Statistics in focus

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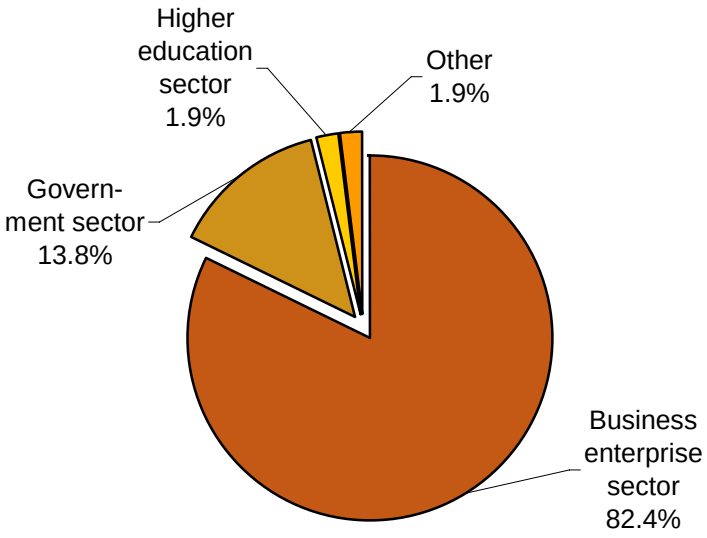
Patents and R&D expenditure

Most EPO patent applications submitted by EU businesses

Figure 1: Patent applications to the European Patent Office (EPO) broken down by institutional sector for EU-25, in 2002



Source: Eurostat, patent statistics

Main findings

- Businesses applied for most EPO patents (82.4%). Only 17.6% of EPO patent applications are from other institutional sectors.
- A high level of gross domestic expenditure on R&D (GERD) leads in most countries to a high number of patent applications to the EPO or patents granted by the USPTO.
- The United States, Germany and Japan are worldwide leaders in patenting at the European Patent Office (EPO) and at the United States Patent and Trademark Office (USPTO).
- The ratio of business enterprise R&D to EPO patent applications in the business sector tells us that EU patent applications require less research funds than American or Japanese applications.
- Analysis of the results of the Patent Scorecard 2006 reveals that, in spite of American leadership in US patenting activity, Europe plays a significant role in US patenting in industrial sectors such as pharmaceuticals (47%), telecommunications (39%), energy and environmental (38%), chemicals (29%), and automotive and transportation (27%).

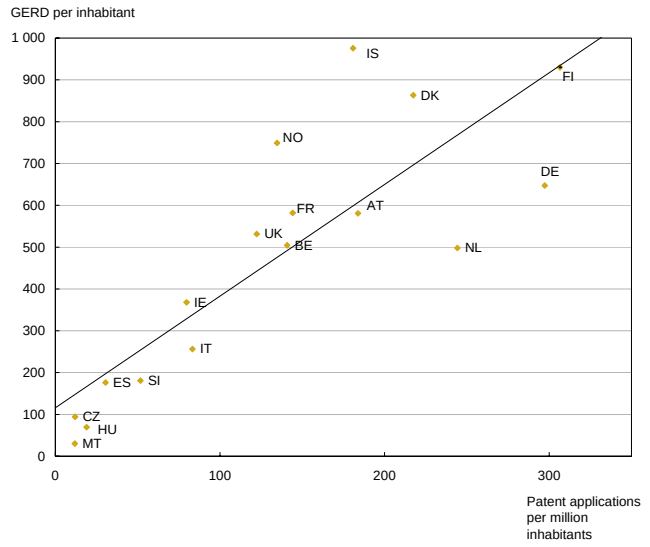
Patent statistics provide important indicators for measuring R&D output. Long time series are available and data allow cross-country comparison. This publication looks more closely at the role of patent applications and patents granted as an output of R&D expenditure. The link between R&D expenditure and patents is not straightforward. R&D expenditure is allocated in three areas: basic research, applied research, and development. Basic research, in particular, generally does not lead directly to inventions and patents. Inventions can also be protected by licences, trademarks or copyrights.

There is also a time lag between funds being spent and an invention being ready for a patent application. Patent procedures take several years and some patents are not granted, because they do not fulfil the criteria. This also depends on the national research structures and on the underlying economic activities.

Figure 1 shows all patent applications from the EU-25 to the EPO in 2002 broken down by institutional sector. The breakdown distinguishes four sectors: BES – business enterprise sector, GOV – government sector, HES – higher education sector, and OTH – other. The business enterprise sector accounts for by far the most patenting activity in the EU-25 with 82.4%. The government sector comes second with 13.8%. Other sectors produce very few EPO patent applications.

R&D expenditure and EPO patent applications are correlated

Figure 2: Patent applications to the EPO per million inhabitants and R&D expenditure per inhabitant, in 2002



Only countries with more than 10 patent applications per million inhabitants. Data for EL, LU and SE are not available.

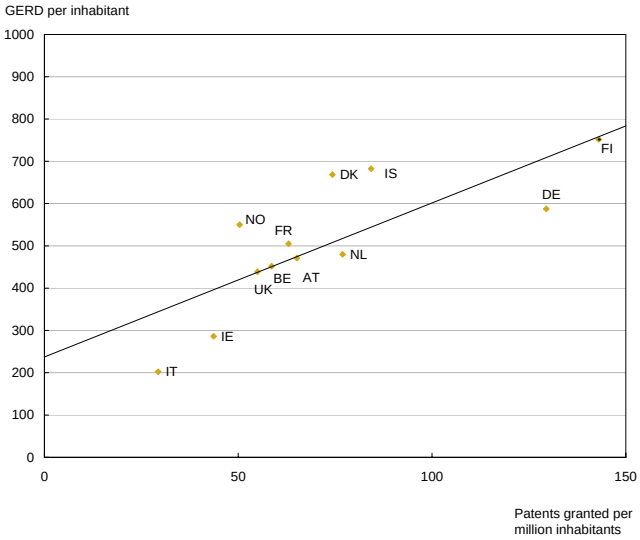
Source: Eurostat, R&D statistics and patent statistics

Figures 2 and 3 correlate patent applications/patents granted with R&D expenditure.

Figure 2 shows patent applications to the EPO per million inhabitants and R&D expenditure per inhabitant in 2002. The trend line indicates a positive correlation between the two indicators. The higher the R&D expenditure, the higher the number of patent applications produced by a country tends to be. EU Member States such as Malta, the Czech Republic and Hungary that spent less than EUR 100 per inhabitant on R&D produced less than 20 patent applications per million inhabitants in 2002. The R&D expenditure of Denmark, Finland and Iceland stood at more than EUR 800 per inhabitant and the number of patent applications per million inhabitants was 181 for Iceland, 217 for Denmark and 307 for Finland. As Figure 2 reveals, Iceland spent more on R&D per inhabitant than Finland, but produced fewer patent applications.

Belgium and the Netherlands provide another interesting comparison. With around EUR 500 R&D expenditure per inhabitant, both countries allocate the same amounts to R&D, but the number of patent applications per million inhabitants is 141 and 244 for Belgium and the Netherlands respectively.

Figure 3: Patents granted by the USPTO per million inhabitants and R&D expenditure per inhabitant, in 1999

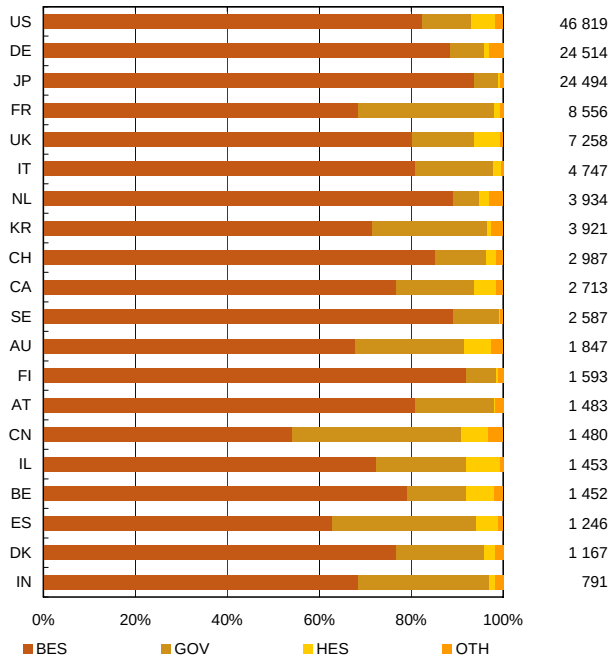


Only countries with more than 10 patents granted per million inhabitants. Data for EL, LU and SE are not available.

Source: Eurostat, R&D statistics and patent statistics

Figure 3 shows patents granted by the United States Patent and Trademark Office (USPTO) per million inhabitants and R&D expenditure per inhabitant in 1999. As the trend line shows, the two indicators are also correlated. The United Kingdom, Belgium, Austria and Finland are on this trend line. Countries below the trend line, such as Italy, Ireland, the Netherlands and Germany, produced more patents in relation to GERD spent. Countries above the trend line, such as Norway, France, Denmark and Iceland, produced fewer patents than expected from their R&D expenditure.

Figure 4: Patent applications to the EPO by institutional sector for the 20 leading countries worldwide and total number, 2002



Source: Eurostat, patent statistics

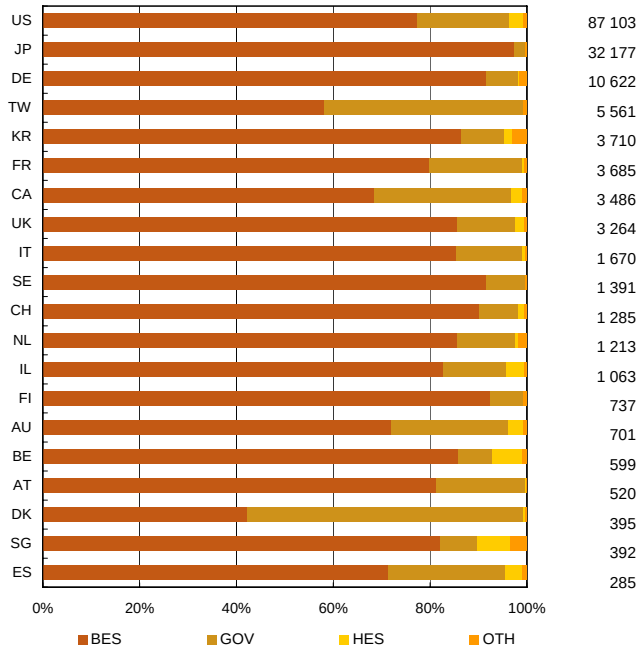
Figure 4 shows the 20 leading countries worldwide in number of patent applications to the EPO in 2002. The United States leads by far with 46 819 patent applications, followed by Germany and Japan with 24 514 and 24 494 patent applications respectively. While the second and third-placed countries are almost level, the numbers fall sharply thereafter. Eleven of the 20 worldwide leaders are EU-25 Member States. Along with Japan, there are three other Asian countries among the 20 best performing countries: South Korea (8), China (15) and India (20).

The business enterprise sector is the most active in EPO patenting. This general statement conceals some national differences. China is the only country among the 20 countries shown in which the business enterprise sector accounts for less than 55%, whereas in many other countries the BES accounts for 70% or more. For EU Member States the BES share ranges from 63% in Spain to 92% in Finland, compared with 82% in the United States.

The government sector is always the second-largest sector in EPO patenting. China has the highest percentage with more than 36% of Chinese patent applications coming from the government sector. This sector is also strong (around 30%) in Spain and France compared with the EU-25 average of 13.8%. The government share of American patent applications is 10.8%.

The patent output of the other institutional sectors is in general rather small. One exception is the higher education sector in Israel, which is involved in more than 7% of all patent applications from that country.

Figure 5: Patents granted by the USPTO by institutional sector for the 20 countries leading worldwide and total number, 1999



Source: Eurostat, patent statistics

The results for patents granted by the USPTO for the 20 leading countries worldwide in 1999 are quite similar.

Roughly, the same countries are worldwide leaders, but the ranking is not the same. For patents granted by the USPTO, the United States is the absolute leader followed by Japan and Germany. The total numbers fall rapidly with the ranking. While 87 103 USPTO patents granted are American, only 32 177 are Japanese and 10 622 are German. Among the 20 leading countries, there are the same eleven EU Member States, but the four Asian countries are: Japan (2), Taiwan (4), South Korea (5) and Singapore (19).

Most USPTO patents are also granted to enterprises. There is one exception: Denmark. 57% of Danish patents granted by the USPTO go to the government sector.

In Singapore, close to 7% of successful applications to the USPTO come from applicants in the higher education sector such as universities. In other countries, this sector often produces few patents (between 1% and 2% of all USPTO patents granted).

Table 6: Total number of patent applications to the EPO as ratio per billion BERD, HERD and GOVERD in 2002 and total number of patents granted by the USPTO as ratio per billion BERD, HERD and GOVERD in 1999, EU-25 Member States, candidate countries, JP, RU, US

		EPO - 2002				USPTO - 1999			
		Total number	number of patent applications in BES as ratio of billion BERD	number of patent applications in GOV as ratio of billion GOVERD	number of patent applications in HES as ratio of billion HERD	Total number	number of patents in BES as ratio of billion BERD	number of patents in GOV as ratio of billion GOVERD	number of patents in HES as ratio of billion HERD
EU-25	EU-25	59 756	410 s	342 s	28 s	24 733	211 s	128 s	6 s
EU-15	EU-15	59 074	412 s	346 s	29 s	24 602	213 s	131 s	6 s
Belgium	BE	1 452	314	495	83	599	155	147	39
Czech Republic	CZ	122	125	203	13	29	54	42	8
Denmark	DK	1 167	280	657 r	26	395	77	437	2
Germany	DE	24 514	587	251	26	10 622	290	104	4
Estonia	EE	10	199	556	0	3	171	149	0
Greece	EL	109	:	:	:	10	32	15	0
Spain	ES	1 246	199	353	29	285	78	82	7
France	FR	8 556	268	444	16	3 685	158	131	4
Ireland	IE	311	232 r	493	58	163	172	395	14
Italy	IT	4 747	545	315	15	1 670	251	102	3
Cyprus	CY	5	607	60	33	2	231	94	0
Latvia	LV	13	112	1 237	20	1	0	121	0
Lithuania	LT	10	99	240	0	1	579	0	0
Luxembourg	LU	69	:	232	:	36	:	:	:
Hungary	HU	193	351	439	11	52	263	178	20
Malta	MT	5	1 305	255	47	3	:	:	:
Netherlands	NL	3 934	773	199	38	1 213	243	116 i	5
Austria	AT	1 483	383	965	2	520	:	:	:
Poland	PL	179	277	191	12	21	26	17	2
Portugal	PT	49	101 e	63 e	4 e	12	36	22	2
Slovenia	SI	103	333	277	33	12	54	43	7
Slovakia	SK	41	256	421	13	6	33	89	6
Finland	FI	1 593	434	210	7	738	258	106	2
Sweden	SE	2 587	:	:	:	1 391	197	381	1
United Kingdom	UK	7 258	279	350	59	3 264	163	143	12
Iceland	IS	52	268 f	128 f	4 f	23	219	62	0
Norway	NO	610	251	214	1	224	135	101	0
Switzerland	CH	2 987	:	3 479	36	1 286	:	:	:
Bulgaria	BG	36	924	362	108	9	294	94	0
Croatia	HR	87	267	864	0	7	:	:	:
Romania	RO	30	59	497	30	5	36	60	35
Turkey	TR	118	189	535	1	10	11	55	2
Japan	JP	24 494	234	98	7	32 178	358	56	4
Russia	RU	591	56	341	36	210	106	141	62
United States	US	46 819	187 pi	195 pi	54 pi	87 116	393 i	969 i	76 i

Source: Eurostat, patent statistics

Table 6 shows output/input ratios by institutional sector (business enterprise sector, government sector and higher education sector) for EPO and USPTO data.

Taking the EU-25, enterprises applied in 2002 for 410 EPO patents per billion BERD input. In comparison, the United States produced only 187 patent applications per billion BERD. With 234 patent applications per billion BERD, the result for Japan was better than for the United States, but below the EU average. Germany, Italy, the Netherlands and Finland achieved higher results than the EU average with respectively 587, 545, 773 and 434 EPO patent applications per billion BERD. For France and the United Kingdom, the output/input ratio was lower than the EU average with 268 and 279 EPO patent applications per billion BERD respectively.

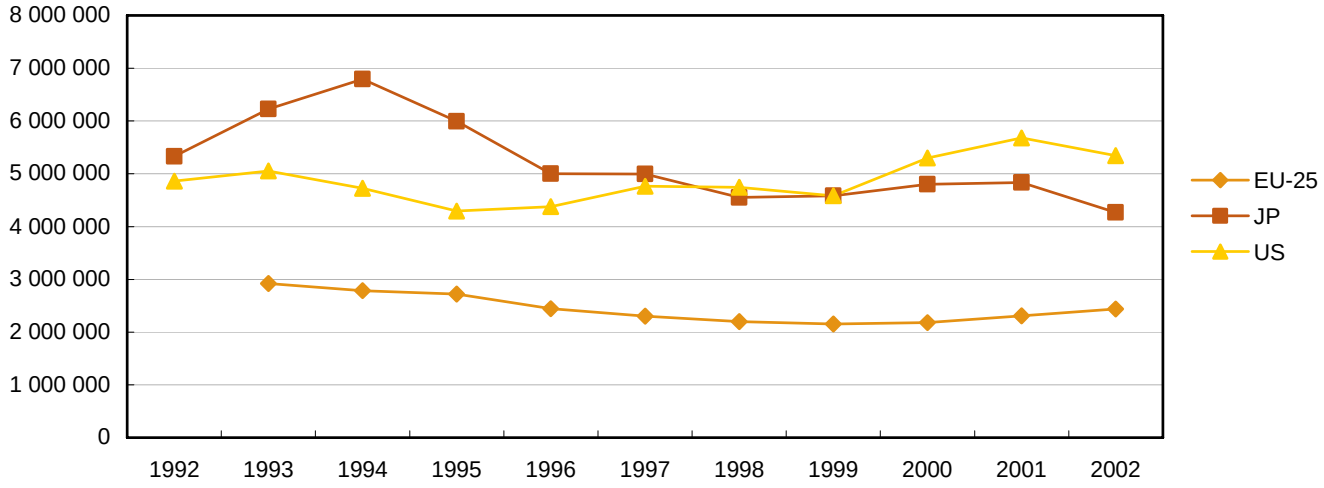
For the EU, the results are quite similar for patents granted by the USPTO. The countries mentioned above with higher results also exceed the EU average of 211 patents granted per billion BERD input. Those that failed to reach the EU average for the EPO also failed to reach the EU average for the USPTO. By contrast, the United States does better than the EU average with 393 patents granted per billion BERD. Japan, with 358 patents granted per billion BERD, also beat the EU average, but did not match the US.

This analysis should take into account the "home advantage" for R&D funds for the European Union and the United States. Countries always spend the largest share of their R&D funds in their home country, with consequently more patenting at the EPO or at the USPTO.

The output/input ratios for countries with very low patenting activity (less than 10 patents per institutional sector) could not be interpreted as strictly.

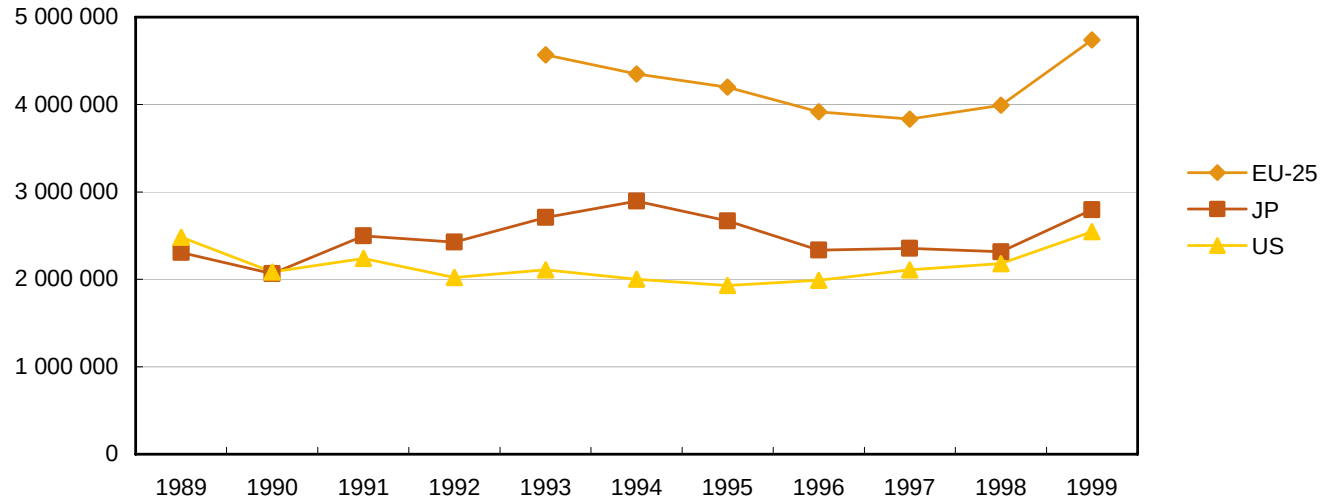
EU patent applications to the EPO are less expensive than US ones

Figure 7: Average R&D expenditure for a patent application to the EPO in BES, 1992-2002, EU-25, US, and JP, in euro



Source: Eurostat, patent statistics

Figure 8: Average R&D expenditure for a patent granted by the USPTO in BES, 1989-1999, EU-25, US, and JP, in euro



Source: Eurostat, patent statistics

Figures 7 and 8 illustrate the average R&D expenditure per patent application/patent granted in the business sector over time for the EU-25, Japan and the United States. Whereas Figure 7 is based on EPO data for the years 1992 to 2002, Figure 8 uses USPTO data for the period 1989 to 1999.

An EU patent application to the EPO in 2002 costs on average EUR 2.4 million in terms of R&D expenditure. The amount seems high, but not all funds spent on R&D are used exclusively and directly for patenting activities at the EPO or USPTO. Also, no distinction can be made between funds used for EPO or USPTO patenting. The patents themselves are very different depending on the industrial sector. Some patents need very little research while others require the work of a group of researchers over many years.

The average US patent application to the EPO in 2002 costs EUR 5.3 million in terms of R&D

expenditure whereas Japan spent an average of EUR 4.3 million on each patent application to the EPO. In 1994, Japan spent in terms of R&D expenditure close to EUR 7 million per patent application but after that the amount fell steadily. Since 1999, Japanese EPO patent applications have been less expensive than those of the US, but they are still more expensive than EU applications. The European curve fell from EUR 3 million in 1989 to nearly EUR 2 million in 1999 and finished up in 2002 close to EUR 2.5 million.

Looking at Figure 8, EU patents granted by the USPTO are much more expensive in relation to BERD than patents granted by the USPTO for Japan and the United States. Whereas an EU patent needed an average R&D investment of EUR 4.7 million, only EUR 2.8 million and EUR 2.5 million were required respectively for a Japanese or an American patent.

While the average expenditure for patents granted by the USPTO from the United States and Japan stood at between EUR 2 and 3 million per patent during the whole period, EU patents were consistently costlier, at between EUR 4 and 5 million.

USPTO requesting more timely and useful information from patent applicants

Proposal would improve patent quality and may bring quicker decisions

[Extract] As part of its ongoing efforts to promote investment in innovation and spur economic growth, the Department of Commerce's U.S. Patent and Trademark Office (USPTO) today announced a new proposal that would streamline and improve the patent application review process. The new proposal would encourage patent applicants to provide the USPTO the most relevant information related to their inventions in the early stages of the review process…

Source: USPTO, press release 6th July 2006

The Patent Scorecard 2006

An American company called Intellectual Property Intelligence Quotient (ipIQ) specialising in patent research, publishes an annual "Patent Scorecard". The 2006 edition of the Patent Scorecard is broken down by company, including all US patents held by each company across multiple industry sectors. The companies chosen are the world's 2 500 largest technology firms.

Table 9: US patenting activity broken down by industrial sector and world region, as a percentage of 2 500 of the world's top technology firms, 2005

	Industrial sector	North America	Asia	Europe
1	Aerospace and defence	81%	2%	17%
2	Automotive and transportation	29%	44%	27%
3	Biotechnology	90%	-	10%
4	Chemicals	34%	37%	29%
5	Consumer electronics	9%	87%	7%
6	Consumer products	56%	36%	8%
7	Electronics and instruments	53%	42%	5%
8	Energy and environmental	51%	11%	38%
9	Food, beverage, and tobacco	46%	25%	29%
10	Industrial equipment and materials	50%	32%	18%
11	Information technology	42%	57%	-
12	Medical devices	76%	15%	9%
13	Pharmaceuticals	47%	6%	47%
14	Semiconductors	40%	48%	12%
15	Telecommunications	55%	6%	39%

Source: Eurostat based on ipIQ, Patent Scorecard 2006

The 2 500 companies are split into 15 industrial sectors (see Table 9). As the companies' activities are sometimes very diverse, some companies may be part of several industrial sectors. The Patent Scorecard 2006 covers data to December 2005.

For each industrial sector, the same analysis is made. ipIQ comments on the overall patenting activity of the sector. Then a list shows the Top 10 companies with highest level of technology strength (see methodological notes) in the sector.

For example, in the automotive and transportation sector, the EU company Bosch ranks fourth in 2005 after Denso, Delphi Automotive Systems and Honda. Bosch was number three in 2004, before Honda.

A second listing shows several significant movers, which are companies that lost or gained several places compared with the year before. In the pharmaceuticals sector, the company Sanofi-Aventis moved up three positions from 15th to 12th.

Looking at US patenting activity at international level, American leadership is undeniable in several industries such as aerospace and defence, biotechnology, and medical devices. Japan leads in consumer electronics and, to a lesser extent, in information technology. Europe performs as well as the United States in pharmaceuticals. Europe's share of the automotive and transportation, chemicals, and telecommunications sectors is nearly as large as that of the US.

➢ Essential information – Methodological notes

1. Gross domestic expenditure on R&D

Gross domestic expenditure on R&D (GERD) is total intramural expenditure on R&D performed on the national territory during a given period. It includes R&D performed within a country and funded from abroad but excludes payments made abroad for R&D.

BERD	Business enterprise expenditure on R&D
GOVERD	Government sector expenditure on R&D
HERD	Higher education sector expenditure on R&D

Source: Eurostat, R&D statistics

2. Patent statistics

The production of patent statistics at Eurostat was reorganised in 2005. This means that the data shown in this Statistics in Focus publication and on the Eurostat webpage are no longer entirely comparable with the data published previously.

In 2005, only one single raw database – mainly compiled based on input from the European Patent Office (EPO), the US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO) – was used to produce an extended set of tables and indicators on the Eurostat webpage. This will also be done in the years to come. The aggregated patent statistics are produced on a raw data set delivered by the OECD. This raw data set will be replaced by PATSTAT for the next data productions.

Eurostat continues to produce the patent statistics (source: Eurostat/EPO) it started some years ago. However, these statistics are now produced using the priority year of the application, and not the year of filing as previously. The data values are, however, similar. These data are in general less extensive than the data released by Eurostat. This is because all PCT applications filed to the EPO (i.e. applications made in accordance with the procedure under the Patent Cooperation Treaty) are taken into consideration by Eurostat whereas the OECD datasets do so only in part. Eurostat has implemented the changes described above as only one single data source is now used (as described above) and as the data produced provide a better reflection of the innovation and R&D performance of an economy.

For all further details, please see the Eurostat metadata on patent statistics posted on the webpage.

Counting patents with multiple inventors

Where a patent lists several inventors from different countries, the respective contributions from each country are taken into account. This is done in order to eliminate multiple counting of such patents. For example, a patent that lists the inventors as 1 French, 1 American and 2 German residents will be counted as 1/4 of a patent for France, 1/4 for the USA and ½ for Germany.

Breakdown by institutional sector

It should be mentioned that the decision to classify an applicant in an institutional sector is not always straightforward. Many patent applications are made in collaboration between institutions in two or more sectors. For instance, a scientific project can be financed by the business enterprise sector but executed by a state-owned University.

Source: Eurostat, patent statistics

3. Patent Scorecard 2006

From a methodological point of view, data are not comparable to those shown in the main part of the publication. (On the one hand, data sources are different and on the other hand, the Scorecard does not give any detailed information on the methodology used for the breakdown by industry and for the geographical aggregation.)

For the industry top 10 and the significant movers, five indicators are calculated for 2005 and as a 5-year average. These indicators are technology strength, the current impact index (CII), science linkage (SL), the technology cycle time (TCT) and the patent count. The rankings are based on technology strength. Technological strength provides an overall assessment of a company's intellectual property and innovation strength. Calculations represent all US patents filed as of December 2005.

Source: IPIQ, Patent Scorecard 2006

Symbols

:	not available
e	estimated value
f	forecast
i	more information in explanatory notes
p	provisional value
s	Eurostat estimate
r	revised value

Country codes

AU	Australia
CA	Canada
CN	China
IL	Israel
IN	India
KR	South Korea
SG	Singapore

Data presented in this Statistics in Focus reflect availability in Eurostat's reference database as at June 2006.

Further information:

Data: EUROSTAT Website/Home page/Science and technology/Data

- Science and technology
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  - Survey on innovation in EU enterprises
  - High-tech industry and knowledge-intensive services
  - Patent statistics

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