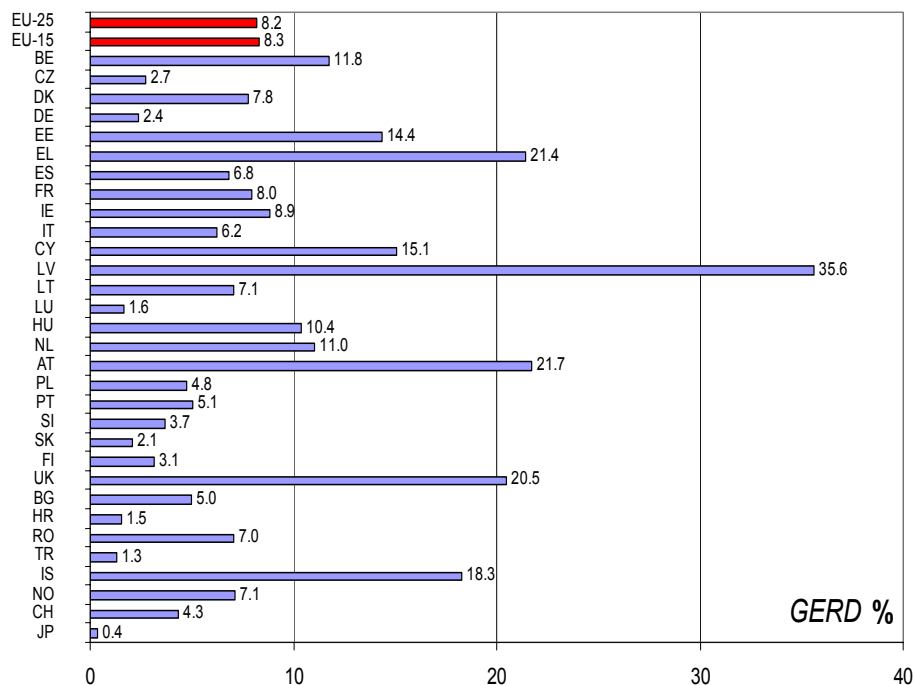


R & D and internationalisation

Figure 1: Percentage of Total expenditure (GERD) on R&D financed by abroad, 2002



IT: 1996; IE, LU, CH: 2000; BE, DK, EL, NL, PT, IS, NO: 2001
 Source: Eurostat; OECD for DK, EL, IT, LU, NL, IS, NO, CH and JP. EU-25, EU-15: OECD estimates
 MT: not available

Statistics in focus

SCIENCE AND TECHNOLOGY

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R&D Statistics

Author

SIMONA FRANK

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Main findings

- The share of foreign funding at EU-25 level in 2002 reached 8.2% for total expenditure on R&D (GERD) and 10.1% for expenditure on R&D in the Business Enterprises sector (BES). For many EU-25 Member States, the share of financing from abroad was less than 10%. This is especially true for some larger Member States such as Spain, Germany and Italy.
- For smaller Member States, the share of foreign funding in BES was generally higher for small enterprises. Furthermore, for those countries where the proportion is generally low, there seems to be a preference for the attribution of funds from abroad to smaller enterprises.
- Foreign ownership of domestic inventions is high in the new Member States. This is also the case for Luxembourg, Bulgaria and the Russian Federation.
- Domestic ownership of inventions made abroad is mainly high in small open countries, such as Luxembourg (82.2%), Malta (71.4%) and Cyprus (62.5%). In Switzerland, this proportion amounted to 50.0%.
- The United Kingdom (255 233) and Germany (240 619) have the most foreign students participants in tertiary education. This is almost five times the number registered for Spain and six times the number recorded for Italy.



Foreign R&D funding of particular importance in Latvia, Austria and the United Kingdom

As shown in Figure 1, Latvia had the highest percentage of R&D financing from abroad (over 35%). Foreign R&D funding was also important in Austria, Greece and in the United Kingdom, where it reached proportions of over 20%. At the level of the EU-25, the share of foreign funding of total R&D expenditure (GERD) reached 8.2%.

With regard to R&D expenditure in the Business Enterprise sector financed from abroad (see Table 1), Latvia, Austria and the United Kingdom were the highest while the value for Greece at just over 8%, was notably lower than the proportion of GERD financed by abroad. The countries with the highest shares were 44.5% (Latvia), 30.1% (Austria), 27.2%

(United Kingdom) and 22.6% (Hungary). In these countries, the proportion of foreign investments in R&D is notably higher for the Business Enterprise sector than for total R&D expenditure. To a lesser degree, this applies also to the EU-25 total (10.1% versus 8.2% for the total) and the EU-15 total (10.2% versus 8.3%).

In 14 out of 25 EU Member States, the share of financing from abroad is less than 10% both in total R&D expenditure (GERD) and in R&D expenditure in the Business Enterprise sector. Among these countries are large Member States such as Germany, Spain and Italy.

Table 1: Percentage of Business Enterprise expenditure on R&D financed from abroad, broken down by NACE sections; 2002

	BES Total	Agriculture, hunting, forestry and fishing (NACE A-B)	Mining and quarrying (NACE C)	Manufacturing (NACE D)	Electricity, gas and water supply (NACE E)	Wholesale and commission trade (NACE G)	Transport (NACE I60 to I64)	Real estate, renting and business activities (NACE K)	Services (NACE L to Q)
EU-25	10.1	:	:	:	:	:	:	:	
EU-15	10.2	:	:	:	:	:	:	:	
BE	10.3 ^p	:	:	:	:	:	:	:	
CZ	2.3	0.7	0.0	1.3	0.0	47.6	0.0	2.6	
DK	5.2	:	:	4.7	:	8.1	:	5.7	
DE	2.4	:	:	2.6	:	:	:	1.4	
EE	9.7	:	:	1.3	:	16.4	:	21.6	
EL	8.3	:	:	:	:	:	:	:	
ES	5.9	:	2.2	4.8	2.8	2.3	1.9	9.6	
FR	10.2	21.8	7.7	11.0	1.4	:	4.2	7.2	
IE	4.5	:	:	:	:	:	:	:	
IT	6.8	:	:	6.1	3.2	10.1	23.4	11.6	
CY	14.4	:	:	0.5	100.0	:	100.0	26.1	
LV	44.5	:	:	:	:	:	:	:	
LT	7.2	:	:	:	:	:	:	:	
LU	0.9 ^e	:	:	:	:	:	:	:	
HU	22.6	0.3	0.0	16.4	6.5	87.8	1.5	4.2	
MT	8.4	:	:	0.0	0.0	:	:	0.0	
NL	14.3	:	:	:	:	:	:	:	
AT	30.1	:	:	27.5	27.6	6.2	0.6	50.4	
PL	1.4	5.4	2.5	1.5	3.0	0.0	0.3	1.3	
PT	3.6	10.1	0.0	2.4	3.8	5.7	0.1	8.4	
SI	1.8	26.5	0.0	0.8	:	1.2	:	8.9	
SK	1.2	2.1	:	0.4	:	:	:	2.5	
FI	1.0	3.7	0.0	0.5	1.4	5.8	1.3	2.5	
SE	2.9	:	:	:	:	48.1	15.7	5.0	
UK	27.2	:	:	:	:	:	:	:	
BG	1.1	0.0	0.0	0.3	:	:	:	4.1	
HR	2.6 ^p	:	:	:	:	:	:	3.1 ^p	
RO	5.0	5.3	2.8	5.4	2.5	:	0.7	1.9	
TR	1.6	3.3	0.0	1.4	1.3	:	0.0	8.3	
IS	25.3	:	:	:	:	:	:	32.1	
NO	8.4	:	:	:	:	:	:	:	
CH	5.8	:	:	:	:	:	:	:	
JP	0.5	:	0.2	0.6	:	:	:	0.1	

DK, AT: 1998 – LU, CH: 2000 – EE, EL, IE, PT, SK, SE, IS, NO: 2001

Source: Eurostat; OECD for AT, DK, EL, IT, NL, SE, IS, NO, CH, JP

EU-25, EU-15: OECD estimates

When looking at the breakdown of foreign funding of Business Enterprise sector expenditure on R&D by economic activity (NACE-classification – Table 1), three countries showed a high share in wholesale and retail trade (NACE G), Hungary (87.8%), Sweden (48.1%) and the Czech Republic (47.6%). In the sector of Manufacturing (NACE D), Austria, Hungary and France accounted for the highest proportion of foreign funding, with 27.5%, 16.4% and 11.0% respectively.

In the domain of agriculture, hunting, forestry, and fishing (NACE A-B), Slovenia and France recorded the highest share of foreign funding with 26.5% and 21.8% respectively. With the exception of Cyprus, where the totality of R&D expenditure in the Business Expenditure sector came from abroad, Italy displayed the highest proportion in the transport sector (23.4%) followed by Sweden (15.7%). Relatively high proportions of foreign R&D investments were registered in the Services' sector (NACE L to Q): besides Romania (more than 70%) and Iceland (30.1%), Austria led among the EU Member States (40.0%), followed by Portugal (21.7%) and Hungary (11.5%).

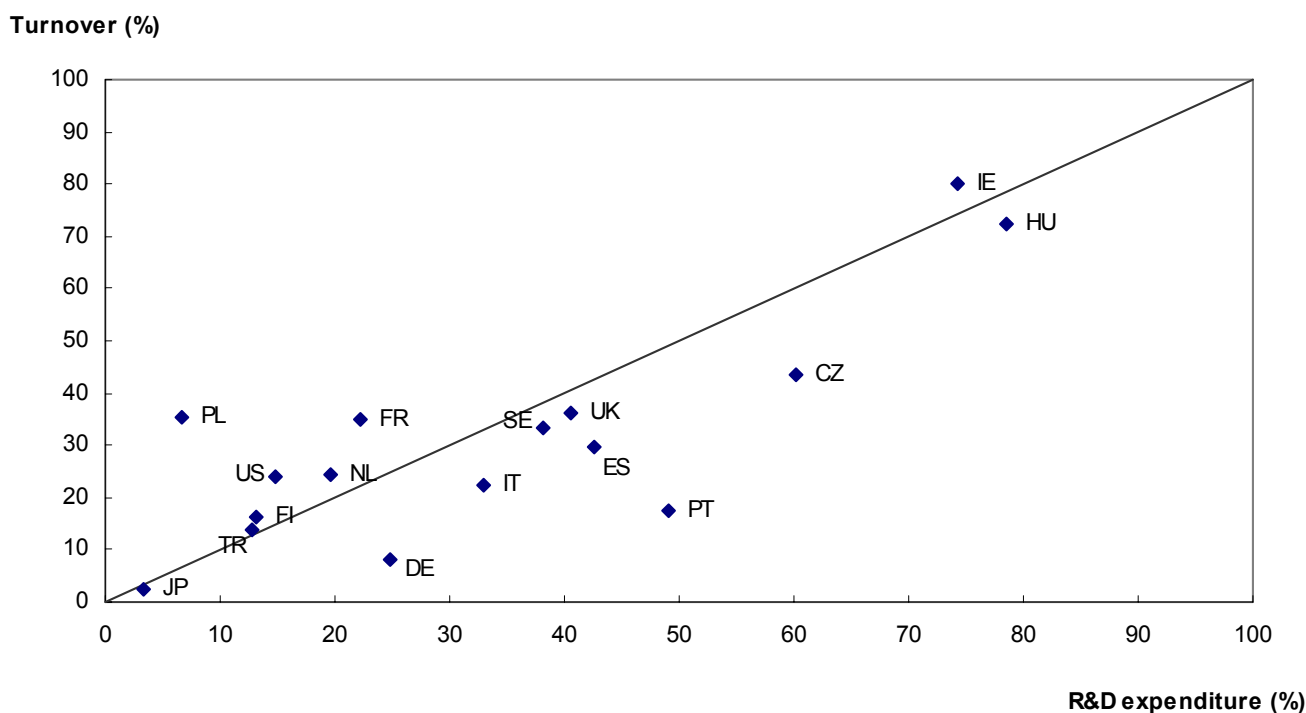
No breakdown by economic activity is available for some countries displaying highest ratios in R&D investment by abroad (LV, UK).

Figure 2 outlines the share of foreign affiliates in manufacturing R&D expenditure as well as turnover. Their share in manufacturing R&D varied widely among the countries, ranging from approximately 3% in Japan to over 70% in Ireland and Hungary. The share of R&D conducted by foreign affiliates was also high in Sweden, the United Kingdom, Spain, Portugal, and the Czech Republic (over 35%).

Concerning the share in turnover, foreign subsidiaries reached around 35% in Poland, France and the United Kingdom and more than 40% in the Czech Republic. The highest values by far were registered for Ireland and Hungary where the proportions reached approximately 80% and 70%, respectively.

In relation to their proportion of turnover, the R&D efforts of foreign affiliates were particularly high in Germany and Portugal, followed by Italy, Spain and the Czech Republic. In these countries the subsidiaries of companies abroad exceed domestic firms for their spending in R&D compared to their turnover. This ratio is more balanced for foreign actors in Turkey, Sweden, the United Kingdom, Ireland and Hungary. In Poland, the United States and France, foreign companies are less engaged in industrial R&D, in relation to their turnover, than domestic enterprises.

Figure 2: Share of foreign affiliates in manufacturing R&D expenditure and turnover (in %), in 2001



NL, SE, TR, JP, US: 2000; DE, UK: 1999; HU: 1997; IT: 1992
Source: OECD

Large enterprises show high shares of foreign R&D expenditure in Cyprus, France and Hungary

Taking a look at the relation between R&D spending financed from abroad and the size of the enterprises (Table 2), it can be noted that in the category of large enterprises (companies with 250 or more persons employed), expenditure from abroad has the highest share in Hungary (49.0%), France (29.8%) and Cyprus (29.7%). In the case of Cyprus, it appears that small enterprises (1 to 49 persons employed) reach almost the same percentage as the large ones. In the Czech Republic the share of foreign R&D funding is higher for small and medium-sized enterprises (8.0% and 7.2%) than for large enterprises (less than 1%).

Germany, as a big country, displayed rather low shares in funding from abroad of BES in relative

terms (2.4%). For Estonia (53.6%), Portugal (31.1%), Romania (25.5%), Bulgaria and Slovakia (7.8%), the share is significantly higher for small businesses.

A particular situation is recorded for Malta, where R&D investments from abroad, influenced by the size of the economy, only occurred in the medium-sized enterprise category.

For smaller countries, the ratio is rather higher for small companies, but for larger countries the tendency is the opposite. Furthermore, when the relative share of foreign funding in the total is rather small, the ratio seems generally higher for small companies. This is notably the case for Portugal, Slovakia, Bulgaria and Finland.

Table 2: Percentage of Business Enterprise expenditure on R&D financed from abroad by enterprise size-class, 2002

	Total	1-49 persons employed	50-249 persons employed	250 or more persons employed
CZ	2.3	8.0	7.2	0.8
DE	2.4	2.1	1.4	3.0
EE	9.8	53.6	0.9	5.0
ES	5.9	10.2	3.7	14.2
FR	10.2	15.2	8.4	29.8
CY	14.4	29.0	7.3	29.7
HU	22.6	22.1	1.3	49.0
MT	8.4	0.0	16.7	0.0
PT	3.6	31.1	6.4	7.1
SK	1.2	7.8	1.6	1.6
FI	1.0	5.6	1.8	1.0
BG	1.1	16.6	0.3	0.0
RO	5.0	25.5	2.3	14.3
RU	8.4	6.8	4.1	29.1

DE, PT: 2001
Source: Eurostat

The highest share of foreign students in Cyprus, Switzerland and Austria

Table 3 shows the participation of foreign students in tertiary education (according to the ISCED 97 classification).

In absolute terms, the United Kingdom leads with more than 255 000 foreign students. It is followed by Germany (240 619) and by France with 221 567 foreign students.

In relative terms, Cyprus has the highest share of foreign students in tertiary education (28.9%)

followed by Switzerland (17.7%), Austria (13.5%), Belgium and the United Kingdom (11.2% each).

It might be surprising to see that the proportions of foreign students in Italy and Spain remain fairly small. Small shares were also recorded in most new Member States like Poland, Estonia, Lithuania, Slovenia and Slovakia.

Differences can also be noticed when looking at the subjects of study. 'Science, Mathematics and Computing' seems to attract relatively many foreign students in Denmark and Sweden, as their share in the number of students studying these subject appears higher than the global average (12.8% in 'Science, Mathematics and Computing', against 9.0% of foreigners in total tertiary education for Denmark; the equivalent figures for Sweden were 10.0% versus 7.8%). In the United Kingdom the choice of foreign

students is rather 'Engineering, Manufacturing and Construction', as the share of foreigners is 21.8% in this domain, against 11.2% in total tertiary education.

Germany and the United Kingdom are the Member States that had the highest share of foreign students studying 'Science, Mathematics and Computing' (15.7% and 14.3%), whereas close to 30% of all foreign students in Finland were studying 'Engineering, Manufacturing and Construction'.

Table 3: Participation of foreign students in tertiary education according to the ISCED 97 classification, 2003

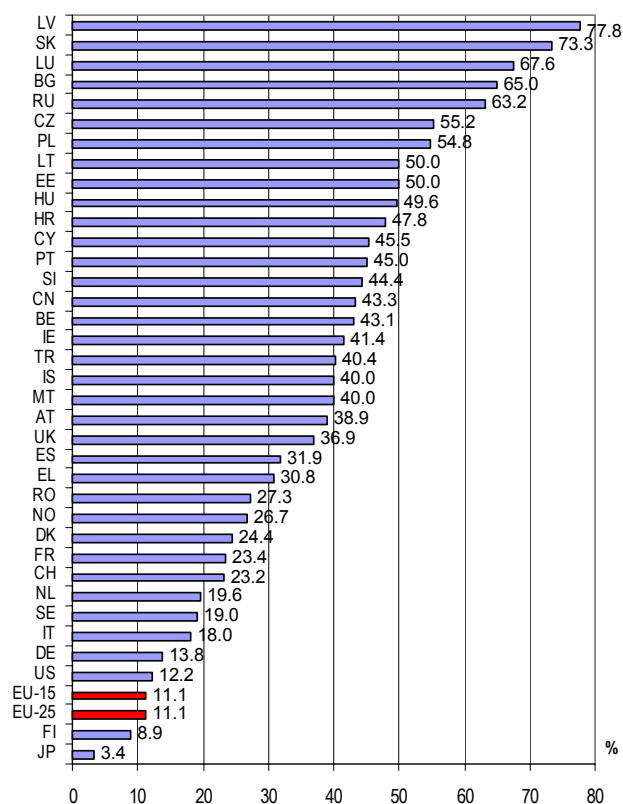
	Total		Science, Mathematics and Computing			Engineering, Manufacturing and Construction		
	Number	% of total students	Number	% of total students in this field	% of all foreign students	Number	% of total students in this field	% of all foreign students
BE	41 856	11.2	3 422	11.1	8.2	2 911	7.3	7.0
CZ	12 474	4.3	1 555	5.3	12.5	1 753	3.0	14.1
DK	18 120	9.0	2 306	12.8	12.7	2 937	13.5	16.2
DE	240 619	10.7	37 783	11.5	15.7	41 318	12.1	17.2
EE	1 090	1.7	:	:	:	:	:	:
EL	12 456	:	:	:	:	:	:	:
ES	53 639	2.9	:	:	:	:	:	:
FR	221 567	10.5	:	:	:	:	:	:
IE	10 201	5.6	:	:	:	:	:	:
IT	36 137	1.9	2 219	1.5	6.1	4 953	1.6	13.7
CY	5 282	28.9	592	24.9	11.2	58	9.1	1.1
LV	2 390	2.0	80	1.0	3.3	51	0.4	2.1
LT	689	0.4	7	0.1	1.0	174	0.5	25.3
LU	:	:	:	:	:	:	:	:
HU	12 226	3.1	715	2.7	5.8	1 743	3.1	14.3
MT	409	4.6	13	2.8	3.2	22	3.3	5.4
NL	20 531	3.9	1 600	5.1	7.8	2 117	4.0	10.3
AT	31 101	13.5	3 488	13.1	11.2	3 957	12.7	12.7
PL	7 617	0.4	135	0.1	1.8	465	0.2	6.1
PT	15 483	3.9	:	:	:	:	:	:
SI	963	0.9	87	1.8	9.0	165	0.9	17.1
SK	1 651	1.0	81	0.6	4.9	258	0.9	15.6
FI	7 361	2.5	745	2.2	10.1	2 146	2.8	29.2
SE	32 469	7.8	4 201	10.0	12.9	6 166	8.6	19.0
UK	255 233	11.2	36 538	11.9	14.3	38 667	21.8	15.1
BG	8 025	3.5	172	1.5	2.1	1 053	2.1	13.1
HR	671	0.6	:	:	:	:	:	:
RO	9 730	1.5	154	0.5	1.6	769	0.6	7.9
TR	15 719	1.3	1 269	0.9	8.1	2 227	0.9	14.2
IS	580	4.3	69	4.8	11.9	30	3.4	5.2
NO	11 060	5.2	2 107	8.7	19.1	740	5.5	6.7
CH	32 847	17.7	4 683	21.8	14.3	5 030	19.8	15.3
JP	86 505	2.2	1 458	1.2	1.7	11 889	1.7	13.7
US	586 316	3.5	114 370	:	19.5	102 853	:	17.5

Source: Eurostat

Should students study both science and engineering in Austria, some double counting may exist.

Patent applications: foreign inventions most likely from another EU Member State

Figure 3: Share of patent applications to the European Patent Office (EPO) owned by foreign residents, in total patents invented domestically, 2002



Source: OECD

According to patent applications made to the European Patent Office (see Figure 3), foreign ownership of domestic inventions in 2002 is 65% or higher in Latvia (77.8%), Slovakia (73.3%), Luxembourg (67.6%) and Bulgaria (65.0%). In Russian Federation, this proportion amounted to 63.2%. For other large countries, fairly high shares (around 40%) were recorded in Canada, Turkey and the United Kingdom. In the latter country, a large share of inventions is owned by US companies and is mainly related to the inventive activity of their foreign affiliates.

A global view of Figure 3 reflects that the new Member States are the countries where the largest part of ownership of domestic inventions is foreign. But this is also the case for Luxembourg and Russian Federation.

With regard to the low value at EU-25 level (11.1%), it can be concluded that for a given Member State, even if most of the ownership of inventions was foreign, the majority originates from other EU Member States.

At the lower end, it appears that only 12.2% of the inventions in the United States were accounted for by

foreign residents, just behind Germany (13.8%) and Italy (18.0%).

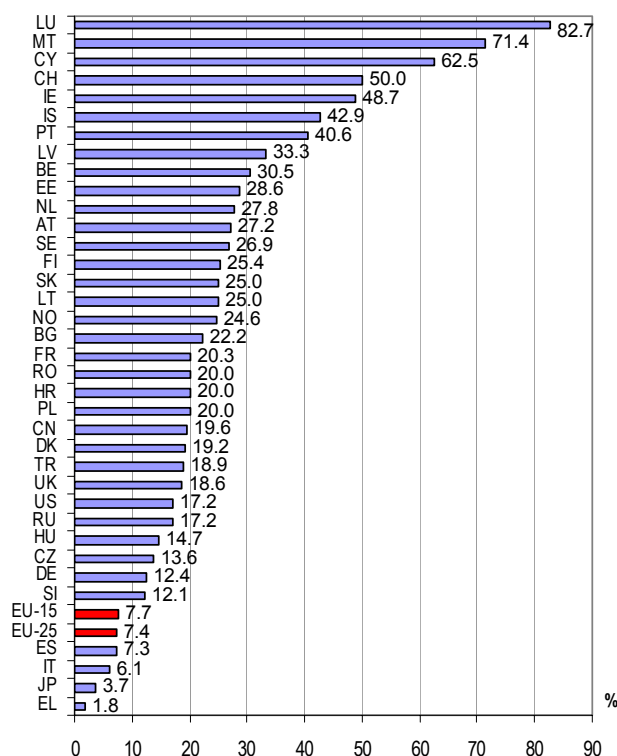
A particular situation occurs in Japan which, despite its size, is much less internationalised in terms of cross-border ownership of inventions. The respective share amounted to only 3.4% in 2002.

Roughly the same share was found for domestic ownership of inventions made abroad (see Figure 4). Proportions appeared notably high in small countries (but not specifically in the new Member States as before): for example, more than 80% of all inventions owned by residents of Luxembourg were made abroad. Malta and Cyprus followed with shares of 71.4% and 62.5% respectively. Four other countries displayed shares between 40 and 50%.

Although the United States, due to its size, is one of the largest owners of patents covering foreign inventions, the share of foreign inventions in its patent portfolio is only 17.2%.

Again, looking at the low value for the EU-25 aggregate (7.4%), the principle applies that even if an invention is made abroad for a given Member State, it is most likely that this happened in another EU country.

Figure 4: Share of patent applications to the European Patent Office (EPO) for inventions made abroad, in total patents owned by domestic residents, 2002



Source: OECD

➤ ESSENTIAL INFORMATION – METHODOLOGICAL NOTES

This SIF shows that measurement of internationalisation is already possible and feasible on the basis of existing data sources.

1. R&D expenditure

R&D data are compiled in accordance with the guidelines laid down in the Proposed standard practice for surveys of research and experimental development — *Frascati Manual*, OECD, 2002.

R&D expenditure is broken down by the following sectors of performance: business enterprise (BES), government (GOV), higher education (HES) and private non-profit (PNP). It is further broken down into five sources of funds: BES, GOV, HES, PNP and abroad.

Sources: Eurostat, R&D statistics

Data for Japan and the United States are taken from the OECD — *Main Science and Technology Indicators (MSTI)*.

2. R&D expenditure in foreign affiliates (FATS)

Another approach to measuring the internationalisation of R&D is related to the statistics on the structure and activity of foreign affiliates (FATS).

An EU regulation is in the pipeline. On the basis of this draft Regulation, data will be collected from the reference year 2005 onwards.

OECD already collects data on R&D in foreign affiliates and, for example, the correlation of turnover and R&D expenditure related to foreign affiliates is an important indicator of internationalisation.

Sources:

OECD – Activities of Foreign Affiliates (AFA/FATS)

3. Education

The main source of data is the joint UIS (UNESCO Institute of Statistics)/OECD/Eurostat (UOE) questionnaires on education statistics, which constitute the core database on education. Data on regional enrolments and foreign language learning are collected additionally by Eurostat. Countries provide data, coming from administrative records, on the basis of commonly agreed definitions.

The methodological requirements are set up in cooperation with the participating countries. The definitions and methodological requirements are available on the site address:

http://forum.europa.eu.int/Public/irc/dsis/edtcslibrary?l=/public/unesco_collection

The International Standard Classification of Education (ISCED) is the basis for international education statistics. The full description of ISCED-97 levels is available on the site address:

http://forum.europa.eu.int/Public/irc/dsis/edtcslibrary?l=/public/measuring_lifelong/classifications/isced97_levels

and the full description of ISCED-97 fields of education and training on the site address:

http://forum.europa.eu.int/Public/irc/dsis/edtcslibrary?l=/public/measuring_lifelong/classifications/isced97_fields

Foreign students are measured according to their citizenship. Overestimation of foreign students may therefore exist in countries where permanently resident second generation migrants with foreign nationalities constitute an important group of students. The indicators presented in this Statistics in Focus concern foreign students of whom a sub-set can be considered to be internationally mobile students.

4. Patent applications to the EPO (European Patent Office)

Patent applications are counted according to specific criteria designed to measure innovative potential and therefore are not comparable with other data sources that use different methods to build up the indicators.

Data on patent applications refer to priority date; it corresponds to the first filing and therefore it is the closest to the invention date.

An increasing share of EPO patent applications is controlled by applicants whose country of residence is different from the country of residence of the inventor. Such cross-border ownership practices are mainly the result of multinational activities and two main types of indicators can be composed:

- Indicators that show to which extent the foreign firms control domestic inventions
- the indicators that provide the mirror image and it shows to which extent domestic firms control inventions made by residents of other countries.

Sources: OECD, Patent Database

SYMBOLS

- : not available
- e : estimated value
- p : provisional value

The data presented in this publication reflect the state of data availability in Eurostat's reference database and OECD database as of February 2005.

Further information:

Databases

[EUROSTAT Website/Science and technology/Research and development/Statistics on research and development](#)

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This publication has been produced in collaboration with Mr. Detlef HERRMANN