COMPENDIUM OF PATENT STATISTICS

2007

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14 December 1960, and which came into force on 30 September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in member countries, while maintaining financial stability, and thus to contribute to the development of the world economy.

- To contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and

- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became members subsequently through accession at the dates indicated hereafter: Japan (28 April 1964), Finland (28 January 1969), Australia (7 June 1971), New Zealand (29 May 1973), Mexico (18 May 1994), the Czech Republic (21 December 1995), Hungary (7 May 1996), Poland (22 November 1996), Korea (12 December 1996) and the Slovak Republic (14 December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

FOREWORD

The Compendium of Patent Statistics 2007 provides the latest available internationally comparable data on patents. Patent indicators presented in this publication are specifically designed to reflect recent trends in innovative activities across a wide range of OECD member and non-member countries.

Patent-based statistics reflect the inventive performance of countries, regions and firms, as well as other aspects of the dynamics of the innovation process (*e.g.* co-operation in innovation or technology paths). Patent indicators, along with other science and technology indicators, thus contribute to our understanding of the innovation system and the factors that support economic growth. For example, using the inventors' address, indicators can be developed to monitor the internationalisation of and international collaboration in science and technology (S&T) activities.

The results presented in this document reflect the efforts of the OECD, the European Patent Office (EPO) and the OECD task force on patent statistics to improve the quality and availability of patent statistics for researchers and policy makers. Furthermore, OECD activity on patent statistics benefited from strong support from the Japan Patent Office (JPO). The focus of OECD work in this area is not only limited to the development of patent indicators; efforts are also made to develop methodologies and guidelines for compiling and interpreting patent indicators, and to improve accessibility of such information for users. Statistics reported in this compendium differ from data published in other sources, such as patent office data. This is mainly due to methodology. OECD's patent indicators are designed to reflect inventive activity, whereas patent data reported in annual reports of patent offices are designed to reflect their own activity and are primarily for administrative purposes (*e.g.* budget planning). Therefore, the data reported here should not be compared with those published by patent offices.

The 2007 edition is the fifth edition in an annual series. With each edition, there is a continuing effort to provide new or improved patent indicators for international comparisons. The 2007 edition has made extended use of the EPO's the Worldwide Statistical Patent Database and the comprehensive data set on JPO applications set up by the JPO and the University of Tokyo (IIP database). A series of new indicators was drawn to highlight patenting activities in key technology fields such as nanotechnologies. A new section presents patenting activity by regions. The electronic version of this document, together with spreadsheets containing the data used in charts and graphs, plus a glossary of terms and a brief note on patenting procedures, is available on the OECD patent statistics web site:

www.oecd.org/sti/ipr-statistics

The OECD's patent statistics task force includes representatives from the European Commission (EC), Eurostat, the EPO, the JPO, the US National Science Foundation (NSF), the US Patent & Trademark Office (USPTO) and the World Intellectual Property Organization (WIPO). This work has greatly benefited from the support of those institutions.

This edition was prepared by Hélène Dernis of the OECD Directorate for Science, Technology and Industry, with contributions from Dominique Guellec, Masatsura Igami, Teruo Okazaki, Colin Webb and Maria Pluvia Zuniga Lara. The EPO provided much of the data and Bruno van Pottelsberghe de la Potterie of the EPO commented on the draft.

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HIGHLIGHTS

- After the surge in patenting in the 1990s, the increase in patent applications slowed at most patent offices in the early 2000s. The number of triadic patent families and the number of patents filed under the PCT procedure increased by 2% on average between 2000 and 2005 (2004 for PCT).* Patents applied for at the USPTO grew at an average of 6% over the same period, whereas EPO and JPO patents increased by less than 2%. At other national patent offices, the number of patent applications followed a similar downturn after 2000, with the exception of the Chinese patent office (SIPO), where the number of filings continuously increased by more than 20% a year on average from 2000 onwards.

- The European Union, Japan and the United States have comparable shares in total triadic patent families (respectively 28.4%, 28.8% and 31% in 2005). Patenting activity is concentrated in a set of countries: the United States, Japan, Germany, Korea, France and the United Kingdom accounted for 86% of total OECD triadic patent families in 2005; these countries represented 81% of OECD R&D expenditures in 2005. Japan, Switzerland, Germany and the Netherlands have the highest patent intensities, relative to other economic aggregates. Korea is increasingly involved in innovative activity: patent intensity ratios of Korea grew rapidly since 1995.

- Emerging technologies have contributed much of the overall growth in patenting. Over half of the PCT applications of Finland, the Netherlands and Singapore in 2005 related to ICT technologies, and this proportion has more than doubled within the patent portfolio of China from the mid-1990s onwards. While the number of biotechnology patents grew at a steady rate in the 1990s, the years 2000s have been marked by a strong drop in biotechnology patenting. This phenomenon is partly due to more stringent criteria applied by patent offices for granting patents on genetic material. The proportion of biotechnology patents fell slightly in most countries compared to the level in the late 1990s. In 2004, Denmark had the highest share of patents for inventions relating to biotechnology among all patent applications.

- The late 1990s saw the emergence of patents related to new technologies, such as nanotechnology, and progress in energy-related technologies (notably wind energy and fuel cells) and space-related patents. The proportion of nanotechnology patents has more than doubled between the mid-1990s and the mid-2000s. The United States (40%), Japan (19%) and Germany (10%) accounted for nearly two-thirds of the nanotechnology patents filed under the PCT. Among environmental technology patents, inventions relating to renewable energy and motor vehicle abatement evolved rapidly since the mid-1990s (around 18% a year on average).

- Over the 2002-04 period, more than 80% of all PCT applications were owned by companies; the remainder were owned by government, universities, private non-profit institutions and individuals. This share has remained stable over the last decade, with the exception of China, where the proportion jumped from 22% in 1996-98 to over 50%. The proportion of patents owned by universities increased markedly since the mid-1990s in Japan and in European countries, especially in Denmark, France, Germany, Ireland and Italy. In India, 23% of patent applications originate from government, whereas this share stands at less than 3% on average for all patents in most countries.

- The section on regional patenting assesses the geographical concentration of innovative activities within countries: inventive activities are highly concentrated in a small number of regions. The concentration index is the strongest in Hungary, Spain, Japan and Sweden. Among all countries, California (United States) and Tokyo (Japan) filed for more PCT patents in 2004, both for ICT-related inventions and biotechnology inventions, than other regions.

- Data on patent applications filed at the EPO show an increase in the level of internationalisation and international collaboration on inventive activities. R&D activities of multinational firms are increasingly internationalised. Inventions originating from Luxembourg, the Russian Federation and Singapore widely owned/co-owned and co-invented by foreign residents. At the opposite end of the scale, Japan and Korea have much less internationalised innovative activity. More than half of the patent portfolios of Ireland and Switzerland originate from co-operation with inventors from other countries. Partnerships with other countries are mainly driven by common language, historical links and geographical proximity.

- Insights into scientific linkages to technology may be revealed by the propensity to cite non-patent literature (NPL) in patent publications. Patent applications in the fields of ICT, biotechnology, pharmaceuticals and other fine organic chemistry have higher shares of citations to NPL indicating that these technologies are more closely linked to scientific R&D than others. Looking at shares of NPL citations by origin of inventor highlights those countries whose international patenting activities are concentrated in these more science intensive technologies.

** All data reported in this section refer to the priority date (the first date of filing of a patent application, anywhere in the world, to protect an invention), which is the date closest to the date of invention. Owing to the time lag between priority date and the availability of patent information, data can be reported up to 2005 (estimates). However, it should be noted that although the data refers to "priority" year 2005, all the indicators are based on available information up to mid-2007.*

European Union figures refer to EU25.

METHODOLOGICAL BACKGROUND

Patents are an exclusive right issued by authorised bodies to inventors to allow them to make use of and exploit their inventions for a limited period of time (generally 20 years). Patents are granted to firms, individuals or other entities as long as the invention is novel, non-obvious and industrially applicable. In return for the rights, the applicant must disclose information relating to the invention for which protection is sought.

Patents as indicators of science and technology activities

Patent statistics provide a measure of innovation output, as they reflect the inventive performance of countries, regions, technologies, firms, etc. They are also used to track the level of diffusion of knowledge across technology areas, countries, sectors, firms, etc., and the level of internationalisation of innovative activities. Patent indicators can serve to measure the output of R&D, its productivity, structure and the development of a specific technology/industry. Conversely, patents can also be used as an input indicator, as they represent a source of information for subsequent inventors.

Patent indicators have many advantages, mainly: *i)* they have a close link to inventions; *ii)* they cover a broad range of technologies on which there are sometimes few other sources of data; *iii)* the contents of patent documents are a rich source of information; and *iv)* patent data are readily available from patent offices. However, patents are also subject to certain drawbacks: *i)* the value distribution of patents is skewed as many patents have no industrial application (and hence are of little value to society) whereas a few are of substantial value; *ii)* many inventions are not patented because they are not patentable or inventors may protect their inventions using other methods, such as secrecy, lead time, etc.; *iii)* the propensity to patent differs across countries and industries; *iv)* differences in patent regulations make it difficult to compare counts across countries; and *v)* changes in patent law over the years make it difficult to analyse trends over time.

The focus of the OECD work is to develop patent indicators that can be used, in combination with other science and technology (S&T) indicators, to address various policy issues. Most patent indicators presented in this compendium provide a measure of innovative output, thus reflecting the inventive performance of countries, regions, technology, etc. A selection of indicators is also used to measure diffusion of ideas, technologies and the level of internationalisation and international collaboration across countries.

Counting patents

To count patent data, certain methodological choices have to be made, and these can have significant influence on the derived indicators and may result in conflicting messages. It is therefore important to rely on methods that minimise statistical bias while conveying a maximum amount of information. In order to interpret patent indicators accurately, the following concepts are important.

Geographical distribution:

To attribute a patent to a country, three main criteria can be used:

- Counts by *priority office* (country where the first application is filed, before protection is extended to other countries). These indicate the attractiveness of a country's patenting process, the quality of intellectual property regulations (rules and cost of patenting), the reputation of the patent office and general economic features (*e.g.* market size).
- Counts by the *inventor's country* of residence. These inform about the inventiveness of the local labour force.

- Counts by the *applicant's country* of residence (the owner of the patent at the time of application). These indicate control of the invention.

Patents with multiple inventors from different countries:
Such patents can either be partly attributed to each country mentioned *(fractional count)* or fully attributed to every relevant country *(simple count)*, thus generating multiple counting at an aggregate level. In general, fractional counting procedures are used to compute counts by countries, but the alternative is sometimes preferable as for indicators on international co-operation.

Reference date:
The choice of one date among the set of dates included in patent documents is also important.

- The *priority date* (first date of filing of a patent application, anywhere in the world, to protect an invention) is the earliest and therefore closest to the invention date. This date does not depend on the administrative process of the patent office or the procedure used to file the patent application.
- Counts by *application date* introduce a bias owing to a one-year lag between residents and foreigners. The latter usually first file a patent application at their domestic office (the priority office) and later in other countries. The lag increases up to 31 months for Patent Co-operation Treaty (PCT) applications entering the regional/national phase.
- Counts according to the *grant date* can be misleading for drawing conclusions about innovative activity. The number of patents granted is not only a function of the flow of patent applications, but also depends on the administrative process of the patent office (its budget, number of examiners, etc.).

Most indicators in this compendium are presented according to the priority date and the country of residence of the inventors. The applicant's residence country is also used for measuring patenting by type of institution and cross-border analysis.

Timeliness

In spite of their value in providing a good measure of technology output, indicators based on patents are often criticised for being outdated. Choosing the priority date as a reference date might be considered to weaken the timeliness of the patent indicators for data users: this issue arises from a question of the labelling of published statistics. While patent statistics based on the grant date may appear more up to date, they do not indicate the date of the invention. Therefore, data provided in the OECD compendium of patent statistics differ from those published by other sources: OECD's patent indicators are designed to reflect inventive and creative activity, whereas patent data presented in annual reports of patent offices are intended to reflect their own activity, primarily for administrative purposes (*e.g.* budget planning).

The issue of timeliness arises because of the legal delays faced by a patent application before its content is publicly released. In most patent offices an application is usually published within 18 months of the priority date. However, at the USPTO, prior to the change in rules regarding the publication of patent applications in November 2000, publication only occurred after the patent had been granted. Therefore, the time lag between priority date and publication can be up to five years. Similarly, it can take up to 31 months for patent applications filed using the PCT procedure to enter the "national/regional" phase and another one to six months for the data to become available.

Furthermore, with the surge in patent filings over the last decade, patent offices face a heavier workload. The growing number of applications to be processed by patent examiners increases the delays in examination and patent processing, thus generating a *backlog* of patent filings that have not been processed or published at the USPTO. In order to improve the timeliness of OECD patent indicators, patents are "*nowcasted*" (*i.e.* estimations of the recent past – *see* Annex A) at an aggregate level for the latest years.

1. TRIADIC PATENT FAMILIES

- About 53 000 triadic patent families were filed worldwide in 2005, a sharp increase from less than 35 000 in 1995. Growth during the second half of the 1990s was at a steady 7% a year on average until 2000. The beginning of the 21st century was marked by a slowdown, with patent families increasing by 2% a year on average (Figure 1.1).
- The United States, the European Union and Japan show similar trends, with a stronger deceleration in Japan after 2000. The number of triadic patent families remained stable in Australia, Germany, France, Sweden and Switzerland, while those originating from Denmark, Finland and the United Kingdom decreased respectively by 2%, 6% and 1% on average between 2000 and 2005.
- The United States accounts for 31% of patent families (Figure 1.2), a loss of around 3 percentage points from its level in 1995 (34.4%); the relative proportion of patent families originating from Europe also tended to decrease, losing more than 4 percentage points between 1995 and 2005 (to 28.4% in 2005). On the contrary, the share of Japan in triadic patent families gained almost 2 percentage points, reaching nearly 29% in 2005.
- Changes in country shares show a surge in innovative activities performed in Asia. China entered the top 15 countries in 2005, having gained 16 positions since 1995. Korea also rose significantly in terms of ranking and share, contributing to 6% of patent families in 2005. Patent families from these economies increased notably in the late 1990s and after 2000, with an upsurge ranging from 20 to 37% per year in China, India, Korea and Chinese Taipei.

Box 1.1. Triadic patent families

Patent families are commonly constructed on the basis of information from a single patent office. While patents filed at a given patent office represent a rich source of data, these data show certain weaknesses. The "home" advantage bias is one of them, since, proportionate to their inventive activity, domestic applicants tend to file more patents in their home country than non-resident applicants. Furthermore, indicators based on a single patent office are influenced by factors other than technology, such as patenting procedures, trade flows, proximity, etc. In addition, the value distribution of patents within a single patent office is skewed: many patents are of low value and few are of extremely high value. Simple patent counts would therefore give an equal weight to all patent applications.

The OECD has developed *triadic patent families* in order to reduce the major weaknesses of the traditional patent indicators described above. Triadic patent families are defined at the OECD as a set of patents taken at the European Patent Office (EPO), the Japan Patent Office (JPO) and US Patent and Trademark Office (USPTO)* that protect a same invention. In terms of statistical analysis, they improve the international comparability of patent-based indicators, as only patents applied for in the same set of countries are included in the family: home advantage and influence of geographical location are therefore eliminated. Second, patents included in the family are typically of higher value: patentees only take on the additional costs and delays of extending protection to other countries if they deem it worthwhile.

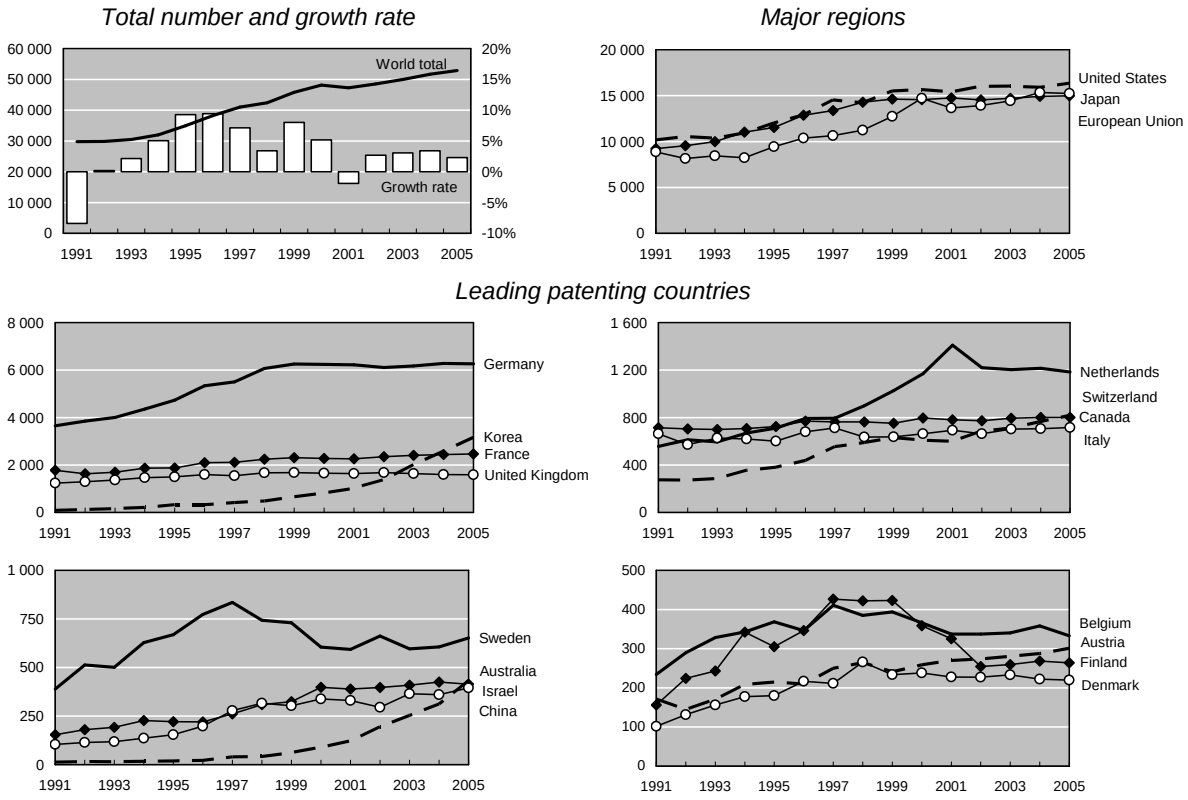
The criteria for counting triadic patent families are the earliest priority date (first application of the patent worldwide), the inventor's country of residence, and fractional counts. Owing to time lag between the priority date and the availability of information, 1998 is the latest year for which triadic patent families data is almost completely available. Data from 1998 onwards are OECD estimates based on more recent patent series ("nowcasting" – see *Annex A*).

* USPTO patents refer to the granted patents: prior to the change in rules regarding the publication of patent applications at the USPTO, only patent grants were published.

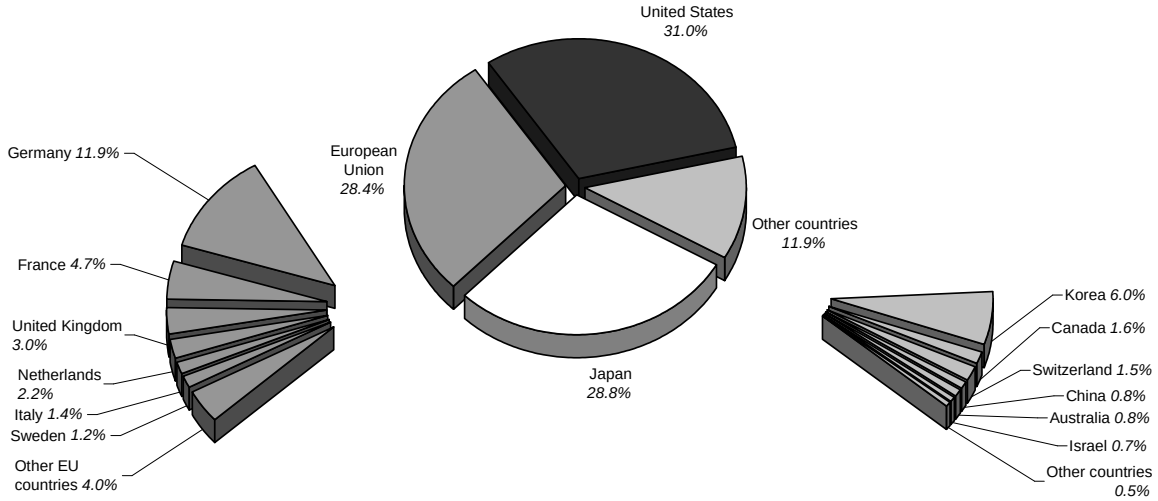
For further reading

Dernis, H. and M. Khan (2004), "Triadic Patent Families Methodology", *STI Working Paper* 2004/2, OECD, Paris.

1.1. Trends in triadic patent families[1]



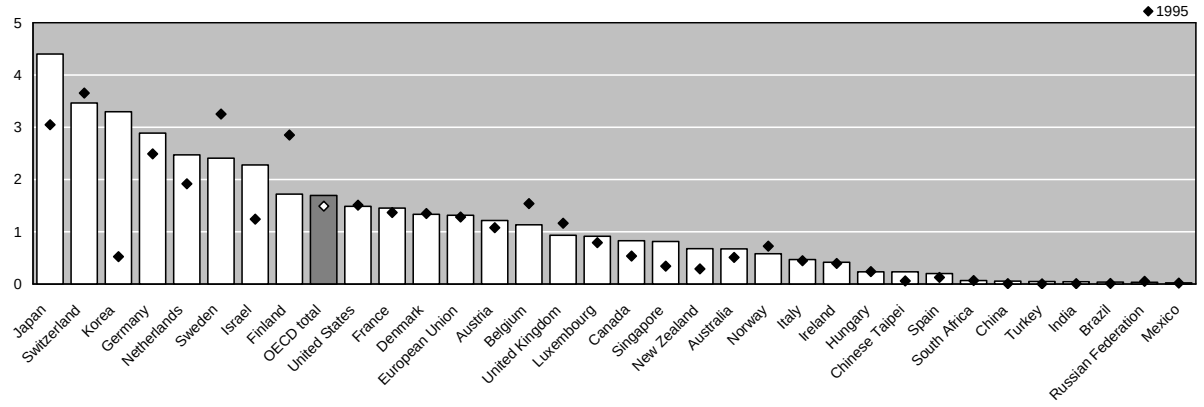
1.2. Share of countries in total triadic patent families,[1] *2005*



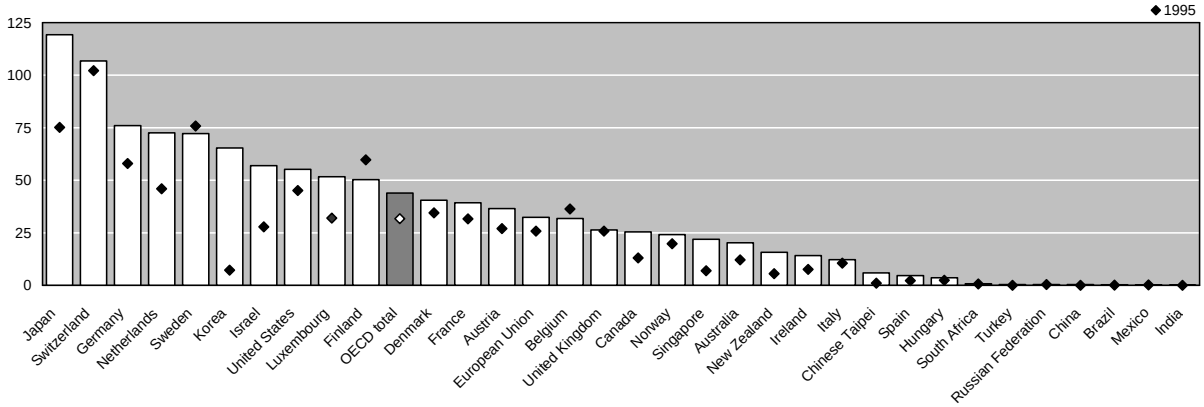
Notes: Patent counts are based on the earliest priority date, the inventor's country of residence and fractional counts.
Data mainly derives from EPO Worldwide Statistical Patent Database (April 2007).
1. Patents all applied for at the EPO, USPTO and JPO. Figures from 1998 onwards are estimates.

Source: OECD, Patent database, June 2007.

1.3. Triadic patent families[1] over GDP,[2] *2005*



1.4. Triadic patent families[1] per million population, *2005*



Notes: Patent counts are based on the earliest priority date, the inventor's country of residence and fractional counts.
Data mainly derive from EPO Worldwide Statistical Patent Database (April 2007).

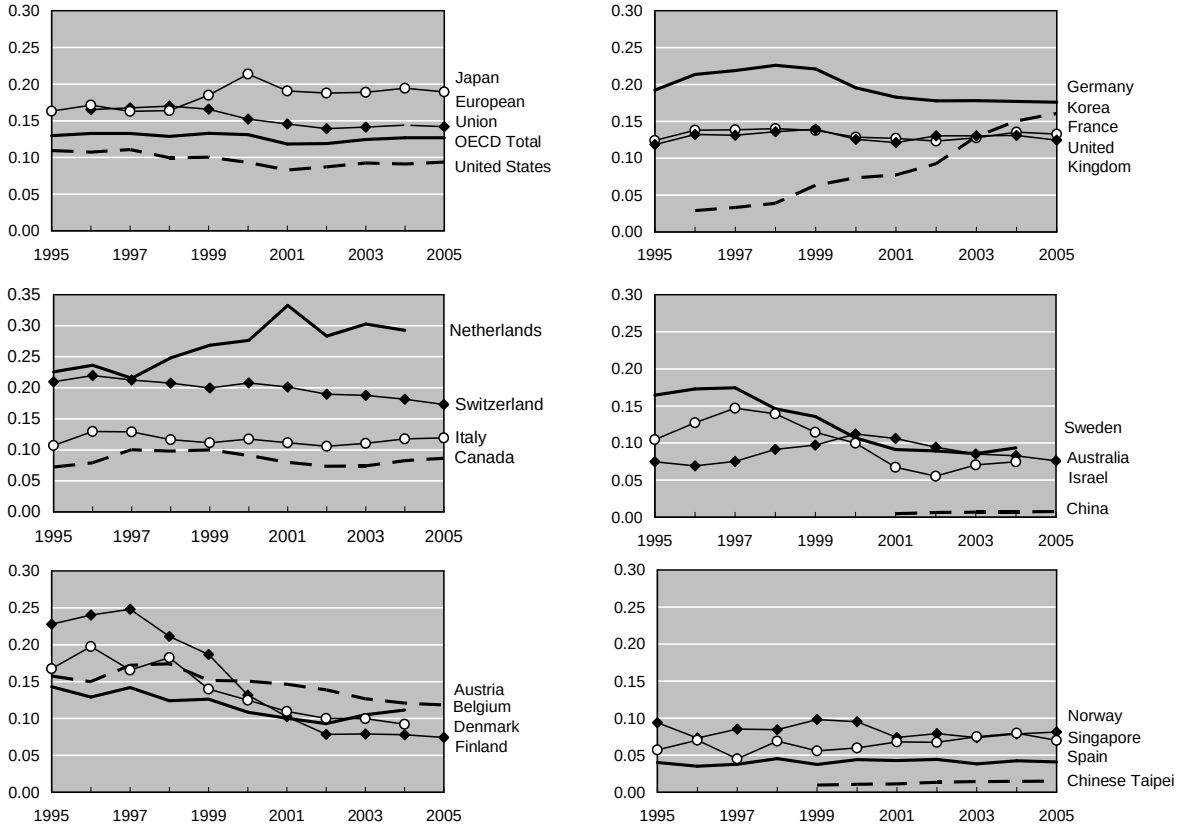
1. Patents all applied for at the EPO, USPTO and JPO. Figures for 2005 are estimates.
Only countries/economies with more than 20 families in 2005 are included.
2. Gross domestic product (GDP), billion 2000 USD using purchasing power parities.

Source: OECD, Patent database, June 2007.

- When triadic patent families are normalised using indicators of GDP or population (Figures 1.3 and 1.4), Germany, Japan, the Netherlands and Switzerland are among the five most innovative countries in 2005. Ratios for Finland, Israel, Korea and Sweden are above the OECD average (1.7 patent family per billion US dollars of GDP and 44 families per million habitants respectively). Japan has the highest patenting propensity: more than 4 families per billion US dollars of GDP and 119 per population. Switzerland follows with 3 families (over GDP) and 107 (per inhabitants) respectively.
- Most countries have seen their patent intensity increase. One of the largest increase occurred in Korea between 1995 and 2005, from 0.5 to 3.3 (GDP ratio) and from 7.2 to 65.4 (population ratio). By size, China has less than 0.4 patent families per million population. However, ratios for Belgium, Finland and Sweden decreased markedly since the mid-1990s.

1.5. Ratio of triadic patent families[1] to industry-financed GERD[2]

OECD total, major regions and leading patenting countries



Notes: Patent counts are based on the earliest priority date, the inventor's country of residence and fractional counts.
Data mainly derives from EPO Worldwide Statistical Patent Database (April 2007).

1. Patents all applied for at the EPO, USPTO and JPO. Figures for 1998 to 2005 are estimates.
2. Gross domestic expenditure on R&D (GERD) financed by industry, million 2000 USD using purchasing power parities, lagged by one year. Data for Italy refer to Business enterprise expenditure on R&D, financed by industry.

Source: OECD, Patent and R&D Databases, June 2007.

- The number of triadic patent families is strongly correlated with R&D expenditures (R2 = 0.98). The more a country spends on R&D (such as the United States, Japan, Germany and France), the higher the propensity of patenting. The patent intensity (triadic patent families divided by industry-financed R&D) of the main OECD regions followed a stable pattern. Japan has the highest patent intensity among the three regions from the end 1990s, whereas it used to be similar to the intensity observed in the European Union before 1999. In contrast, the United States has a lower propensity to patent, below the OECD average, which has slightly decreased from 2000 onwards.
- The United States' lower patent intensity (compared to the European Union and Japan) is due to a greater increase in industry-financed R&D expenditure than in triadic patents, especially in the late 1990s. During the same period in Japan, the number of triadic patent families increased more rapidly than R&D expenditures financed by the industry sector, while both increased at a similar rate in the European Union.
- Germany, Japan, Korea, the Netherlands and Switzerland have the highest level of patent intensity in the OECD area, with a range from 160 patent families per billion USD of R&D expenditures (in Korea) to nearly 300 (in the Netherlands) in recent years. However, this indicator shows a steady decrease for Germany and Switzerland, due to a lower increase in patenting since the turn of the millennium. In contrast, patenting intensity rose significantly in Korea and in the Netherlands since the mid-1990s, owing to a more rapid growth in patenting than in R&D expenditures.

2. PATENTING AT NATIONAL, REGIONAL AND INTERNATIONAL LEVEL

2.1. Major regions

- The number of patent applications to the USPTO rose substantially in the late 1990s by an average 7% a year (Figure 2.1.1), followed by a slowdown to 3% on average between 2001 and 2004. The pattern was similar at the EPO, where the number of patent applications grew by 10% a year on average over the period 1995-2000, followed by a downturn (-2.3%) in 2001. 2002 to 2005 figures show that growth picked up again. Data for the JPO show slower growth of about 3% a year on average between 1995 and 2000. A reverse trend was observed in 2002-2003, before starting up again. However, the level of patenting at the JPO remains high, with around 400 000 patent applications estimated for 2005.
- Growth in number of patents is mostly driven by residents, especially at the JPO and USPTO. In 2005, half of USPTO grants are due to US inventors, and Japanese residents accounted for more than 70% of JPO patents applications in 2005. Besides the home advantage effect, highlighted by the predominance of residents in patents taken at the three major offices, some countries show a solid propensity to protect their inventions on these targeted markets. For example, Germany scores among the top three countries at the EPO, the JPO and the USPTO; Korea also contributes strongly (Figure 2.1.2).
- The relative share of patents has increased in Israel and in China, India and Chinese Taipei since the mid-1990s. In 2005 Israel represented 0.8% of USPTO grants and 0.9% of EPO patents applications, compared to 0.5% at the two offices in 1995. Even though the number of patents originating from China remains relatively low compared to total filings, its share was multiplied by 8 at the USPTO between 1995 and 2005, and by 15 at the EPO.

Box 2.1. Patent indicators based on a single patent office

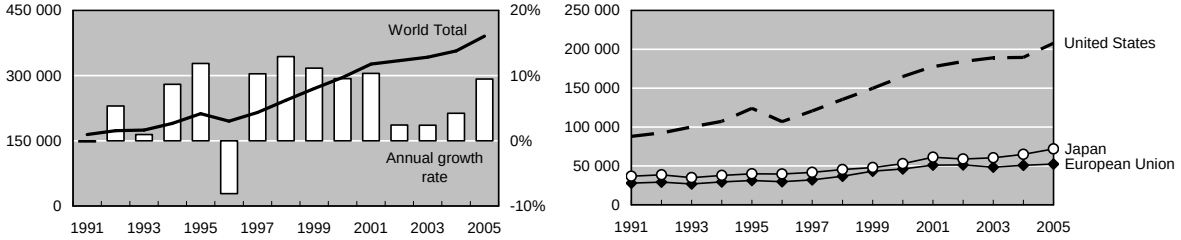
Indicators derived from the number of patents filed at a single patent office, national or regional, reflect to some extent the market attractiveness of the region where the patent is filed. However, they are subject to certain drawbacks that limit cross-comparisons of data from patent offices, in addition to the shortcomings described in Box 2.1. Patents applied for or granted in different countries depend on the rules and regulations of the office where protection of the invention is sought: certain technologies or innovations may not be patentable at one national intellectual property office but may be recognised in another one (*e.g.* software, genetic sequences, etc.). Furthermore, trend analysis is sensitive to changes in patent law over the years: the protection afforded to patentees worldwide and the growing list of technologies covered are likely to give companies more incentive to patent.

The Worldwide Statistical Patent Database developed at the EPO provides a useful instrument for measuring patenting activities worldwide. The database covers bibliographic details on patents filed at more than 70 patent offices worldwide, and represents more than 50 million documents (see Annex A). Except for the major offices, most figures for national patent offices reported in this section are derived from this data source, based on the same criteria of priority date and inventors' country of residence. Figures for the JPO are based on the IIP patent database, using data published in JPO annual reports for estimating latest trends. Patent counts for the USPTO refer to patent applications, derived from USPTO patent statistics reports (the OECD database covers long time series on patents granted: up to 2001 the USPTO disclosed patent information only after grant).

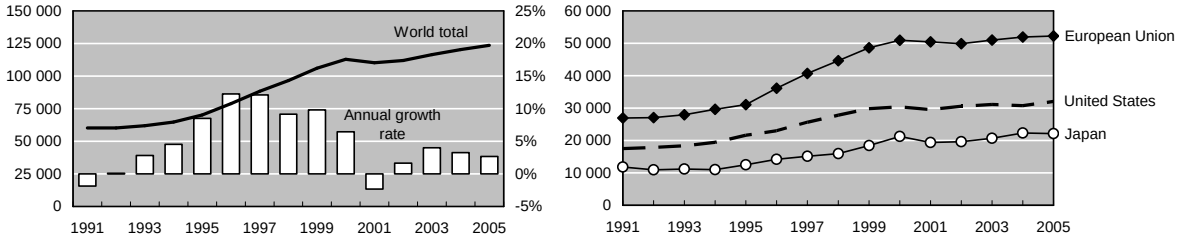
2.1.1. Trends in patents taken at the three major regions

Total number, growth rate and major regions

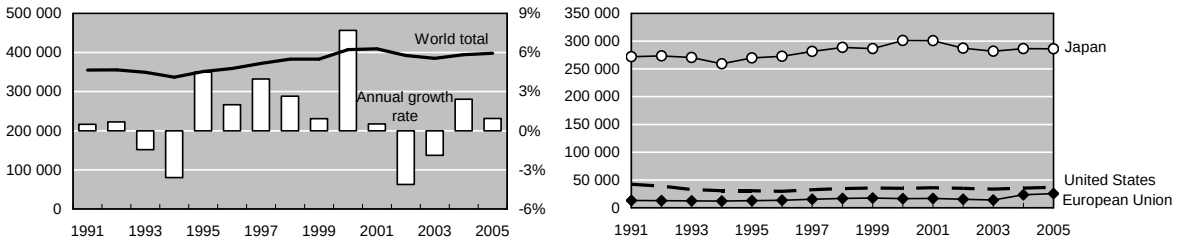
Patent applications to the USPTO[1]



Patent applications to the EPO[2]

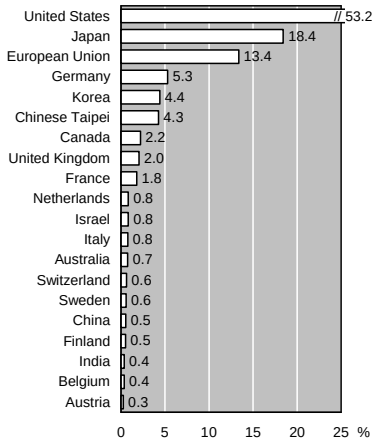


Patent applications to the JPO[3]

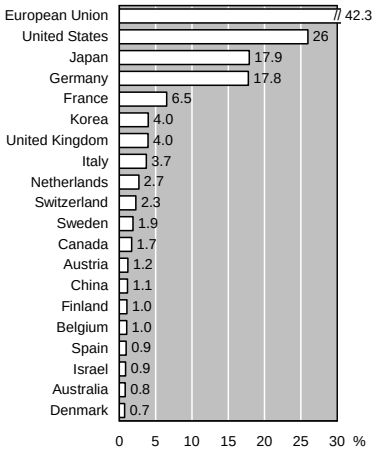


2.1.2. Share of countries in patents taken at the three major regions, 2005

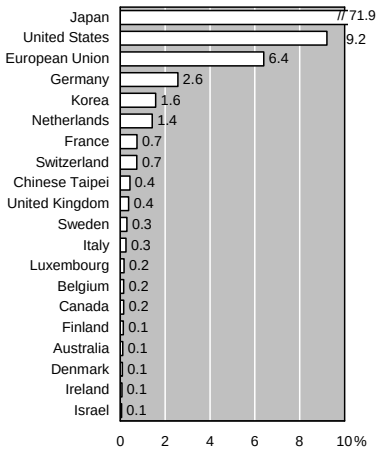
USPTO[1]



EPO[2]



JPO[3]



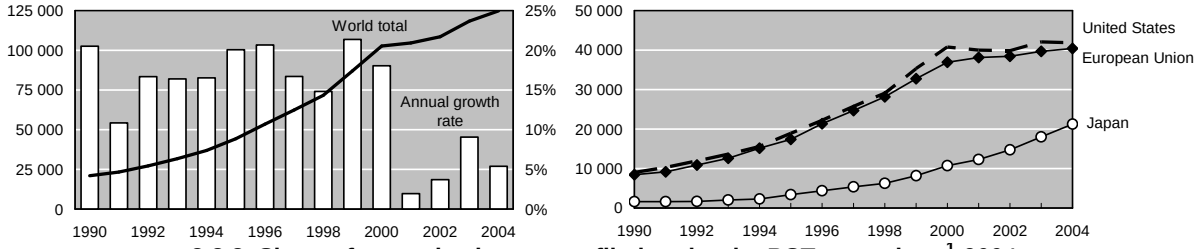
1. Patent applications to the USPTO. Patent counts are based on the first-named inventor's country of residence and the application date.
2. Patent applications to the EPO, including Euro-Direct and Euro-PCT regional phase. Patent counts are based on the priority date, the inventor's country of residence and fractional counts. Figures for 2004 and 2005 are estimates.
3. Patent applications to the JPO. Patent counts are based on the applicant's country of residence and the application date, fractional counts. Figures for 2001 to 2005 are estimates based on JPO annual reports.

Sources: USPTO patent statistics reports;
OECD, Patent database, June 2007;
IIP Patent Database, 2005 and JPO annual reports.

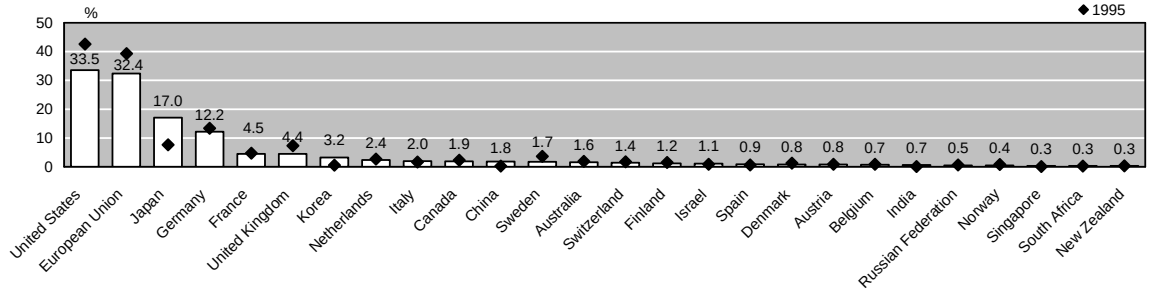
2.2. Patents filed under the Patent Co-operation Treaty (PCT)

2.2.1. Patents applied for under the PCT procedure,[1] EPO designations

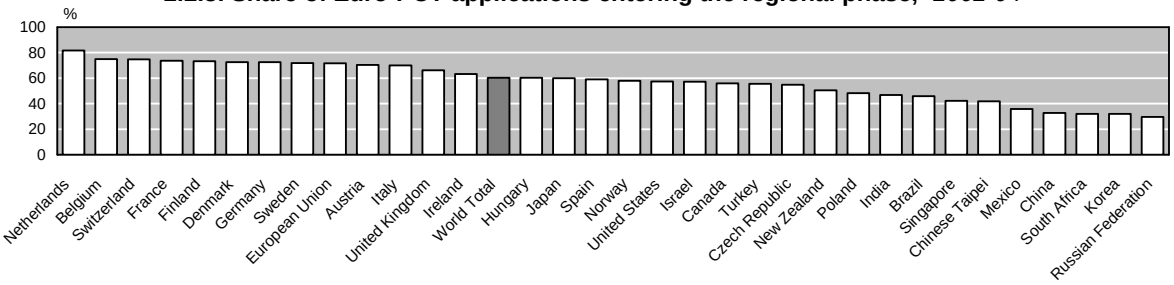
Total number, growth rate and major regions



2.2.2. Share of countries in patents filed under the PCT procedure,[1] *2004*



2.2.3. Share of Euro-PCT applications entering the regional phase,[2] *2002-04*



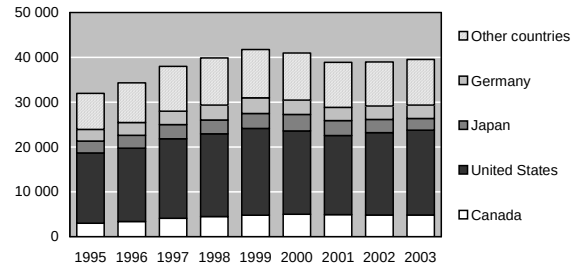
Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. Patent applications filed under the PCT, at international phase, designating the EPO.
2. The graph only covers countries with more than 250 patents filed under PCT for the period 2002-04.

Sources: OECD, Patent database, June 2007.

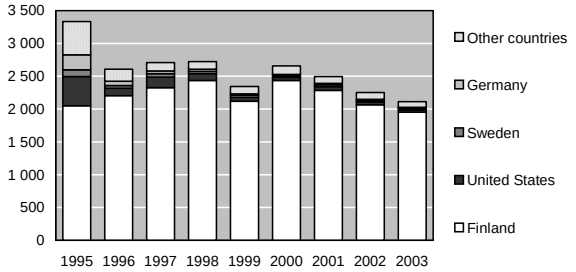
- The Patent Co-operation Treaty (PCT) makes it possible to seek patent rights in a large number of countries by filing a single international application. An application may be filed by anyone who is a national or resident of a contracting state. The applicant has an additional 18 months to decide whether or not to seek a national or regional patent. If the applicant wishes to enter the national or regional phase within the international application, he/she must do so within 31 months of the priority date.
- The PCT procedure is increasingly used to file patent applications, with nearly 125 000 patents designating the EPO (Euro-PCT) for the priority year 2004 (Figure 2.2.1). This expansion is strongly correlated with the number of contracting states which has doubled since the mid-1990s. However, figures after 2000 show slower growth in PCT filings.
- In 2005, most Euro-PCT filings originated from the United States, the European Union and Japan (Figure 2.2.2). Nevertheless, the relative shares of the United States (33.5%) and the European Union (32.4%) have decreased by more than 7 percentage points from 1995, while that of Japan doubled from 7.7% to 17% during the same period. The shares of China, India and Korea in total patents filed also increased significantly.
- On average, about 60% of Euro-PCT applications entered the EPO regional phase between 2002 and 2004. The Netherlands has the highest transfer rate of PCT into EPO regional phase (82%). European countries are more likely to transfer PCT into the EPO regional phase (above 70% of PCT), while countries such as China, Korea, South Africa and the Russian Federation have less than 40%.

2.3. Trends in patents taken at selected national patent offices

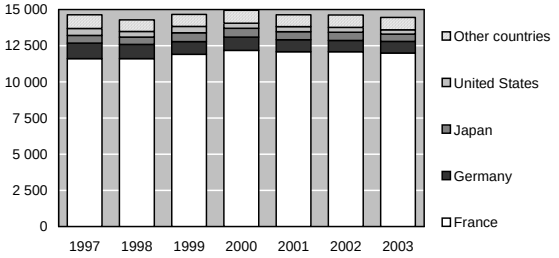
2.3.1. CIPO, Canada[1]



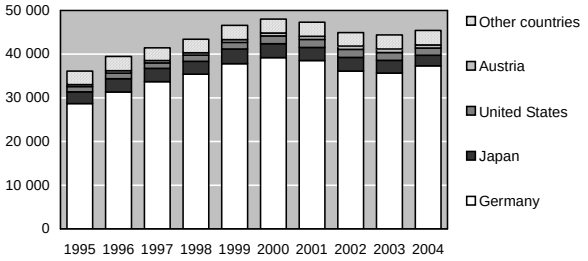
2.3.2. PRH, Finland[2]



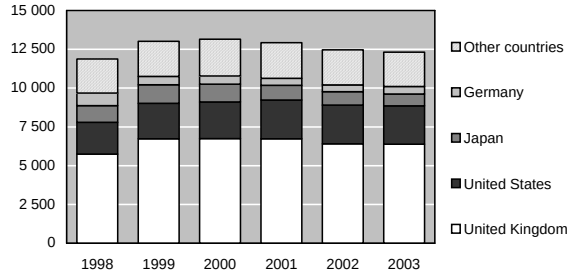
2.3.3. INPI, France[3]



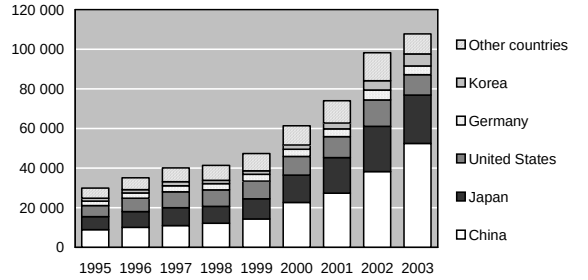
2.3.4. DPMA, Germany[4]



2.3.5. The Patent Office, United Kingdom



2.3.6. SIPO, China[5]



Notes: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
Data derive from the EPO Worldwide Statistical Patent Database (April 2007).

1. The Canadian Intellectual Property Office.
2. The National Board of Patents and Registration of Finland. 1999 figures are underestimated.
3. Institut National de la Propriété Intellectuelle. Inventors' countries of residence are based on data from INPI.
4. Deutsches Patent- und Markenamt.
5. State Intellectual Property Office of the Popular Republic of China.

Source: OECD, Patent database, June 2007.

- The EPO Worldwide Statistical Patent Database provides a useful set of data for obtaining patent indicators at national level. The figures presented above were compared to data provided in statistical reports published by national patent offices. For the French and German patent offices, lower figures on patent filings are due to unpublished or modified patent applications (at INPI, about 11-12% of patents filed are not published). Figures for the United Kingdom are similar to patent applications "published" as reported in the UK Patent Office's statistical reports.
- Patenting activity rose slightly until 2000 in Canada and Germany, whereas a steady trend was observed in France and in the United Kingdom. A downward trend is observed in these countries and in Finland after 2000. In contrast, the number of patents filed at China's SIPO grew at an average rate of 17% between 1995 and 2003.
- While Canadian inventors account for 12.2% of patents taken at CIPO, the United States contributes to nearly 50% of Canadian patents. In the UK Patent Office, most foreign applications come from the United States (20%), Japan (6%) and Germany (4%). The patent offices of Finland, France and Germany are strongly subject to the home advantage effect: more than 80% of filings are domestic. In China, 61% of patents are due to foreigners targeting the Chinese market, of which mostly Japanese inventors (23%).

3. PATENTING IN SELECTED TECHNOLOGY AREAS

3.1. ICT-related patents

- The number of ICT-related patents grew steadily from the mid-1990s to reach more than 40 000 patents at the EPO in 2003, with an average increase of 8.7% a year over 1995-2003 (Figure 3.1.1). Growth was moderate in the United States (5.9%) and in Japan (7.2%). In most European countries, the number of ICT patents grew at an average of 9.5% a year (17.4% in Denmark). The number of ICT-related patents rose strongly in Asia: China and India applied for 387 and 105 EPO patents, respectively, in 2003, up from less than five in 1995.
- The top three countries in ICT-related patenting under the PCT are the United States (33.3%), Japan (17.1%) and Germany (12.2%). China, Finland, Japan, Korea and the Netherlands have a large concentration of ICT-related patents in their patent portfolio: their country shares are higher in ICT-related patents than in total patents (Figure 3.1.2).
- The number of ICT-related patents increased more rapidly than the total number of patents filed under the PCT procedure: the share of ICT patents in total patents rose in almost all countries from the late 1990s to the beginning of the 2000s (Figure 3.1.3). Over the period 2002-04, more than 50% of patents relate to ICT in Finland, the Netherlands and Singapore, whereas ICT-related patents represent on average 34.6% of total PCT filings. The proportion of ICT patents in total has more than doubled in China, up from 17.3% in 1996-98 to 43.4% in 2002-04.

Box 3.1. Identifying technology areas for patents

Within a patent document, several sections can be analysed in order to connect the patent to the relevant technology: the International Patent Classification system (IPC) and the national patent classification system; the title of the invention; the abstract describing the invention and the list of claims. One or several classification codes are attributed during the patent examination process. However, for emerging technologies, a specific category or class might not yet be incorporated in the patent classification systems, which makes it difficult to identify patents related to these technologies afterwards. Therefore, to select patents related to specific technological domains, one can either look at the IPC classes and subclasses, and/or search for appropriate key words within the text fields of the patent document. Such a method might exclude, or include, patents that are, or are not, relevant for a specific domain, but it makes it possible nonetheless to provide a relatively good picture of innovative activity in the technology field. The 8th edition of IPC is used to identify patents in the ICT or biotechnology sectors.

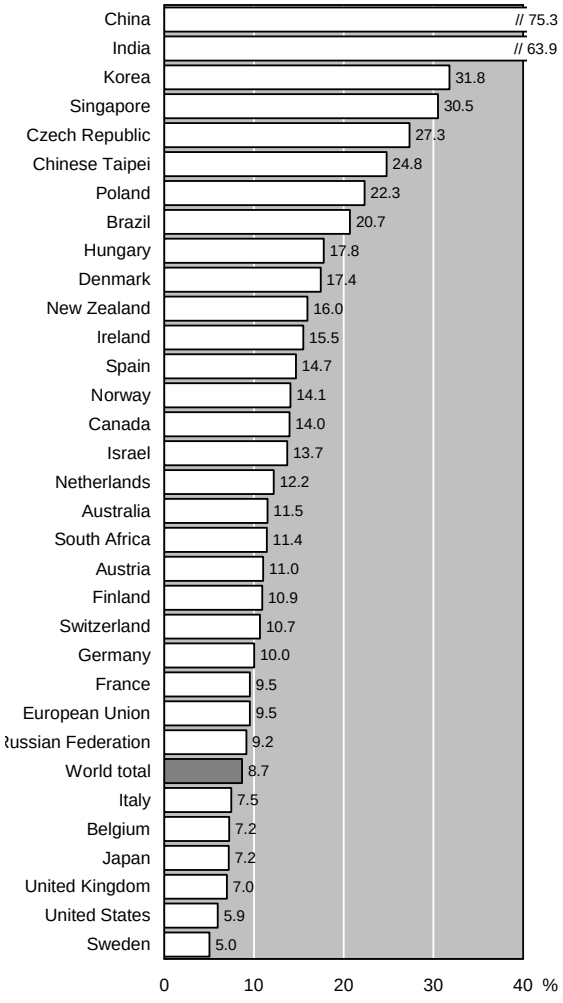
Patents in the ICT sector can be split into four fields, based on selected IPC codes:

- Telecommunications:
  [G01S,G08C,G09C,H01P,H01Q,H01S3/(025,043,063,067,085,0933,0941,103,133,18,19,25),
  H1S5,H03B,H03C,H03D, H03H,H03M,H04B,H04J,H04K,H04L,H04M,H04Q].
- Consumer electronics: [G11B,H03F,H03G,H03J,H04H,H04N,H04R,H04S].
- Computers, office machinery:
  [B07C,B41J,B41K,G02F,G03G,G05F,G06,G07,G09G,G10L,G11C,H03K,H03L].
- Other ICT:
  [G01B,G01C,G01D,G01F,G01G,G01H,G01J,G01K,G01L,G01M,G01N,G01P,G01R,G01V,G01W,G02B6,
  G05B,G08G,G09B,H01B11,H01J(11/,13/,15/,17/,19/,21/,23/,25/,27/,29/,31/,33/,40/,41/,43/,45/),H01L].

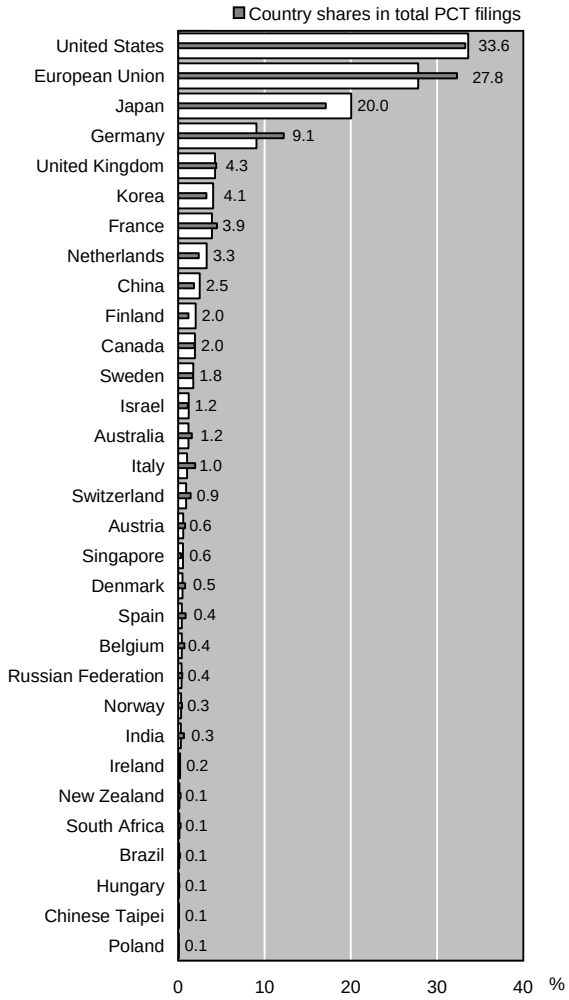
Patents in biotechnology:
[A01H1/00,A01H4/00,A61K38/00,A61K39/00,A61K48/00,C02F3/34,C07G(11/00,13/00,15/00),
C07K(4/00,14/00,16/00,17/00,19/00),C12M,C12N,C12P,C12Q,C12S,G01N27/327,
G01N33/(53*,54*,55*,57*,68,74,76,78,88,92)].

For further details
International Patent Classification, 8th edition, 2000: www.wipo.int/classifications/ipc/ipc8.

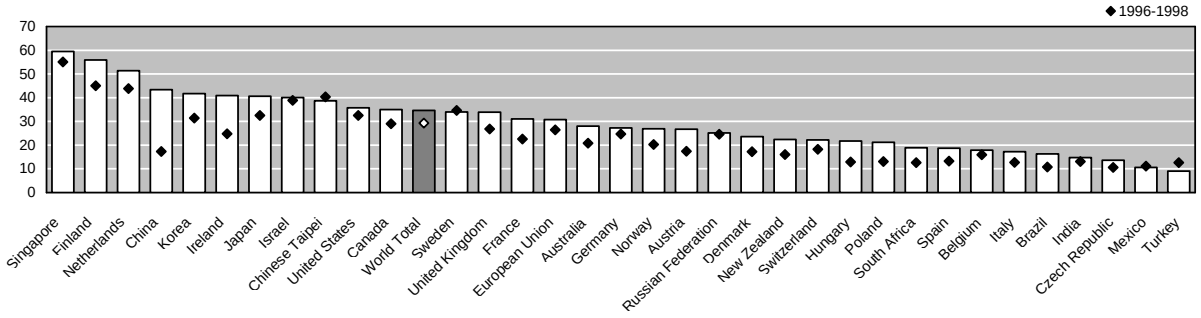
3.1.1. Trends in ICT-related patent applications[1] to the EPO,[2]
average annual growth rate 1995-2003



3.1.2. Share of countries/economies in ICT-related patents[1] filed under PCT,[3]
2004



3.1.3. ICT-related patents[1] as a percentage of national total (PCT filings)[3]
Selected countries/economies,[4] 2002-04



Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. The definition of ICT-related patents is presented in Box 3.1.
2. The graph only covers countries/economies with more than 100 patent applications to the EPO in 2003.
3. Patent applications filed under the PCT, at international phase, designating the EPO.
4. The graph only covers countries/economies with more than 250 patents filed under PCT for the period 2002-04.

Source: OECD, Patent database, June 2007.

3.2. Patents in nanotechnology

- Inventive activities in nanotechnology have been gathering momentum since the end of the 1990s. International applications for nanotechnology patents, filed under the PCT, increased steadily from the mid-1980s to the mid-1990s and have risen strongly over the past decade; at 24.2%, the annual growth rate in nanotechnology surpasses that of the overall PCT applications (12%) for the period 1995-2004.
- In 2004, the United States had the highest share of nanotechnology patents filed under the PCT (40.3%), followed by the European Union (26.4%), Japan (19%) and Germany (10%). From 2002 to 2004, an average of 0.9% of total PCT filings related to nanotechnology. Shares in total nanotechnology patents are larger than shares in total PCT filings in Ireland, Japan, Poland, Singapore and the United States (Figure 3.2.1).
- Most countries report a significant increase in the shares of nanotechnology in total national patenting in the mid-2000s (Figure 3.2.2) as compared to the late 1990s, although activity remains relatively limited (0.8% on average).
- Nanotechnology is multifaceted. At present, it consists of a set of technologies on the nano-metre scale rather than a single technological field. It covers "Electronics", "Optoelectronics", "Medicine and biotechnology", "Measurements and manufacturing", "Environment and energy", and "Nano materials".
- Most nanotechnologies, especially those related to "Electronics" and "Optoelectronics", seem to be developed through a top-down process in which nano-structures are created by the miniaturisation of existing technologies (Figure 3.2.3).
- Another group of nanotechnologies is developed by a bottom-up process. The development of such technologies, *e.g.* "Nano materials", has been particularly intense in the past decade and is fuelled by scientific discoveries such as carbon nanotubes and fullerenes. At this stage, bottom-up nanotechnology is likely to have a relatively small impact on fields of application. It will take a while for bottom-up nanotechnologies to have social and economic impacts.

Box 3.2. Definition of nanotechnology patents

Reflecting the increasing interest and importance of nanotechnology in patents, the United States Patent & Trademark Office (USPTO), the European Patent Office (EPO), and the Japan Patent Office (JPO) have made intense efforts to improve their respective classification systems and collect all nanotechnology-related patents in a single patent class. Nanotechnology patent applications identified via the EPO are analysed in this section. The EPO definition of nanotechnology is the following:

"The term nanotechnology covers entities with a controlled geometrical size of at least one functional component below 100nm in one or more dimensions susceptible to make physical, chemical or biological effects available which are intrinsic to that size. It covers equipment and methods for controlled analysis, manipulation, processing, fabrication or measurement with a precision below 100nm."

Identification of nanotechnology patents requires hard work. In the EPO, a nanotechnology working group (NTWG) was created in 2003. At first, it worked on the definition of nanotechnology in order to watch trends in nanotechnology patents. Then the NTWG identified nanotechnology patents through keyword searches, consultations with nanotechnology experts in the EPO, and peer reviews by external experts. Patent applications from 15 countries or organisations were analysed. As a consequence of these endeavours, about 90 000 out of 20 million patent or non-patent literature documents were tagged to class Y01N.

Nanotechnology patent applications were further categorised into six fields of application by the OECD, *e.g.* "Electronics", "Optoelectronics", "Medicine and biotechnology", "Measurements and manufacturing", "Environment and energy", and "Nano materials", based on the International Patent Classification.

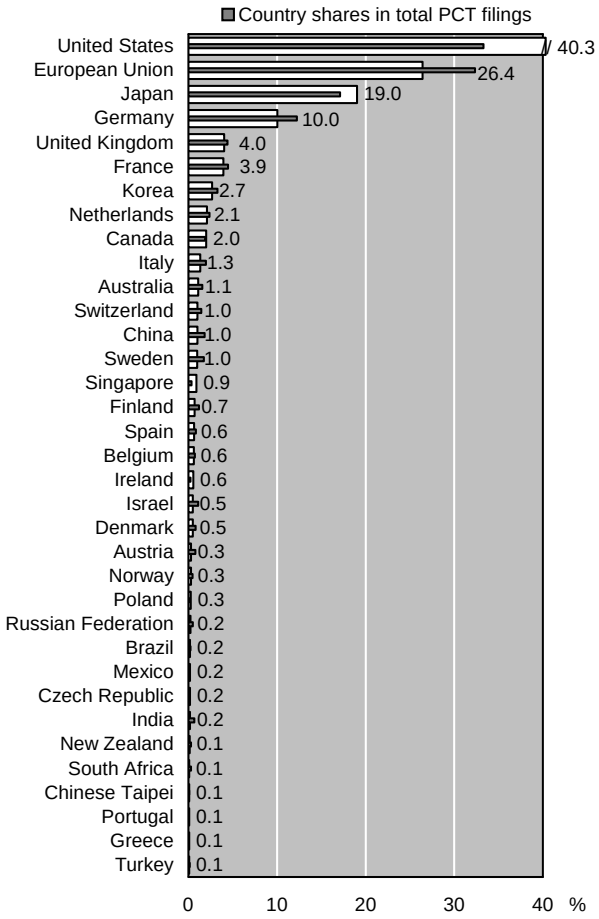
For further reading

Scheu, M., V. Veefkind, Y. Verbandt, E. Molina Galan, R. Absalom and W. Förster (2006), *Mapping nanotechnology patents: The EPO approach*, *World Patent Information* 28, pp. 204-211.

Igami, M. and T. Okazaki (2007), "Capturing Nanotechnology's Current State of Development via Analysis of Patents", *STI Working Paper* 2007/4, OECD, Paris.

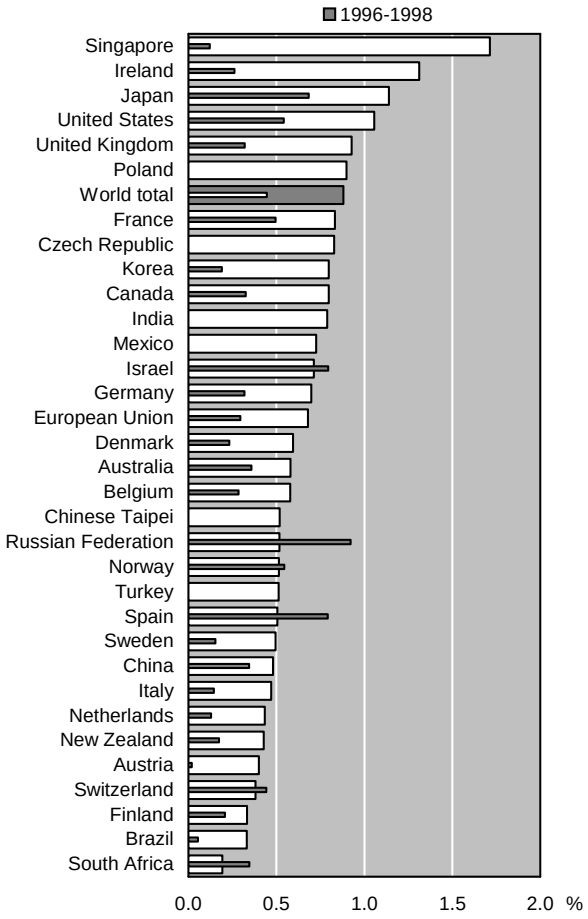
3.2.1. Share of countries in nanotechnology patents[1] filed under PCT,[2]

2004

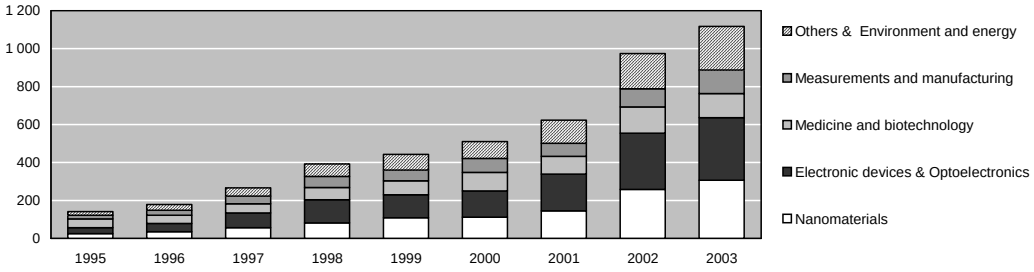


3.2.2. Nanotechnology patents[1] as a percentage of national total (PCT filings)[2]

Selected countries/economies,[3] 2002-2004.



3.2.3. Trends in nanotechnology patents[1] by application fields



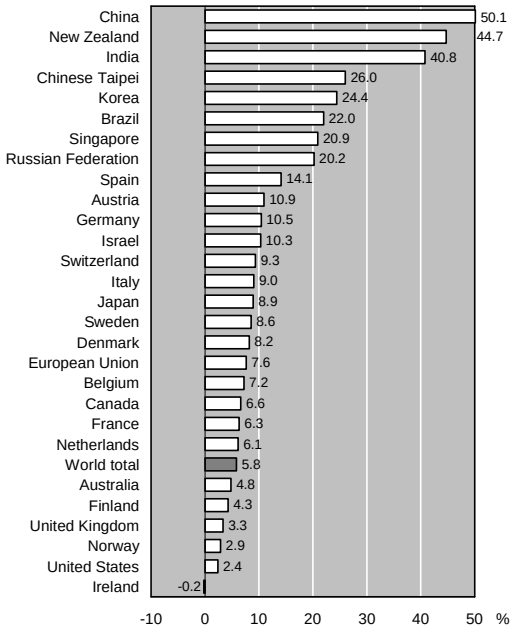
Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. Nanotechnology patents identified by tag Y01N in EPO's database EPODOC; see Scheu *et al.* (2006).
2. Patent applications filed under the PCT, at international phase, designating the EPO.
3. The graph only covers countries/economies with more than 250 patents filed under PCT for the period 2002-04.

Source: OECD, Patent Database based on a list of patents selected by the EPO, June 2007.

3.3. Biotechnology patents

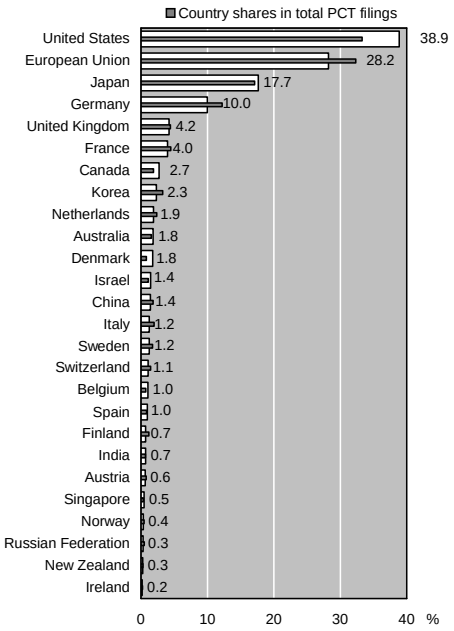
3.3.1. Trends in biotechnology patent applications[1] to the EPO,[2]

average annual growth rate 1995-2003



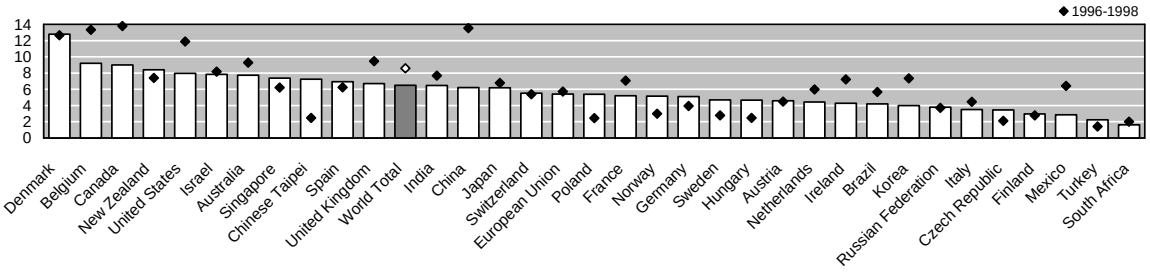
3.3.2. Share of countries in biotechnology patents[1] filed under PCT,[3]

2004



3.3.3. Biotechnology patents[1] as a percentage of national total (PCT filings)[3]

Selected countries/economies,[4] 2002-04



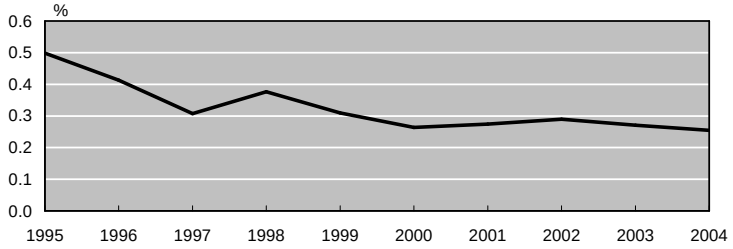
Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. The definition of biotechnology patents is presented in Box 3.1.
2. The graph only covers countries/economies with more than 150 patent applications to the EPO in 2003.
3. Patent applications filed under the PCT, at international phase, designating the EPO.
4. The graph only covers countries/economies with more than 250 patents filed under PCT for the period 2002-04.

Source: OECD, Patent database, June 2007.

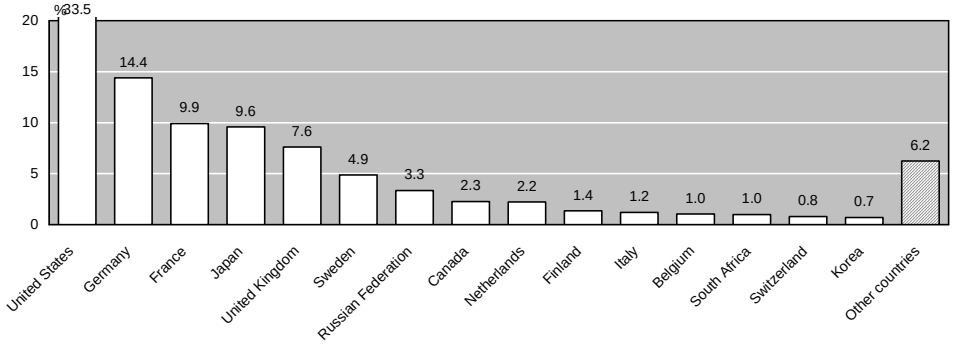
- Applications for biotechnology patents to the EPO grew by 5.8% a year between 1995 and 2003 (Figure 3.3.1). However, the number of biotechnology patents started to decrease from 2000 (-6% on average over 2000-03, compared to +13% between 1995-2000). The surge in the late 1990s was partly due to the flow of patent applications concerning the human genome, while the reduction in the 2000s is often explained by patent offices' more stringent criteria for granting patents on genetic material.
- In 2004, the United States had the highest share of biotechnology patents filed under the PCT procedure (38.9%). Japan and Germany had 17.7% and 10.0%, respectively (Figure 3.3.2). Australia, Belgium, Canada, Denmark, India, Israel, Japan, Spain and the United States had more patents in biotechnology than in other technical fields.
- From 2002 to 2004, biotechnology represented 6.5% of total PCT filings, compared to 8.6% in the late 1990s (Figure 3.3.3). This share reached more than 12% of all PCT applications in Denmark, Belgium and Canada to follow with around 9%. The relative weight of biotechnology in all international patent filings decreased between the mid-1990s and the early 2000s in most countries.

3.4. Patents related to nuclear energy

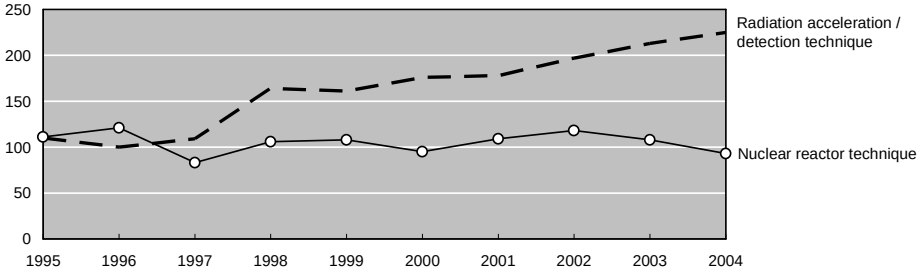
3.4.1. Nuclear energy patents[1] as a percentage of national total (PCT filings)



3.4.2. Share of countries in nuclear energy patents,[1] *1987-2004*



3.4.3. Technical fields[2] in nuclear energy patents[1]



Note: Patent counts are based on the earliest priority date, the residence of the inventors and fractional counts.

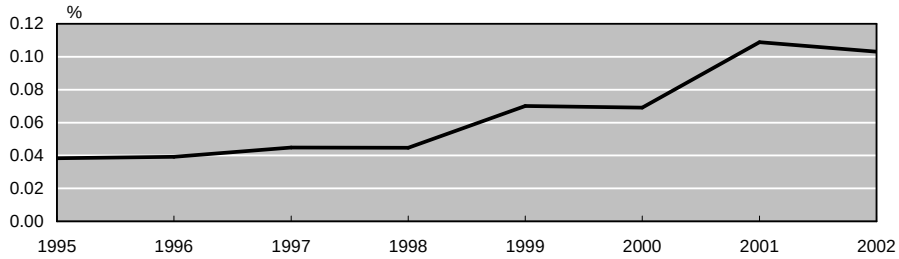
1. Nuclear energy patents are identified using IPC codes: G01T (measurement of nuclear or x-radiation), G21B (fusion reactors), G21C (nuclear reactors), G21D (nuclear power plant), G21F (protection against radiation), G21G (radioactive sources), G21H (obtaining energy from radioactive sources), G21J (nuclear explosives), G21K (radiation filters), and H05H (plasma technique and acceleration of neutral molecular or atomic beams). Data refers to patent applications filed under the PCT, at international phase, designating the EPO.
2. Patents in nuclear reactor technique are defined as G21B, G21C, G21D and G21F.
   Patents in radiation acceleration/detection technique are defined as G01T, G21G, G21H, G21J, G21K and H05H.

Source: OECD, Patent database, June 2007.

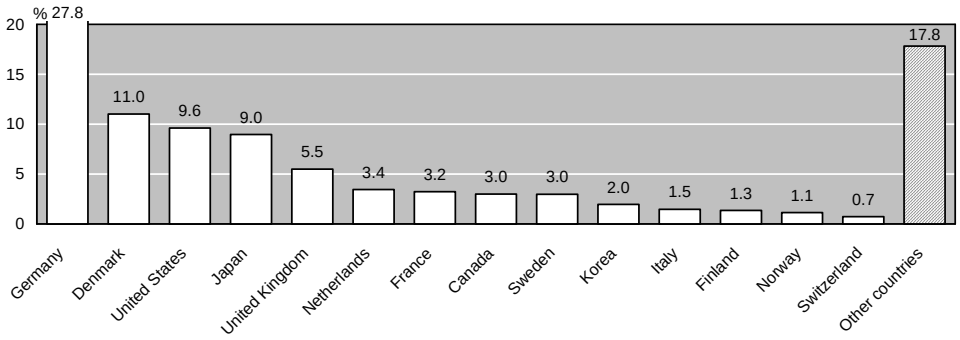
- Shares of nuclear energy patents in total PCT patents have been decreasing over the last decade (Figure 3.4.1).
- The United States has the highest share of nuclear energy patents, contributing to 33.5% of all nuclear energy patents (Figure 3.4.2). Germany, France, Japan and the United Kingdom follow in the top 5 ranking countries.
- The breakdown of nuclear energy by technical fields highlights changes of technical trend in the mid-1990s: patents related to ''Nuclear reactor technique'' remain stable whereas ''Radiation acceleration / detection technique'' increased at an average growth of 8% a year since 1995 (Figure 3.4.3). ''Radiation acceleration / detection technique'' is integrated in most nuclear energy patents in the 2000s.

3.5. Patents related to wind energy technology

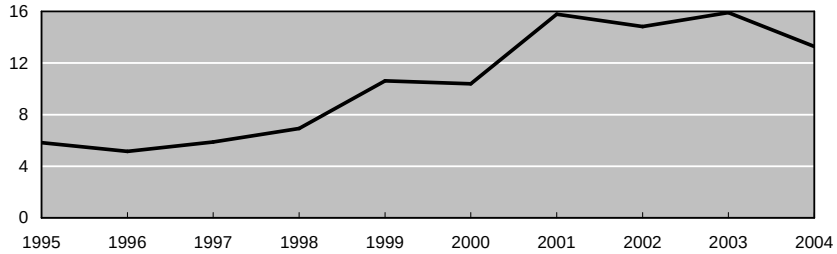
3.5.1. Wind energy patents[1] as a percentage of national total (PCT filings)



3.5.2. Share of countries in wind energy patents,[1] *1987-2002*



3.5.3. Share of wind energy patents[1] in patents related to wind energy and surrounding relevant techniques[2]



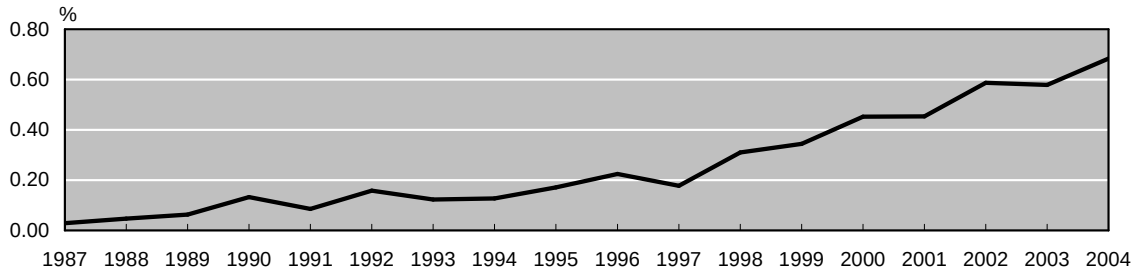
Note: Patent counts are based on the earliest priority date, the residence of the inventors and fractional counts.
1. Wind energy patents are identified using IPC code F03D (wind motors). Data refer to patent applications filed under the PCT, at international phase, designating the EPO.
2. Patents in relevant techniques surrounding wind energy are defined as H02P (control or regulation of electric motors, generators, or dynamo-electric converters), H02K (dynamo-electric machines), and H02J (circuit arrangements or systems for supplying or distributing electric powers).

Source: OECD, Patent database, June 2007.

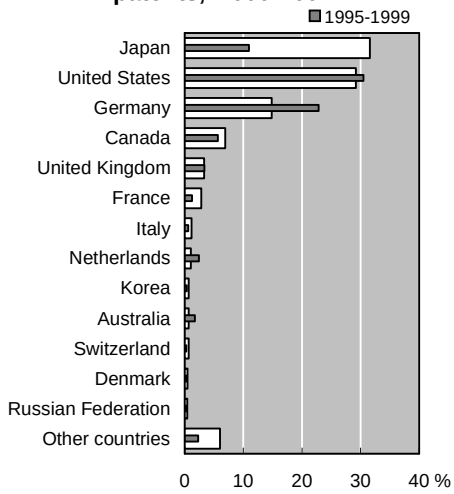
- Since the mid-1990s, the share of wind energy patent applications in all PCT patents increased at an average growth of 25% a year (Figure 3.5.1).
- About 28% of PCT filings related to the wind energy were invented in Germany (Figure 3.5.2). Denmark is also a strong contributor to wind energy inventions (11%), ranked after Germany. The United States and Japan follow with 9% and more PCT filings in wind energy.
- Figure 3.5.3 shows that among all techniques surrounding wind energy, the share of patents related to wind motor, which is the key wind energy technique component, has increased markedly since the mid-1990s.

3.6. Patents related to fuel cells technology

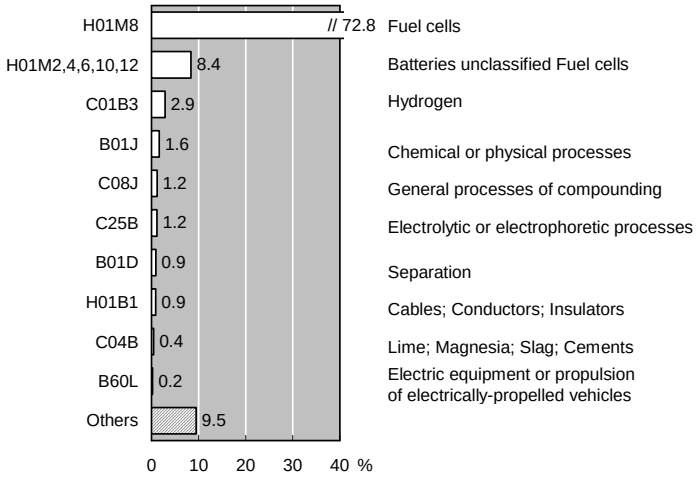
3.6.1. Fuel cells patents[1] as a percentage of national total (PCT filings)



3.6.2. Share of countries in fuel cells patents,[1] *2000-2004*



3.6.3. Share of related-techniques[1] in fuel cells patents,[2] *1987-2004*



Note: Patent counts are based on the priority date, the residence of the inventors and fractional counts.
1. Fuel Cells patents are identified using IPC H01M8/00-8/24, and refer to patent applications filed under the PCT, at international phase, designating the EPO.
2. Different techniques were identified according to the main IPC code of fuel cells patent: Separation (B01D); Chemical or physical processes (B01J); Electric equipment or propulsion of electrically-propelled vehicles (B60L); Hydrogen (C01B3); Lime, Magnesia, Slag, Cements (C04B); General processes of compounding (C08J); Electrolytic or electrophoretic processes (C25B); Cables, Conductors, Insulators (H01B1); Batteries - unclassified Fuel cells (H01M2,4,6,10,12); Fuel cells (H01M8).

Source: OECD, Patent database, June 2007.

- Since 1997, the share of fuel cells patents in total patent applications at the EPO has increased sharply (Figure 3.6.1). The number of patents related to fuel cells technologies grew by an average of 10% a year between 1997 and 2004.
- While the United States was the main contributor in fuel cells patents over the period 1995-1999, Japan took the top place with 32% of all fuel cells patents in the early 2000s (Figure 3.6.2). Germany also had large shares in fuel cells patents, of about 15%. The shares of Japan, France and Italy grew significantly compared to their levels in the late 1990s. Conversely, Germany contributed less to fuel cells patents in the early 2000s.
- Different techniques are associated with fuel cells technologies in patent applications. Such techniques are identified by the main IPC of fuel cells patents. If most fuel cells patents relate to "pure" fuel cells technology, fuel cells have strong connections with technologies relating to batteries and to hydrogen (Figure 3.6.3).

3.7. Patents in environment-related technologies

- Technological change plays a crucial role in reducing pollution and in coping with environmental constraints. Compared to pollution control and waste treatment technologies, which are generally imposed by law, energy-efficient innovation is the result of both stronger regulation and the need for alternative sources of energy in the face of rising fuel prices.
- Overall, there has been a modest increase in patenting in renewable energy and in motor vehicle abatement technologies (Figure 3.7.1). Technologies related to renewable energy appear as the most dynamic group. They include wind, solar, geothermal technologies, wave and tide, biomass and waste technologies. Within this group, solar, wind power and waste-to-energy have exhibited rapid growth, particularly since the mid-1990s.
- Patenting activity in motor vehicle abatement technologies is strong, although the average annual growth rate lags that of renewable energy. The rise in innovation activity in this area is positively related to changes in the regulatory framework (*i.e.* automotive emissions control) in the main producer countries. Furthermore, foreign regulatory pressures appear to influence domestic innovation. For instance, Japanese inventors played a lead role in the development of catalytic converters, even though the regulatory "shock" initially came from the United States. Japan, the United States and Germany dominate innovation activity in this field (Figure 3.7.2).

Box 3.3. Identifying patents in environment-related technologies

World Intellectual Property Organization (WIPO) descriptions of the IPC classification (8th Edition) were used to identify IPC codes that matched environmental technologies more closely. Keyword searches were also conducted to find patents embedding technology specific to a particular field (see Johnston and Hascic, 2007a, 2007b).

Renewal technologies: Based on an extensive literature on technology developments in the area of renewable energy, a set of keywords was identified. These were used to determine IPC codes which relate directly to renewable energy in the areas of wind, solar, geothermal, wave-tide, biomass and waste (see Johnston and Hascic, 2007b).

Motor vehicle abatement: Identifying IPC codes and relying on keyword searches, a set of technologies relating to emission control was identified. Automobile pollution control technologies comprise all technologies used to reduce pollutants produced and released into the atmosphere by automobiles. These automotive-generated emissions fall broadly into two categories based on the point of emission: *i)* tailpipe or exhaust emissions; and *ii)* evaporative emissions (Johnston and Hascic, 2007a). Abating pollution from vehicles must target both tailpipe and petrol tank venting. Searches conducted for these technologies are primarily based on specific regulations imposed on the automobile sector such as the US Tier standards and the European Union's Euro standards. The IPC codes identified are broadly categorised into the three major technology groups identified above: *i)* those that relate to improvements in engine (re)design and therefore generate fewer emissions; *ii)* those that treat pollutants produced before they are released into the atmosphere; and *iii)* those that reduce evaporative emissions. Unfortunately, the last category is somewhat opaque, because there is no IPC sub-classification that clearly defines improvements to nozzles and/or canisters.

For further reading

Johnston, N. and I. Hascic (2007a). *Environmental Regulation and International Innovation in automotive Emissions Control Technologies*. OECD, Paris.

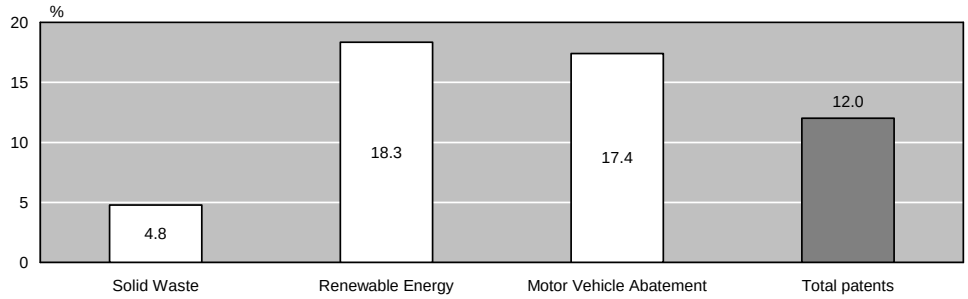
Johnston, N. and I. Hascic (2007b). *Renewable Energy Policies and Technological Innovation: Empirical Evidence based on Patent Counts*. OECD, Paris.

For further details

International patent classification (IPC, 8th edition, 2006): www.wipo.int/classifications/ipc/ipc8

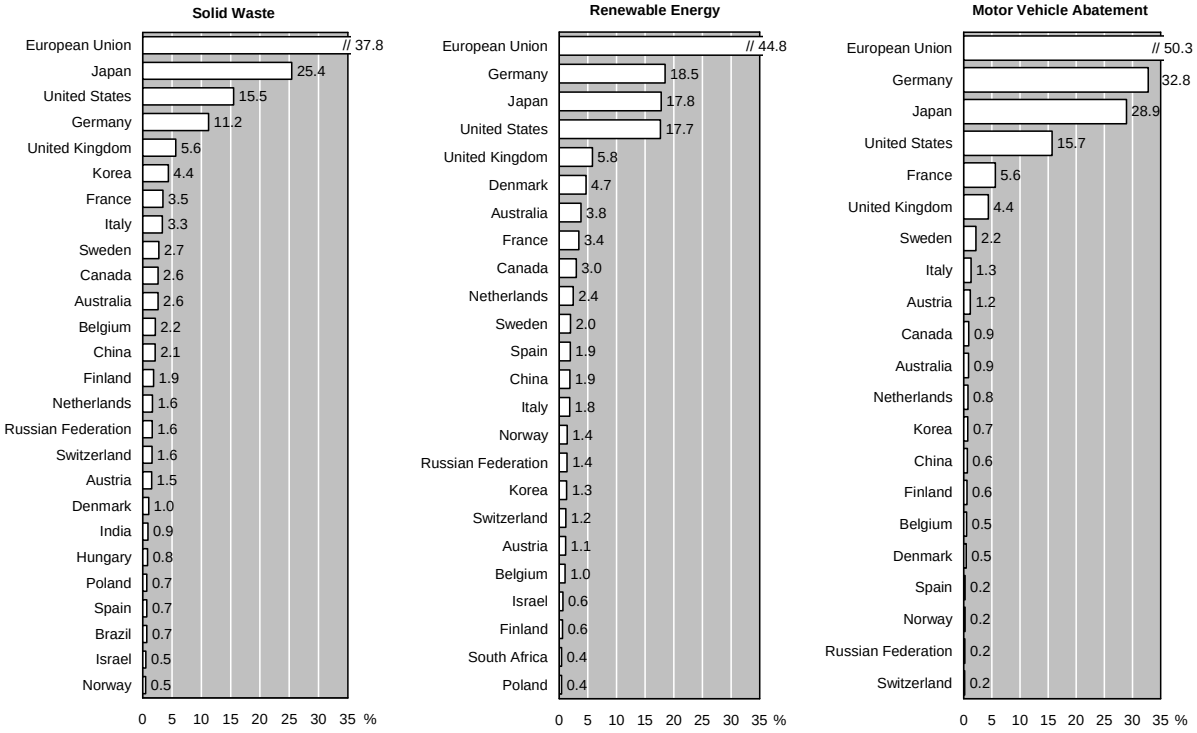
3.7.1. Trends in patents filed under PCT in selected environmental technologies[1]

Average annual growth rate, 1995-2004



3.7.2. Share of countries in EPO patent applications in environmental technologies[1]

2000-2004



Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. Patent applications filed under the PCT, at international phase, designating the EPO.

Source: OECD, Patent database, June 2007.

- Overall, the European Union has the largest share for the three technology fields. Japan leads in solid waste technologies and Germany in motor vehicle abatement technologies. For renewable energy, Japan, the United States and Germany report a similar performance. Other countries reporting a share above 5% are the United Kingdom (solid waste and renewable energy), Denmark (renewable energy), and France (motor vehicle abatement).

3.8. Patents related to space

- The space sector has often been considered one of the main frontrunners of technological development. This was evident at the beginning of the space age (1950s to 1960s), which yielded pioneering space systems. In the past two decades the rise of ICT has resulted in a new innovation paradigm benefiting both space systems and innovative "down-to-earth" applications. In recognition of this, The Global Forum of Space Economics was launched by the OECD in early 2006 to assist in understanding the opportunities and challenges of the space sector.
- Analysis of patents provides some insight into innovative activities concerning the electrical and mechanical machinery and equipment required for space-based systems (satellites, launchers etc.) as well as the downstream applications that benefit from such systems as telecommunications and navigation systems.
- Using the definition in Box 3.4, 2 367 space-related patent applications published by the EPO between 1980 and 2005 were identified as well as 2 708 patents granted by the USPTO. The majority of inventions filed at these patent offices (about 98%) originate from inventors based in OECD countries – with the United States, France, Germany and Japan being the main sources (Figure 3.8.1). While space-related inventiveness in countries like France and Germany has been more oriented towards cosmonautics, in countries such as Japan, the emphasis seems to be towards downstream applications (Figure 3.8.2).
- Since the 1980s the number of space-related patents granted by USPTO has tripled relative to all patents while the growth in space-related applications to EPO has been less marked (Figure 3.8.3). In both cases, observed growth is mainly due to the increasing number of patents concerning downstream ICT applications.

Note of caution: Not all innovations are subjected to patenting processes. However, in the field of space technology under-representation of innovative activity within patent systems may be more marked since much space-related R&D is performed by or for national defence agencies and hence subject to greater secrecy. Also, in this analysis no adjustments have been made for inventions filed at both EPO and USPTO.

Box 3.4. Defining space-related patents

For this analysis, space-related patents are defined using a mixture of IPC codes and keywords. The principle IPC class used is B64G "Cosmonautics; vehicles or Equipment thereof" which covers technology specific to developing and maintaining space-based systems; space exploration and peripheral equipment related to cosmonautics. In order to capture patents relating to applications relying on space-based technology, patent applications with the following IPC codes were chosen:

- G01S – Radio direction-finding; radio navigation; determining distance or velocity by use of radio waves; locating or presence-detecting by use of the reflection or re-radiation of radio waves;
- H01Q – Aerials;
- Radio transmission systems: H04B7/185, /19 and /195 - Space-based or airborne stations, Earth-synchronous stations and Non-synchronous stations;

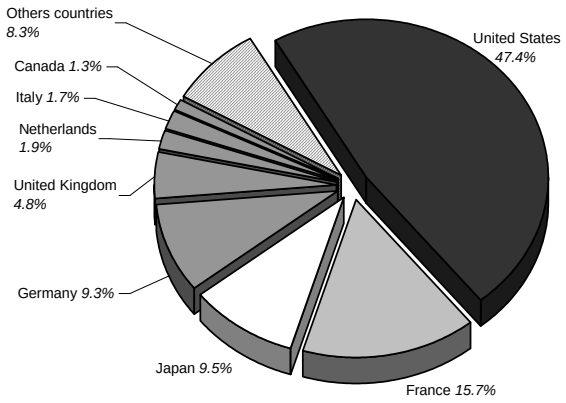
These were chosen *only if* the title of the patent application contains one or more of the following phrases: "GPS", "global position", "satellite", "remote sensing", "earth observation" and "geographic information system".

Note that this definition overlaps with that of ICT. Further work is required to refine this definition – for example, to better capture patented scientific instruments used for zero gravity R&D in space stations (that may contribute to advances in other fields such as biotechnology).

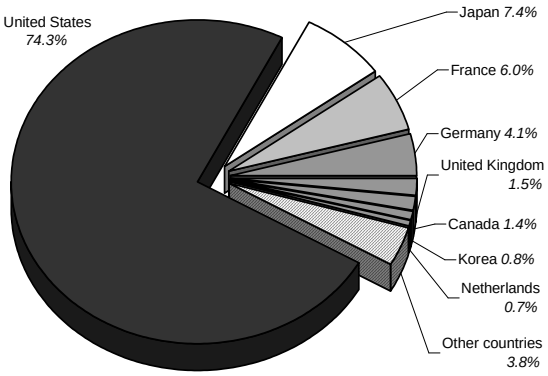
For further reading
The Space Economy at a Glance (OECD, 2007).

3.8.1. Share of countries in space related patents,[1] *1980-2005*

EPO

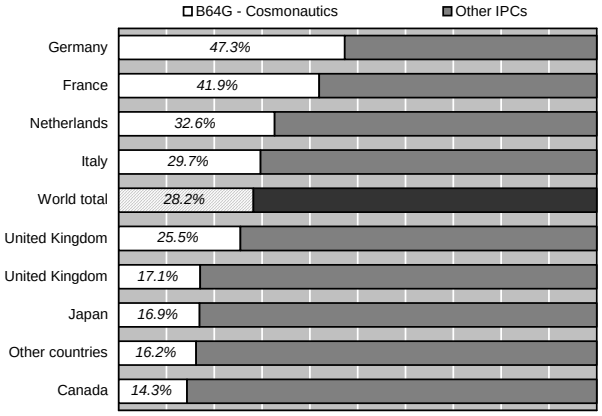


USPTO

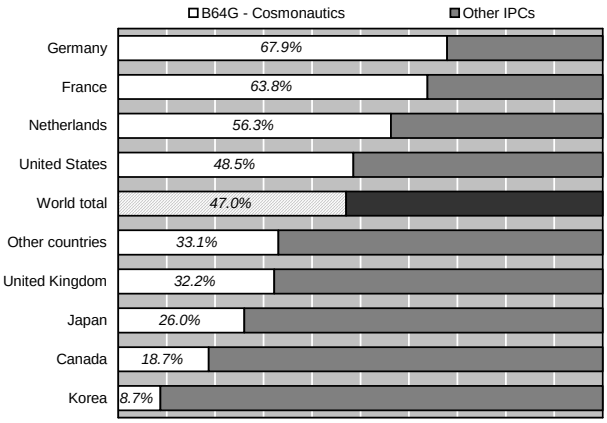


3.8.2. Share of cosmonautics (B64G) in space-related patents,[1] *1980-2005*

EPO

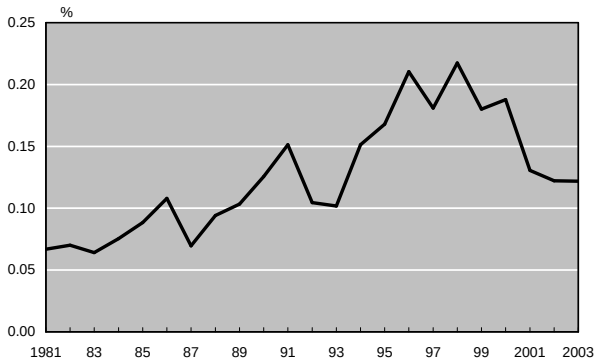


USPTO

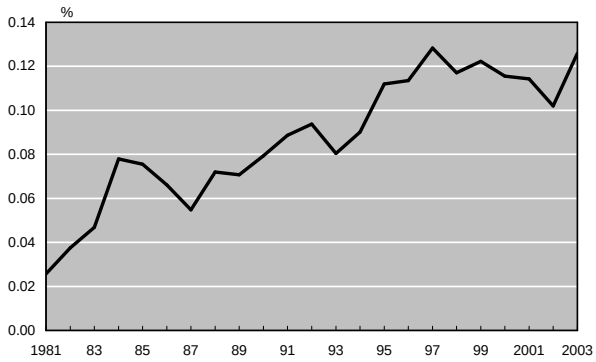


3.8.3. Share of space-related patents in total patents[1]

EPO



USPTO



Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. The definition of space-related patents is presented in the methodological Box 3.4.

Source: OECD, Patent database, June 2007.

4. PATENTS BY INSTITUTIONAL SECTORS

- The allocation of patents to institutional sectors shows that a vast majority of patents are owned by companies. In 2005, 82% of all PCT patent filings came from companies (Figure 4.1). This average is true for almost all OECD countries. The proportion of patents owned by industries is lower in France (61%) and in Spain (53%). In China however, the rate of company ownership jumped from 42% in 1995-97 to 70% in 2001-03.
- The share of public institutions (government laboratories and universities) in the ownership of patents reflects both the strength of their technological research and the legal framework. In certain countries, like Sweden or until recently Germany or Japan, university professors are entitled to own patents resulting from their research. However, such patents are not registered as belonging to public institutions but to individuals or businesses.
- Among OECD countries, Ireland has the highest proportion of patents taken by universities (9.7% over 2002-04), a noticeable increase compared to the mid-1990s, when universities represented 3.5% of patent ownership in Ireland (Figure 4.2). In Australia, Belgium, China, Spain, the United Kingdom and the United States, the higher education sector contributes to 6 to 8% of all international patent applications.
- Between 1996-98 and 2002-04, the share of patents filed by universities slightly decreased in Australia, Canada and the United States but increased markedly in Japan and the European Union, notably France and Germany. This increase results directly from policy changes that occurred in these countries in the early 2000s. Emerging economies, such as Brazil, Israel and Singapore, also show a stronger proportion of patents taken by universities relative to other countries. This proportion was the highest in China in the mid-1990s, but has decreased by half since then.

Box 4.1. Allocation of patents by institutional sectors

Patent indicators are frequently used to assess the innovative performance and technology progress of countries, regions or in certain specific domains and technology fields. More and more studies tend to expand such analysis to include the originating companies, universities, government and individuals, that could highlight for instance the dynamics underlying the innovative performance of countries.

Methods for allocating an institutional sector to patents were developed in a recent project led by Eurostat, in line with the *Frascati Manual* (2002). These methods consist mainly in analysing a set of key words ("clues" to identify the sector) in the name of the patent applicant. However, "(…) whilst the definition of categories is generally clear and precise, the matching of name characteristics to different categories is not clear-cut for certain types of organisation" (van Looy, du Plessis and Magerman, 2006). A separate category for hospitals was included, as the governance under which they operate is not always straightforward. The algorithm for sector attribution was applied to records on patent applications filed under PCT, in the OECD Patent Database, allocating patent documents to individuals, private enterprises, government, universities, hospitals or private non-profit organisations.

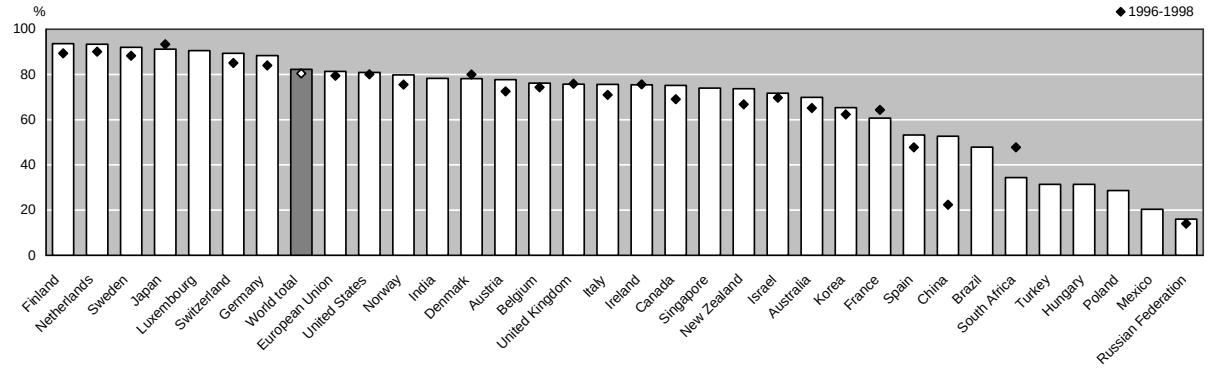
Harmonisation of applicants' names is another important issue to tackle if one aims to pursuit analysis at the applicant level. There's a high degree of heterogeneity of applicants' names in patent databases: unique names in patent databases would make possible a more in-depth analysis of patents, and possibly the capacity to match patent data with other economic data at company level, as well as to identify the institutional sector to which the patents belong. Several efforts are being undertaken to resolve this issue.

For further reading

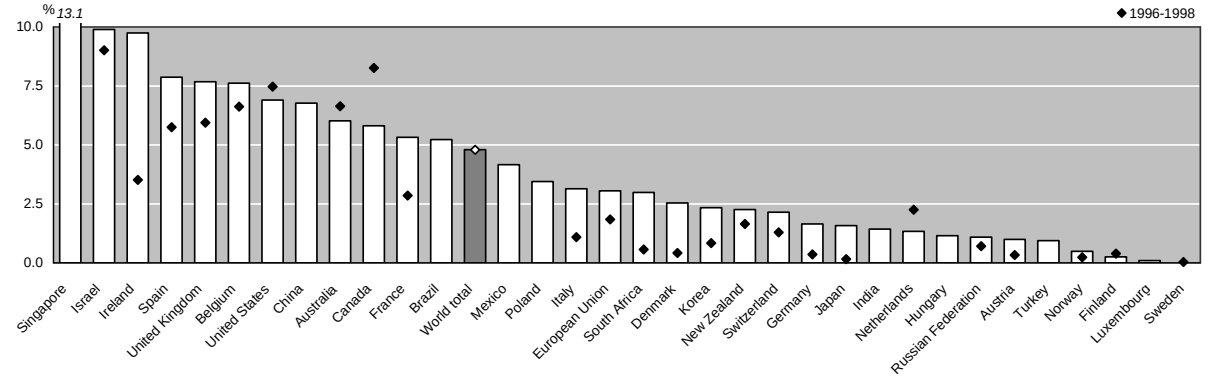
Magerman, T., Van Looy, B. and Song. X. (2006). "Data Production Methods for Hamonized Patent Indicators: Patentee Name Harmonization", EUROSTAT Working Paper and Studies, Luxembourg.

Van Looy, B., du Plessis, M. and Magerman, T. (2006). "Data Production Methods for Hamonized Patent Indicators: Assignee Sector Allocation", EUROSTAT Working Paper and Studies, Luxembourg.

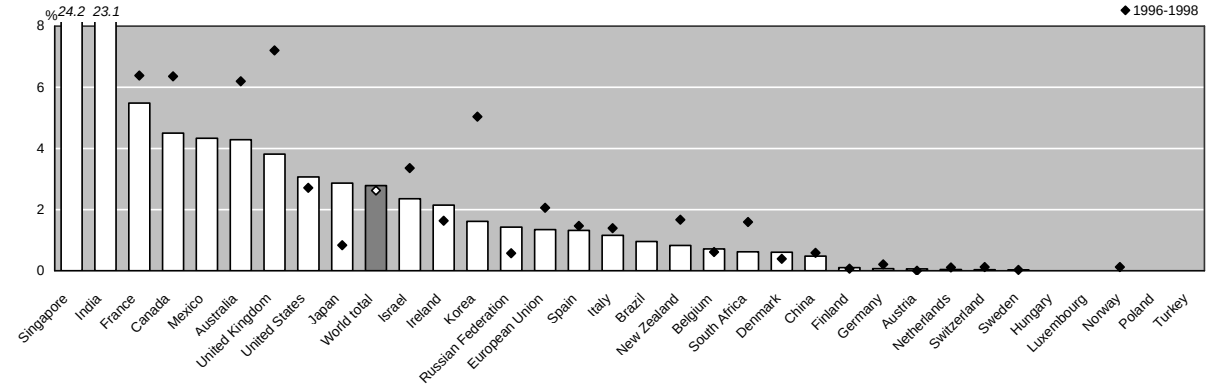
4.1. Share of patents filed under PCT[1] owned by Industry,[2] *2002-2004*



4.2. Share of patents filed under PCT[1] owned by universities[2] *2002-2004*



4.3. Share of EPO patent applications[1] owned by government,[2] *2002-2004*



Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts.
1. Patent applications filed under the PCT, at international phase, designating the EPO. Only countries with more than 300 PCT filings per period are included.
2. EPO patent applications are attributed to institutional sectors using an algorithm developed by Eurostat.

Source: OECD, Patent Database, using the Eurostat sector attribution algorithm, June 2007.

- India and Singapore have the highest share of patents owned by government agencies (23.1% and 24.2% respectively). France is at the top of all OECD countries, with 5.5% of patents owned by the French government. This proportion has risen significantly since the mid-1990s for Japan, whereas it decreased by more than 2 percentage points in Australia, Canada, Korea and the United Kingdom to less than 5% in 2004 (Figure 4.3).

5. PATENTS BY REGIONS

- Analysis of regional patenting is a way to assess the concentration of innovative activities within countries. The number of PCT applications by region is an indicator that specifies prominent innovative regions acting as crucial knowledge sources in the world.
- Inventive activities are concentrated in a small number of regions, and the degree of concentration is much higher than population (Figure 5.1). The average adjusted geographic concentration index in OECD countries is 0.56. The geographical concentration is stronger in Hungary (0.75), Spain (0.70), Japan (0.69). Sweden (0.69), the Netherlands (0.61), the United Kingdom (0.57), Finland (0.57), Korea (0.57) and Norway (0.56).
- Austria and Switzerland have the lowest geographical concentration (0.38 and 0.36 respectively), although the degrees of concentration in PCT applications are much higher than in population.
- California (United States) and Tokyo (Japan) are leading regions in the number of PCT applications, both in ICT and in biotechnology (Figures 5.2 and 5.3). In Europe, Noord-Braband in the Netherlands produces the largest number of PCT patent applications in ICT. Düsseldorf (Germany) is the largest contributor of biotechnology patents.
- Among the leading regions in ICT, Noord-Braband also has the highest number of PCT applications per million labour force, followed by Tokyo (Japan), East Anglia (United Kingdom), and Lansi-Suomi (Finland), indicating the strong concentration of highly skilled personnel in these regions.
- Massachusetts (United States) produces the largest number of PCT applications in biotechnology, per million labour force, among the leading regions. The number of patents relative to the labour force are also larger in Düsseldorf (Germany), Maryland (United States), Ibaraki (Japan), Kyoto (Japan), Delaware (United States), and East Anglia (United Kingdom), compared to other regions.
- Due to the skewed distribution of PCT patent applications by regions, these rankings could change dramatically depending on the reference year, except for regions with high patenting activities, such as California and Tokyo.

Box 5.1. Definition of regions and adjusted geographic concentration index

The Nomenclature of Territorial Units for Statistics (NUTS) is a geo-code standard for referencing the administrative division of countries in the European Union for statistical purposes. There are three levels of NUTS defined. Regions in the EU countries are defined by NUTS2 except for Ireland. Ireland is treated as one region.

OECD has classified regions within each member country. The classification is based on two territorial levels (TL). The higher level (Territorial Level 2) consists of about 300 macro-regions and the lower level (Territorial Level 3) is composed of more than 2 300 micro-regions. Regions in Australia, Canada, Korea, Norway, Switzerland, and United States are defined by TL2. Regions in Japan are defined by TL3. Iceland is treated as one region. No regional patent data is available for Mexico, New Zealand and Turkey. About 300 regions in 26 OECD countries are defined.

In order to compare the concentration of population and triadic patent families of regions in different degree of aggregation, the adjusted geographic concentration index (AGC) was calculated, which is defined as:

$$GC = \sum_{i=1}^{N} |y_i - a_i|$$

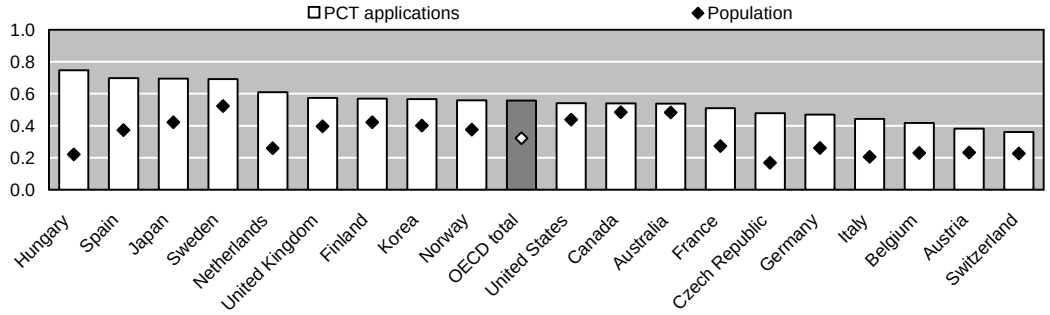
and $AGC = GC / GC^{MAX}$

where a_i is the share of region *i* in population or triadic patent families, a_i is the area of region i as a percentage of the country area, and N stands for the number of regions. The geographic concentration index (GC) is adjusted by the maximum value of the GC index. Thus, the AGC index lies between 0 (no concentration) and 1 (maximum concentration) in all countries. The AGC is suitable for international comparisons of geographic concentration for regions in different degrees of aggregation.

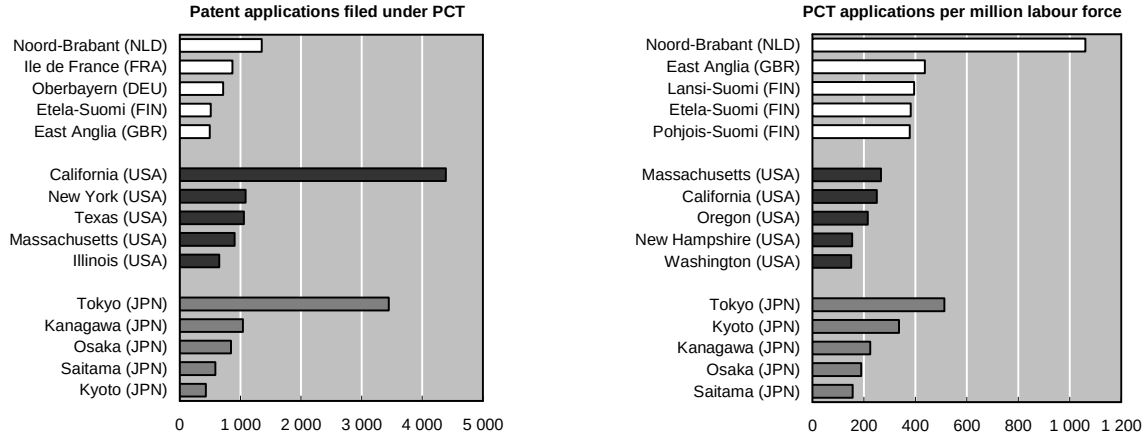
For further reading

OECD (2007), *Regions at a Glance*, OECD, Paris.

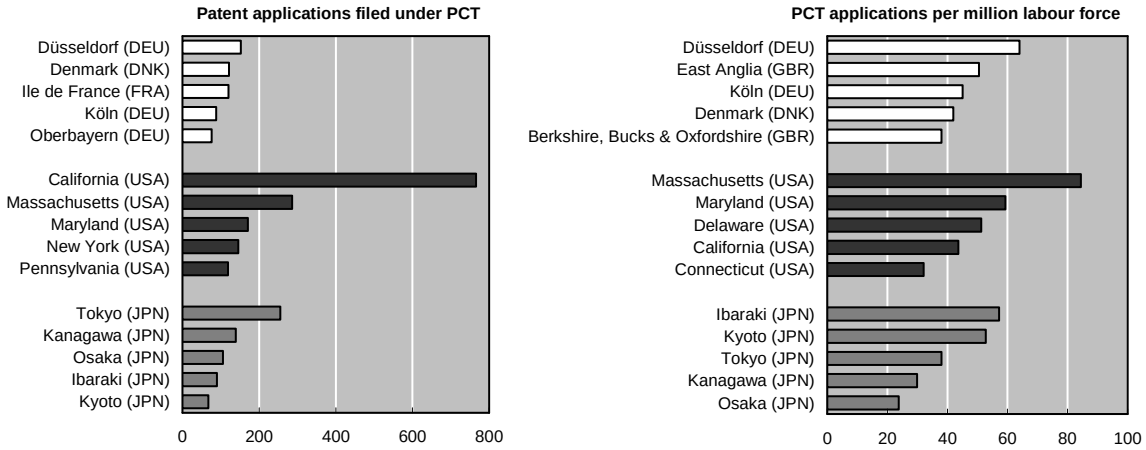
5.1. Geographic concentration in total PCT applications,[1] *2004*



5.2. ICT-related patents by regions in Europe, the United States and Japan,[2] *2004*



5.2. Biotechnology patents by regions in Europe, the United States and Japan,[3] *2004*



Note: Patent counts are based on the priority date, the inventor's region of residence and fractional counts. Countries in which 60% or more inventors' addresses are assigned to regions are included in the graphs.

1. Only countries with more than 100 PCT in 2004 are included in the graph.
2. Only regions with more than 100 PCT in 2004 are included in the graph. The definition of ICT-related patents is presented in the methodological box 3.1.
3. Only regions with more than 20 PCT in 2004 are included in the graph. The definition of biotechnology patents is presented in the methodological box 3.1.

Sources: OECD, Patent database, June 2007;
OECD, Territorial database, April 2007.
Eurostat Regional Statistics, April 2007.

6. INTERNATIONAL COOPERATION IN INVENTIVE ACTIVITIES

6.1. Cross-border ownership

- The technological activities of multinational firms are increasingly internationalised. In the search for new technological competences, better adaptation to markets and lower research and development costs, companies are moving research activities overseas more intensively.
- On average, 16.7% of all inventions filed at the EPO were owned or co-owned by a foreign resident in 2001-03, a notable increase from 11.6% in 1991-93 (Figure 6.1.1).
- The extent of internationalisation, as reflected in foreign ownership, varies substantially across countries. In the Russian Federation, Luxembourg and Hungary, over 50% of domestic inventions belong to foreign residents, a higher share than in 1991-93. However, in Finland, India, Korea, Poland and Singapore, foreign ownership has decreased markedly, owing in part to an increase in domestic patenting activity.
- The United States and Germany report declining shares of foreign ownership (to 14 and 15%, respectively), as do Korea and Japan, which report the lowest shares in 2001-03 (4.5 and 3.7%, respectively). The United Kingdom is an exception among large countries, with around 40% of domestic inventions owned by foreign residents, compared to 30% in the early 1990s.

Box 6.1. Patents as an indicator of the internationalisation of science and technology activities

Patent documents show the inventor(s) and the applicant(s) – the owner of the patent at the time of application – along with their addresses and thus their country or countries of residence. In most cases, the applicant is an institution (generally a firm, university or public laboratory), but sometimes an individual.

An increasing share of patent applications is owned or co-owned by applicants whose country of residence is different from the country of residence of the inventor(s). The decision to allocate R&D activities abroad has essentially two economic motivations (Guellec and van Pottelsberghe, 2001): the need to adapt products and processes to host markets ("asset-exploiting" strategies) and to acquire new knowledge assets ("asset-seeking" strategies). Cross-border ownership is mainly the result of activities of multinationals; the applicant is a conglomerate and the inventors are employees of a foreign subsidiary. Patent data thus make it possible to track the international circulation of knowledge from "inventor" countries to "applicant" countries.

The internationalisation measures (of S&T activities) presented here relate respectively to foreign ownership of domestic inventions and its mirror image - domestic ownership of inventions made abroad. The first evaluates the extent to which foreign firms control domestic inventions. The second assesses the extent to which domestic firms control inventions made by residents of other countries.

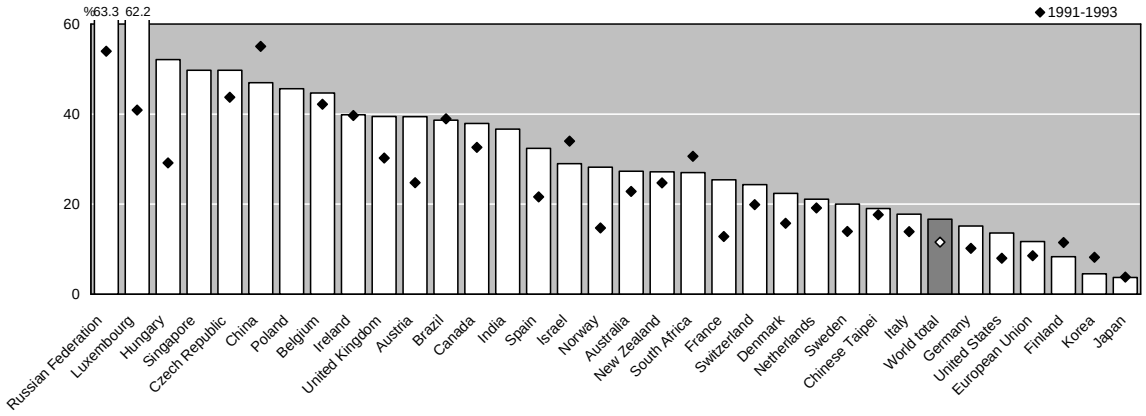
Another measure of international co-operation refers to the share of patents involving inventors with different countries of residence. As inventors in different countries differ in their specialisation and knowledge assets, they look for knowledge beyond national boundaries to overcome the lack of technological resources. International collaboration by researchers can take place either within a multinational corporation (providing research facilities in several countries) or through a research joint venture among several firms or institutions (collaboration between universities or public research organisations).

The analysis here is based on patent applications to the EPO. Patents granted by the USPTO show similar internationalisation trends.

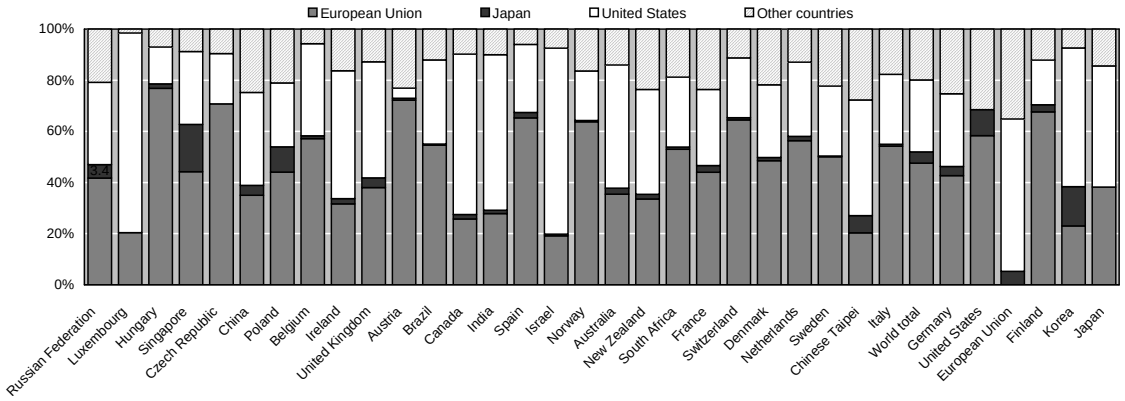
For further reading

Guellec D. and B. van Pottelsberghe (2001). "The Internationalisation of Technology Analysed with Patent Data", *Research Policy*, 2001, vol. 30, issue 8, 1253-1266.

6.1.1. Foreign ownership of domestic inventions,[1] *2001-2003*



6.1.2. Foreign ownership of domestic inventions[1]
*Partner in the three major regions***,** *2001-2003*

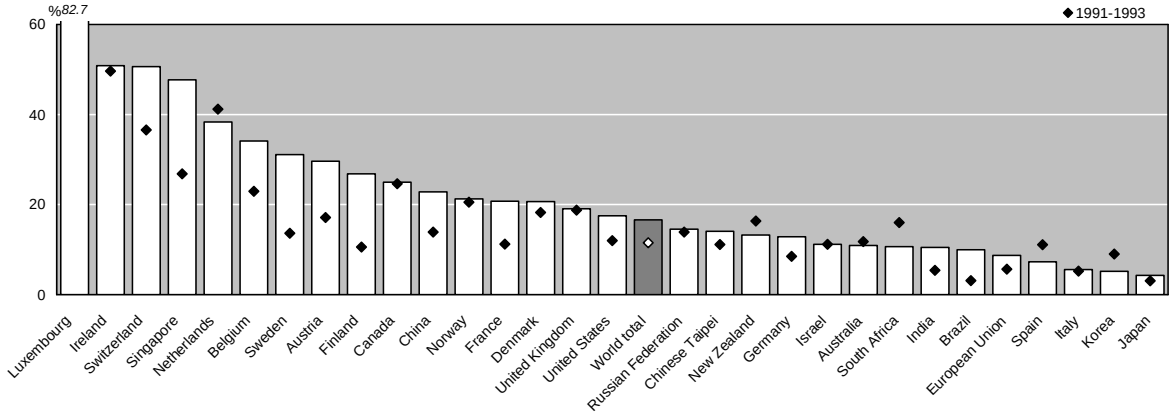


Note: Patent counts are based on the priority date, the inventor's country of residence, using simple counts.
The EU is treated as one country; intra-EU co-operation is excluded.
This graph only covers countries/economies with more than 300 EPO applications over 2001-2003.
1. Share of patent applications to the EPO owned by foreign residents in total patents invented domestically.

Source: OECD, Patent database, June 2007.

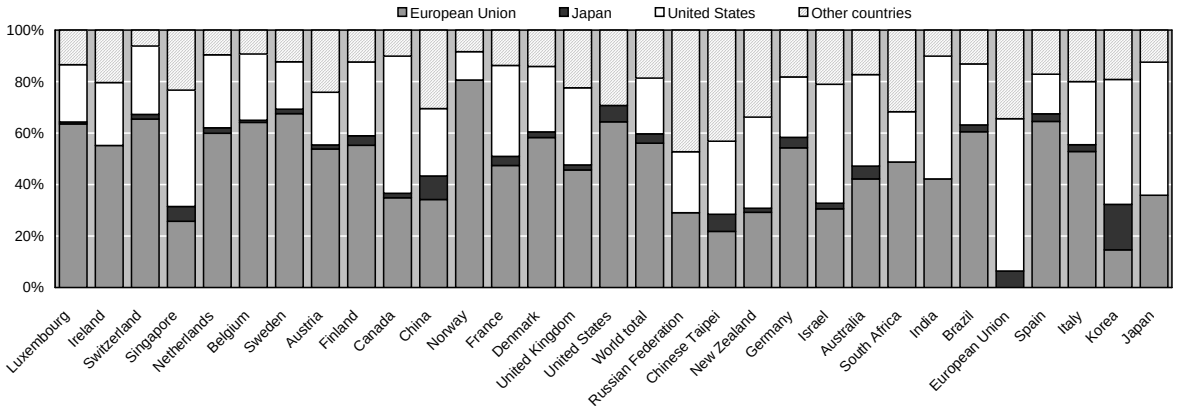
- The breakdown of foreign ownership by main owner (country) shows the importance of geographical and cultural proximity in cross-border activities (Figure 6.1.2). The origin of foreign ownership in European countries is largely intra-regional (companies from EU countries owning inventions in other EU countries). US ownership appears strong in Canada, Ireland, India, Israel and Luxembourg but also in Korea and Japan.
- While the United States dominates foreign ownership of domestic inventions in India, European countries are the main owner of inventions subject to cross-border ownership in Brazil, the Russian Federation, Singapore and South Africa.

6.1.3. Domestic ownership of inventions made abroad,[1] *2001-2003*



6.1.4. Domestic ownership of inventions made abroad[1]

Partner in the three major regions, 2001-2003



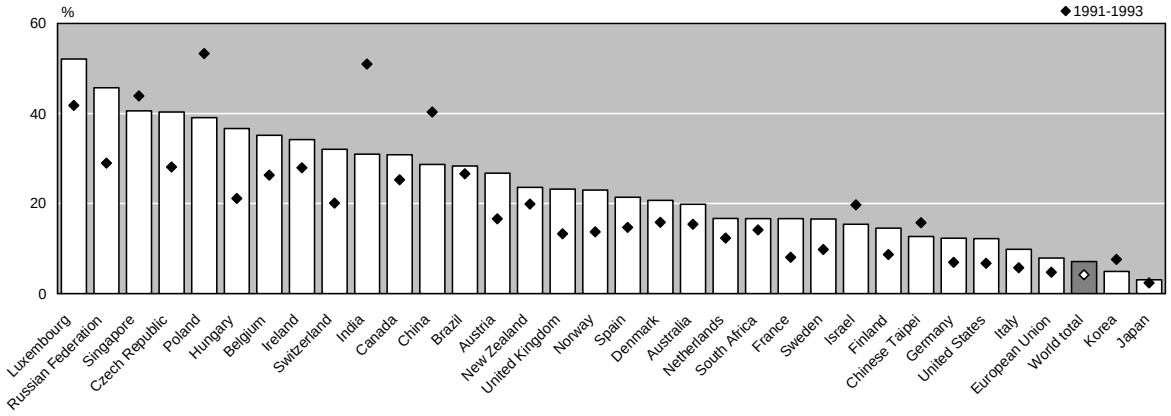
Note: Patent counts are based on the priority date, the applicant's country of residence, using simple counts.
The EU is treated as one country; intra-EU co-operation is excluded.
The graph only covers countries/economies with more than 300 EPO applications over the period 2001-2003.
1. Share of patent applications to the EPO invented abroad in total patents owned by country residents.

Source: OECD, Patent database, June 2007.

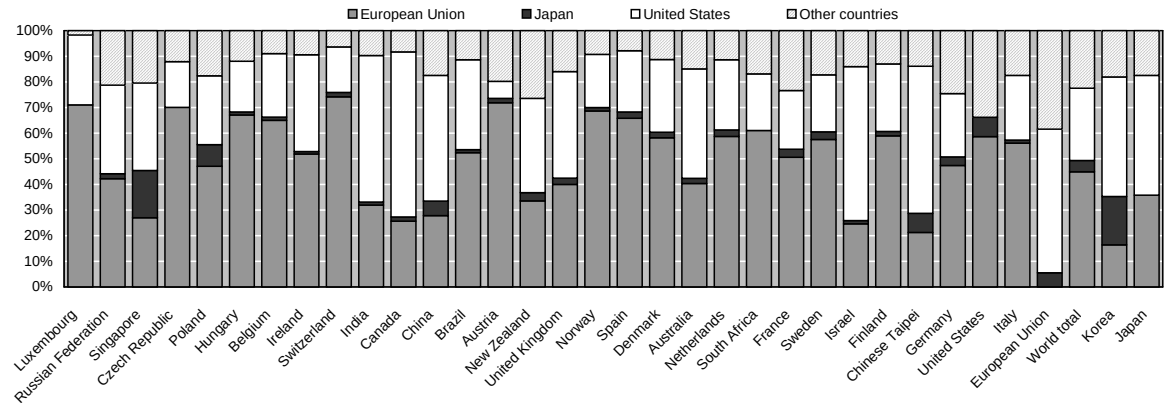
- In the early 2000s, most economies became more strongly involved in cross-border inventive activity. In particular, the share of foreign inventions in patents owned by domestic companies more than doubled in Brazil, Finland, India and Sweden from the early 1990s (Figure 6.1.3). This climb seems to coincide with a stronger global economic presence. A significant rise is also reported for France, where the share increased from 11 to 21% in 2001-03.
- Patents filed at the EPO show that domestic ownership of inventions made abroad is particularly high in small open economies. In Luxembourg more than 80% of inventions owned were made by inventors abroad and more than 30% in Belgium, Ireland, the Netherlands, Singapore, Sweden and Switzerland. Italy, Japan, Korea and Spain report the weakest share of inventions made abroad (less than 10%).
- More than 50% of inventions with cross-border ownership in 2001-03 were made with inventors located in European countries, twice the number of inventions made by US inventors (Figure 6.1.4).
- The breakdown by country shows that geographical and cultural proximity matters in the choice of location. European countries own inventions from other EU countries more frequently than from other locations; when intra-EU locations are excluded, the United States is the leading location.
- Canada, India, Israel, Korea, Japan and Singapore own more patents with US inventors than with EU inventors. China shows a more even distribution of domestic ownership across regions while the Russian Federation collaborates mostly with other countries.

6.2. Co-inventions

6.2.1. Patents with foreign co-inventors,[1] *2001-2003*



6.2.2. Patents with foreign co-inventors[1]
partner in the three major regions, 2001-2003



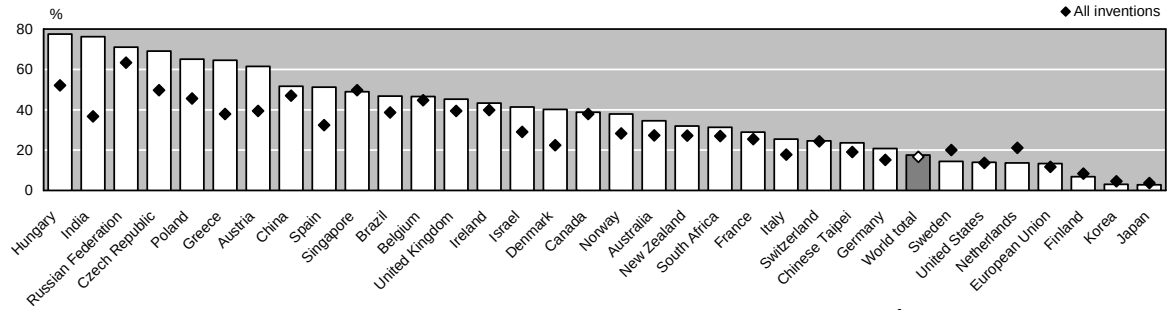
Note: Patent counts are based on the priority date, the inventor's country of residence, using simple counts.
The EU is treated as one country; intra-EU co-operation is excluded.
The graph only covers countries/economies with more than 300 EPO applications over the period 2001-2003.
1. Share of patent applications to the EPO invented abroad in total patents owned by country residents.

Source: OECD, Patent database, June 2007.

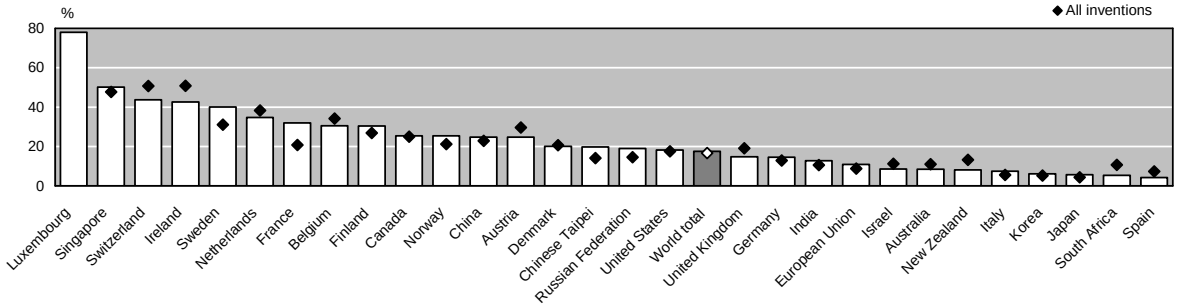
- International co-operation is a particular aspect of the globalisation of research activities. The world share of patents involving international co-invention increased from 4% in 1991-93 to 7% in 2001-03 (Figure 6.2.1).
- The extent of international co-operation differs significantly between small and large countries. Small and less developed economies engage more actively in international collaboration. Co-invention is particularly high in Luxembourg (52%), followed by the Russian Federation, Singapore, the Czech Republic and Poland. This reflects these countries' need to overcome limitations due to the size of internal markets and/or the lack of the necessary infrastructure to develop technology.
- Large countries, such as France, Germany, the United Kingdom and the United States report international co-operation of between 12 and 23% in 2001-03, the greatest expansion in the extent of international collaboration from the early 1990s. In France, for instance, it increased from 8 to 16% in 2001-03.
- The breakdown of collaboration by main partner country reveals patterns similar to those reported for cross-border ownership (Figure 6.2.2): European countries collaborate essentially with other EU countries; whereas Canada, China, India, Israel, Korea and Japan collaborate the most with the United States. More than 20% of inventions made in India and Canada are co-invented with a US inventor, Brazil and South Africa collaborating mainly with EU inventors.

6.3. Internationalisation of ICT-related inventions

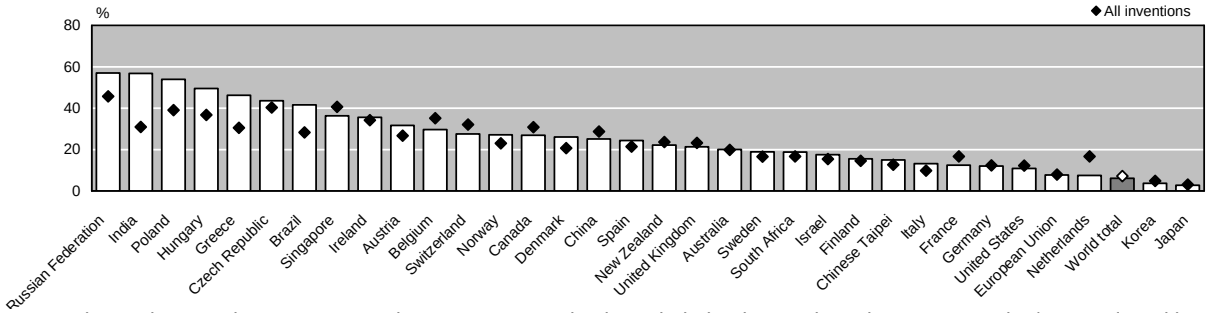
6.3.1. Foreign ownership of domestic ICT-related inventions,[1] *2001-2003*



6.3.2. Domestic ownership of ICT-related inventions made abroad,[1] *2001-2003*



6.3.3. ICT-related patents with foreign co-inventors,[1] *2001-2003*



Notes: The EU is treated as one country; intra-EU co-operation is excluded. The graphs only cover countries/economies with more than 50 EPO patent applications in ICT over the period 2001-2003.

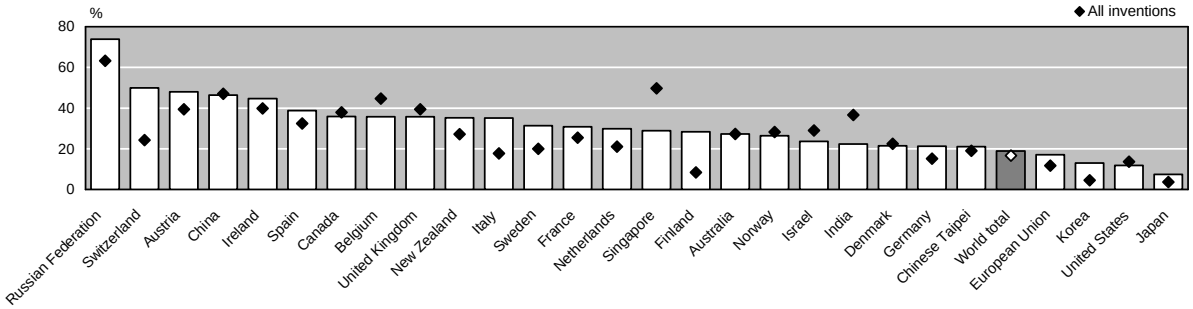
1. These indicators are defined in sections 6.1 and 6.2. The definition of ICT-related patents is presented in the methodological box 3.1.

Source: OECD, Patent database, June 2007.

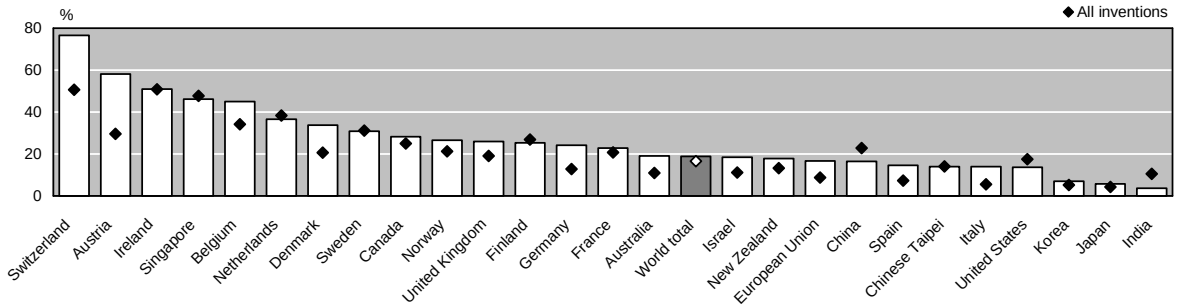
- The level of internationalisation varies across technology areas. Because they constitute a strategic tool for global competitiveness, ICT technologies are more internationalised than other technologies: 17.5% of all patents in this field involve cross-border ownership (Figures 6.3.1 and 6.3.2).
- Non-OECD countries such as India, the Russian Federation, Brazil and China show a high level of foreign ownership in ICT-related patents. Compared to their overall share, foreign ownership is especially high in India and China, a pattern that reflects their increasing technological inventiveness.
- Domestic ownership of inventions made abroad highlight discrepancies across countries (Figure 6.3.2): European economies such as Luxembourg, Switzerland, Ireland and Sweden are more active in the acquisition of foreign ICT inventions. Italy, Korea, Japan, South Africa and Spain, on the other hand, have the lowest levels of domestic ownership of inventions made abroad.
- The proportion of international co-inventions in ICT is much higher in Brazil, Greece and India than in other technologies (Figure 6.3.3). Germany, the United States, the Netherlands, Korea and Japan interact less with foreign inventors than smaller non-OECD countries (less than 15%)

6.4. Internationalisation of biotechnology-related inventions

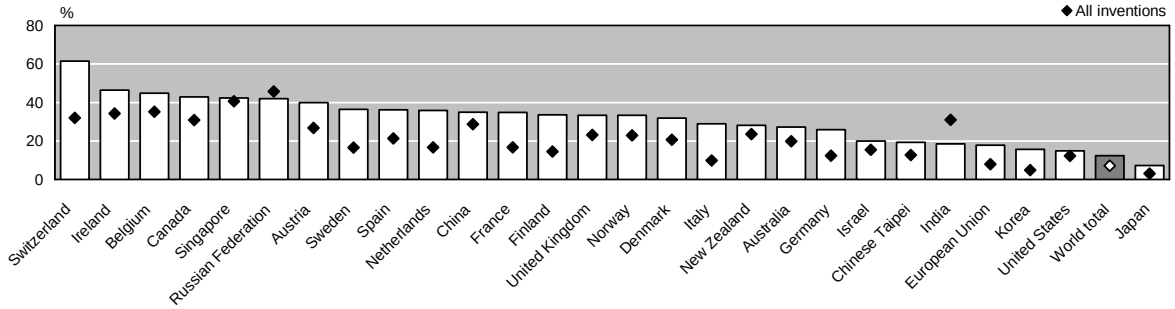
6.4.1. Foreign ownership of domestic biotechnology-related inventions,[1] *2001-2003*



6.4.2. Domestic ownership of biotechnology-related inventions made abroad,[1] *2001-2003*



6.4.3. Biotechnology-related patents with foreign co-inventors,[1] *2001-2003*



Notes: The EU is treated as one country; intra-EU co-operation is excluded. The graphs only cover countries/economies with more than 40 EPO patent applications in biotechnology over the period 2001-2003.

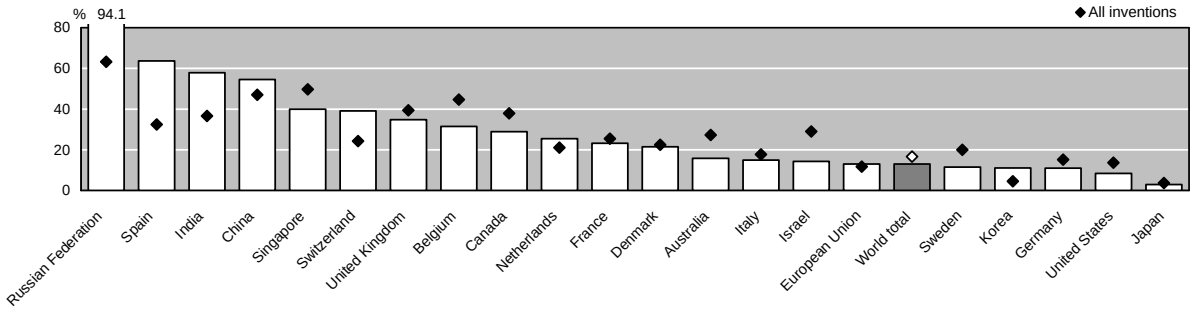
1. These indicators are defined in sections 6.1 and 6.2. The definition of biotechnology patents is presented in the methodological box 3.1.

Source: OECD, Patent database, June 2007.

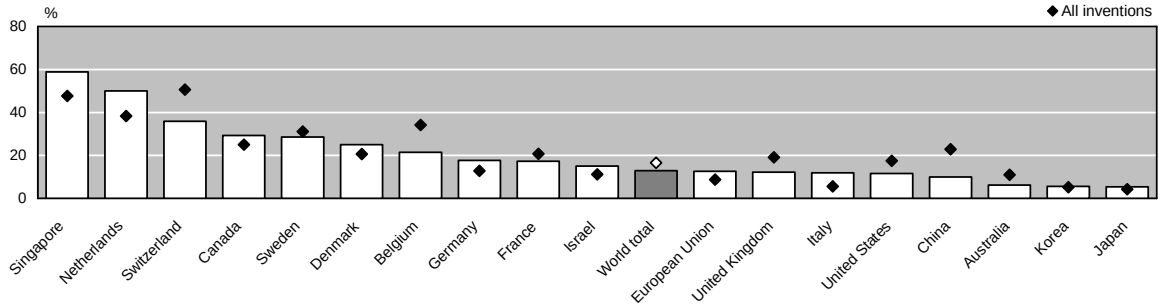
- Biotechnology patents show higher levels of foreign ownership (Figure 6.4.1): on average 18.9% of patents have a foreign resident as owner against an overall average of 17%. This is particularly true for most European countries (17% compared to 12% for all inventions).
- The United States has a smaller share of foreign ownership of domestic inventions (Figure 6.4.1) and own their own inventions in biotechnology more intensively than for other technologies (Figure 6.4.2). They are also less frequently involved in international co-invention than other countries (Figure 6.4.3).
- Switzerland is one of the most cooperative countries in biotechnology patenting, with more than 50% of cross-border ownership and co-inventions. Belgium, Canada and Ireland also have high propensity to collaborate with abroad.
- In all reported countries, except for the Russian Federation and India, the level of international co-invention is higher for biotechnology inventions than it is for all inventions. This is notably the case for France, Finland, Germany, Italy, Japan, Korea, the Netherlands and Sweden.

6.5. Internationalisation of nanotechnology-related inventions

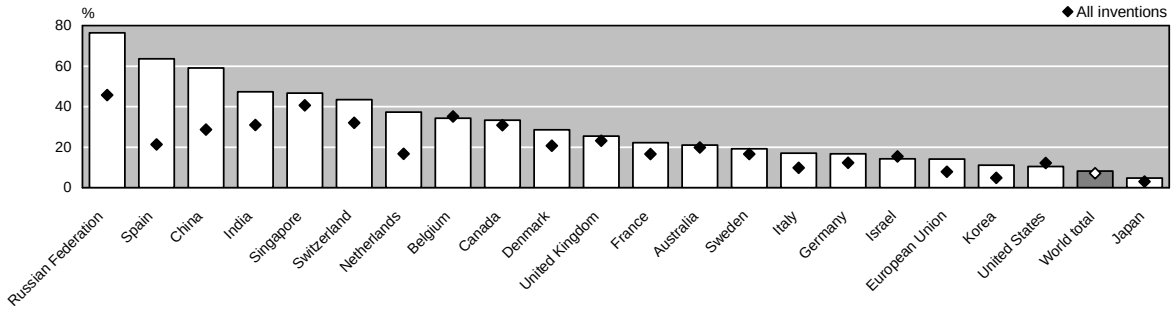
6.5.1. Foreign ownership of domestic nanotechnology-related inventions,[1] *2001-2003*



6.5.2. Domestic ownership of nanotechnology-related inventions made abroad,[1] *2001-2003*



6.5.3. Nanotechnology-related patents with foreign co-inventors,[1] *2001-2003*



Notes: The EU is treated as one country; intra-EU co-operation is excluded. The graphs only cover countries/economies with more than 10 EPO patent applications in nanotechnology over the period 2001-2003.

1. These indicators are defined in sections 6.1 and 6.2. Nanotechnology patents are identified as in section 3.2.

Source: OECD, Patent database, June 2007.

- Ratios of foreign ownership of nanotechnology-related inventions are more than 50% in Russian Federation, Spain, India, and China (Figure 6.5.1). These countries also engage more actively in international collaboration (Figure 6.5.3). The small number of inventions in these countries, *i.e.* less than 30 inventions, suggests that inventive activities in these countries rely strongly on knowledge of multinationals.
- Intensity of foreign ownership in nanotechnology-related inventions is relatively high in Switzerland and Korea compared to in total inventions (Figure 6.5.1). These countries also have a relatively large ratio of co-inventions. Combining these observations and the fact that these two countries are leaders in nanotechnology-related inventions, multinationals likely try to acquire new knowledge assets in these countries.
- Domestic ownership of nanotechnology-related inventions made abroad accounts for more than 25% in Singapore, Netherlands, Switzerland, Canada, Sweden, and Denmark (Figure 6.5.2). Knowledge of nanotechnologies in these countries owes in some part to human resources in foreign countries.

7. SCIENCE LINKAGES IN TECHNOLOGY

- Most published patent applications include a list of references, or citations, to earlier patents and "non-patent literature" (NPL) such as scientific papers that capture "prior art" and determine the boundaries of a patent's claims for novelty, inventive activity and industrial applicability. In general, the references are determined by the patent examiner and are included in the "search report". Some may have been provided by the applicant.
- By looking at the variations in shares of NPL in citations across patent classes (Figure 7.1), insights into the technologies that are closer to scientific R&D, and thus more dependent on the progress of scientific knowledge, begin to unfold. Analysis of over 540 000 international patent applications (filed under PCT) published by EPO shows that in the last 15 years the IPC sub-classes that have a higher than average share of citations to NPL (over 15%) are mainly in the fields of biotechnology, pharmaceuticals, other fine organic chemistry and information and communications technology (ICT). This is consistent with other observed patterns of science-industry linkages in these fields such as university spin-offs, industry-university co-operation in research and development, and the tendency for bio-technology companies to cluster around universities.
- Similar calculations by country of inventor reveal that higher shares of NPL in citations occur in countries whose international patenting activity is more concentrated in these high-activity or emerging technology fields. For example, Indian inventors have a recent history of international patenting activity and a relatively high proportion of their applications are in biotechnology and pharmaceuticals, which have closer links to science.
- The importance of science in developing technology differs across fields. The role of science depends not only on advances in basic research but also on the potential for industrial applicability and the market opportunities that the science creates. For 1990-2004 about 55% of citations in biotechnology-related international patents are to NPL. There is little cross-country variation, which suggests some general homogeneity in the rate of technological advances but possibly hides some structural differences across countries in this field.

Box 7.1. Issues to be considered when analysing European and international citations

• An increasing number of applicants file patents under PCT before entering the EPO process in the regional phase. However, if EPO has acted as the international search authority (ISA) and undertaken the international search, then most citations will appear in the international (WO) document rather than the EPO document. In order to count citations in a European patent application correctly, information from both the international and the European searches need to be combined.

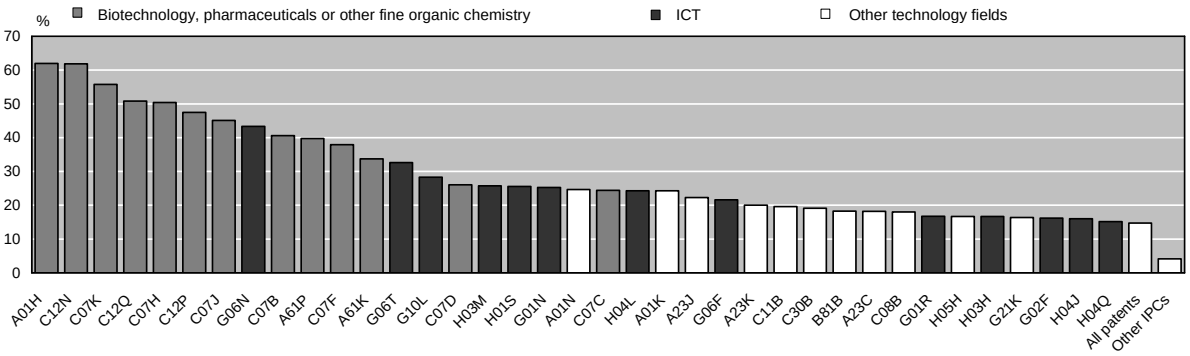
• PCT and EPO publications include information for five different types of citations: i) added by examiners during the search (whether or not provided by the applicant); ii) provided by the applicant but not used in the search report; iii) added during examination; iv) provided during opposition proceedings; and v) other. Most citations in PCT and EPO publications (about 95%) are added by examiners in the search report; these are the citations analysed here.

• Non-patent literature (NPL) consists not only of peer-reviewed scientific papers but also includes conference proceedings, databases (DNA structures, gene sequences, chemical compounds, etc.) and other relevant literature. However, previous studies have found that total NPL is a good proxy for scientific papers in similar types of analyses. References to certain types of NPL such as "patent abstracts" and commercial online patent database services have been removed for the purposes of this analysis.

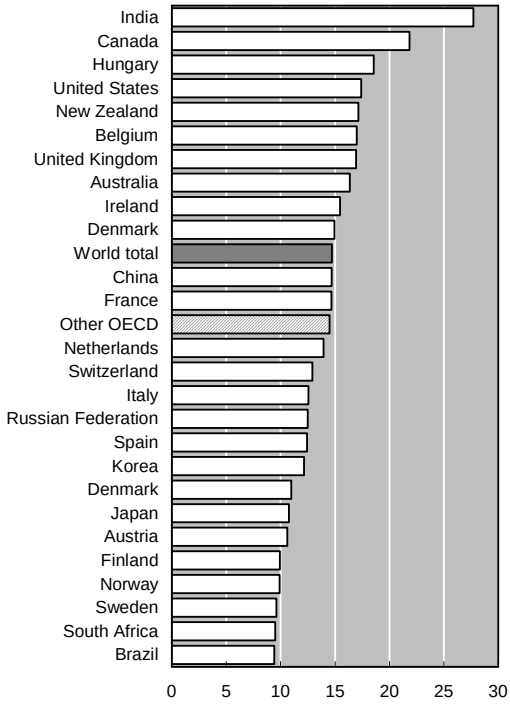
For a detailed description of International Patent Classification (IPC) sub-classes
www.wipo.int/classifications/fulltext/new_ipc/ipcen.html

For further reading
European Commission, "Linking Science to Technology Bibliographic References in Patents", DG Research project report, 2002.
Jaffe, A. and M. Trajtenberg, *Patents, Citations and Innovations: a Window on the Knowledge Economy*, MIT Press, ISBN 0 262 10095 9, 2002.
Webb, C., H. Dernis, D. Harhoff and K., Hoisl (2005). "Analysing European and International Patent Citations - A Set of EPO Patent Database Building Blocks", *STI Working Paper* 2005/9, OECD, Paris.

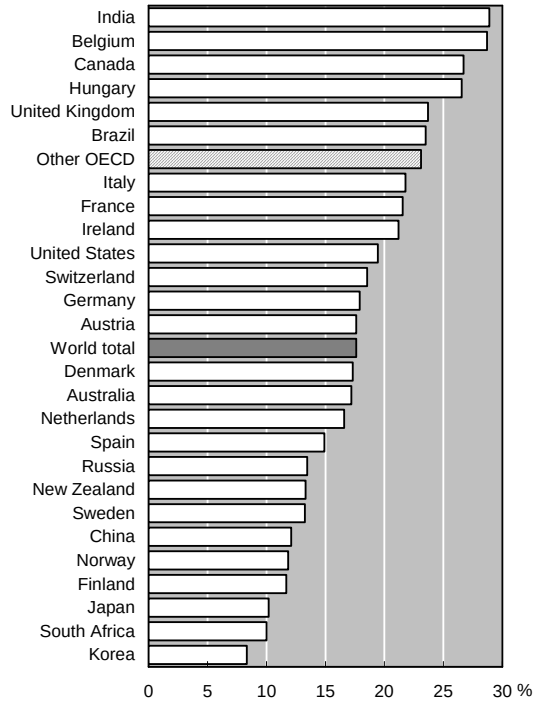
7.1. Share of NPL in citations in search reports of PCT patent applications
1990-2004, by IPC sub-class[1]



7.2. Share of NPL in citations, all patents
1990-2004, by country of inventor[2]



7.3. Share of NPL in citations, ICT-related patents
1990-2004, by country of inventor[2]



1. Only those IPC sub-classes (out of over 600) with a share of NPL citations greater than the average (14.7%) and with more than 150 patent applications published in the period 1990-2004.
2. Fractional counting used where more than one inventor on the patent application. Other OECD includes Czech Republic, Greece, Iceland, Luxembourg, Mexico, Poland, Portugal, Slovak Republic and Turkey.

Sources: OECD, EPO citations database 2006;
EPO Worldwide Patent Statistics, DocDB and REFI databases;
WIPO Patent database.

- For the more established field of ICT, the average share is about 18% and varies across countries in a range of 10-25% (Figure 7.3). Low shares suggest that the latest ICT innovations are based more on existing technology while higher shares suggest that certain countries are still benefiting from scientific R&D in ICT. This is partly a consequence of structural differences across countries and of technological specialisation within this broadly defined field.

ANNEX A
PATENT DATABASES – OECD AND EPO

The OECD patent database covers patent records (micro-data) for a large number of countries and patent offices, and mainly derives from the EPO's worldwide statistical patent database (PATSTAT). At present, the following patent statistics are processed and published on a regular basis: "triadic" patent families, filings at the EPO and grants at the USPTO. The integration of data from the JPO and other selected national patent offices, as well as international applications following the PCT procedure, is currently under way. However, at present, these are not published on a regular basis, as further work is necessary to develop indicators based on the OECD methodology (*e.g.* counts based on priority date, residence of inventor, etc.) and to validate the data.

EPO Worldwide Statistical Patent Database

The worldwide statistical patent database, also known as "PATSTAT", was developed by the EPO in 2005, using their collection of patent data and their knowledge of patent data. Much of the data is extracted from the EPO's master bibliographic database, DocDB, also known as the EPO Patent Information Resource. It includes bibliographic details on patents filed at 73 patent offices worldwide and covers more than 50 million documents. A broad number of fields included in patent documents are covered, such as application details (claimed priorities, application and publication), technology classes, inventors and applicants, title and abstract, patent citations and non-patent literature text, etc. The data set should be complemented in the near future by a set of harmonised applicants' names for EPO and USPTO documents, provided by Eurostat. However, depending on the patent offices, the coverage of national data may be partial or delayed.

The EPO worldwide statistical patent database (April 2007) consists of 16 tables. It is to be released by the EPO twice a year, in the early spring and the early autumn. Each version will present a snapshot of the source databases at a single point in time. A comprehensive data catalogue is provided along with the tables, describing the fields' codes. An additional document lists currently available fields and the time period covered for each country. The content and design of this database is not intended to be static: a "change management procedure" has been put in place by the EPO to allow task force members to request changes in the data catalogue (*i.e.* including additional information, variables, etc.) at a reasonable time before each release.

The policy for using and disseminating the EPO worldwide statistical patent database is governed by agreements drawn up between the EPO and individual institutions represented on the task force. Task force members can request the EPO to send extra copies to third parties, which will be invoiced at "marginal cost", and the data will be diffused to non-task force members (researchers, government agencies) if they agree to the conditions of data dissemination: "*not to be used for commercial purposes*."
Source: EPO.

EPO patent applications (Euro-Direct + PCT international/regional phase)

All patents filed at the EPO, either directly or indirectly via the PCT procedure, are covered, from 1978 onwards (application date). Data are downloaded weekly from the EPO's website and major updates are made at least twice a year (EPOLINE database). This dataset includes bibliographic records on each patent document published by the EPO: priority, application, PCT, when applicable, and publication data; patent status such as grant, refusal, withdrawal; list of IPC codes; English title; designated states; and inventors'/applicants' names, address and country of residence.
Source: EPO.

USPTO patent grants

This dataset covers all patents that were granted by the USPTO, from 1976 onwards (date of grant). Data are downloaded weekly from USPTO's website and major updates are made at least twice a year. As for the EPO, this dataset includes bibliographic records on each USPTO grant: priority, application, PCT, when applicable, and publication data; list of IPC codes as well as US patent classification; title and abstract; number of claims; and inventors'/applicants' names, address and country of residence.
Source: USPTO.

Patent applications to the JPO

The JPO provides the OECD with patent data on a regular basis. However, work is necessary to develop indicators based on the OECD methodology (*e.g.* counts based on priority date, residence of inventor, etc.). Furthermore, the IIP Patent Database was recently developed jointly with the Institute of Intellectual Property of Japan (IIP) and the University of Tokyo. It was designed for analysis of patent statistics and based on data up to 2003 (fiscal year).
For further details, see: Goto, A. and K. Motohashi, "Construction of Japanese Patent Database for Research on Japanese Patenting Activities", *http://www.iip.or.jp/e/patentdb/paper.pdf*
Source: IIP.

European and international citation data tables

The data tables currently cover all patent applications published by the EPO and WIPO, under the Patent Cooperation Treaty, from their introduction in 1978 up to July 2005. The data tables are available on CD-ROM, on request from OECD, for research use only.
For further details refer to: Webb *et al.* (2004), "Analysing European and International Patent Citations: A Set of EPO Patent Database Building Blocks", OECD.
Source: EPO.

OECD indicators on patents

A core set of indicators constructed from the OECD patent database is available free of charge on the OECD website at *www.oecd.org/sti/ipr-statistics* (database section). The online database covers the following patent indicators based on the EPO, the USPTO and the "triadic" patent families, split into three categories: patents by main IPC, by main USPC and indicators of international co-operation on patents. The database allows users to select any of the indicators mentioned based on various selection criteria: dates (priority, application, grant) and reference country (inventor and applicant country). More than 100 countries are covered, along with various zone totals. Patent indicators are also diffused through various OECD publications on a regular basis *(e.g. Main Science and Technology Indicators; OECD Science, Technology and Industry Scoreboard)*. In OECD publications, patent indicators for the latest years are estimated at aggregated level.

Nowcasting patent-based indicators

Timeliness is a major drawback of patent data, which cannot easily be circumvented. Various studies have tackled this issue, testing different approaches (trend analysis; auto-regressive models, transfer models using available information, econometric models, applicants' surveys, etc.). In 2007, different methods were implemented at the OECD to provide nowcasts for EPO patents and triadic patent families up to priority year 2005.

Estimations of the aggregate number of EPO applications are based on estimations of the number of Euro-PCT applications (PCT proceeding to the EPO regional phase). Euro-PCT applications 2004 forecasts are based on the estimated transfer rate of PCT filings at international phase into the regional phase. 2005 is based on partially available data on direct EPO filings and PCT at international phase.

Triadic patent families are estimated until 2001-2002 using data on "biadic" patent families (patents taken at the EPO and JPO). Then, a second model built on the relationship between triadic patent families and EPO patent applications is used to estimate data up to 2005.

For further reading
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