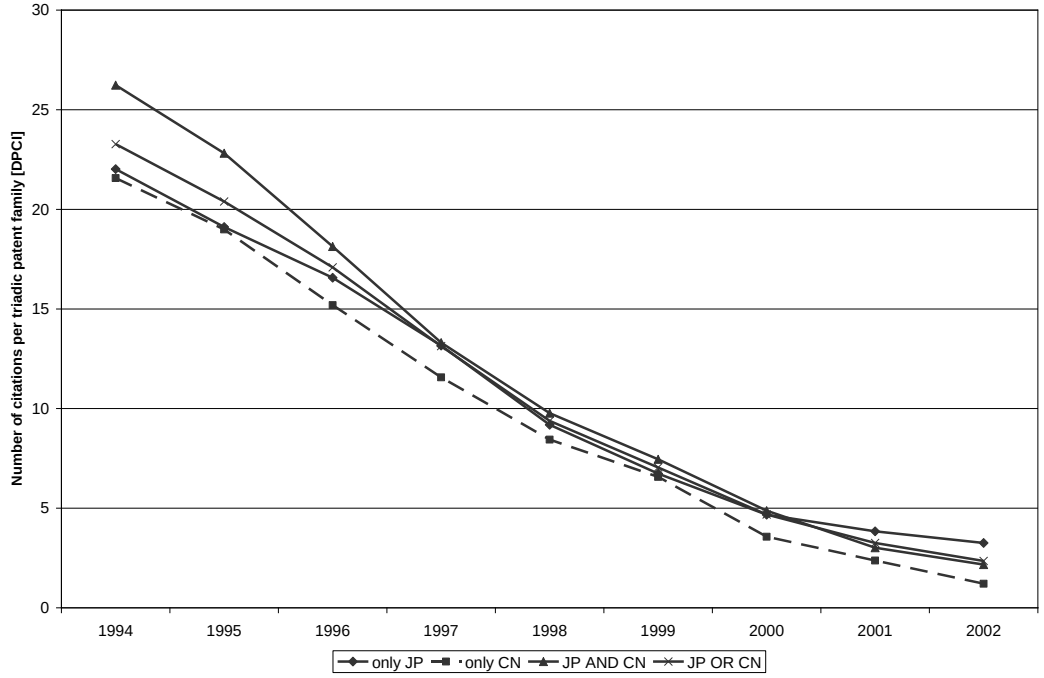

Figure 7: Citation frequency of triadic patent families registered in Japan, China, (Japan AND China) and (Japan OR China) in mechanical engineering

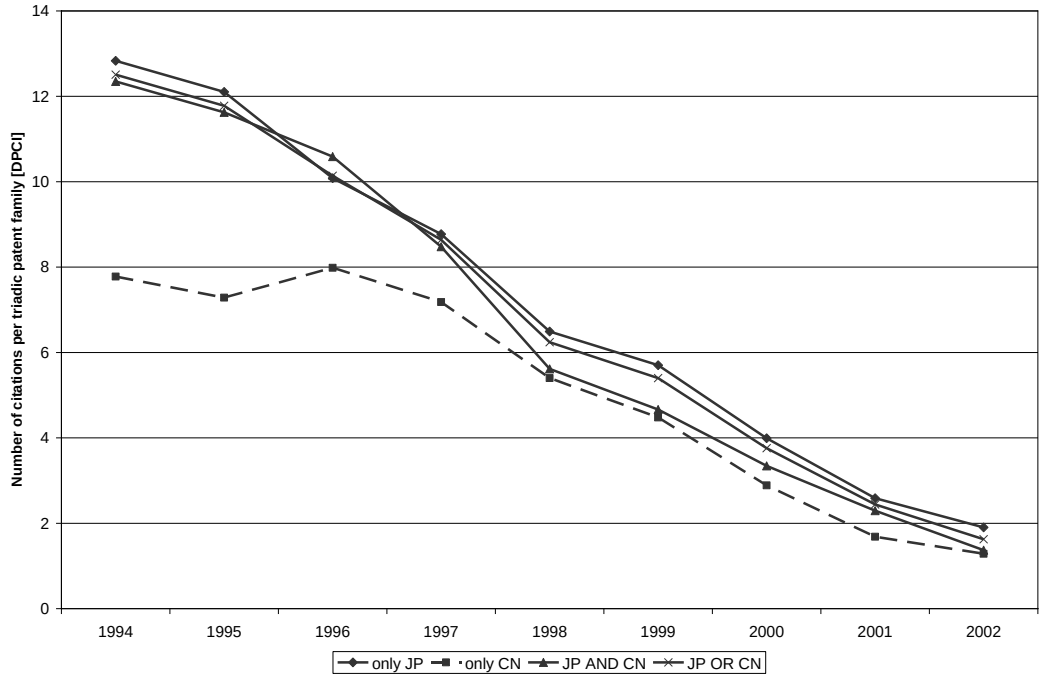

Figure 8: Citation frequency of triadic patent families registered at the EPO, in Germany, (EPO AND Germany) and (EPO OR Germany) in telecommunications.

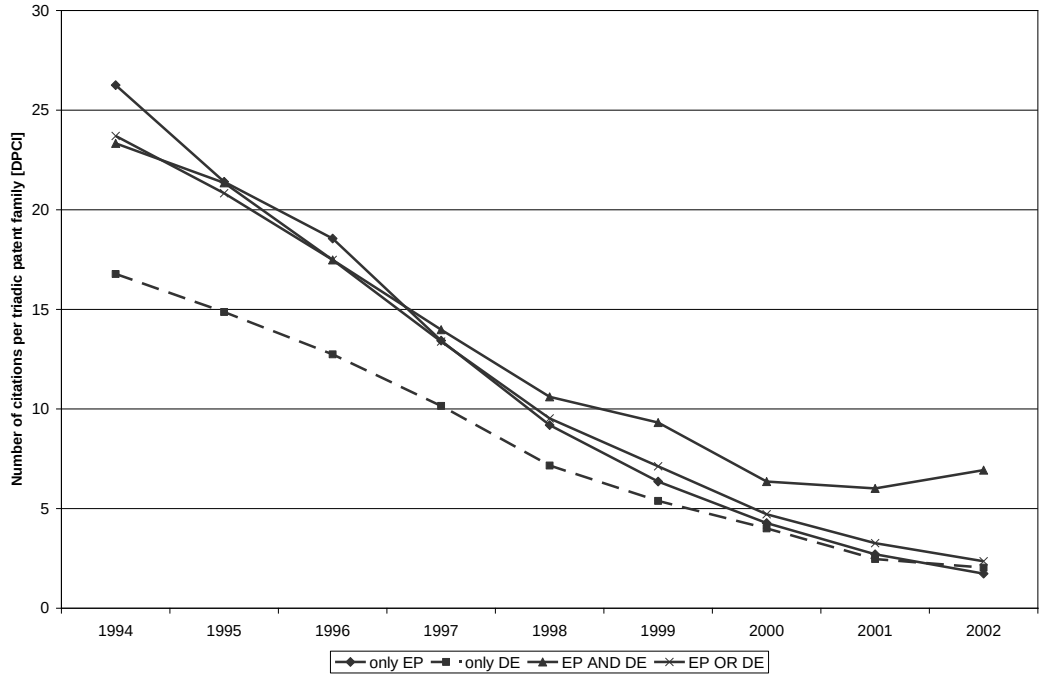

Figure 9: Citation frequency of triadic patent families registered at the EPO, in Germany, (EPO AND Germany) and (EPO OR Germany) in mechanical engineering.

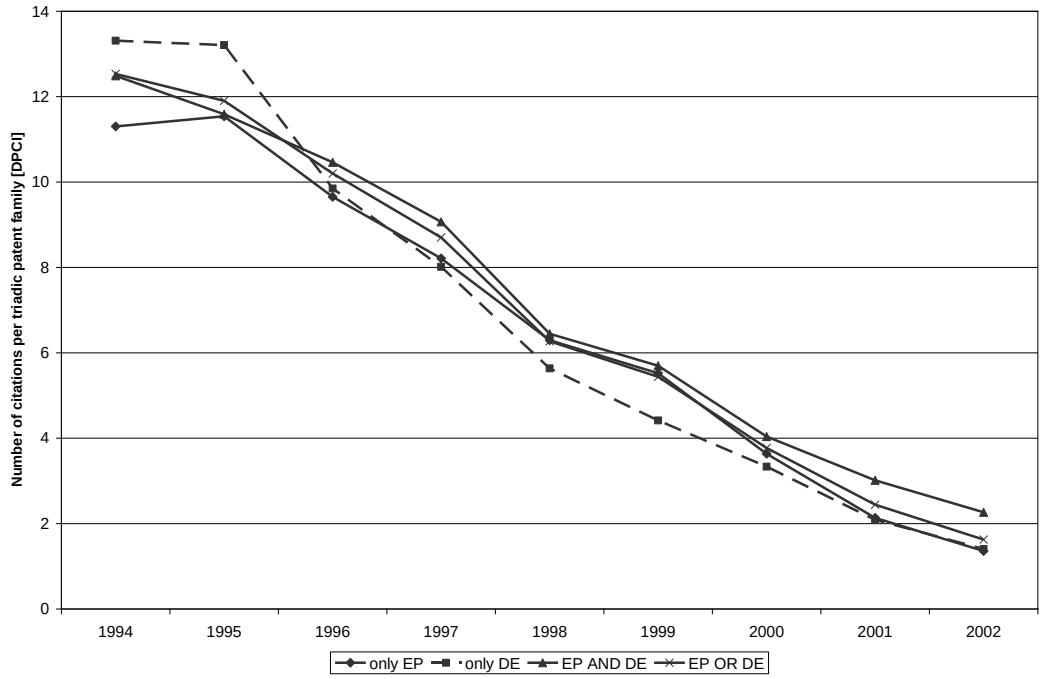

Figure 10: Patent activity in 2002 in the G-7 countries plus Finland and Sweden for triadic definitions (1) and (9).