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Science, technology and innovation in Europe

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Preface

"Transforming the European Union by 2010 into the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion". This was the strategic goal set by the European Council in Lisbon in 2000, later known as the 'Lisbon Strategy'. Two years later, at a Council meeting in Barcelona, a further aim was added to spend at least 3% of GDP on research by 2010, of which two thirds should be financed by the Business sector.

In March 2005, the Lisbon Strategy was re-launched with the initiative 'Working together for growth and jobs', one of whose central messages is that "knowledge and innovation are the beating heart of European growth". More recently, at a Council meeting in Brussels in March 2006, it was recognised that Europe should invest more in knowledge and growth.

In this context, relevant and meaningful indicators on Science, Technology and Innovation are paramount in informing policy-makers as to where Europe stands in moving towards more knowledge and growth. This information is also necessary to better gauge how Europe is evolving, compared with the United States, Japan, China and other main economies.

The statistics and indicators presented in this 2006 edition of "Science and Technology in Europe" map Europe's recent performance on R&D, innovation, high-tech industries and knowledge-based services, patenting and human resources in science and technology.

Although the publication follows in the footsteps of previous editions in its structure and content, much effort has been made to both extend coverage and make data more up-to-date. In addition to comparisons with the United States and Japan, one novel feature is the inclusion of China and the Russian Federation, where possible. For European countries, additional regional data provide a closer focus within the national picture.

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DISCLAIMER

The opinions expressed in this publication are those of the individual authors alone and do not necessarily reflect the position of the European Commission.

Data source

Eurostat is the data source for all tables and figures in this publication unless specified otherwise.

Maps

GISCO, Eurostat.

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Overview and executive summary

This publication presents an analysis of Science and Technology in Europe by looking at the main statistical indicators in this field. The publication, intended for both generalists and specialists, comprises three main parts:

- Part 1: Investing in R&D,
- Part 2: Monitoring the knowledge workers,
- Part 3: Productivity and competitiveness,
- And also methodological notes and abbreviations and symbols.

The primary focus of the statistics and indicators in this publication is on the 25 European Union Member States and, to a lesser extent, the European Economic Area (EEA). This publication also looks at the EU candidate countries, wherever data are available and reliable. For the moment no data for the FYROM are available. To provide high-level international comparison, data for China, Japan, the United States and Russian Federation are also presented, where possible. There is also a regional analysis of the situation within the EU Member States. The data reflect the information available at Eurostat on 1st January 2006.

Given the numerous data sources involved, the coverage of the time series differs from one indicator to another. However, the first year taken into consideration for most indicators in this publication is 1994 (except for patents). As far as possible, this publication sets out to provide detailed and coherent time series.

Consistency with the reporting presented in previous publications is also maintained, complemented by further information in response to user requirements. All data presented in this Panorama are available on Eurostat's reference database NewCronos, with the exception of material in chapters 5 and 8.

Government Budget Appropriations or Outlays on R&D - GBAORD

Chapter 1 shows that budget appropriations for R&D in the United States amounted to approximately 90 billion 1995 constant PPS in 2004. In the European Union, the equivalent figure was just in excess of 60 billion 1995 constant PPS, whereas it did not quite reach the 20 billion mark in Japan.

As a percentage of GDP, GBAORD in EU-25, Japan and the United States amounted to 0.76%, 0.71% and 1.08%, respectively. During the period 1994 to 1999, GBAORD in the United States and in EU-15 expressed in relative terms (as a percentage of GDP) declined, compared with an increase in the same period in Japan. Between 1999 and 2004, trends were quite different. GBAORD in EU-15 expressed as a percentage of GDP was stable, whereas it increased slightly in Japan and even more so in the United States.

Within EU-25 in 2004, Finland (1.03%) and France (1.01%) had the highest proportions of government budgeting spent on R&D activities as a proportion of their respective GDPs. At the other end of the scale, Greece, Cyprus, Lithuania, Luxembourg, Latvia, Romania and Malta showed GBAORD ratios no higher than 0.3% of GDP.

Looking at the distribution of GBAORD by socio-economic objective, "Research financed from General University Funds (GUF)" accounted for the lion's share of EU-15's GBAORD, accounting for 31.6% of the total. In Japan, the main socio-economic objective was also "Research financed from GUF", with an even higher proportion (33.5%). However, in the United States over half of total GBAORD in 2004 was allocated to "Defence" (55.8%). Among Member States, the distribution by socio-economic objective varies: "Research financed from GUF" represented, in 2004, the largest share of total GBAORD in twelve EU-25 Member States for which such data are available. The objective "Defence" was the leading socio-economic objective only in the United Kingdom (31.9%) and in France (24.4%). Belgium (33.3%), Ireland (27.1%), Finland (25.9%) and Spain (23.4%) allocated a large part of their total government R&D budget to "Industrial production and technology".

At the EU-15 level, budgets increased between 1999 and 2004 for all socio-economic objectives except for "Production and rational utilization of energy" and "Agricultural production and technology". "Industrial production and technology" (6.6%) and "Protection and improvement of human health" (4.7%) had the highest rates of increase.

R&D expenditure

Chapter 2 gives the most recent trends in R&D expenditure. In 2004, R&D expenditure as a share of GDP in the EU-25 decreased slightly to 1.90%. The gap with regard to R&D expenditure in Japan (3.15% in 2003) is widening as R&D expenditure as a share of GDP in Japan is growing. However, the gap with the United States (2.59%) is closing as R&D expenditure as a share of GDP in the United States is falling.

Looking at the estimates by institutional sector, most of R&D expenditure is carried out in the business enterprise sector (BES). The BES accounted in 2003 for 64% of R&D expenditure in EU-25, which is below the percentages in the United States (69%) and Japan (75%).

In 2004, the leading EU-25 Member States in terms of R&D intensity were Sweden and Finland, with 3.74% and 3.51% of GDP devoted to R&D expenditure, respectively. Other EU-25 countries with R&D intensity rates above the EU average of 1.90% are Denmark (2.61%), Germany (2.49%), Austria (2.26%), France (2.16%) and Belgium (1.93%). R&D intensity in the new Member States is on average below the EU-25 figure. Although the Czech Republic and Slovenia achieved rates of above 1.20%, all the other new Member States were below the 1% mark in 2004.

In 2004, the EU-25 spent EUR 195 billion on R&D, recording an annual growth rate of 3.4% compared to 2003. Most R&D in the EU-25 is carried out in Germany (EUR 55.1 billion), France (EUR 35.6 billion) and the United Kingdom (EUR 30.6 billion). These three countries accounted for almost 2/3 of total R&D expenditure in EU-25. The highest annual average growth rates (AAGR) achieved from 1999 to 2004 were in new Member States: Lithuania (21.5%), Hungary (18.5%), Estonia (17.7%) and Cyprus (16.2%). The Russian Federation (24.7%) and China (20.9%) also achieved very high AAGR.

The top 15 R&D regions in EU-25 in terms of R&D expenditure as a percentage of GDP (R&D intensity), were mainly located in Germany (seven regions out of 15 were German). In 2002 the German region Braunschweig came first with 7.11%, which is more than three times the EU-25 average. Stuttgart (DE) and Oberbayern (DE) followed with 4.86% and 4.65% respectively.

In terms of absolute R&D expenditure the region Île de France was well ahead, with 7.9% of the R&D expenditure in EU-25, but as a ratio of GDP the region ranked only thirteenth.

R&D personnel

As documented in Chapter 3, 1.46% of total employment in EU-25 was in R&D in 2004, the head count (HC) being 2.82 million people. When measured in full-time equivalent (FTE), EU-25 R&D personnel amounted to more than 2 million, which represents an increase of 1.3% compared to the previous year.

At national level, Iceland led with 3.48% of total employment in R&D in 2003, ahead of Finland (3.11%), Sweden (2.49%), Denmark (2.29%) and Norway (2.26%).

In 2004, 53.4% of R&D personnel in EU-25 were employed in the business enterprise sector - BES, 31.1% in the higher education sector - HES and 14.3% in the government sector - GOV.

In 2003, Germany and France employed almost half of the EU-25 R&D personnel measured in full-time equivalent, as their R&D personnel amounted to 473 000 and 346 000 persons respectively. Germany and France were ahead in all institutional sectors, often followed in third and fourth position by Spain and Italy.

In 2004, over 1.2 million researchers, measured in FTE, were employed in EU-25, an increase of 57 800 since 2002. The majority of EU-25 Member States (except for Latvia and Hungary) saw their number of researchers increase between 2002 and 2004. Most European researchers work in Germany (269 000), France (193 000) and Spain (101 000).

Female researchers were under-represented in the EU-25 compared to male, especially in the business enterprise sector. In 2003, they accounted for 28.3% of total researchers and for only 19.6% of researchers in the BES. The percentage of female researchers was in general higher in the new Member States and candidate countries.

In 2003, in EU-25, 573 000 R&D researchers measured in FTE were employed in the BES. The largest share of these business R&D researchers were working in the manufacturing sector (413 000). "Natural sciences" accounted for the highest proportion of researchers in the higher education and the government sectors.

In 2003, close to one quarter of R&D personnel in full-time equivalent were concentrated in the ten leading regions. Accounting for 6.7% of the total, Île de France (FR) was the leading region in terms of R&D personnel in FTE. The leading region in terms of the proportion of R&D personnel in total employment in 2003 was Wien (AT) with 4.1%. Nevertheless, with five regions among the top 15, German regions are well ranked.

Human Resources in Science and Technology - HRST

Chapter 4, which is concerned with Human Resources in Science and Technology, shows that the overall number of students taking tertiary education courses is growing in Europe, at an annual average rate between 1998 and 2003 of 5% for male students, and of up to 6% for female students. In 2003, over 14 million people in the EU were following tertiary education courses, of whom more than 350 000 were PhD students. One student in four, in 2003, was following a course either in "science, mathematics and computing" or in "engineering, manufacturing and construction". Though female represented more than half of all students in most countries, engineering courses, and to a lesser extent science courses, attract fewer female. Accounting for 54.7% of the EU's total tertiary education student numbers, female represented only 14.3% in engineering courses and 10.6% in science courses.

Europe's tertiary education institutions produced close on 2.5 million new graduates in 2003 in the EU. This compared with just over 1 million new graduates in Japan and over 2.3 million in the United States. Comparing these new graduates against the young population group, for every thousand people aged 20-29 in the EU there were around 48 new graduates. A higher proportion of female students graduated (compared to the female share of the student population). On average, 59.7% of all graduates were female in the EU in 2003. In comparison, the proportion of female graduates from tertiary education in Japan was 49.0% and in the United States 57.4%.

The stock of human resources in S&T (HRST) is growing over time. In order, Germany, the United Kingdom and France had the highest number of HRST in 2004 (more than 10 million in each country), which accounted for nearly half of the EU's 76 million HRST between 25 and 64 years old.
However, in terms of total employment in the same age group, the 29.5 million persons working in S&T and having a tertiary education (HRSTC) accounted for 15% of total employment. This proportion goes up to 25% when people working in S&T without tertiary level education are included (HRSTO).

In the majority of EU countries, scientists and engineers were predominantly male. The highest share of scientists and engineers (S&E) in 2004 is found in Belgium, where 7.5% of the labour force declared that they had an occupation qualifying them as SE.

Services have far more S&T workers than manufacturing. Close to half of the people working in the "other knowledge-intensive services", which include 'Education' and 'Health' and 'Social work', had completed tertiary S&T education in 2004.

In general, unemployment rates in 2004 for HRST were much lower than for non HRST. In the EU, the HRST unemployment rates reached only 3%, while the rate of unemployment for non HRST climbed to 10%.

At the regional level and ranked according to the percentage of people in the labour force who are HRST, Brabant Wallon (BE) was the leading region in the EU in 2004. More than half (67.0%) of the total labour force was either employed in S&T or had a tertiary education in S&T. The highest regional concentration of Human resources in S&T in terms of occupation (HRSTO) as a share of the labour force is found in capital regions, in regions in central Europe and in the Nordic countries.

Looking at mobility, countries with a large population had the greatest number of employed HRST aged 25-64 years who changed job during 2004. The United Kingdom registered the highest number of HRST job-to-job mobility, with 925 000 persons, followed by Germany (730 000 persons), France (571 000 persons) and Spain (447 000 persons). The 25-34 year olds are more likely than higher age groups of HRST to move from one job to another.

Innovation

Chapter 5 presents the two main European instruments for measuring and analysing innovation: the Community Innovation Survey (CIS) and the European Innovation Scoreboard (EIS). As new CIS 4 data will become available only in autumn 2006, the CIS 4 is only explained briefly. More details are given on the results of the 2005 EIS, which is partly based on CIS data. The core part of the EIS is the calculation of the Summary Innovation Index (SII), which makes it possible to divide the EU-25 Member States into four groups depending on their innovation performance:

- *Leading countries*: Switzerland, Finland, Sweden, Denmark and Germany
- *Average performance*: France, Luxembourg, Ireland, United Kingdom, Netherlands, Belgium, Austria, Norway, Italy and Iceland.
- *Catching up*: Slovenia, Hungary, Portugal, Czech Republic, Lithuania, Latvia, Greece, Cyprus and Malta.
- *Losing ground*: Estonia, Spain, Bulgaria, Poland, Slovakia, Romania and Turkey.

Patents

Total patents

Patents statistics are widely used to generate indicators that help to measure a country's technological output. Chapter 6 looks at patenting activity at international, national and regional level. The analysis uses European Patent Office (EPO) data. At national level the analysis takes into account United States Patent and Trademark Office (USPTO) data and at the international level also the data related to triadic patent families.

In 2002, 59 736 patent applications to the EPO came from EU Member States, 46 816 from the United States and 24 494 from Japan. 87 116 patents granted by the USPTO came from inventors residing in the United States, 32 178 from Japanese residents and 24 733 from European residents. These figures show that there is a home country advantage. Data on patent families are generally less biased, as the "home advantage" disappears to a certain extent. In 1999, 36% of triadic patents came from American investors and 29% each from European and Japanese investors.

Looking at absolute EPO patent applications Germany is far ahead, while in terms of population size Finland and Sweden were the best performing EU countries.

At regional level patenting activities are highly concentrated. Most of the EU regions among the best performing regions are German, but in absolute numbers Ile de France (FR) leads with 3 282 patent applications to the EPO. In relative numbers Noord-Brabant (NL) was on the top with 885 patent applications per million inhabitants. The French capital region ranks first in biotechnology with 145 patent applications to the EPO whereas Noord-Brabant (NL) is absolute leader in the ICT field with 1 428 patent applications.

High-tech patents

In 2002, EU-25 inventors applied for 11 052 high-tech patents to the EPO, as against American investors applying for 13 958 and Japanese for 6 255. In 1999, the USPTO granted 3 820 high-tech patents to European inventors, 8 013 to Japanese inventors and 23 224 to Americans.

In terms of absolute EPO applications Germany is again well ahead, but in terms of population size Finland and Sweden are the best performing countries in high-tech patenting.

At regional level, Oberbayern (DE), Noord-Brabant (NL) and Île de France (FR) lead in high-tech patenting. High technology is divided in six groups: Aviation (AVI), Computer and automated business equipment (CAB), Communication technology (CTE), Lasers (LSR), Micro-organism and genetic engineering (MGE), Semi-conductors (SMC). In many countries 'Computer and automated business equipment (CAB)' and 'Communication technology (CTE)' are the groups where most patenting takes place.

High-tech industries and knowledge based services

Chapter 7 analyses Europe's performance in high technology and knowledge-intensive services by looking at statistics on enterprises (value added, labour productivity, etc.), venture capital investments, high-tech trade, employment and R&D personnel and expenditure.

Enterprises in high-tech industries and knowledge-intensive services

In high-tech manufacturing, labour productivity amounted to EUR 63 000 persons employed for EU-25, well above the figure for total manufacturing (EUR 45 000). This structural difference held true for most EU-25 Member States.

In 2002, an EU-25 enterprise in manufacturing generated a production value of EUR 2.5 million, whereas an enterprise in high-tech manufacturing achieved a value of EUR 4.4 million.

An EU-25 enterprise invested on average EUR 108 000 in tangible goods. Again, the gross investment in tangible goods per enterprise was higher in high-tech manufacturing than in total manufacturing. In a number of countries, this investment was even higher in medium-high-tech manufacturing. For EU-25, investment in machinery and equipment was highest in medium-high-tech manufacturing, where an average of EUR 244 000 per enterprise was spent.

Venture Capital Investment

In 2004, venture capital investment (VCI) was highest in Sweden and in the United Kingdom, both at earlier stage and at expansion and replacement stage.

High-tech trade

When comparing the three leading economies in the world, the United States achieved the highest share of high-tech exports related to total exports. In 2004, the respective ratios were 28.6%, 22.4% and 18.2% for the United States, Japan and EU-25.

Employment in high-tech industries and knowledge-intensive services

In 2004, almost 130 million people were employed in services in EU-25, whereas more than 36 million were employed in manufacturing. Of the 130 million jobs in services in EU-25, half of these were in knowledge-intensive services (KIS) and the other half in less knowledge-intensive services (LKIS).

Of the 36 million people employed in manufacturing, 11 million were in medium-high-tech manufacturing (5.7% of total employment) and more than 2.2 million in high-tech manufacturing (1.1% of total employment). Of the total workforce in manufacturing and services of 166 million, almost 20 million persons were employed in high-tech manufacturing and services within the EU in 2004.

In EU-25 less than 30% of all persons employed in manufacturing were female. This ratio was often higher in the new Member States than in the old ones. The highest ratio of female employment was in high-tech manufacturing (35.6%). In EU-25, 60.1% of persons employed in all services were female. This proportion is about twice as high as the employment share of female in total manufacturing. However the proportion of female employees was lower in knowledge-intensive services (KIS) and lower still in high-tech KIS, with ratios of 53.4% and 33.8% respectively.

In 2004, regions specialised in high-tech and medium-high-tech manufacturing sectors were highly concentrated in Germany. Capital regions were strong in knowledge-intensive services (KIS) and in high-tech KIS.

R&D in high technology

For the EU-25 Member States for which data are available, more than 90% of total business R&D expenditure was spent in high and medium-high-tech manufacturing in Germany, Hungary and in the United Kingdom.

In general, the proportion of researchers among R&D personnel was higher in high-tech manufacturing than in total manufacturing. Hungary had the highest proportion with 85.8% of researchers in high-tech manufacturing.

2005 EU industrial R&D investment scoreboard

Chapter 8 (produced by the European Commission's Directorate General for Research) presents the main results of the 2005 EU industrial R&D investment Scoreboard. The Scoreboard compares the R&D investment performance of 700 EU companies with 700 non-EU companies. All the main regions in the world showed an increase in R&D investment in 2004 compared with 2003. As with the 2004 Scoreboard, EU companies performed worse than non-EU companies in terms of R&D investment growth, although 2004 brought a turnaround for EU companies from a decrease of 2.0% (top 500) to an increase of 0.7% (top 700).

R&D investment is highly concentrated in the EU. Three countries (Germany, France and the United Kingdom) account for around three quarters of both total R&D investment and sales and about 60% of the total number of EU Scoreboard companies.

The economic sectors with the highest rates of growth in R&D investment worldwide are services, pharmaceuticals and biotechnology. Each region of the world has a different specialisation. The EU, the United States and the rest of the world group (especially Switzerland) specialise in pharmaceuticals and biotechnology.

PART1

Chapter 1 - Government Budget Appropriations or Outlays on R&D - GBAORD

1

1.1 Introduction

Government budget appropriations or outlays on R&D - GBAORD - are all appropriations allocated to R&D in central government or federal budgets and therefore refer to budget provisions, not to actual expenditure. Provincial or state government elements should be included where the input is significant. Unless otherwise stated, data include both current and capital expenditure and cover not only government-financed R&D performed in government establishments, but also government-financed R&D in the business enterprise, private non-profit and higher education sectors, as well as abroad. Data on actual R&D expenditure, which are not available in their final form until some time after the end of the budget year concerned, may well differ from the original budget provisions. This and further methodological information can be found in the ***Frascati Manual***, OECD, 2002.

These data are assembled by national authorities using data for public budgets. This involves a two-step process:

- Within the budget statistics, it is first necessary to identify the budget items that involve R&D;
- The R&D content of these budget items must then be measured or estimated.

GBAORD data measure government support to R&D activities or, in other words, how much priority Governments place on the public funding of R&D. The figures are difficult to compile because they are not obtained through surveys, but in most countries national budget data are used as the administrative data source. Problems of data compilation are due to the fact that national budgets have their own terminology and methodology and therefore often fail to match with the Eurostat/OECD methodology set out in the 'Proposed standard practice for surveys of research and experimental development' (***Frascati Manual***, OECD, 2002).

Government R&D appropriations or outlays on R&D are broken down by socio-economic objectives on the basis of NABS - ***Nomenclature for the analysis and comparison of scientific programmes and budgets***, Eurostat 1994.

Eurostat collects aggregated data, which are checked and processed, and compared with other data sources such as the MSTI - OECD.

Then, all the necessary aggregates are calculated (or estimated). For data in national currency, ECU/EUR current, current PPS and 1995 constant PPS, EU aggregates are calculated as the sum of the corresponding countries. For 2004, EU aggregates are estimated using provisional data and by estimating the annual average growth rate. GBAORD broken down by socio-economic objective are available for EU-15 but not for EU-25.

The analysis of GBAORD data in the present publication covers the period 1994 to 2004, with 2004 being provisional. The chapter is divided into two main parts:

- A worldwide perspective,
- A European perspective.

Each part focuses first on overall GBAORD and trends. In a second step, the analysis focuses on GBAORD broken down by socio-economic objectives of the NABS.

Please note that data presented in the present publication reflect data availability in Eurostat's reference database as of 20 February 2006.

For more details on the methodologies used, please refer to the methodological notes.

1.2 A worldwide perspective: EU-25, Japan and the United States

Total GBAORD

The United States allocated more public funds to R&D than did the European Union and Japan

Of the three major economies, it was the United States that allocated most Government Budget appropriations or Outlays to Research and Development (GBAORD), both in absolute and in relative terms.

As Figure 1.1 shows, total GBAORD from the United States amounted to some 90 billion 1995 constant PPS in 2004. In the European Union, it was slightly above 60 billion, whereas it did not quite reach the 20 billion in Japan.

However, in relative terms (as a percentage of GDP) the differences are less significant than in absolute terms. Indeed, 1.08% of GDP was spent as GBAORD in the United States in 2004 as against 0.76% in the European Union and 0.71% in Japan.

During the period 1994 to 1999, GBAORD in the United States and in the EU-15 expressed in relative terms (as a percentage of GDP) declined and followed similar trends. By contrast, in Japan it increased during the same period. In other words, there was a convergence of GBAORD at the international level. In 1999, GBAORD amounted to 0.84%, 0.72% and 0.62% respectively in the United States, EU-25 and Japan.

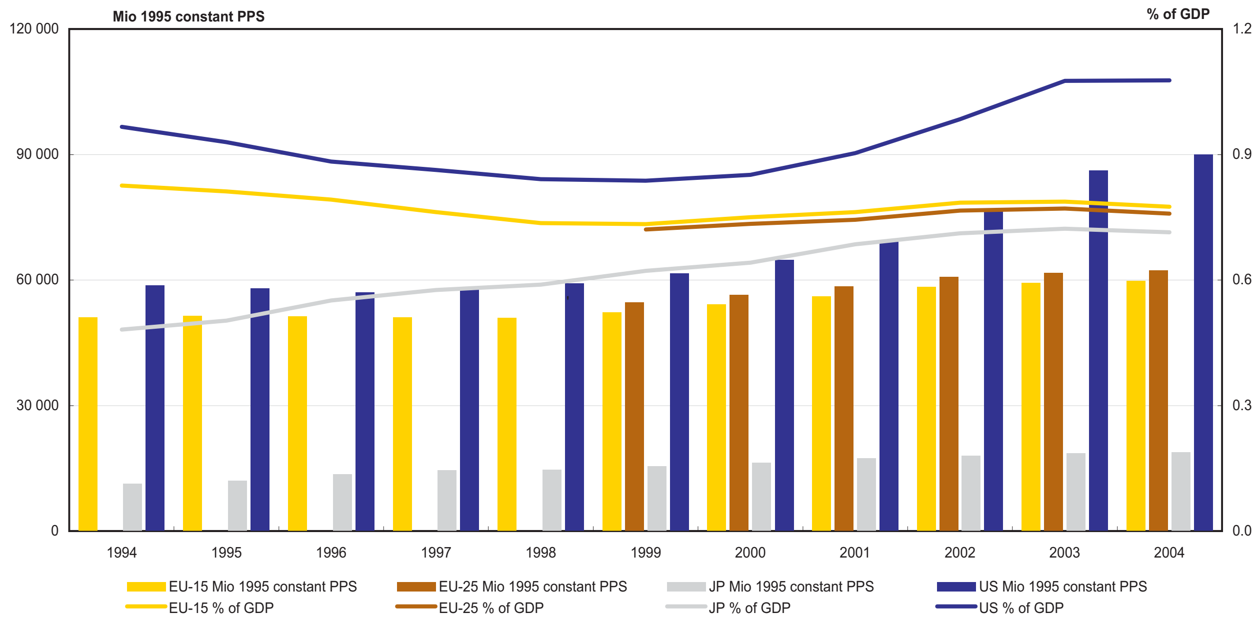
Between 1999 and 2004, trends were quite different. GBAORD of EU-15 expressed as a percentage of GDP was stable, whereas it increased slightly in Japan and even more so in the United States. Since 2003, the GBAORD/GDP ratio has above 1% in the United States.

In absolute terms, GBAORD both in the United States and at the level of EU-15 were quite stable between 1994 and 1999. As shown in Table 1.3, the annual average growth rate (AAGR) of the total GBAORD expressed in real terms (1995 constant PPS) was 0.9% and 0.4% respectively for this period.

In Japan, GBAORD expressed in 1995 constant PPS rose faster, at an annual rate of 6.5% during the same period.

Between 1999 and 2004, GBAORD in the United States and in EU-15 increased even faster than between 1994 and 1999, with the annual average growth rate standing at 7.9% and 2.7% respectively. In Japan, GBAORD carried on growing (4.1%), albeit at a lower level than between 1994 and 1999. However, the annual growth rate was still higher than in EU-15.

Figure 1.1 **GBAORD in million 1995 constant PPS and as a percentage of GDP, EU-15, EU-25, Japan and the United States - 1994 to 2004**



Eurostat estimates: EU-15 and EU-25.
Provisional data: EU-15 and EU-25 2004.

National estimate: US 2004.
Break in series: US 2000.

1

GBAORD by socio-economic objectives

The United States allocated more public funds, but to less diversified research

Figure 1.2 presents GBAORD broken down by socio-economic objectives of the NABS - Nomenclature for the analysis and comparison of scientific programmes and budgets.

In 2004, the main EU-15 socio-economic objective was "Research financed from General University Funds (GUF)". Indeed, almost one third (31.6%) of the total GBAORD was allocated to this objective.

In Japan, the main socio-economic objective was also "Research financed from GUF" with an even higher proportion (33.5%). In the United States, it was "Defence" which accounted for more than half of total GBAORD (55.8 %). By comparison, "Defence" within EU-15 ranked as the third main objective and accounted for only 14.7% of total GBAORD.

Japan's second main socio-economic objective of the government R&D budget was "Production, distribution and rational utilization of energy" (17.1%). Unlike in Japan, energy in EU-15 and in the United States was one of the less important objectives, with 2.5% and 1.2% of total GBAORD respectively.

After "Defence", the United States earmarked the largest part of their budget to "Protection and improvement of human health" (23.1%). By comparison, EU-15 only allocated 6.8% of its total GBAORD and Japan 3.9%.

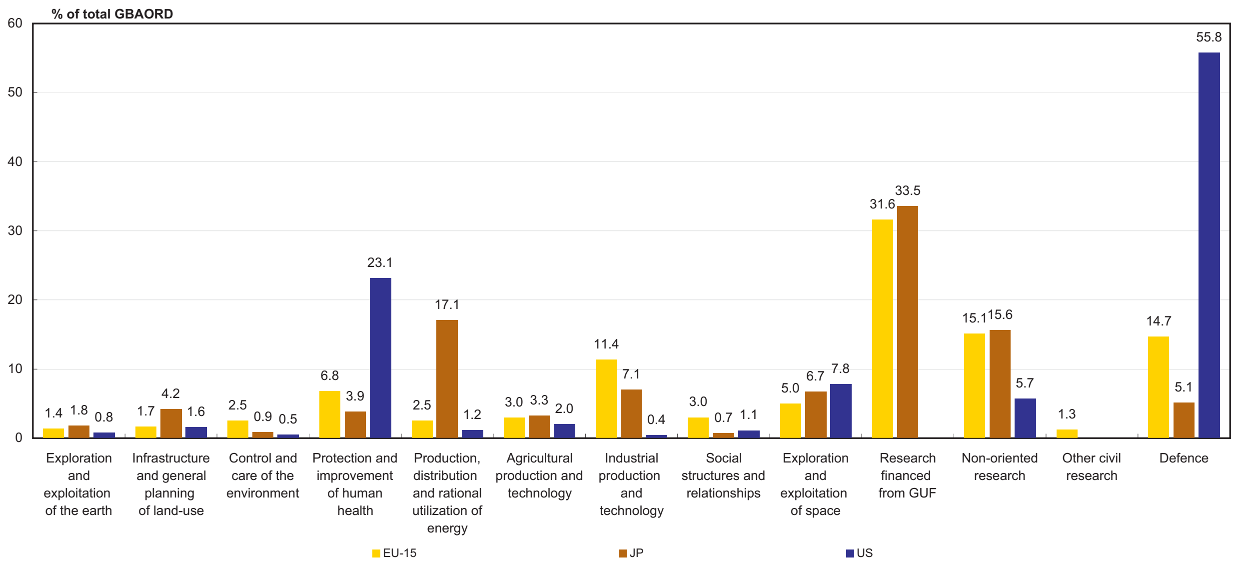
At EU-15 level, "Research financed from GUF" was followed by the objective "Non-oriented research" with 15.1%. After "Defence" (14.7%) came the objective "Industrial production and technology" with 11.4% of total GBAORD respectively.

Summing up, then, government budgets financed less diversified research in the United States than in EU-15 and in Japan. In fact, almost 80% of the total GBAORD in United States went to only two objectives.

Taking a look at objectives that receive little funding from the governments of the three major economies, we find mainly objectives related to the earth: "Exploration and exploitation of the earth", "Infrastructure and general planning of land use", "Control and care of the environment", "Agricultural production and technology". The same is also true of the objective "Social structure and relationships".

Figure 1.2

Distribution of GBAORD by socio-economic objective in percentage, EU-15, Japan and the United States - 2004



Eurostat estimate based on provisional data: EU-15.
National estimate: US 2004.

The United States consistently concentrates GBAORD in the domains "Defence" and "Protection and improvement of human health"

Table 1.3 shows the real annual average growth rate (AAGR) of GBAORD broken down by socio-economic objectives for the periods 1994-1999 and 1999-2004 (calculated on GBAORD expressed at constant prices).

Between 1994 and 1999, GBAORD in EU-15 (0.4%) and in the United States (0.9%) were quite stable, whereas it increased markedly (6.5%) in Japan.

Between 1999 and 2004, trends were very different, with the AAGR of total GBAORD at 7.9%, 4.1% and 2.7% in the United States, in Japan and in EU-15 respectively.

However, trends in total GBAORD conceal large discrepancies between socio-economic objectives. As a matter of fact, GBAORD in EU-15 decreased for six socio-economic objectives between 1994 and 1999 while it increased at an annual rate of 6.9% for the objective "Protection and improvement of human health" during the same period. The European objective that decreased fastest during the period 1994-1999 was "Defence" (-3.7%).

In Japan, GBAORD grew for all objectives during the period 1994-1999. The one that increased fastest was "Infrastructure and general planning of land use" (22.0%) followed by "Industrial production and technology" (19.5%).

In the United States, five socio-economic objectives saw their GBAORD decline between 1994 and 1999, including "Production, distribution and rational utilisation of energy" at an annual rate of -18.3%. By contrast, "Non-oriented research" increased at a rate of 9.8%.

Between 1999 and 2004, GBAORD in EU-15 decreased only for "Production, distribution and rational utilization of energy" (-3.2%) and to a lesser extent for "Exploration and exploitation of space". The objective that rose fastest was "Industrial production and technology" (6.6%) followed by "Protection and improvement of human health".

Once again, GBAORD in Japan increased, between 1999 and 2004, for all the socio-economic objectives, at annual rates of between 0.7% and 8.6%.

With the exception of "Infrastructure and general planning of land use", GBAORD also grew for all socio-economic objectives in the United States between 1999 and 2004. Furthermore, three of them had a high annual growth rate: "Social structure and relationship", "Protection and improvement of human health" and "Defence". In other words, the United States continued to focus the Research and development budget in these areas.

Table 1.3 **Annual average real growth rate (AAGR) of GBAORD by socio-economic objective, EU-15, Japan and the United States - 1994 to 1999 and 1999 to 2004**

Socio economic objectives	EU-15		Japan		United States	
	1994-1999	1999-2004	1994-1999	1999-2004	1994-1999	1999-2004
01. Exploration and exploitation of the earth	-2.9	1.6 s	11.7	8.6	-8.4	5.9
02. Infrastructure and general planning of land-use	0.7	4.1 s	22.0	7.8	-3.4	-0.1
03. Control and care of the environment	0.4	1.9 s	12.4	8.3	-1.6	0.0
04. Protection and improvement of human health	6.9	4.7 s	11.4	5.0	5.8	10.1
05. Production, distribution and rational utilization of energy	2.2	-3.2 s	5.2	1.7	-18.3	3.0
06. Agricultural production and technology	-1.7	0.0 s	6.3	3.1	0.2	3.8
07. Industrial production and technology	-1.7	6.6 s	19.5	5.8	0.9	1.3
08. Social structures and relationships	4.1	2.4 s	1.3	0.7	-1.5	12.5
09. Exploration and exploitation of space	-2.0	-0.1 s	2.8	5.5	0.5	1.5
10. Research financed from GUF	1.8	2.6 s	3.6	2.3	:	:
11. Non-oriented research	2.9	3.2 s	14.2	8.2	9.8	6.8
12. Other civil research	-1.1	0.3 s	:	:	:	:
13. Defence	-3.7	2.4 s	1.3	6.3	0.2	8.9
86. Total civil	**1.3**	**2.8 s**	**6.8**	**4.0**	**1.8**	**6.7 e**
99. Total GBAORD	**0.4**	**2.7 s**	**6.5**	**4.1**	**0.9**	**7.9 e**

AGGR is calculated in 1995 constant PPS.
EU-15: Eurostat estimate and 2004 provisional data.
National estimate: US 2004.

1

1.3 A European perspective

Total GBAORD

Upward trend in European GBAORD since 1999

In 2004, the European Union allocated almost EUR 78 billion to GBAORD, representing, in constant terms, 62 billion of 1995 constant PPS.

Total GBAORD of the European Union grew over the whole period from 1994 to 2004, based on current prices (EUR).

When GBAORD is expressed in 1995 constant PPS, two distinct periods can be observed. The first lasted from 1994 to 1998, when the total GBAORD of EU-15 was quite stable.

The second period was from 1999 onwards, during which GBAORD grew constantly and exceeded 60 billion 1995 constant PPS.

Building Knowledge Europe: The EU's new Research Framework Programme 2007-2013

The Commission has put forward an ambitious proposal for the EU Seventh Research Framework Programme 2007-2013 (FP7). Subtitled "Building the European research area of knowledge for growth", FP7 is designed to respond to the competitiveness and employment needs of the EU. The Commission proposes in particular to double the FP7 budget compared with FP6, rising to EUR 67.8 billion over the period 2007-2013.

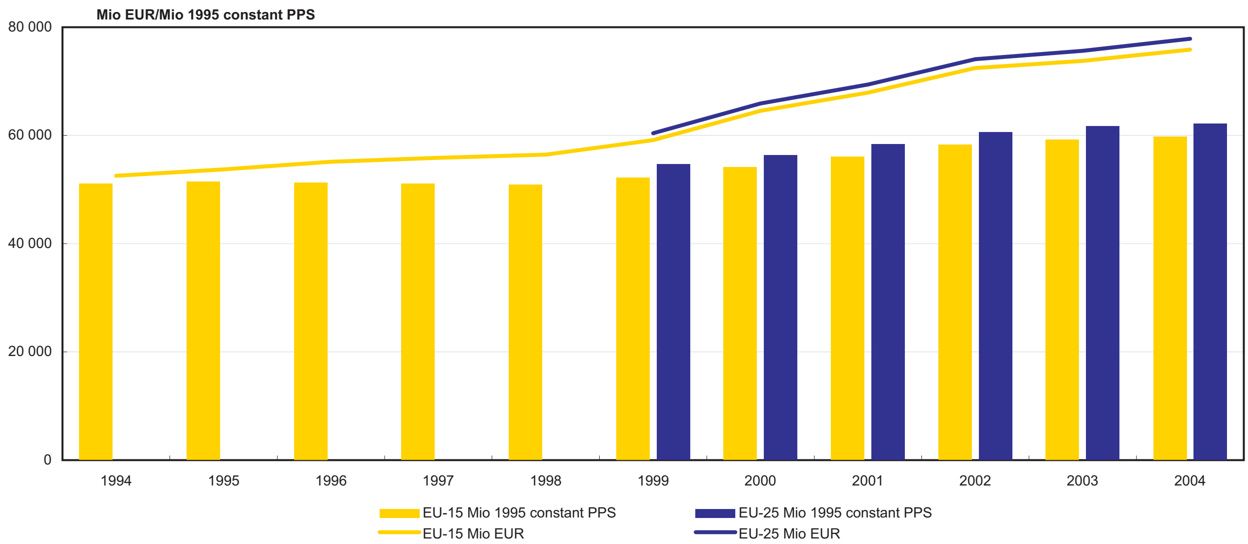
Will these increased resources be well spent?

Even with the proposed increase in funds, the European research budget will represent less than 10% of public spending on research and development within the European Union, unless Member States follow the EU's lead and fulfil their commitment to devote more national resources to research and development.

Source: European Commission, 2005.

Figure 1.4

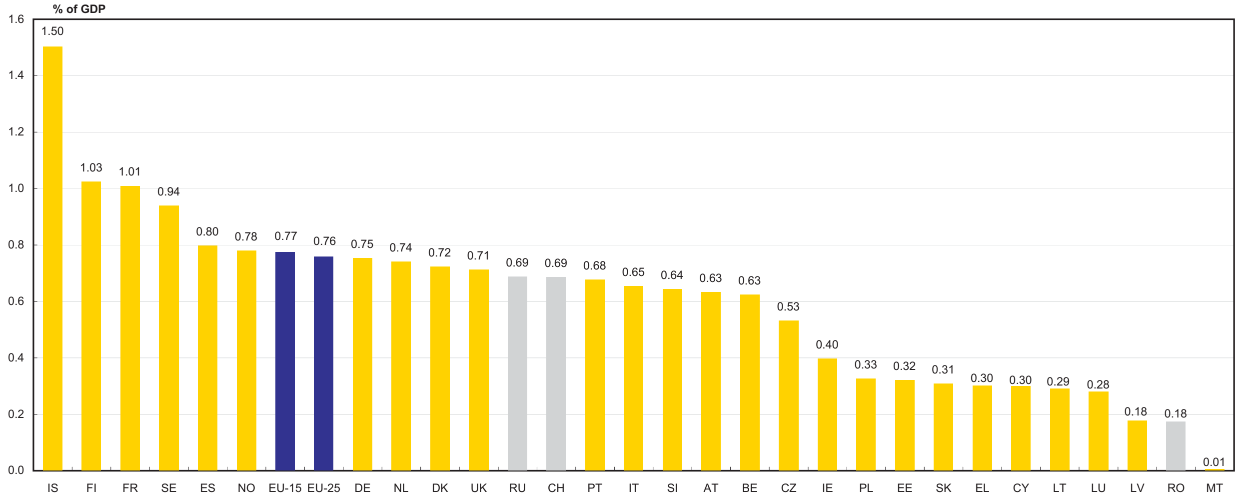
Total GBAORD in million euro and in million 1995 constant PPS, EU-15 and EU-25 - 1994 to 2004



Eurostat estimates: EU-15 and EU-25.
Provisional data: EU-15 and EU-25 2004.

Figure 1.5

Total GBAORD as a percentage of GDP, EU-25 and selected countries - 2004



Eurostat estimates: EU-15 and EU-25.
National estimate: EE.
Provisional data: SE, ES, EU-15, EU-25, DE, UK, IT, SI, AT, CZ, PL, CY, RO.
Exceptions to the reference year: 2005: IT,
2003: FR, LV and RU,
2002: CH,
2001: EE, LT.

France, Spain and Nordic countries lead in terms of GBAORD as a proportion of GDP

Figure 1.5 shows, by country, GBAORD expressed as a percentage of GDP. The main advantage of this indicator is to remove the weight of countries and thus facilitate a comparison of GBAORD across countries.

In 2004, total GBAORD of EU-25 accounted for 0.76% of GDP. The EU-15 average was slightly higher, at 0.77%.

However, the European average masks large differences between countries. As a matter of fact, Iceland led with 1.50% of GDP devoted to GBAORD in 2004. Two other countries had a GBAORD higher than 1% of GDP: Finland (1.03%) and France (1.01%). France was also the second-ranked European country for allocating the highest public budgets to R&D in absolute terms (EUR).

In Sweden, Spain and Norway GBAORD as a percentage of GDP was also higher than the European average (0.76%).

GBAORD of ten Member States ranged between the European average (0.76%) and 0.5% of their GDP. It was especially true for three out of the four main European countries in terms of budgets granted to GBAORD expressed in absolute terms: Germany (0.75%), the United Kingdom (0.71%) and Italy (0.65%).

At the end of the scale, there were Greece, Cyprus, Lithuania, Luxembourg, Latvia, Romania and Malta, where GBAORD was at or below 0.3% of GDP. Moreover, GBAORD did not even attain 0.2% in Latvia, Romania and Malta. In Malta, GBAORD stood at a negligible 0.01% of GDP.

1

In 2004, four countries shared 70% of total EU-25 GBAORD: Germany, France, the United Kingdom and Italy

Figure 1.6 shows the share of EU-25 total GBAORD granted by the four main budgeting countries. In 2004, total GBAORD of EU-25 amounted to almost EUR 78 billion at current prices.

Germany allocated the highest budgets to GBAORD, with EUR 16.7 billion. It was closely followed by France with 16 billion, and to a lesser extent by the United Kingdom and Italy with EUR 12.2 and EUR 9.2 billion respectively. These four Member States were responsible for approximately 70% of the EU-25 total GBAORD (EUR 77.9 billion).

The remaining 21 Member States together granted EUR 23.7 billion or approximately 30% of the EU-25 total GBAORD. Of these, seven allocated more than one billion euro to GBAORD: Spain, the Netherlands, Finland, Belgium, Sweden, Austria and Denmark. It was also the case for Norway.

At the other end of the scale, five Member States allocated less than EUR 100 million to GBAORD. These were Luxembourg, Lithuania, Cyprus, Malta and Latvia.

Nordic countries lead in terms of budgets allocated to GBAORD per capita; new Member States and Romania were still lagging far behind

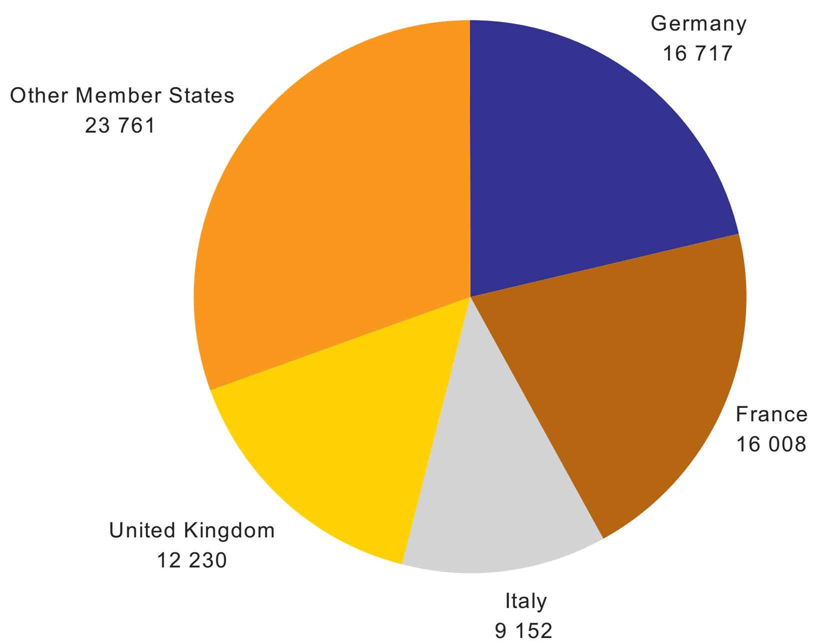
Figure 1.7 shows the EU-25 Member States that allocated the highest amounts to government support for R&D (based on GBAORD) per inhabitant in 2004. These countries were Finland, Sweden and France with EUR 294, EUR 292 and EUR 268 per capita respectively.

Iceland and Norway assigned even more per inhabitant: EUR 510 and EUR 343 respectively.

Four other countries granted more than EUR 200 per capita: Denmark (EUR 260), the Netherlands (EUR 223), the United Kingdom (EUR 205) and Germany (EUR 203).

All the new Members States and Portugal allocated less that EUR 100 per inhabitant to GBAORD. In Malta, Romania and Latvia, it was even less than EUR 10 per person.

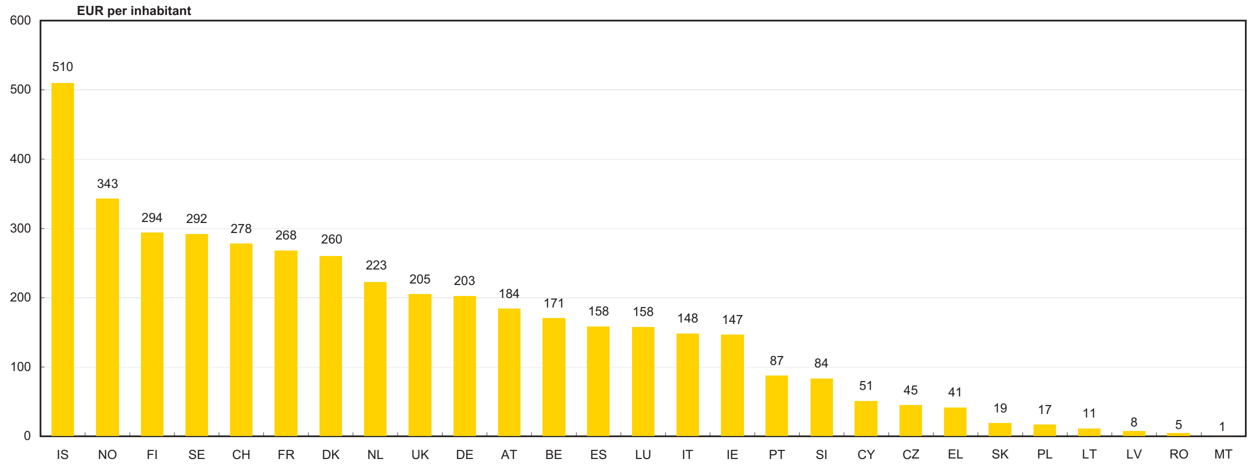
Figure 1.6 Distribution of EU-25 total GBAORD in million euro - 2004



Exceptions to the reference year: 2005: IT,
2003: FR.
Provisional data: DE, IT and UK.
Eurostat estimates: EU-25.

Figure 1.7

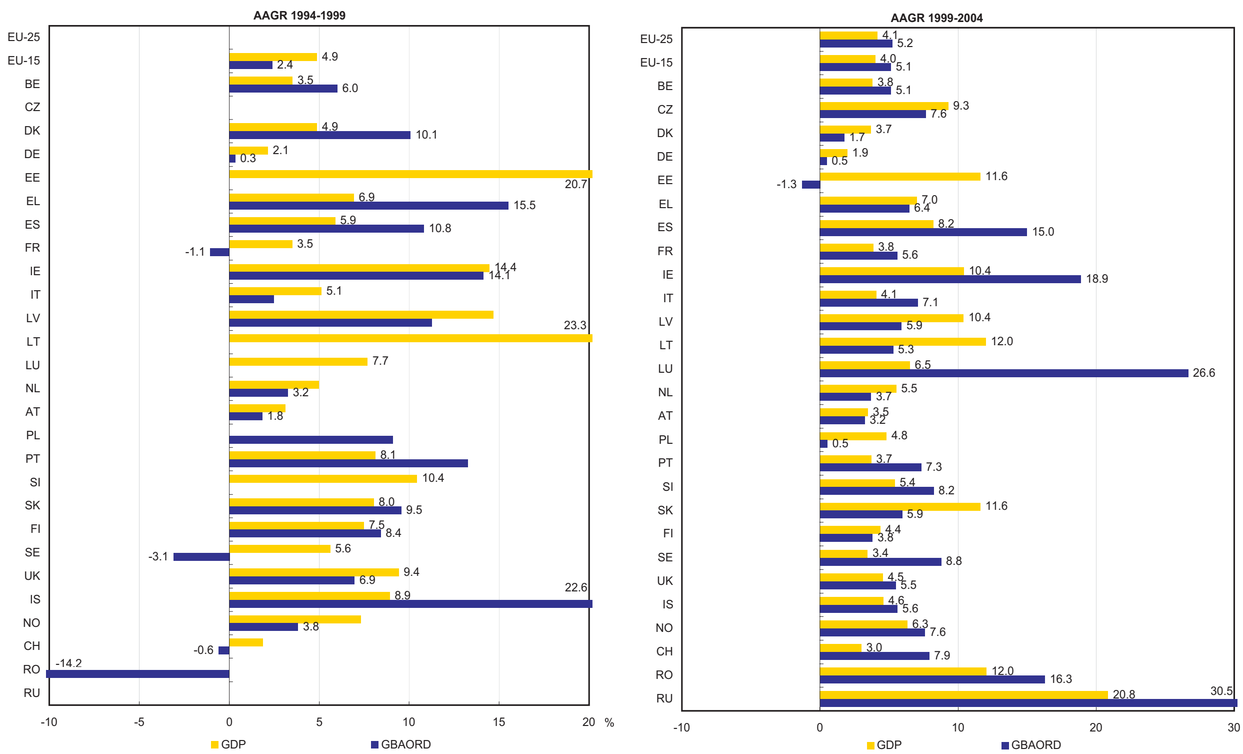
Total GBAORD in euro per inhabitant, EU-25 and selected countries - 2004



Exceptions to the reference year: 2003: EL, FR, LV,
2002: CH,
2001: IT, LT.
Provisional data: SE, UK, DE, AT, BE, ES, LU, IE, PT, SI, CY, CZ, PL, RO.

Figure 1.8

Annual average growth rate (AAGR) of GBAORD and of GDP (expressed in current euro), EU-25 and selected countries - 1994 to 1999 and 1999 to 2004



AAGR is not calculable for MT because data are available for only two years.
AAGR is calculated in current EUR.
Exception to the reference period (1994-1999) for GBAORD:
CH: 1994-2000.

Exceptions to the reference period (1999-2004) for GBAORD:
1999-2001: LT, EE (EE 2001: estimated data),
1999-2003: FR, LV, RU,
1999-2005: IT (2005: provisional data),
2000-2002: CH,
2000-2004: LU,
2002-2004: CZ (2004: provisional data).

Figure 1.8 compares, by country, the annual average growth rate (AAGR) between 1994 and 1999 and between 1999 and 2004 of total GBAORD (expressed in current prices) with the AAGR of GDP.

In EU-15, GBAORD expressed in current terms increased between 1994 and 1999 at a rate of 2.4%. However, GDP rose faster than GBAORD, at a rate of 4.9% over the same period.

By contrast, GBAORD in EU-15 grew, between 1999 and 2004, at a rate of 5.1%, in other words, at a higher rate than GDP growth (4.0%) over the same period.

For EU-25, the annual average growth rates of GBAORD and GDP between 1999 and 2004 were similar to EU-15: 5.2% and 4.1% respectively.

However, large differences exist across Member States. Between 1994 and 1999, four countries, including two Member States, saw their GBAORD decrease: Sweden (-3.1%), France (-1.1%), Romania (-14.2%) and Switzerland (-0.6%).

Only eight countries, including seven Member States, saw their GBAORD grow faster than their GDP: Belgium, Denmark, Greece, Spain, Portugal, Slovakia, Finland and Iceland. The AAGR was even as high as 22.6% and 15.5% in Iceland and Greece respectively.

Between 1999 and 2004, trends differed quite markedly. In fact, GBAORD in the European Union grew faster than GDP. Moreover, and with the exception of Estonia, GBAORD increased for all countries. However, large differences still exist between countries.

Countries where government support for R&D increased most markedly were Russia, Luxembourg, Ireland and Romania, at annual growth rates of 30.5%, 26.6%, 18.9% and 16.3% respectively. This is not altogether surprising since GBAORD (as a percentage of GDP) was very low for these latter three countries in 2004 (see figure 1.5).

The AAGR of GBAORD in Spain was 15.0% between 1999 and 2004. All other countries had an AAGR of GBAORD of less than 10% over the same period.

In contrast to the European average, twelve countries had GBAORD growth rate which was lower than the GDP growth rate: the Czech Republic, Denmark, Germany, Estonia, Greece, Latvia, Lithuania, the Netherlands, Austria, Poland, Slovakia and Finland.

With the exception of Finland, all the above countries had a GBAORD, expressed as a percentage of GDP, lower than the EU-25 average (0.76%) in 2004 (see Figure 1.5).

The growth of GBAORD was lower than the EU-25 average (5.2%) only in Belgium, Denmark, Germany, Estonia, the Netherlands, Austria, Poland and Finland. The AAGR of GBAORD was even lower than 1% in Germany and in Poland and was negative in Estonia.

Frascati Manual
'Proposed standard Practice for surveys of research and experimental development'

There are two ways of measuring how much governments spend on R&D. The first and most accurate is to hold surveys of the units that carry out R&D (firms, institutes, universities, etc.) in order to identify the amount effectively spent on R&D over the previous year and the share financed by government. The sum of R&D spending in a national territory (see Chapter 6, Table 6.1) is known as "government-financed gross domestic expenditure on R&D" (government-financed GERD).

Unfortunately, owing to the time required to carry out such surveys and process the results, government-financed GERD data do not become available until between one and two years after the R&D has been carried out. Furthermore, the R&D-performing units responding to the surveys are sometimes unable to report on where their particular grant or contract fits into the government's overall S&T policy.

In consequence, a second way of measuring government support for R&D has been developed using data from budgets. This essentially involves identifying all the budget items involving R&D and measuring or estimating their R&D content in terms of funding. These estimates are less accurate than performance-based data but as they are derived from the budget, they can be linked to policy through classification by "objectives" or "goals". The specifications of such budget-based data are described in this chapter. Budget-based data are now officially referred to as "government budget appropriations or outlays for R&D" (GBAORD).

Source: Abstract from the Frascati Manual (Chapter 8 - GBAORD, introduction), OECD, 2002.

GBAORD by socio-economic objectives

Figure 1.9 shows GBAORD for EU-15 broken down by socio-economic objectives of the NABS - *Nomenclature for the analysis and comparison of scientific programmes and budgets*.

In 2004, the main socio-economic objective within EU-15 was "Research financed from General University Funds (GUF)", with 31.6% of total GBAORD allocated. It accounted for more than twice the second and the third main objectives, namely "Non-oriented research" and "Defence", which represented 15.1% and 14.7% of total GBAORD respectively.

The objective "Industrial production and technology" followed and accounted for 11.4% of total GBAORD in 2004.

GBAORD as an indicator of national research policy

Government budget appropriations or outlays for research and development (GBAORD) are relevant as an indicator of national science policy.

It is a particularly relevant and valid indicator of science policy when we look at changes over time according to the objectives for the funding, since the relative ups and downs of different objectives can be taken as indicators of changes in governments' priority setting with respect to different research objectives.

The argument for using this measure is that the greater the proportion of the total budget allocated to a specific objective within a national policy, the higher priority the specific objective can be said to be given and vice versa.

Source: The Danish Centre for Studies in Research and Research Policy, 2005/2.

"Protection and improvement of human health" represented 6.8% of total GBAORD whereas the remaining socio-economic objectives represented 5% or less than 5% each. The areas where EU-15 granted the smallest budgets in 2004 were "Other civil research", "Exploration and exploitation of the earth", "Infrastructure and general planning of land-use", "Control and care of the environment", "Production and rational utilization of energy".

As a proportion of total GBAORD, of the six main socio-economic objectives, only "Defence" and "Exploration and exploitation of the space" saw their share decrease between 1994 and 2004 (Figure 1.9).

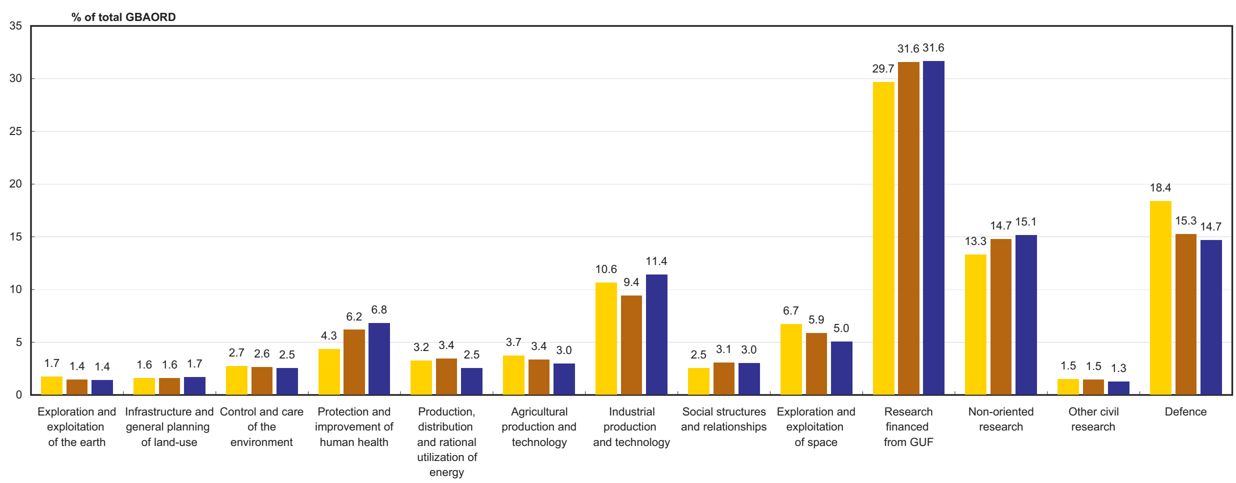
Figure 1.10 shows the trends in these six main EU-15 socio-economic objectives expressed in real terms (1995 constant PPS) between 1994 and 2004.

These trends can be summarised in two major categories. The first corresponds to objectives that decreased between 1994 and 1999 but grew between 1999 and 2004. This was the case for "Industrial production and technology" and "Defence" (See also Figure 1.11).

The second category corresponds to objectives that increased over the whole period 1994-2004, namely "Protection and improvement of human health", "Research financed from GUF" and "Non-oriented research". The real AAGR was as high as 6.9% for "Protection and improvement of human health" between 1994 and 1999.

Looking at the data for all socio-economic objectives expressed in constant terms, only two of them decreased over the whole period 1994-2004: "Agricultural production and technology" and "Exploration and exploitation of space" - Figure 1.11.

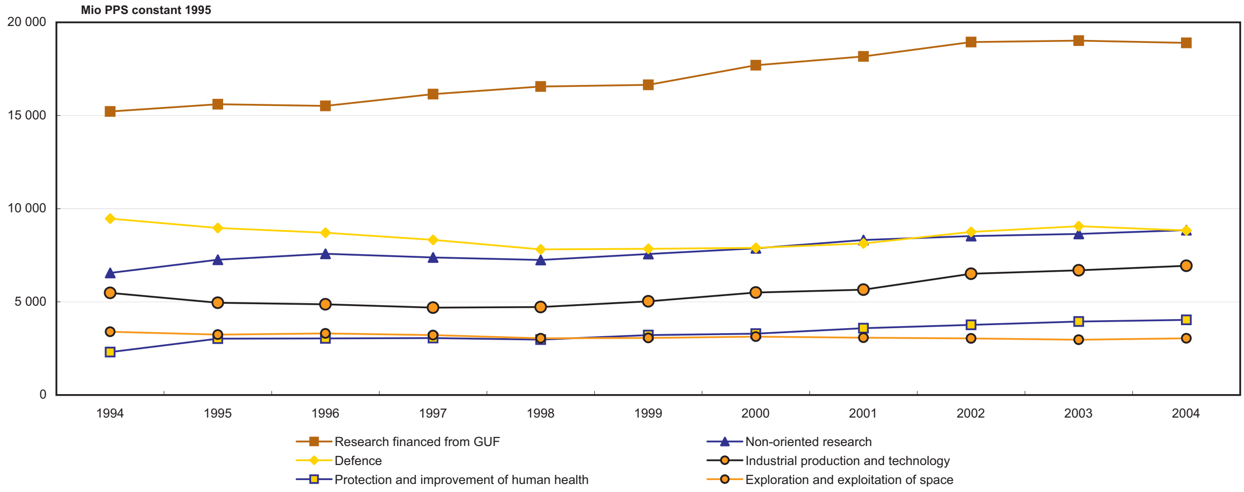
Figure 1.9 Distribution of GBAORD by socio-economic objective in percentage, EU-15 - 1994, 1999 and 2004



EU-15: Eurostat estimate, 2004 provisional data.

Figure 1.10

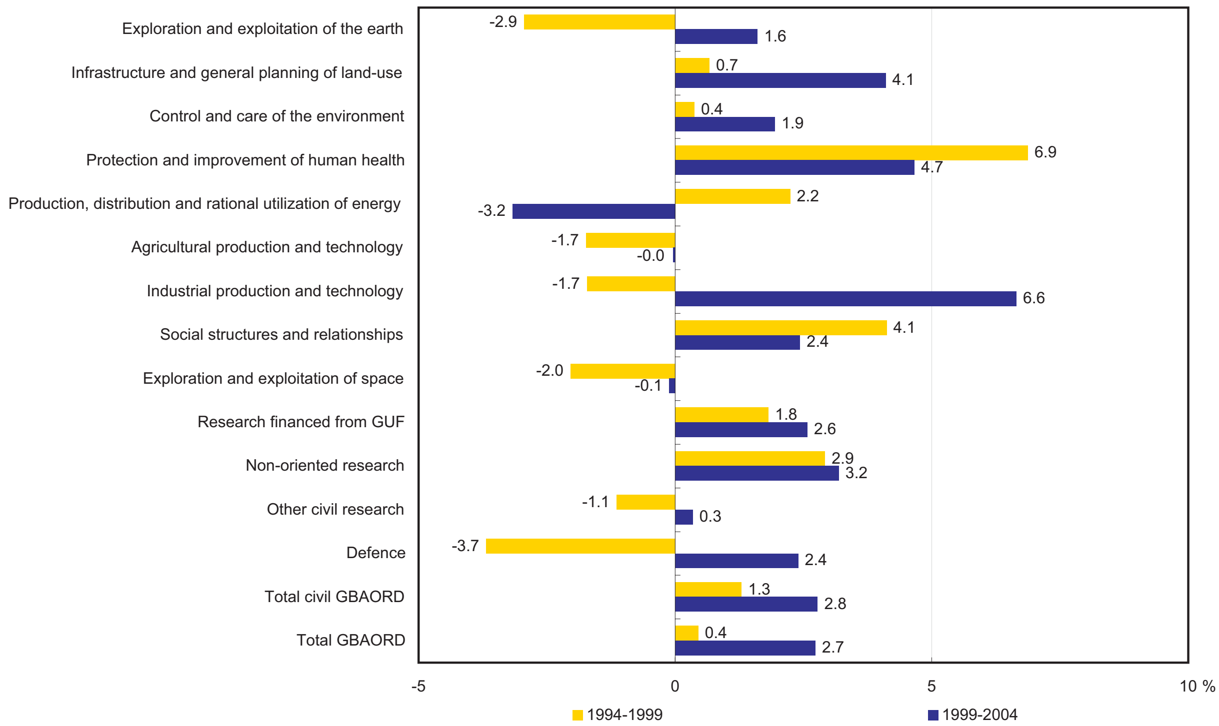
Main NABS socio-economic objectives in million 1995 constant PPS, EU-15 - 1994 to 2004



EU-15: Eurostat estimate, 2004 provisional data.

Figure 1.11

Annual average real growth rate (AAGR) of GBAORD by socio-economic objective, EU-15 - 1994 to 1999 and 1999 to 2004



AGGR is calculated in 1995 constant PPS.
EU-15: Eurostat estimates and provisional data for 2004.

Table 1.12 shows, by country, the distribution of GBAORD by socio-economic objective as a percentage of total GBAORD and total GBAORD in EUR million at current prices.

Apart from being the main socio-economic objective at EU-15 level, "Research financed from GUF" accounted, in 2004, for the largest share of total GBAORD in twelve EU-25 Member States for which data by socio-economic objectives of the NABS are available. It was also the most important objective in Iceland and Norway.

The objective "Defence" was the leading socio-economic objective only in the United Kingdom and in France, with 31.9% and 24.4% of total GBAORD respectively. However, it represented 19.7% and 19.6% in Sweden and Spain respectively. Hence, the fact that "Defence" represented a substantial share of total European GBAORD is mainly due to the contribution made by this group of countries.

"Non-oriented research" was the second socio-economic objective in terms of importance within EU-15. It was also the first objective for four new Member States: the Czech Republic (26.2%), Poland (65.1%), Slovenia (60.5%) and Slovakia (40.5%).

Compared to the EU-15 average (11.4%), some countries allocated a large part of their total government R&D budget to "Industrial production and technology". This was especially the case in Belgium (33.3%), Ireland (27.1%), Finland (25.9%) and Spain (23.4%).

More than 10% of total GBAORD was granted to "Agricultural production and technology" only in Ireland, Cyprus, Latvia, Malta, Portugal and Slovakia. Iceland spent approximately one fifth of its budgets on this objective.

Health R&D accounted for more than 10% only in Latvia, Lithuania and in the United Kingdom.

The area where the EU-15 granted the smallest budgets in 2004 was "Other civil research". Budgets allocated were also small for the objectives "Exploration and exploitation of the earth", "Infrastructure and general planning of land-use", "Production and rational utilization of energy" and "Control and care of the environment". None of the countries allocated 10% or more of their total GBAORD to any one of these four objectives.

Table 1.12 **Total GBAORD in million euro and GBAORD by socio-economic objective as a percentage of total, EU-25 and selected countries - 2004**

	Exploration and exploitation of the earth	Infrastructure and general planning of land-use	Control and care of the environment	Protection and improvement of human health	Production, distribution and rational utilization of energy	Agricultural production and technology	Industrial production and technology	Social structures and relationships	Exploration and exploitation of space	Research financed from GUF	Non-oriented research	Other civil research	Defence	Total civil GBAORD	Total GBAORD in mio eur
EU-25	:	:	:	:	:	:	:	:	:	:	:	:	:	:	**77 868 s**
EU-15	**1.4 s**	**1.7 s**	**2.5 s**	**6.8 s**	**2.5 s**	**3.0 s**	**11.4 s**	**3.0 s**	**5.0 s**	**31.6 s**	**15.1 s**	**1.3 s**	**14.7 s**	**85.3 s**	**75 864 s**
BE	0.6 p	0.6 p	1.4 p	1.7 p	2.0 p	1.9 p	33.3 p	3.7 p	10.9 p	17.5 p	23.2 p	3.0 p	0.3 p	99.7 p	1 774 p
CZ	3.2 p	4.1 p	4.2 p	7.5 p	2.0 p	4.8 p	11.5 p	2.5 p	0.9 p	21.7 p	26.2 p	8.0 p	3.4 p	96.6 p	459 p
DK	0.7	1.3	1.9	7.2	1.7	5.6	6.1	6.9	2.0	44.4	19.8	1.2	1.3	98.7	1 406
DE	1.8 p	1.9 p	3.4 p	4.3 p	2.9 p	2.0 p	12.1 p	4.0 p	5.3 p	39.4 p	17.1 p	0.6 p	6.1 p	93.9 p	16 717 p
EE	:	:	:	:	:	:	:	:	:	:	:	:	:	:	21 e
EL	3.5 p	3.1 p	3.6 p	8.0 p	2.6 p	5.2 p	9.0 p	5.2 p	0.3 p	46.1 p	11.9 p	1.0 p	0.6 p	99.4 p	499 p
ES	1.0 p	3.7 p	2.1 p	8.6 p	1.5 p	4.9 p	23.4 p	1.6 p	3.1 p	19.7 p	6.2 p	4.7 p	19.6 p	80.4 p	6 687 p
FR	1.0	0.5	3.1	5.4	4.2	2.1	5.5	0.9	8.5	24.4	18.0	2.0	24.4	75.6	16 008
IE	3.4 pe	0.8 pe	2.5 pe	5.2 pe	0.8 pe	12.7 pe	27.1 pe	0.8 pe	-	34.7 pe	11.8 pe	-	-	100 pe	591 pe
IT	2.8 p	1.0 p	2.7 p	8.1 p	4.1 p	3.6 p	12.3 p	5.0 p	8.4 p	42.2 p	5.9 p	-	3.9 p	96.1 p	9 152 p
CY	1.6 p	1.6 p	1.2 p	4.5 p	-	28.9 p	-	11.4 p	-	30.6 p	20.1 p	-	-	100 p	37 p
LV	0.9	0.3	2.4	11.1	2.1	13.4	16.5	5.9	1.3	-	20.7	24.7	0.8	99.3	18
LT	1.6	5.2	5.2	10.3	0.9	5.4	15.6	8.7	-	-	-	47.0	0.1	99.9	39
LU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	72
HU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
MT	-	-	-	-	-	29.0	25.1	45.9	-	-	-	-	-	100	0.2
NL	0.4	5.8	2.8	3.4	3.3	4.6	9.7	2.8	3.3	46.5	10.7	4.8	2.0	98.0	3 623
AT	2.2 p	2.0 p	1.6 p	4.3 p	0.7 p	2.5 p	11.6 p	2.1 p	0.2 p	58.4 p	14.2 p	0.1 p	0.0 p	100 p	1 500 p
PL	1.3 p	1.3 p	1.4 p	1.4 p	1.7 p	1.4 p	5.0 p	1.4 p	-	-	65.1 p	15.0 p	5.0 p	95.0 p	639 p
PT	1.7 p	4.8 p	3.7 p	8.1 p	0.9 p	11.8 p	16.7 p	3.6 p	0.2 p	33.0 p	11.0 p	3.6 p	0.8 p	99.2 p	915 p
SI	0.4 p	0.9 p	2.2 p	1.9 p	0.5 p	3.1 p	19.1 p	2.8 p	-	1.5 p	60.5 p	-	7.2 p	92.8 p	167 p
SK	-	0.7	2.7	1.3	2.0	10.0	6.2	5.4	-	23.4	40.5	2.2	5.5	94.5	102
FI	1.1	1.9	1.9	6.7	4.9	6.0	25.9	5.7	1.8	26.6	15.3	-	2.3	97.7	1 535
SE	0.2 p	2.5 p	1.8 p	0.9 p	2.9 p	2.7 p	6.3 p	6.2 p	0.6 p	44.3 p	12.0 p	-	19.7 p	80.3 p	2 624 p
UK	2.1 p	1.4 p	1.8 p	13.7 p	0.3 p	3.3 p	5.2 p	3.2 p	1.6 p	19.8 p	15.3 p	0.5 p	31.9 p	68.1 p	12 230 p
IS	-	6.9	0.4	7.6	2.4	19.9	2.5	9.4	-	33.1	17.7	-	-	100	148
NO	1.9	2.0	2.2	7.5	2.3	8.7	7.6	6.5	2.0	38.3	14.4	-	6.7	93.3	1 571
EEA	:	:	:	:	:	:	:	:	:	:	:	:	:	:	**79 561 s**
CH	0.3	0.5	0.3	1.7	1.2	2.7	3.4	1.2	4.6	61.0	5.7	16.9	0.5	99.5	2 018
RO	0.4 p	2.9 p	2.1 p	2.5 p	1.6 p	7.2 p	12.2 p	1.5 p	2.5 p	-	41.0 p	25.3 p	0.8 p	99.2 p	103 p
RU	:	:	:	:	:	:	:	:	5.6	:	:	44.3	50.1	49.9	2 620

Exceptions to the reference year: 2005: IT, 2003: FR, LV, RU, 2002: CH. 2001: LT, EE, 2000: LV by socio-economic objective, As previously stated, at the EU-15 level, budgets increased between 1999 and 2004 for all socio-economic objectives except for "Production and rational utilization of energy" and "Agricultural production and technology". The latter objectives declined, with an AAGR of -3.2% and -0.04% respectively - See Table 1.13.

"Industrial production and technology" had the highest rate of increase (6.6%) between 1999 and 2004. It was followed by "Protection and improvement of human health" (4.7%).
However, the European average trends conceal some fairly large differences between countries.

With the exception of the Czech Republic, Austria and Slovenia, "Research financed from GUF", the first socio-economic objective in the European Union, grew in all countries between 1999 and 2004, attaining an AAGR of even 22.7% in Ireland.

"Defence", another main objective at European level, varies considerably among individual Member States, both in terms of trends and volume. Indeed, it increased sharply in some countries such as Lithuania and Slovenia, and to a lesser extent in Denmark, Italy and Sweden, whereas it decreased in Germany, Greece, the Netherlands and Portugal.

Government R&D budget trends for "Industrial production and technology", which increased most at EU-15 level, also vary from country to country. While GBAORD allocations to this objective increased at an AAGR of approximately 60% in Lithuania and in the United Kingdom, Slovakia's decreased at a rate of -15.5% between 1999 and 2004.

By comparison, the trends in budgets allocated to "Protection and improvement of human health" are less varied. At the EU-15 level, it was the second objective in terms of growth, and only two EU-25 Member States reduced the budgets granted to it: Slovakia (-25.2%) and Sweden (-5.2%).

Conversely, "Production and rational utilization of energy", which decreased at EU-15 level, grew between 1999 and 2004 in the Czech Republic, Greece, Italy, Lithuania, the Netherlands, Austria, Portugal and Slovakia. The AAGR was even as high as 20.4% in Lithuania.

Table 1.13 **Annual average real growth rate (AAGR) of GBAORD by socio-economic objective, EU-25 and selected countries - 1999 to 2004**

	Exploration and exploitation of the earth	Infrastructure and general planning of land-use	Control and care of the environment	Protection and improvement of human health	Production, distribution and rational utilization of energy	Agricultural production and technology	Industrial production and technology	Social structures and relationships	Exploration and exploitation of space	Research financed from GUF	Non-oriented research	Other civil research	Defence	Total civil GBAORD	Total GBAORD
EU-25	:	:	:	:	:	:	:	:	:	:	:	:	:	:	**2.6**
EU-15	**1.6**	**4.1**	**1.9**	**4.7**	**-3.2**	**0.0**	**6.6**	**2.4**	**-0.1**	**2.6**	**3.2**	**0.3**	**2.4**	**2.8**	**2.7**
BE	-6.0	-6.2	-9.1	7.6	-2.0	-6.4	10.3	-0.3	1.0	1.1	3.6	-8.0	0.3	3.3	3.2
CZ	8.7	10.4	9.6	2.9	10.0	10.4	16.1	33.5	9.9	-5.5	7.5	22.7	8.5	6.5	6.6
DK	-10.4	-5.7	-9.7	8.3	-2.3	-7.6	-10.9	-4.5	-4.1	4.1	-1.1	9.2	19.4	-0.5	-0.3
DE	-0.2	1.3	-0.4	4.8	-4.6	-5.4	-1.5	3.1	2.9	0.3	1.0	20.2	-6.2	0.2	-0.3
EE	:	:	:	:	:	:	:	:	:	:	:	:	:	:	-6.4
EL	-2.3	0.0	5.9	12.1	14.1	-2.5	-1.0	7.2	-11.2	2.5	12.9	32.0	-5.0	3.8	3.7
ES	-4.0	43.0	4.2	22.1	-9.9	16.0	15.2	23.9	0.3	4.7	11.1	50.3	4.0	11.6	9.8
FR	11.6	-0.5	22.8	3.3	-0.1	-5.1	1.1	1.0	-2.6	11.7	-1.1	-5.4	5.6	3.2	3.8
IE	75.6	-7.6	27.5	28.0	:	3.7	11.4	-17.5	:	22.7	12.1	:	:	14.2	14.2
IT	12.1	23.5	4.3	6.8	2.4	12.8	13.3	5.7	3.4	2.4	-6.9	:	25.9	3.9	4.3
CY	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
LV	:	:	:	:	:	:	:	:	:	:	:	:	:	:	3.2
LT	-18.8	10.2	37.3	9.1	20.4	-35.7	61.1	-21.8	:	:	:	-8.6	99.2	-4.0	-3.9
LU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	24.3
HU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
MT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
NL	-19.7	7.9	-6.8	1.8	2.2	7.2	-7.3	-3.2	-0.5	0.3	-0.5	4.5	-4.4	-0.3	-0.4
AT	-1.8	6.0	1.8	12.5	2.2	-2.2	12.2	1.8	:	-0.7	2.4	:	:	1.6	1.6
PL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	-1.1
PT	5.4	-4.9	0.8	8.4	5.3	3.2	5.3	5.1	-13.2	2.5	10.5	5.4	-9.4	3.9	3.7
SI	-5.6	-13.4	13.3	3.6	-5.6	1.5	9.6	4.3	:	-9.6	4.4	:	234.9	4.6	6.2
SK	:	-9.8	12.2	-25.2	0.6	-6.7	-15.5	-7.5	:	3.6	4.6	-21.7	:	-2.3	-1.2
FI	-6.7	-2.8	-0.2	1.3	-2.4	3.3	0.7	4.5	-4.4	3.2	6.5	:	13.3	2.1	2.3
SE	-32.9	-9.8	9.7	-5.2	-6.8	15.1	17.8	7.5	-24.6	4.8	:	:	31.3	4.7	7.7
UK	14.4	0.2	-2.1	1.6	-3.8	-1.4	59.5	1.6	-4.0	4.8	10.2	10.8	0.1	5.7	3.7
IS	:	5.8	-3.4	4.4	-0.4	-3.9	2.6	-20.2	:	:	8.2	:	:	4.1	4.1
NO	-0.7	0.3	-3.5	4.1	5.8	3.2	-5.8	1.3	-0.7	2.6	15.8	:	7.8	2.9	3.2
EEA	:	:	:	:	:	:	:	:	:	:	:	:	:	:	**2.6**
CH	17.8	-0.9	-0.9	24.6	13.9	-0.9	33.9	-4.2	:	3.2	:	-12.6	-39.1	2.4	1.6

AGGR is calculated in 1995 constant PPS.
Exceptions to the reference period: 1998-2002: CH, 1999-2003: FR, LV, 2000-2004: LU, 1999-2001: EE (EE 2001: estimated data) and LT, 1999-2005: IT, 2002-2004: CZ.
2004 provisional data: EU-25, EU-15, CZ, DE, ES, IE, IT (2005), CY, LV (2003), AT, PL, SI, SE, UK and EEA.
AAGR is not calculable for MT because data are available for only two years.

PART1

Chapter 2
R&D expenditure

2.1 Introduction

R&D activities are often considered as a main drive for economic development, innovation and growth. They comprise creative work undertaken systematically with a view to increasing the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. The basic statistical variables are R&D expenditure (this chapter) and R&D personnel (see Chapter 3), which are measured at both national and regional levels.

The European goals in R&D, as set by the Lisbon and Barcelona European Councils, are to achieve by 2010 an R&D intensity of at least 3% of GDP for the EU (taking into account the different starting points of Member States), and to have two thirds of R&D expenditure financed by the business enterprise sector.

R&D expenditure means 'intramural' expenditure, i.e. all expenditure on R&D within a statistical unit or sector of the economy during a specific period, whatever the source of funds([1]). Intramural R&D expenditure is broken down by institutional sector, i.e. by sector of performance.

Two manuals are used as methodological references for R&D surveys:

- the Frascati Manual and
- the Regional Manual ([2]).

They provide a model for obtaining comparable statistics between countries.

This chapter presents the key indicators for R&D expenditure as well as the main trends for the last decade. It is divided into three sections:

- Firstly, it focuses on R&D expenditure at the international level, by taking a look at data for EU-25, China, Japan and the United States.
- Secondly, the main trends at the national level are highlighted, by looking at the performance of the EU-25 Member States, Iceland, Norway and Candidate Countries.
- Finally, R&D expenditure at the regional level is analysed, focusing on the regions of the EU-25 Member States, Iceland and Norway.

Two main indicators are used in the various sections of this chapter to present R&D:

- R&D in volume (euro, 1995 constant PPS),
- R&D as a percentage of GDP (R&D intensity).

The main advantage of expressing R&D expenditure as a percentage of GDP is to remove the weight of countries/regions and therefore make it possible to compare R&D expenditure across countries/regions.

Sectors of performance are used to calculate indicators of R&D activity:

- the business enterprise sector (BES),
- the government sector (GOV),
- the higher education sector (HES),
- the private non-profit sector (PNP) and
- all sectors, which corresponds to the sum of the previous four sectors.

In addition to the institutional sectors, other breakdowns are used to present R&D data, such as:

- the source of funds,
- the sector of activity,
- the size class,
- the field of science.

The regional analysis is at NUTS 2 level. Where other levels of NUTS are used on certain occasions for particular countries, this is indicated in a footnote. Readers should also note that under the NUTS classification, for Denmark, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta and Slovenia the entire national territory is considered as a NUTS 0, 1 or 2 region, which means that these countries may appear in rankings at the NUTS 2 level.

The analysis refers to the period 1994-2004. Not all countries cover the same length of time series; in general, where data for 2004 are not available for a particular country, the latest year available is presented.

The complete R&D expenditure time series are available at Eurostat's reference database NewCronos. Data for China, Japan and the United States originate from the OECD - Main Science and Technology Indicators (MSTI).

([1]) Standard method for surveys on R&D and experimental development - Frascati Manual, OECD 2002 - paragraph 358.
([2]) The regional dimension of R&D statistics and of innovation - Regional Manual, Eurostat, 1996.

2.2 A worldwide perspective: EU-25, China, Japan and the United States

R&D expenditure in the European Union fell slightly in 2004 and the gap between the EU and the United States and Japan remains

In 2004, R&D expenditure as a share of GDP in the EU-25 decreased slightly to 1.90%. The gap with regard to R&D expenditure in Japan (3.15% in 2003) is widening as R&D expenditure as a share of GDP in Japan continues to grow. However, the gap to the United States (2.59%) is narrowing as R&D expenditure as a share of GDP in the United States is falling faster than in EU-25.

The overall trend in R&D intensity for the EU-25, China, Japan and the United States was positive even though the United States has been on a downward trend since 2001. The rhythm of change differs in each of these four blocks.

China and Japan gained 0.71 and 0.46 percentage points respectively between 1995 and 2003, ahead of the United States with 0.10 percentage points and the EU-25 0.07 percentage points, over the same period.

The gap between the EU-25 and the United States widened from 0.64 percentage points in 1995 to 0.76 in 1999, but narrowed in 2003 to 0.67 percentage points, whereas the gap between the EU-25 and Japan increased steadily from 0.84 percentage points in 1995 to 1.09 in 1999 and 1.23 percentage points in 2003 (see Figure 2.1).

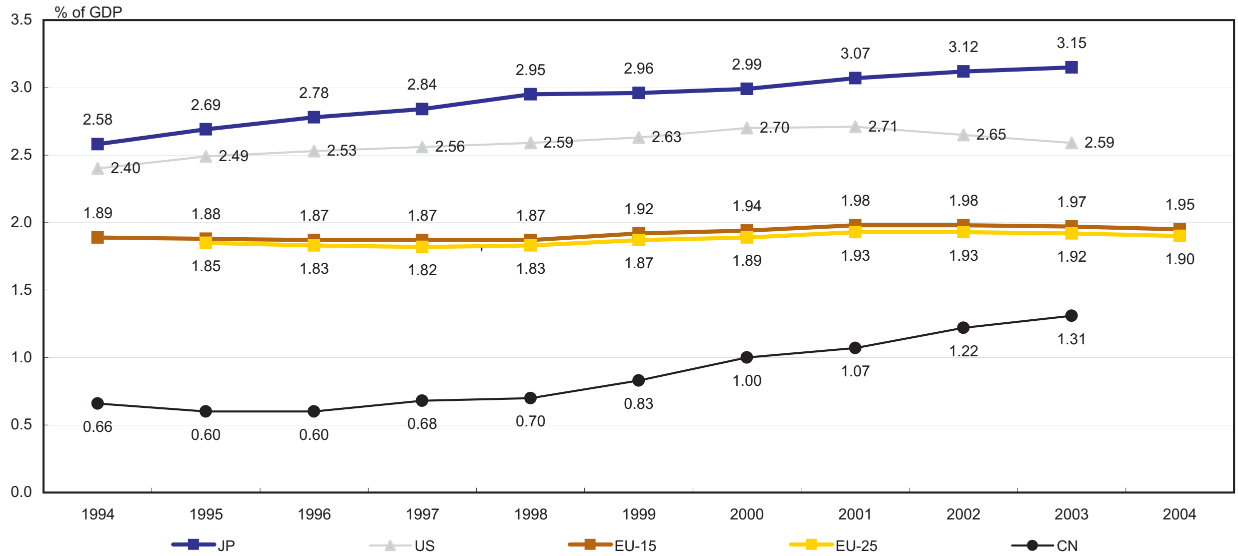
China, which was well down in terms of R&D as a percentage of GDP, narrowed the gap between 1996 and 2003. Whereas in 1996 China's R&D intensity stood at around one third of the EU-25's, it already exceeded two thirds by 2003.

As shown in Figure 2.2, EU-25 devoted EUR 188 billion to R&D expenditure in 2003 as compared to EUR 252 billion for the United States and EUR 120 billion for Japan. Whereas the nominal amounts for European aggregates grew steadily, the amounts for Japan and the United Sates increased from 1999 to 2001 but fell from 2001 to 2003.

Most of R&D expenditure takes place in the business enterprise sector (BES). In 2003, the BES accounted for 64.1% of R&D expenditure in the EU-25, which is below the levels in the United States (68.9%) and Japan (75.0%). Between 1999 and 2003, this ratio decreased slightly for the EU-25, by 0.7 percentage point compared to 1999, and more significantly for the Unites States (6.0 percentage points). By contrast, the BES share of R&D expenditure grew in Japan (4.3 percentage points).

Figure 2.1

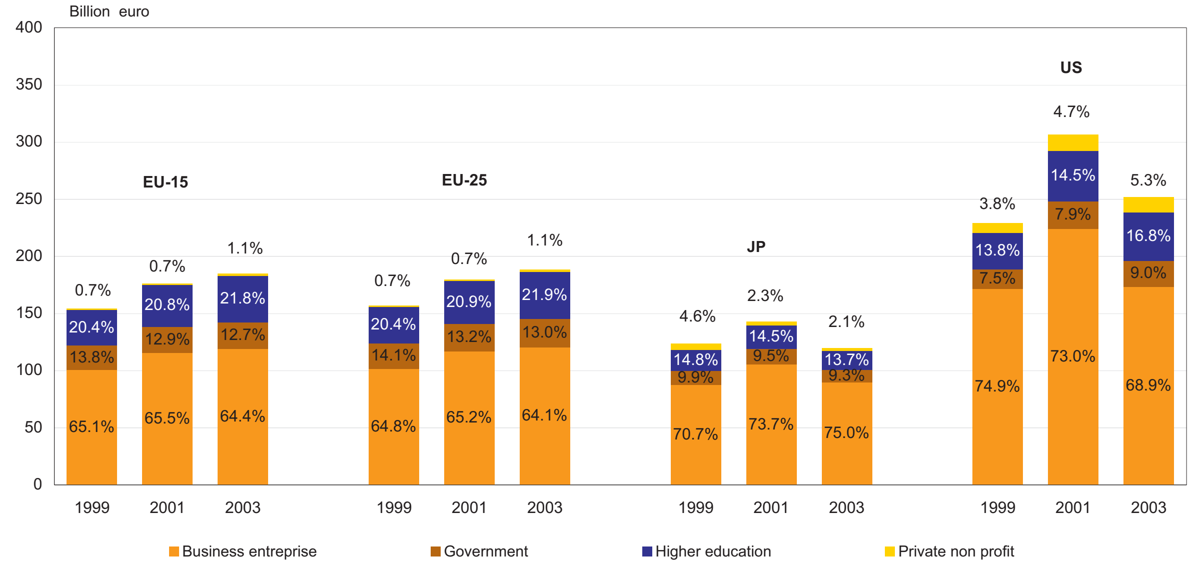
R&D expenditure as a percentage of GDP, all sectors, EU-25, EU-15, China, Japan and the United States - 1994 to 2004



Eurostat estimates: EU-15 and EU-25.
Provisional data: US 2002 and 2003.
Break in series: US 1998, JP 1996, CN 2000.
Estimates: JP 1994.
US: Excludes most or all capital expenditure.

Figure 2.2

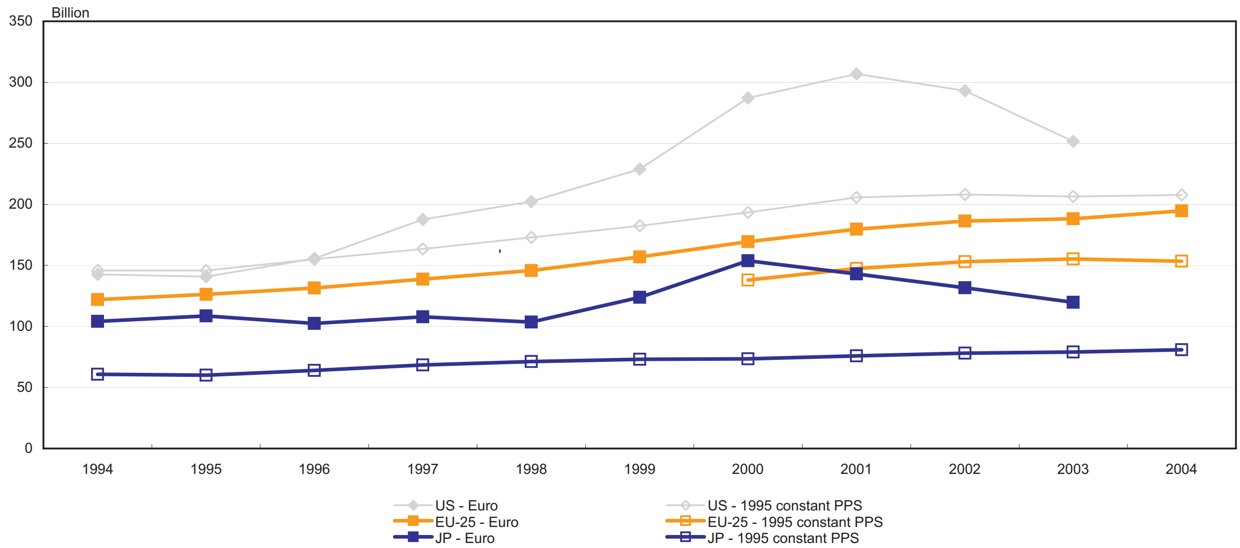
R&D expenditure in billion euro, by sector of performance, EU-25, EU-15, Japan and the United States - 1999, 2001, 2003



Eurostat estimates: EU-15 and EU-25.
Provisional data: US 2003.
Break in series: JP 2001.
US: BES, HES, PNP: Excludes most or all capital expenditure,
GOV: Federal or central government only.

Figure 2.3

R&D expenditure in billion euro and billion 1995 constant PPS, all sectors, EU-25, Japan and the United States - 1994 to 2004



Eurostat estimate: EU-25.
Provisional data: US 2002 and 2003.
Estimate: JP 1994.
Break in series: US 1998, JP 1996.
US: Excludes most or all capital expenditure.

Generally speaking, the shares of R&D expenditure are relatively stable for the higher education sector (HES), government sector (GOV) and the private non-profit sector (PNP). One exception to the rule concerns the HES in the United States, which gained 3.0 percentage points in 2003 compared to 2001.

As shown in Figure 2.3, the gaps for R&D expenditure between the United States on the one hand and the EU-25 and Japan on the other widened in absolute terms (EUR) between 1995 and 2001. In 1994, there was a difference of EUR 21 billion between the EU-25 and the United States, peaking by 2001 at EUR 127 billion. In 2003, the difference fell to EUR 64 billion.

Measured in real terms (1995 constant PPS), the growth and the differences between the United States and the other two blocks are more moderate.

Another way to measure S&T:
Investment in knowledge

Measuring investment in knowledge

Investment in knowledge is defined and calculated as the sum of:

- expenditure on R&D,
- expenditure on total higher education from both public and private sources, and
- expenditure on software.

Simple summation of the three components would lead to an overestimation of investment in knowledge owing to overlaps (R&D and software, R&D and education, software and education). So before calculating total investment in knowledge, the data has to be reworked to derive figures that meet the definition.

Main findings

- In 2002 investment in knowledge amounted to 5.2% of GDP in the OECD area, a share that has increased over time. If expenditure for all levels of education were included, investment in knowledge would be in excess of 9% of GDP for the OECD area.

- The United States invests most in knowledge (6.6%), followed by Japan (5.0%) and the EU (3.8%). The United States and Japan are also moving more rapidly towards a knowledge-based economy than the EU: since 1994, their investment in knowledge to GDP ratios have grown at a higher rate than in the EU.

- The ratio of investment in knowledge to GDP varied from 1.8% to 6.8% across OECD countries. The share was lowest in southern European countries and highest in Nordic countries, Korea and the United States.

- For all the reported countries, except Ireland, the ratio of investment in knowledge to GDP was higher in 2002 than in 1994. For most countries, increases in software expenditure were the major source of increased investment in knowledge. Notable exceptions are Finland (R&D expenditure was the main source of increase) and Greece (higher education and software were the main sources of increase).

Source: OECD Science, Technology and Industry Scoreboard 2005.

2.3 R&D expenditure at the national level

2

R&D intensity

Sweden, Finland and Iceland are the top European countries in terms of R&D expenditure as a percentage of GDP. In absolute terms, Germany is streets ahead

In 2004, the leading countries in terms of R&D intensity were Sweden, Finland and Iceland, with 3.74%, 3.51% and 3.01% of GDP devoted to R&D expenditure, respectively. With ratios above 3%, they even outstripped the United States (2.59% in 2003), but Japan too passed the 3% mark (3.15% in 2003).

Other EU-25 Member States with R&D intensity rates above the EU-25 average of 1.90% are Denmark (2.61%), Germany (2.49%), Austria (2.26%), France (2.16%) and Belgium (1.93%).

Looking at 2002, 2003 and 2004 figures for all sectors, R&D intensity increased most in Estonia and Austria as a proportion of GDP, whereas in Hungary and the United Kingdom the figures were lower for these years.

Table 2.4 **R&D expenditure as a percentage of GDP, by sector of performance, EU-25 and selected countries - 2002 to 2004**

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004
EU-25	1.93 s	1.92 s	1.90 sp	1.24 s	1.23 s	1.22 sp	0.25 s	0.25 s	0.24 sp	0.42 s	0.42 s	0.41 sp
EU-15	1.98 s	1.97 s	1.95 sp	1.28 s	1.27 s	1.26 sp	0.25 s	0.25 s	0.24 sp	0.43 s	0.43 s	0.43 sp
BE	1.99	1.92	1.93 f	1.40	1.34	1.32 f	0.14	0.13	0.15 f	0.42	0.43	0.43 f
CZ	1.22	1.26	1.28	0.75	0.77	0.81	0.28	0.29	0.27	0.19	0.19	0.19
DK	2.55 r	2.59 r	2.61 p	1.76	1.79 r	1.81 p	0.19 r	0.18	0.17 p	0.59	0.60	0.62 p
DE	2.49	2.52	2.49 e	1.72	1.76	1.75 p	0.34	0.34	0.33 e	0.42	0.43	0.41 e
EE	0.75	0.82	0.91 p	0.23	0.28	0.36 p	0.13	0.13	0.12	0.36	0.39	0.42
EL	:	0.62 p	0.58 p	:	0.19 p	0.17 p	:	0.13	0.12 p	:	0.30	0.28 p
ES	0.99	1.05	1.07	0.54	0.57	0.58	0.15	0.16	0.17	0.29	0.32	0.32
FR	2.23	2.18	2.16 p	1.41	1.37	1.36 p	0.37	0.36	0.36 p	0.42	0.42	0.41 p
IE	1.10 r	1.16 r	1.20 r	0.76 r	0.77	0.77 e	0.10	0.09	0.09	0.25	0.29 r	0.33
IT	1.16	1.14	:	0.56	0.54	0.56 p	0.20	0.20	0.17 p	0.38	0.38	:
CY	0.31	0.35	0.37 p	0.06	0.08	0.08 p	0.12	0.13	0.14 p	0.09	0.12	0.13 p
LV	0.42	0.38	0.42	0.17	0.13	0.19	0.08	0.09	0.08	0.17	0.16	0.15
LT	0.67	0.68	0.76	0.11	0.14	0.16	0.22	0.18	0.19	0.33	0.36	0.41
LU	:	1.78 i	1.75 f	:	1.58	1.54 f	0.17	0.19	0.19 p		0.01 ui	0.02 ui
HU	1.02 i	0.95 i	0.89 i	0.36	0.35	0.37	0.34	0.30	0.26	0.26	0.26	0.22
MT	0.28	0.27	0.29 u	0.07	0.08 p	0.10 u	0.05	0.02	0.02	0.16	0.17	0.18
NL	1.72	1.76	1.77 p	0.98	1.01	1.02 p	0.24	0.25 b	0.25 p	0.50	0.49	0.50 e
AT	2.12	2.19 e	2.26 e	1.42	:	:	0.12	:	:	0.57	:	:
PL	0.58	0.56	0.58	0.12	0.15	0.17	0.26	0.23	0.23	0.20	0.18	0.19
PT	0.80 e	0.78	:	0.26 e	0.26	:	0.15 e	0.13	:	0.30 e	0.30	:
SI	1.53	1.54 e	1.61 e	0.91	0.90 e	0.96 e	0.35	0.35 e	0.35 e	0.24	0.25 e	0.25 e
SK	0.58	0.58	0.53	0.37	0.32	0.26	0.15	0.18	0.16	0.05	0.08	0.11
FI	3.43	3.48	3.51	2.40	2.45	2.46	0.36	0.34	0.33	0.66	0.67	0.69
SE	:	3.98	3.74	:	2.95	2.75	:	0.14	0.12	:	0.88	0.86
UK	1.89	1.88	1.79 e	1.25	1.24	1.16	0.17	0.18 r	0.18 e	0.42	0.40	0.39 e
IS	3.14 f	2.97	3.01	1.80 f	1.54	1.70	0.77 f	0.74	0.63	0.51 f	0.63	0.61
NO	1.67	1.75	1.64	0.96	1.00	0.90	0.26	0.26	0.26	0.45	0.48	0.49
EEA	1.92 s	1.92 s	1.90 s	1.24 s	1.22 r	1.22 s	0.25 s	0.25 s	0.24 s	0.42 s	0.42 s	0.42 s
CH	:	:	:	:	:	:	0.03	:	:	0.64	:	:
BG	0.49	0.50	0.51	0.09	0.10	0.12	0.35	0.35	0.34	0.05	0.05	0.05
HR	1.12	1.14	:	0.48	0.45	:	0.25	0.25	:	0.39	0.45	:
RO	0.38	0.40	0.40	0.23	0.23	0.22	0.09	0.13	0.14	0.06	0.04	0.04
TR	0.66	:	:	0.19	:	:	0.05	:	:	0.43	:	:
CN	1.22	1.31	:	0.75	0.82	:	0.35	0.36	:	0.12	0.14	:
JP	3.12	3.15	:	2.32	2.36	:	0.30	0.29	:	0.43	0.43	:
RU	1.25	1.29 r	1.17	0.87	0.88	0.81	0.31	0.33	0.30	0.07	0.08	0.06
US	2.65 pi	2.59 pi	:	1.86 pi	1.79 pi	:	0.23 pi	0.23 pi	:	0.42 pi	0.43 pi	:

LU - HES - 2004: data not available for the University of Luxembourg.
LU - TOTAL, HES - 2003: 2001 data.
US - TOTAL, HES, BES - 2002, 2003: Excludes most or all capital expenditure.
HU - TOTAL - 2002, 2004: Including expenditures not allocated to R&D units.

Looking at the sector figures in Table 2.4, the following trends emerge. In 2004 in the business enterprise sector (BES), Sweden (2.75%) and Finland (2.46%) had the highest R&D intensity. The highest increase compared to the previous year was recorded by Iceland (0.16 percentage points between 2003 and 2004) and Estonia (0.08 percentage points). Despite having by far the highest level, the Swedish figure fell in 2004 by 0.20 percentage points compared to 2003.

In the government sector (GOV), the highest ratios were reported in 2004 by Iceland (0.63%), France (0.36%) and Slovenia (0.35%), whereas in the higher education sector (HES) the Nordic countries Sweden (0.86%), Finland (0.69%) and Denmark (0.62%) were out ahead.

R&D intensity in the new Member States is on average lower than in EU-25. Although R&D intensity is above 1.20% for the Czech Republic and Slovenia, the rest of the new Member States returned figures below 1% in 2004. Slovenia (0.96%) and the Czech Republic (0.81%) had particularly high figures in the BES.

Figure 2.5 sets out a scatter chart where countries are placed according to the annual average growth rate (AAGR) from 1999 to 2004 for R&D as a percentage of GDP (Y axis) and according to R&D as a percentage of GDP (X axis). The Lisbon target of R&D as 3% of GDP is shown as a vertical line, along with the EU-25 average.

China had by far the highest AAGR (more than 12%), followed by Cyprus and Lithuania.

It is interesting to observe that the EU-25 Member States with an R&D intensity above the EU-25 average had, with the exception of Belgium, a consistently positive AAGR.

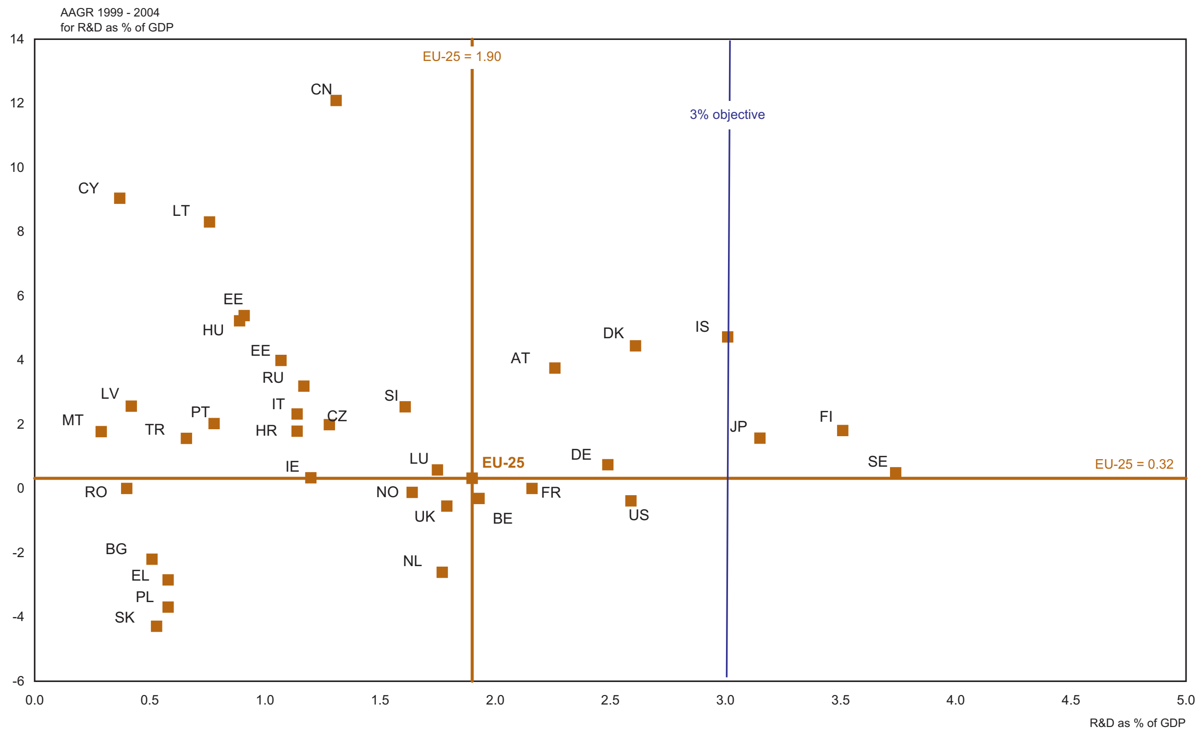
The relaunched Lisbon strategy

Investing more in knowledge and innovation

In view of the importance of R&D for future growth and in providing solutions for many of the problems confronting our society today, the European Council reiterates the commitment entered into at Barcelona, welcomes the progress made concerning setting specific national targets and calls upon all Member States to promote policies and actions aiming at the established overall 3% objective by 2010, taking into account the different starting points of Member States.

Source: Brussels European Council, 23/24 March 2006.

Figure 2.5 **R&D as a percentage of GDP in 2004 and annual average growth rate (AAGR) 1999 - 2004, all sectors, EU-25 and selected countries**



Exceptions to the reference year 2004: IT, PT, HR, CN, JP and US 2003; TR 2002.
Exceptions to the reference period 1999-2004: LU 2000-2004; MT 2002-2004; IT, PT, CN, JP and US 1999-2003; TR 1999-2002.
Forecast: BE, LU.

Provisional data: DK, EE, EL, FR, CY, NL.
Estimates: DE, AT, SI, UK.
Eurostat estimate: EU-25.
US: Excludes most or all capital expenditure.
HU: Including expenditures not allocated to R&D units.

R&D expenditure in volume

Whilst larger economies dominate in absolute terms, R&D expenditure grew fastest in the new Member States

As shown in Table 2.6, most of the R&D in the EU-25 is done in Germany (EUR 55.1 billion), France (EUR 35.6 billion) and the United Kingdom (EUR 30.6 billion). These three countries account for almost 2/3 of total R&D expenditure in EU-25, that is even more than their weight in terms of EU-25 GDP (54%).

In contrast, the top three countries in terms of R&D intensity, Sweden, Finland and Denmark, account for only 10.7% of the EU-25 total.

In general, the highest AAGR from 1999 to 2004 can be found in the new Member States: Lithuania (21.5%), Hungary (18.5%), Estonia (17.7%) and Cyprus (16.2%). Very high AAGR can be observed in the Russian Federation (24.7%) and China (20.9%). It has to be borne in mind, though, for those countries that the absolute figures and the figures as a percentage of GDP are in general very low compared to the United States, Japan and the EU-15 Member States which had lower AAGR.

Table 2.6 **R&D expenditure in million euro, AGR and AAGR, all sectors, EU-25 and selected countries - 1999 to 2004**

	R&D expenditure in million euro						Annual growth rate of R&D expenditure (euro) in %					AAGR (euro) 1999 - 2004 in %
	1999	2000	2001	2002	2003	2004	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004	
EU-25	156 909 s	169 418 s	179 629 s	186 349 s	188 222 s	194 650 sp	8.0	6.0	3.7	1.0	3.4	4.4
EU-15	154 332 s	166 471 s	176 264 s	182 806 s	184 702 s	190 808 sp	7.9	5.9	3.7	1.0	3.3	4.3
BE	4 618	4 964	5 373	5 201	5 177	5 465 f	7.5	8.2	-3.2	-0.4	5.5	3.4
CZ	641	744	832	959	1 013	1 100	16.1	11.8	15.3	5.5	8.6	11.4
DK	3 406	3 892	4 265	4 634 r	4 851 r	5 066 p	14.3	9.6	8.6	4.7	4.4	8.3
DE	48 191	50 619	52 002	53 363	54 538	55 100 e	5.0	2.7	2.6	2.2	1.0	2.7
EE	37	37	49	56	67	83 p	1.1	31.8	14.2	20.0	23.7	17.7
EL	795	:	841	:	951 p	967 p	:	:	:	:	1.7	:
ES	4 995	5 719	6 227	7 194	8 213	8 946	14.5	8.9	15.5	14.2	8.9	12.4
FR	29 529	30 954 b	32 887	34 527	34 569	35 648 p	4.8	6.2	5.0	0.1	3.1	3.8
IE	1 068	1 183	1 315	1 435 r	1 610 r	1 780 r	10.8	11.1	9.1	12.2	10.6	10.8
IT	11 524	12 460	13 572	14 600	14 769	:	8.1	8.9	7.6	1.2	:	6.4
CY	21	25	27	34	41	46 p	14.3	12.1	22.9	21.3	11.1	16.2
LV	25	38	38	42	38	47	51.4	0.6	10.0	-9.2	23.8	13.5
LT	52	73	91	100	111	137	41.4	24.9	9.2	11.0	23.8	21.5
LU	:	364	:	:	426 i	448 f	:	:	:	:	5.2	5.3
HU	309	405	548	706 i	693 i	721 i	31.0	35.2	28.8	-1.8	4.1	18.5
MT	:	:	:	12	11	12 u	:	:	:	-3.4	8.9	2.5
NL	7 563	7 655	8 090	8 018	8 376	8 657 p	1.2	5.7	-0.9	4.5	3.4	2.7
AT	3 762	4 029	4 393	4 684	4 975 e	5 346 e	7.1	9.0	6.6	6.2	7.5	7.3
PL	1 086	1 197	1 323	1 172	1 036	1 139	10.2	10.6	-11.4	-11.6	9.9	1.0
PT	815	:	1 038	1 029 e	1 020	:	:	:	-0.9	-0.9	:	5.8
SI	284	297	341	360	377 e	418 e	4.8	14.8	5.6	4.7	10.7	8.1
SK	126	143	149	148	169	174	13.5	4.5	-0.7	14.0	2.9	6.7
FI	3 879	4 423	4 619	4 830	5 005	5 253	14.0	4.4	4.6	3.6	5.0	6.3
SE	8 608	:	10 459	:	10 642	10 426	:	:	:	:	-2.0	3.9
UK	25 301	28 787	30 254	31 515	30 092	30 644 e	13.8	5.1	4.2	-4.5	1.8	3.9
IS	188	251 e	261	280 f	274	297	33.6	3.6	7.3	-2.1	8.4	9.5
NO	2 445	:	3 037	3 388	3 411	3 309	:	:	11.6	0.7	-3.0	6.2
EEA	159 544 s	172 417 s	182 927 s	190 017 s	191 907 s	198 622 sp	8.1	6.1	3.9	1.0	3.5	4.5
CH	:	6 852	:	:	:	:	:	:	:	:	:	:
BG	69	71	71	81	89	99	3.8	-0.3	14.2	9.3	11.9	7.6
HR	:	:	:	271	292	:	:	:	:	7.9	:	7.9
RO	134	149	177	184	203	235	10.7	18.8	4.0	10.5	15.9	11.9
TR	1 094	1 389	1 172	1 280	:	:	27.0	-15.6	9.3	:	:	5.4
CN	7 695 i	11 714 b	14 063	16 452	16 444	:	52.2	20.0	17.0	0.0	:	20.9
JP	123 909	153 860	143 015	131 726	119 748	:	24.2	-7.0	-7.9	-9.1	:	-0.9
RU	1 812	2 948	4 025	4 545	4 899 r	5 473	62.7	36.5	12.9	7.8	11.7	24.7
US	228 958 i	287 131 i	306 786 i	293 041 pi	251 577 pi	:	25.4	6.8	-4.5	-14.1	:	2.4

LU - 2003: 2001 data for HES.
US: Excludes most or all capital expenditure.
HU - 2002, 2004: Including expenditures not allocated to R&D units.
CN - 1999: Underestimated or based on underestimated data.

Exceptions to the reference period 1999-2004 for the AAGR:
LU 2000-2004; MT 2002-2004; HR 2002-2003; IT, PT, CN, JP and US 1999-2003; TR 1999-2002.

In 2004, Poland and the Czech Republic were the only new Member States to exceed one billion euro in R&D expenditure - Table 2.6.

Looking at R&D expenditure by sector of performance gives some very interesting results (Table 2.7). In the BES, Estonia and Lithuania achieved an AAGR from 2002 to 2004 of more than 30%. In the GOV, the AAGR ranged between -39.9% for Malta and 16.1% for Slovakia. In the HES, the high AAGR of 166.7% for Luxembourg can be explained by the creation of the University of Luxembourg. Next in the ranking were Slovakia (61.1%), Cyprus (27.0%) and Ireland (23.6%).

Table 2.7

R&D expenditure in million euro and AAGR, by sector of performance, EU-25 and selected countries - 2002 to 2004

	Business enterprise sector				Government sector				Higher education sector			
	2002	2003	2004	AAGR 2002-2004 in %	2002	2003	2004	AAGR 2002-2004 in %	2002	2003	2004	AAGR 2002-2004 in %
EU-25	119 951 s	120 581 s	125 172 sp	2.2	24 138 s	24 480 s	24 850 sp	1.5	40 366 s	41 151 s	42 577 sp	2.7
EU-15	118 505 s	119 039 s	123 418 sp	2.1	22 964 s	23 401 s	23 745 sp	1.7	39 462 s	40 274 s	41 621 sp	2.7
BE	3 662	3 608	3 747 f	1.1	373	354	417 f	5.8	1 100	1 150	1 232 f	5.8
CZ	586	618	701	9.3	220	236	233	2.8	150	155	162	4.1
DK	3 198	3 355 r	3 516 p	4.8	341 r	337	323 p	-2.7	1 068	1 126	1 200 p	6.0
DE	36 950	38 029	38 800 p	2.5	7 333	7 307	7 300 e	-0.2	9 080	9 202	9 000 e	-0.4
EE	17	23	32 p	37.4	9	11	11	7.7	27	32	38	18.8
EL	:	286 p	285 p	-0.5	:	198	203 p	2.1	:	457	470 p	2.8
ES	3 926	4 443	4 865	11.3	1 108	1 262	1 428	13.5	2 142	2 492	2 642	11.1
FR	21 839	21 646	22 409 p	1.3	5 709	5 767	5 956 p	2.1	6 512	6 693	6 823 p	2.4
IE	988 r	1 076	1 150 e	7.9	125	127	138 r	5.1	322	407 r	492	23.6
IT	7 057	6 979	7 501 p	3.1	2 565	2 582	2 337 p	-4.5	4 792	5 000	:	4.3
CY	7	9	9 p	17.3	14	16	17 p	10.8	10	13	16 p	27.0
LV	17	13	21	10.6	8	9	9	7.3	17	16	17	0.5
LT	17	23	29	32.2	33	29	34	0.7	50	58	74	22.0
LU	:	379	395 f	4.1	38	45	49 p	9.1	:	2 ui	4 ui	166.7
HU	250	255	297	8.8	232	217	213	-4.1	178	185	177	-0.1
MT	3	4 p	4 u	19.7	2	1	1	-39.9	7	7	8	4.1
NL	4 543	4 804	4 982 p	4.7	1 106	1 213 b	1 243 p	6.0	2 312	2 356	2 430 e	2.5
AT	3 131	:	:	:	266	:	:	:	1 266	:	:	:
PL	238	284	327	17.0	533	421	444	-8.7	398	329	364	-4.3
PT	334 e	338	:	1.2	194 e	172	:	-11.2	386 e	392	:	1.4
SI	215	222 e	249 e	7.5	83	86 e	91 e	4.6	56	60 e	66 e	8.4
SK	95	93	86	-5.3	39	53	53	16.1	13	22	35	61.1
FI	3 375	3 528	3 684	4.5	501	485	497	-0.3	926	962	1 040	6.0
SE	:	7 886	7 667	-2.8	:	371	325	-12.4	:	2 344	2 393	2.1
UK	20 849	19 778	19 897	-2.3	2 786	2 906 r	3 043 e	4.5	7 023	6 442	6 700 e	-2.3
IS	160 f	142	167	2.3	69 f	68	63	-4.5	45 f	58	60	15.3
NO	1 946	1 960	1 813	-3.5	535	515	514	-2.0	907	937	983	4.1
EEA	122 057 s	122 683 s	127 519 sp	2.2	24 742 s	25 063 s	25 427 sp	1.4	41 318 s	42 146 s	43 620 sp	2.7
CH	:	:	:	:	95	:	:	:	1 881	:	:	:
BG	15	18	23	24.7	58	62	67	7.1	8	9	9	5.8
HR	115	114	:	-1.1	60	64	:	6.5	95	114	:	19.6
RO	111	118	130	8.4	44	65	80	34.5	29	19	24	-8.8
TR	367	:	:	:	89	:	:	:	823	:	:	:
CN	10 066	10 256	:	1.9	4 719	4 455	:	-5.6	1 667	1 734	:	4.0
JP	98 059	89 783	:	-8.4	12 563	11 149	:	-11.3	18 286	16 358	:	-10.5
RU	3 176	3 353	3 780	9.1	1 112	1 239	1 383	11.5	247	297	299	10.1
US	205 810 pi	173 366 pi	:	-15.8	25 861 pi	22 761 pi	:	-12.0	46 508 pi	42 153 pi	:	-9.4

LU - HES - 2004: data not available for the University of Luxembourg.
LU - HES - 2003: 2001 data.
US - HES, BES - 2002, 2003: Excludes most or all capital expenditure.

Exceptions to the reference period 2002-2004 for the AAGR: EL, LU, SE 2003-2004; IT (for HES only), PT, HR, CN, JP and US 2002-2003.

Figure 2.8 (all sectors) clearly indicates that 'industry' is R&D's most important source of financing for the EU-15 countries, Iceland, Norway, Switzerland, China, Japan and the United States, although the share of 'industry' compared to other sources of R&D funding varies from country to country. For nine Member States of the EU-25 it accounts for more than 50% of total R&D expenditure.

The sources of finance are more balanced in the new Member States, the candidate countries and the Russian Federation. In these countries the share of the government sector is much more important than the BES. Only in the Czech Republic and in Slovenia the BES share is higher than the GOV share.

In Luxembourg, Finland, Germany, Sweden, Denmark, and Belgium, along with Japan, Switzerland, the Unites States and China, at least 60% of R&D expenditure is financed by 'industry'. Luxembourg is the leader by far, with 80% of funding coming from the BES. 'Government' financing, which is second to 'industry' in terms of importance, exceeds 60% in three countries: Lithuania, Poland, and Bulgaria.

The remaining sources, 'abroad' and 'other national sources', are of minor importance for all countries except for Malta, Austria, Latvia, the United Kingdom and Greece, where more than 15% of R&D expenditure is financed from 'abroad'.

Looking at the way R&D is conducted by the business enterprise sector (BES), it is interesting to consider the source of financing and the share of 'Industry' compared to other sources.

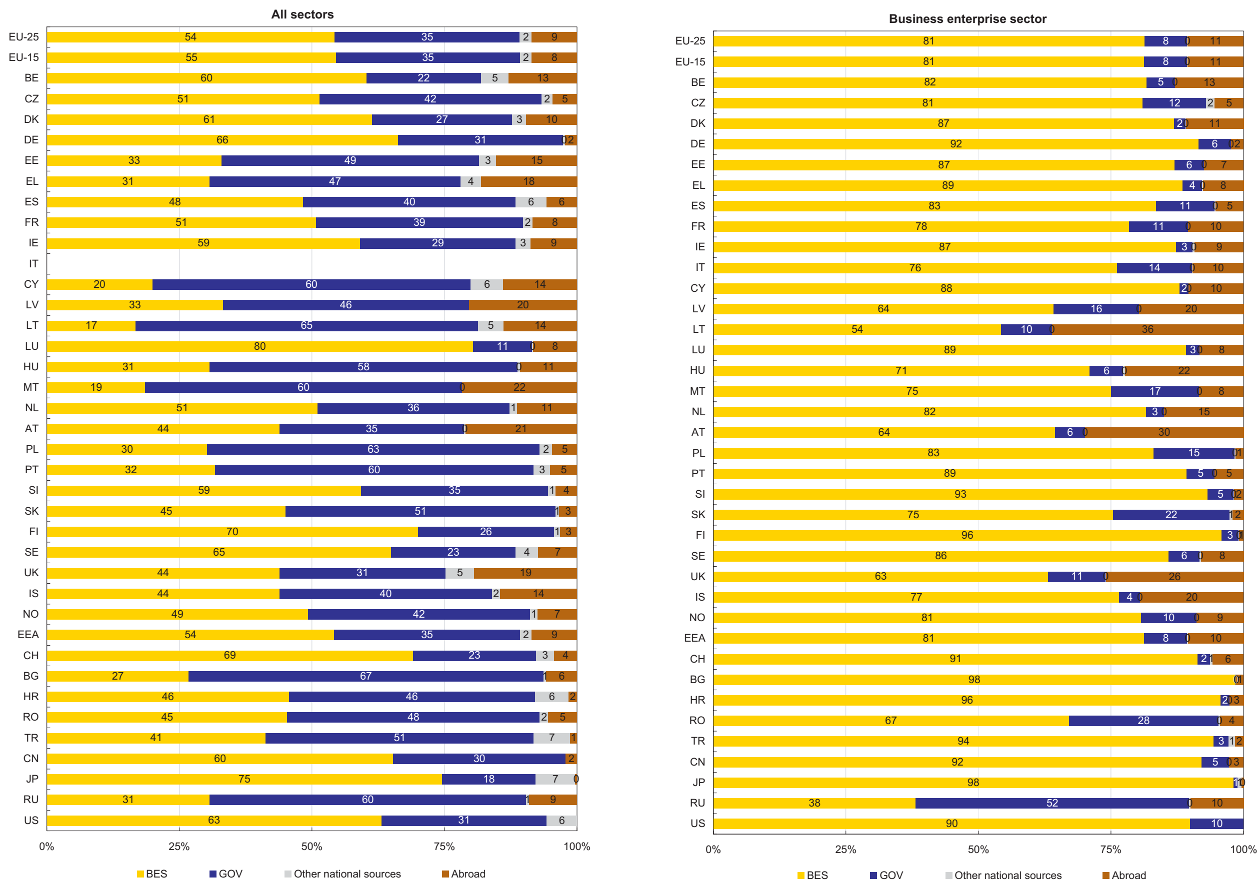
The relaunched Lisbon strategy

Investing more in knowledge and innovation

To provide more and better resources for research and innovation, Member States should **refocus their public expenditure** on research and innovation as well as **promote private sector R&D**.

Source: Brussels European Council, 23/24 March 2006 .

Figure 2.8 **Total and business enterprise R&D expenditure as a percentage of total, by source of funds, EU-25 and selected countries - 2003**



Exceptions to the reference year 2003: MT, HR and TR 2002.
Eurostat estimates: EU-25, EU-15 and EEA.
CN: The sum of the breakdown does not add up to the total, which means that the percentage by sources of funds is underestimated.

Figure 2.8 shows that for eleven EU-25 countries, 85% or more of R&D is financed by 'industry' (similar to the United States at 90%) while Finland is the only EU-25 country approaching Japan's level (98%).

Latvia, Austria, the United Kingdom and Lithuania, on the other hand, report that between 36% and 46% of R&D expenditure by 'industry' is financed by non-industry sources, such as 'government', 'abroad' and 'other national sources'. In the Russian Federation only 38% of business R&D expenditure is financed by 'industry', compared with 52% by 'government'.

The share of government-financed R&D done by the business enterprise sector is particularly high in Romania (28%), Slovakia (22%) and Malta (17%).

Table 2.9 gives a breakdown of business R&D expenditure by sector of activity based on NACE codes. 'Manufacturing' is for EU-25 by far the most important sector of activity, accounting for 82%, followed by 'services' with about 17%. The sum of the other sector adds up to only 1%. With EUR 34.6 billion, Germany was up front in absolute terms in 'manufacturing', whereas the United Kingdom ranked second (EUR 15.2 billion). The United Kingdom ranked first in 'services' with EUR 4.2 billion.

Table 2.9

Business enterprise R&D expenditure in million euro, by sector of activity, EU-25 and selected countries - 2003

	Total	Agriculture, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Services
EU-25	120 581 s	:	:	98 274 s	:	:	20 207 s
EU-15	119 039 s	:	:	97 230 s	:	:	19 785 s
BE	3 608	46	6	2 834	26	57	638
CZ	618	2	1	393	0	8	214
DK	3 449	:c	:c	2 044	:c	11	1 388
DE	38 029	72	25	34 581	81	30	3 239
EE	23	:	:c	10	:c	1	12
EL	286	1	2	188	0	1	94
ES	4 443	30	14	2 375	56	70	1 898
FR	:	:	:	:	:	:	:
IE	1 076	3	0	667	0	0	406
IT	6 979	:	26	5 150	34	14	1 755
CY	9	0	:	4	0	0	5
LV	13	:	:	4	:	0	9
LT	23	:	1	14	2	:	7
LU	379	:	:	179	0	:	200
HU	255	5	0	196	2	1	51
MT	3	:	0	2	0	0	0
NL	4 804	68	95	3 750	24	29	839
AT	3 131	2	3	2 273	14	12	828
PL	284	9	12	194	2	18	48
PT	338	1	1	151	3	4	179
SI	222 e	0 e	6 e	192 e	0	0	25 e
SK	93	2	0	37	:c	:c	54
FI	3 528	1	6	2 800	8	41	672
SE	7 886	23	7	6 336	54	:	1 466
UK	19 778	174	81	15 224	99	44	4 156
IS	141	3	0	138	1	1	96
NO	1 960	42	111	890	7	31	878
CH	5 065	:	:	3 935	:	10	1 120
BG	18	0	0	9	0	0	9
HR	114	4	:	10	0	3	97
RO	118	17	9	73	3	1	15
TR	367	3	1	318	3	0	43
RU	3 176	4	11	216	:	0	2 945

Exceptions to the reference year 2003: MT, AT, TR and RU 2002; CH 2000.

2

One of the results to emerge from an analysis of Table 2.10 on business enterprise R&D expenditure by size class is that the level of R&D expenditure by the BES increases with the size of enterprise for all EU-25 Member States spending more than EUR 1 billion. The sole exception is Ireland, where 'medium enterprises' account for higher amounts of expenditure than 'large enterprises'.

This general rule also held true in the Czech Republic, Luxembourg, Hungary, Bulgaria and Romania, but not in most of the very small countries as they will tend not to have the same proportion of 'large enterprises' as larger countries.

The situation was totally reversed in Russia, where most of business enterprise R&D expenditure was spent in small and medium size enterprises.

It is interesting to take a look at the Danish figures. Comparing 2002 with 2003, BES R&D expenditure by 'small and medium enterprises' decreased, whereas it grew for 'large enterprises'.

Table 2.10 **Business enterprise R&D expenditure in million euro by size class([1]), EU-25 and selected countries - 2002 and 2003**

	Total		Small enterprises		Medium enterprises		Large enterprises	
	2002	2003	2002	2003	2002	2003	2002	2003
EU-25	119 951	120 581	:	:	:	:	:	:
EU-15	118 505	119 039	:	:	:	:	:	:
BE	3 662	3 608	541	577	1 150	1 174	1 971	1 857
CZ	586	618	39	59	185	217	362	342
DK	3 198	3 449	729	456	1 029	877	1 440	2 116
DE	36 950	38 029	:	738	:	4 153	:	33 139
EE	17	23	6	5	7	10	3	7
EL	:	286	:	53	:	117	:	116
ES	3 926	4 443	591	841	1 586	1 706	1 750	1 897
FR	21 839	21 646	1 060	1 436	3 662	3 855	17 117	16 356
IE	988	1 076	229	248	406	442	354	385
IT	:	6 979	:	355	:	1 547	:	5 077
CY	7	9	3	3	2	2	1	4
LV	17	13	6	7	8	4	2	3
LT	17	23	4	2	8	15	6	6
LU	:	379	:	32	:	69	:	278
HU	250	255	31	26	62	55	158	169
MT	3	4	1	:	2	:	0.2	:
NL	4 543	4 804	422	387	:c	:c	:c	:c
AT	3 131	:	268	:	914	:	1 949	:
PL	238	284	29	19	116	157	93	108
PT	334 e	338	49	66	132	138	153 e	134
SI	215	222	:	:	:	:	:	:
SK	95	93	7.4	14	61.1	51	27	28
FI	3 375	3 528	349	309	801	734	2 225	2 485
SE	:	7 886	:	:	:	1 420	:	6 466
UK	20 849	19 778	1 372	1 149	4 856	4 662	14 621	13 967
IS	160	142	:	:	:	:	:	:
NO	1 946	1 960	:	:	:	785	:	715
EEA	122 057 s	122 683 s	:	:	:	:	:	:
CH	:	:	:	:	:	:	:	:
BG	15	18	2	3	5	5	8	10
HR	115	114	:	:	:	:	:	:
RO	111	118	6	18	51	47	54	54
RU	3 176	3 353	1 288	:	1 738	:	150	:

([1]) Small enterprises: 0 to 49 employees,
Medium enterprises: 50 to 499 employees,
Large enterprises: more than 500 employees.

Table 2.11, focusing on the government sector, gives a breakdown of R&D expenditure by fields of science, based on definitions in the OECD's Frascati Manual. (See methodological notes).

Each country shows a different pattern, but as a general rule it seems that 'natural sciences' were give precedence compared to other fields of science. Eleven out of 20 EU-Member States for which data were available got the highest percentage in this field of science. The United Kingdom gave absolute priority to 'natural sciences' with 96%.

For Ireland the main field of science in 2003 was 'agriculture' with 61%, whereas Belgium allocated the same percentage of R&D expenditure to 'engineering and technology'.

'Medical sciences', 'social sciences' and 'humanities' receive the lowest percentages of R&D expenditure in the government sector.

For the field 'medical sciences', Austria had the highest percentage (35%) of R&D expenditure among the other EU-25 Member States. Slovenia led with 26% in the field 'social sciences' while Estonia (36%) led in 'humanities'.

Table 2.11

R&D expenditure by fields of science in million euro and as a percentage of total, Government sector, EU-25 and selected countries - 2003

	Total	Agriculture		Engineering and technology		Medical sciences		Natural sciences		Social sciences		Humanities	
	Mio Euro	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%
EU-25	24 480 s	:	:	:	:	:	:	:	:	:	:	:	:
EU-15	23 401 s	:	:	:	:	:	:	:	:	:	:	:	:
BE	354	61	17	218	61	6	2	34	10	11	3	25	7
CZ	236	24	10	36	15	16	7	130	55	10	4	20	8
DK	337	102	30	51	15	55	16	85	25	26	8	18	5
DE	7 307	393	5	2 075	28	490	7	3 394	46	622	9	333	5
EE	11	1.5	14	0.9	9	2.0	19	2.0	19	0.4	4	3.8	36
EL	198	:	:	:	:	:	:	:	:	:	:	:	:
ES	1 262	215	17	341	27	393	31	209	17	69	5	34	3
FR	5 767	:	:	:	:	:	:	:	:	:	:	:	:
IE	127	77	61	8	6	15	12	7	5	10	8	10	8
IT	2 582	225	9	313	12	431	17	1 230	48	342	13	41	2
CY	16	7.0	45	0.5	3	0.2	2	4.8	31	1.4	9	1.7	11
LV	9	1.8	21	0.5	6	0.2	2	5.2	59	1.1	12	0.0	0
LT	29	5	16	6	20	1	2	12	41	2	7	4	15
LU	45	1	2	21	46	6	13	7	15	10	22	1	1
HU	217	39	18	28	13	19	9	81	37	23	10	28	13
MT	1	:	:	:	:	:	:	:	:	:	:	:	:
NL	1 213 b	:	:	:	:	:	:	:	:	:	:	:	:
AT	266	34	13	14	5	94	35	25	9	38	14	63	24
PL	421	53	13	122	29	58	14	162	38	15	4	11	3
PT	172	45	26	35	20	23	13	47	27	17	10	6	3
SI	83	2	3	7	8	6	8	44	53	22	26	1	1
SK	53	8.1	15	9	18	6	12	20	38	9	17	0	1
FI	515	88	17	196	38	74	14	69	13	55	11	8	2
SE	371	:	:	:	:	:	:	:	:	:	:	:	:
UK	2 941	:	:	:	:	:	:	:	:	:	:	:	:
NO	515	117	23	84	16	47	9	128	25	119	23	20	4
EEA	25 063 s	:	:	:	:	:	:	:	:	:	:	:	:
CH	95	:	:	:	:	:	:	:	:	:	:	:	:
BG	62	19	31	9	14	2	3	25	40	2	3	5	9
HR	64	4	6	4	6	8	12	31	48	11	18	7	11
RO	65	5	7	18	27	15	23	21	32	5	8	3	4
TR	90	:	:	:	:	:	:	:	:	:	:	:	:
CN	3 687 b	218 b	6 b	2 785 b	76 b	137 b	4 b	485 b	13 b	:	:	:	:
JP	11 149	1 854	17	4 972	45	604	5	3 430	31	:	:	:	:
RU	1 239	59	5	546	44	82	7	482	39	33	3	36	3
US	22 761 pi	:	:	:	:	:	:	:	:	:	:	:	:

Exception to the reference year 2003: CN 2000.
US: Federal or central government only.
FI: EUR 25 million are not classified by FOS and therefore the sum of the breakdown does not add up to the total.

Table 2.12 covers the same breakdown of R&D expenditure as Table 2.11, but this time for the higher education sector.

In 2003, 'natural sciences' accounted for the largest share of R&D expenditure in higher education in ten EU-25 Member States for which data were available. It was also the main field of science in the United States. At 52%, the rankings in this field were topped by Latvia.

'Engineering and technology' was the top field of science in Slovenia, the Czech Republic, Lithuania, Poland and Spain, while 'Medical sciences' led in Sweden, Norway, the Netherlands, Denmark and Belgium.

'Social sciences' was the main field in higher education sector only for Luxembourg (53%). However 'social sciences' accounted for a substantial share in Cyprus, Portugal, Spain and Finland.

None of the countries allocate the largest part of R&D expenditure in the higher education sector to 'agriculture' or 'humanities'. However, 'agriculture' accounted for at least 10% of R&D expenditure in higher education in Slovenia (17%), Slovakia (15%), Belgium (11%) and Hungary (10%).

Cyprus and Denmark, with 17% and 16% respectively, had the highest share of R&D expenditure devoted to 'humanities'.

Table 2.12 **R&D expenditure by field of science in million euro and as a percentage of total, higher education sector, EU-25 and selected countries - 2003**

	Total	Agriculture		Engineering and technology		Medical sciences		Natural sciences		Social sciences		Humanities	
	Mio Euro	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%	Mio Euro	%
EU-25	41 151 s	:	:	:	:	:	:	:	:	:	:	:	:
EU-15	40 274 s	:	:	:	:	:	:	:	:	:	:	:	:
BE	1 059	116	11	176	17	263	25	255	24	169	16	80	8
CZ	155	12	8	64	41	24	15	32	21	15	10	8	5
DK	1 126	52	5	134	12	305	27	298	26	157	14	179	16
DE	9 202	359	4	1 909	21	2 387	26	2 645	29	788	9	1 093	12
EE	32	3	8	8	26	3.0	9	12	37	4	13	2	6
EL	457	:	:	:	:	:	:	:	:	:	:	:	:
ES	2 492	61	2	586	24	354	14	563	23	542	22	384	15
FR	6 693	:	:	:	:	:	:	:	:	:	:	:	:
IE	420 e	10 e	2 e	68 e	16 e	72 e	17 e	160 e	38 e	70 e	17 e	40 e	10 e
IT	5 000	:	:	:	:	:	:	:	:	:	:	:	:
CY	13	:	:	0.7	5	0.1	1	6.0	45	4.4	32	2.3	17
LV	16	1.2	7	3.0	19	1.0	6	8.3	52	1.2	8	1.2	8
LT	58	3	6	17	29	12	20	11	19	10	17	5	9
LU	2	0.0	0	0.2	12	0.1	6	0.3	19	0.8	53	0.2	10
HU	185	19	10	37	20	26	14	40	22	28	15	35	19
MT	7	:	:	:	:	:	:	:	:	:	:	:	:
NL	2 184	119	5	486	22	605	28	388	18	:	:	:	:
AT	1 266	70	6	173	14	334	26	387	31	166	13	136	11
PL	329	26	8	113	34	42	13	82	25	46	14	19	6
PT	392	30	8	82	21	31	8	119	30	94	24	36	9
SI	56	9	17	25	44	6	11	4	7	8	15	4	6
SK	22	3	15	5	23	2	11	9	41	2	7	1	3
FI	962	23	2	184	19	232	24	251	26	192	20	80	8
SE	2 033	107	5	518	25	583	29	374	18	266	13	122	6
UK	6 442	:	:	:	:	:	:	:	:	:	:	:	:
NO	937	47	5	112	12	270	29	201	21	204	22	103	11
EEA	42 146 s	:	:	:	:	:	:	:	:	:	:	:	:
CH	1 881	:	:	184	10	337	18	375	20	:	:	:	:
BG	9	0.8	9	4.5	53	0.9	10	1.3	15	0.6	7	0.4	5
HR	114	13	11	28	25	15	13	14	12	30	26	15	13
RO	19	0.5	3	12	62	3.3	17	1.1	6	1.0	5	1.4	7
TR	823	69	8	83	10	477	58	32	4	105	13	58	7
CN	1 004	55	5	658	66	65	7	204	20	:	:	:	:
JP	16 358	703	4	4 043	25	4 370	27	1 972	12	:	:	:	:
RU	297	5	2	150	50	8	3	98	33	28	9	8	3
US	44 377 i	2 588 i	6 i	5 582 i	13 i	11 363 i	26 i	14 751 i	33 i	2 253 i	5 i	:	:

Exception to the reference year 2003:CN 2000.
US: Federal or central government only; excludes most or all capital expenditure; the sum of the breakdown does not add up to the total.
DE: EUR 21 million are not classified by FOS and therefore the sum of the breakdown does not add up to the total.

2.4 R&D expenditure in the European regions

R&D intensity and regional disparities

At the regional level, Braunschweig (7.11% - 2001 data) and Stuttgart (4.86% - 2001 data) lead in terms of R&D intensity

According to Table 2.13, the top 15 regions in the EU-25 with the highest R&D expenditure as a percentage of GDP, i.e. R&D intensity, are mainly located in Germany (seven regions out of 15 were German). Braunschweig (DE) comes first with 7.11%, which is more than three times the EU-25 average. Stuttgart (DE) and Oberbayern (DE) follow, with 4.86% and 4.65% respectively. Apart from the seven German regions, the European top 15 features two regions each from Finland, France and Austria, one British and one Czech region.

The regions with high R&D intensity are the same regions where R&D activity is highly concentrated in terms of volume. For instance, the top four regions account for over 10% of the EU-25 total R&D expenditure. This figure reaches almost 20% when the leading ten regions are considered.

In terms of volume, the region Île de France was well ahead, with 7.9% of R&D expenditure in EU-25, but as ratio of GDP this region ranked only thirteenth.

Table 2.13 **Top 15 EU-25 regions in R&D expenditure as a percentage of GDP, all sectors - 2002**

Regions	as % of GDP	Euro	
		Mio	% of EU-25
EU-25	**1.93**	**186 349**	**100**
EU-15	**1.98**	**182 806**	**98.1**
Braunschweig (DE)	7.11	2 896	1.6
Stuttgart (DE)	4.86	6 146	3.4
Oberbayern (DE)	4.65	6 989	3.9
Berlin (DE)	4.21	3 222	1.8
Pohjois-Suomi (FI)	4.18	608	0.3
East of England (UK)	3.89	4 595	2.9
Tübingen (DE)	3.80	1 767	1.0
Etelä-Suomi (FI)	3.72	2 997	1.6
Karlsruhe (DE)	3.71	2 949	1.6
Midi-Pyrénées (FR)	3.69	2 133	1.1
Dresden (DE)	3.63	1 060	0.6
Stredni Cechy (CZ)	3.49	247	0.1
Île de France (FR)	3.49	14 671	7.9
Wien (AT)	3.49	2 021	1.1
Steiermark (AT)	3.49	907	0.5

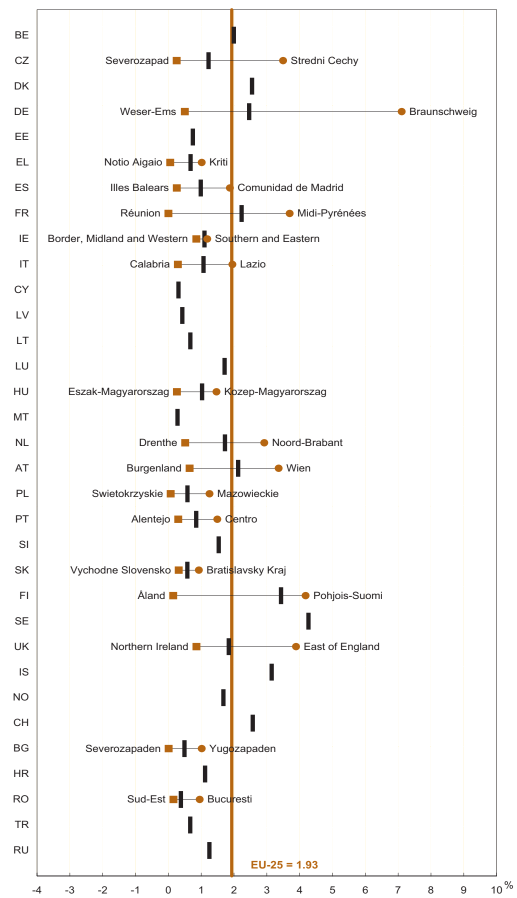
The expenditure ratio '% of EU-25' is calculated by using the same reference year for EU-25 as for the region.
Countries classified at NUTS level 1: UK.
Exceptions to the reference year 2002: DE 2001; UK 1999.

Four of the top 15 R&D regions were small in terms of volume of R&D expenditure (less than 1% of EU-25), but as ratio of GDP they were well ranked: Pohjois-Suomi (FI) ranked fifth, Dresden (DE) eleventh, Stredni Cechy (CZ) twelfth and Steiermark (AT) fifteenth.

Figure 2.14 shows the regional disparities for EU-25 Member States and selected countries. R&D intensity at the national level shows divergent performances by country when the leading region of each country is taken into account.

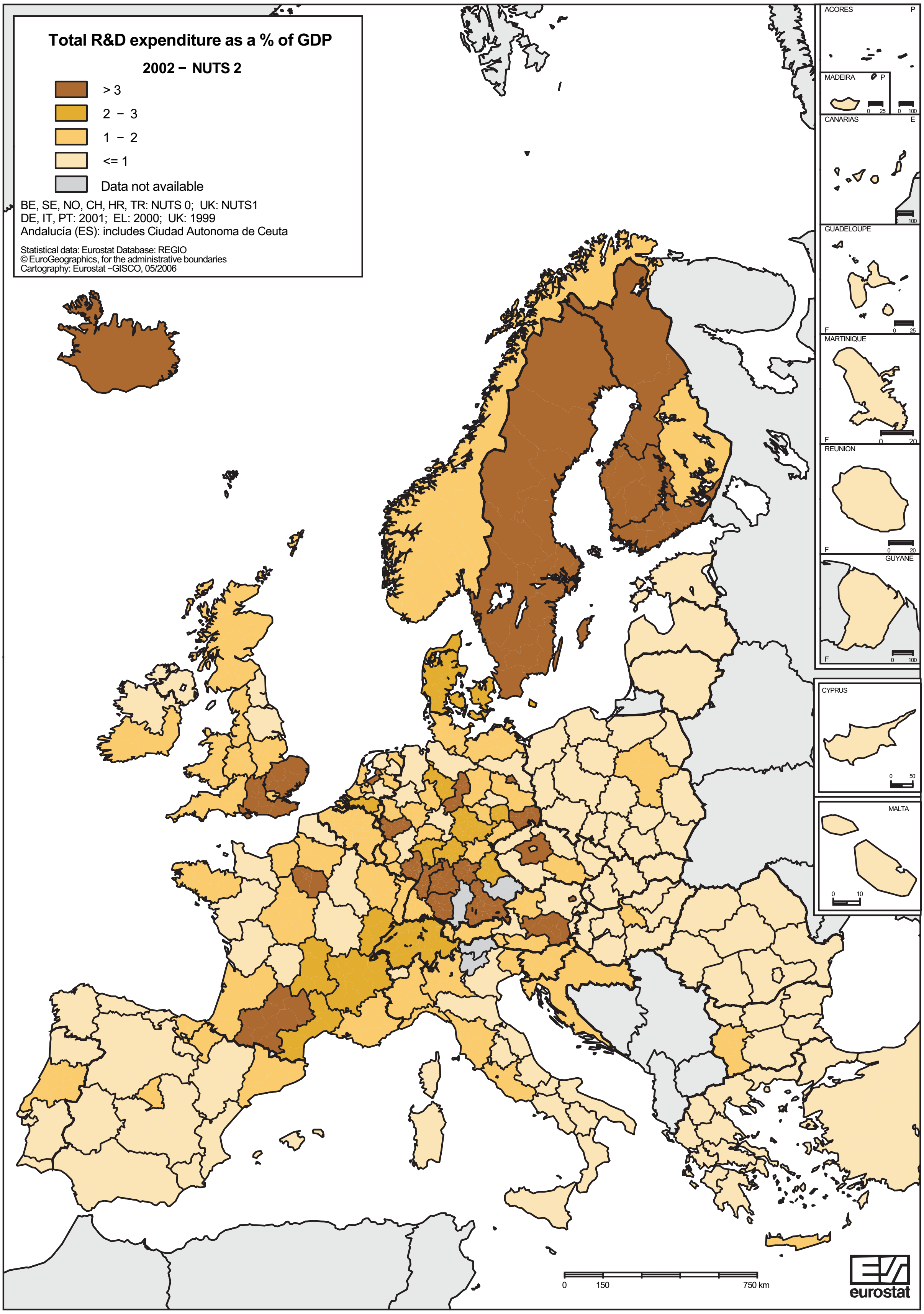
For all sectors together, the pattern is of three main groups of countries. At the top, Germany, Finland and also Sweden (national average only) stand out, with an R&D intensity in their leading region of above 4%.

Figure 2.14 **Regional disparities in total R&D expenditure, as a percentage of GDP EU-25 and selected countries - 2002**



Exceptions to the reference year 2002: DE, NL, PT and SE 2001; BG, IT, LU and CH 2000; EL and UK 1999.
Countries classified at NUTS level 1: UK.

Map 2.15 R&D expenditure as a percentage of GDP, all sectors, EU-25 and selected countries - 2002



The second group features countries where the R&D intensity in the leading region is between the EU-25 average of 1.93% and 4%. This group includes countries with high R&D expenditure in volume, like the United Kingdom and France but also Austria and the Czech Republic.

The Czech Republic, Germany, France, Austria, Finland, Sweden, the United Kingdom and Iceland are the only countries for which R&D intensity, at least in their leading region, was higher than the European target figure of 3% of GDP. In addition, Finland and Iceland had a national average of above the 3% of GDP target.

In the final group, the top region of nine countries has an R&D intensity rate below the EU-25 average; these countries are Greece, Spain, Ireland, Hungary, Poland, Portugal, Slovakia, and also Bulgaria and Romania.

Disparities exist not only among countries but also within regions of the same country. The gap between the leading region and the region at the bottom of the ranking is largest in Germany, where it reaches 6.6 percentage points, and smallest in Ireland, at 0.3 percentage points. With the exception of Northern Ireland in the United Kingdom and Border, Midland and Western in Ireland, with R&D expenditure at almost 0.85% of GDP respectively, R&D intensity in all the other lowest-ranked regions of the Czech Republic, Germany, Greece, Spain, France, Italy, Hungary, the Netherlands, Austria, Portugal, Slovakia and Finland is less than 0.64%.

The disparities within regions are also evident in Map 2.15. Regions with a high level of R&D expenditure as a percentage of GDP are mainly concentrated in Germany, in northern Europe and in the capital regions.

Regional disparities also exist by sector of performance. The situation in the BES is similar to that described for all sectors, the top region for ten countries remaining unchanged - Figure 2.16.

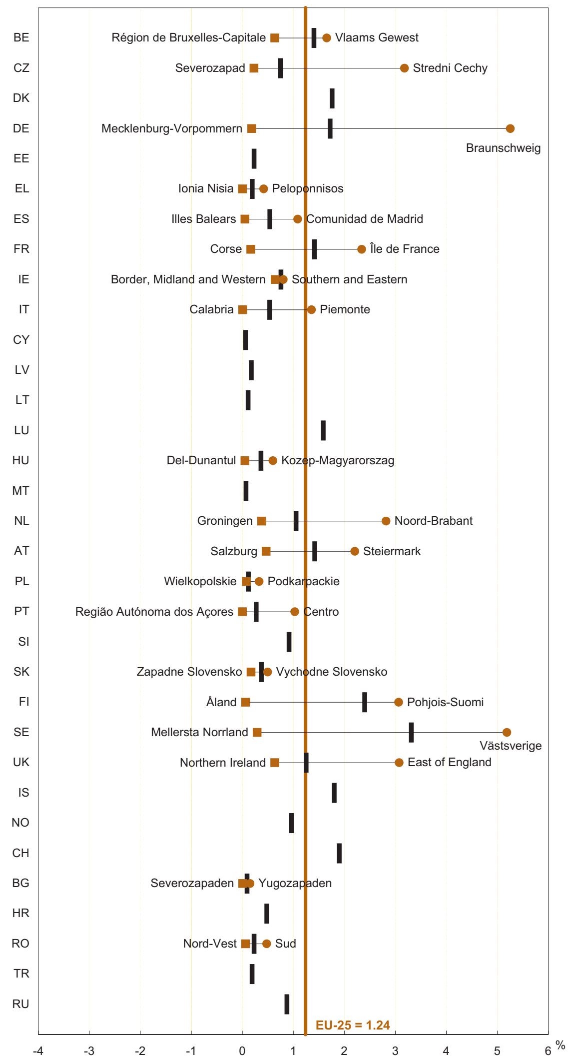
At the top, Braunschweig in Germany led again with a business enterprise R&D intensity of 5.25% of GDP. The leading Swedish region Västsverige followed with R&D expenditure in the business enterprise sector likewise above 5% of GDP.

Germany and Sweden, followed by the Czech Republic, Finland and the United Kingdom, were also the countries with the most pronounced regional disparities. By contrast, regional disparities were lowest in Greece, Ireland, Poland, Slovakia and Bulgaria. In these countries, business enterprise R&D intensity was below 1% for all regions.

Map 2.17 displays the distribution of business enterprise R&D intensity across European regions in 2002.

As is the case for total R&D expenditure, regions with a high level of business enterprise R&D intensity are mainly concentrated in Germany and in northern Europe.

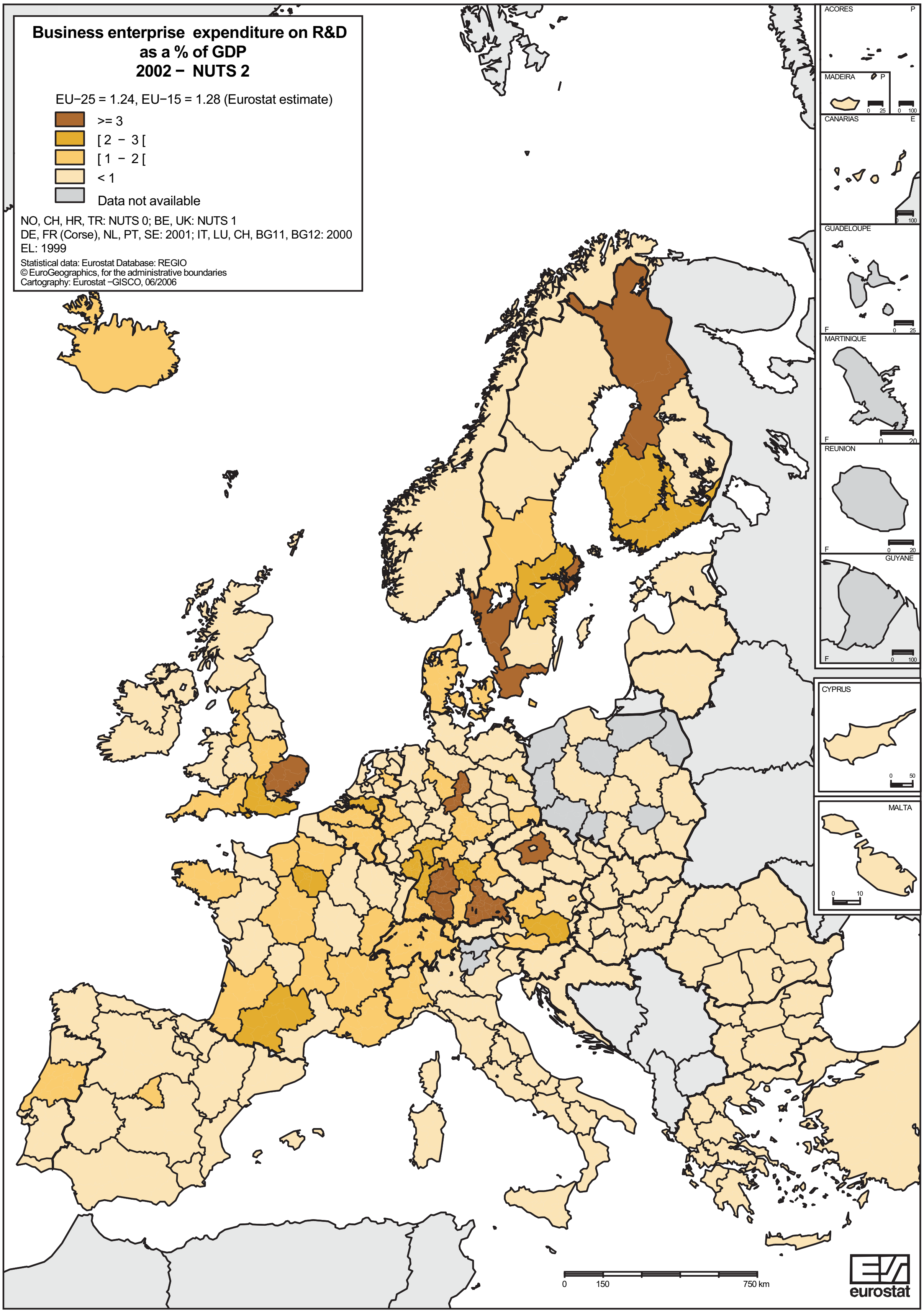
Figure 2.16 Regional disparities in business enterprise R&D expenditure, as a percentage of GDP, EU-25 and selected countries - 2002



Exceptions to the reference year 2002: FR (Corse), NL, PT and SE 2001; BG, IT, LU and CH 2000; EL 1999.
Countries classified at NUTS level 1: BE, UK.

Map 2.17

Business enterprise R&D expenditure as a percentage of GDP, EU-25 and selected countries - 2002



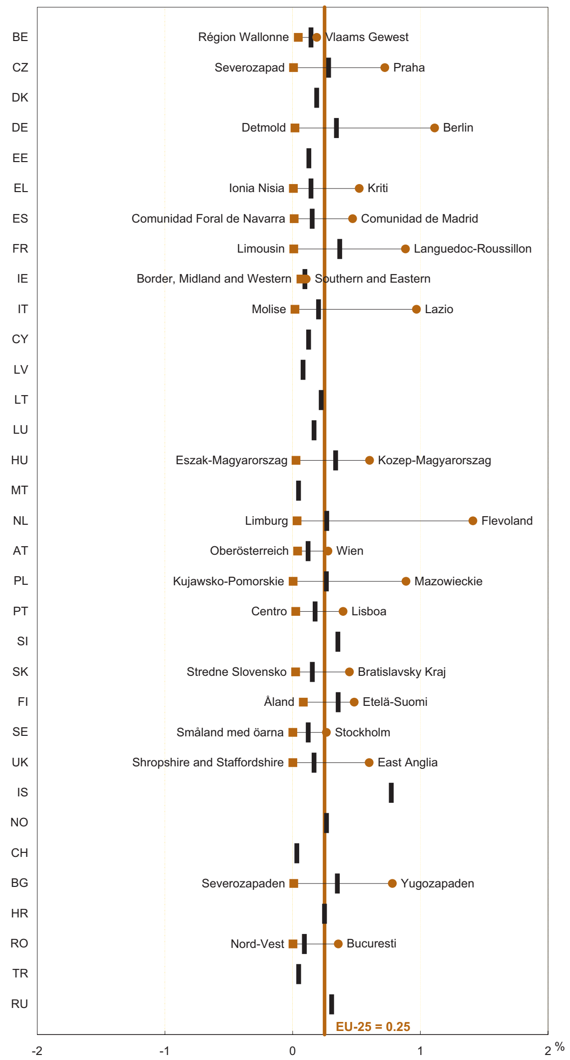
In the government sector, the gaps between countries are less important, with the exception of Flevoland (NL), which comes far ahead of a group of three regions belonging to the leading countries in terms of R&D expenditure: Dresden (DE), Languedoc-Roussillon (FR) and Lazio (IT) - Figure 2.18.

Nevertheless, and by contrast with total and business enterprise R&D expenditure, fewer countries had all their regions below the European average (0.25%). In 2002, Belgium and Ireland were the two countries (for which regional data are available) to be in this particular situation.

Wien (AT) stands out in the higher education sector with an R&D intensity of 1.14%, whereas for all the other leading regions the R&D intensity was below 1.0% in 2002 - Figure 2.19. The leading region from Germany and from the United Kingdom followed with 0.98% and 0.93% of GDP respectively.

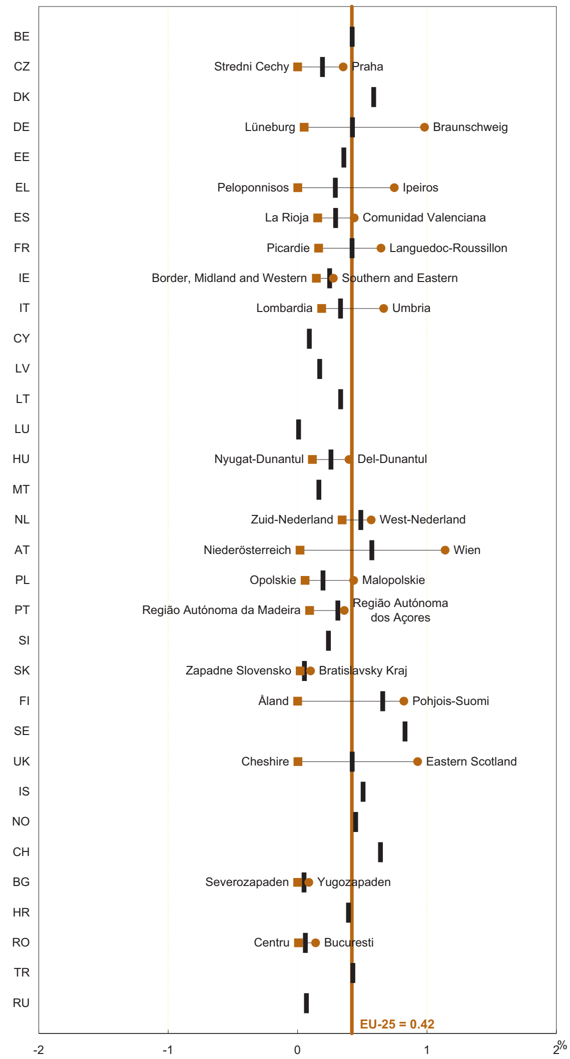
Regional disparities were lowest in the candidate countries Bulgaria and Romania, in Ireland and in Slovakia. These countries, along with the Czech Republic, Hungary and Portugal, had all their regions positioned below the European average (0.42% of GDP) in 2002.

Figure 2.18 **Regional disparities in government R&D expenditure, as a percentage of GDP, EU-25 and selected countries - 2002**



Exceptions to the reference year 2002: EL, NL and PT 2001; IT 2000; SE 1999.
Countries classified at NUTS level 1: BE.

Figure 2.19 **Regional disparities in higher education R&D expenditure, as a percentage of GDP, EU-25 and selected countries - 2002**



Exceptions to the reference year 2002: NL, PT, SE and UK 2001; BG, IT, LU and CH 2000; EL 1999.

2

R&D expenditure in volume and regional disparities

R&D expenditure is concentrated in the leading regions, with the top 10 in 2003 accounting for 30% of the EU-25 total

In 2003, almost 30% of R&D expenditure in the EU-25 was concentrated in ten regions (measured in 1995 constant PPS). Five of these regions were German, two were French, and the others were Danish, Swedish and Italian. Île de France (FR) led the field, with R&D expenditure in this region accounting for 7.8% of total R&D expenditure in the EU-25. Following Île de France were Oberbayern (DE, 3.9%) and Stuttgart (DE, 3.2%).

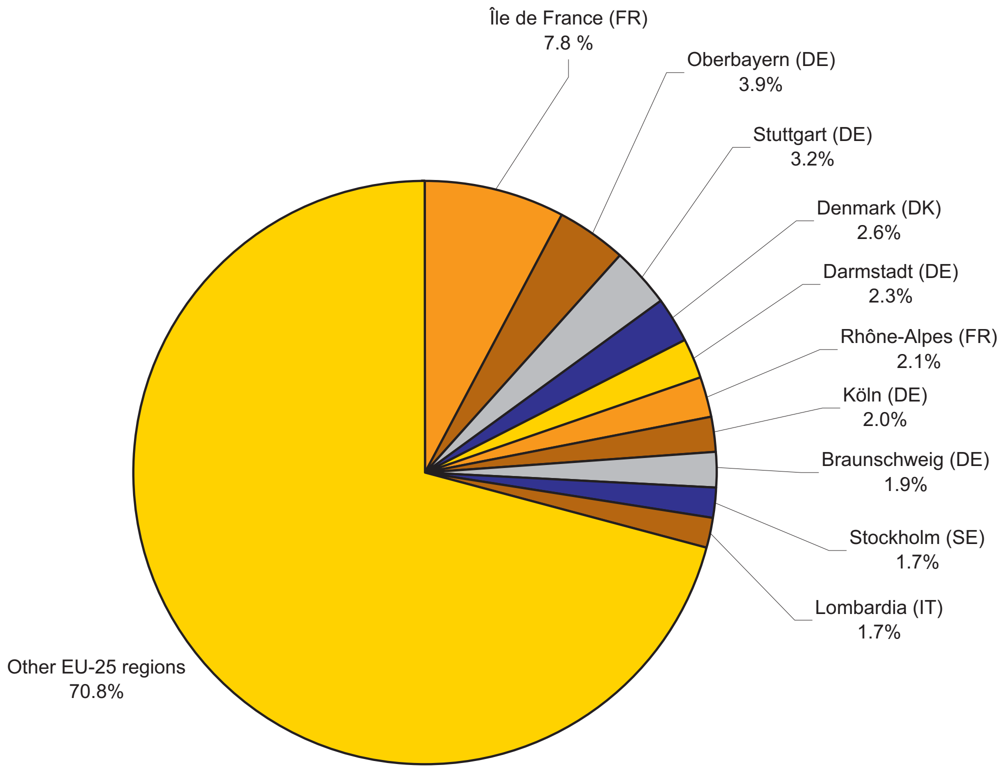
Table 2.21 analyses regional R&D activity within a country at a more detailed level, by showing the top two regions for each country. It should be noted that the number of regions varies from one country to another.

For all sectors, and of those countries with very high levels of R&D expenditure in volume - viz. Germany, France, United Kingdom and Italy - Île de France has the highest regional concentration of R&D, accounting for 42% of total R&D expenditure in France. In Germany the top-ranking region of Oberbayern accounts for only 13% of R&D expenditure, whereas in Italy, Lombardia takes 22% of R&D expenditure.

For other countries, very high levels of R&D concentration, above 40% for the leading region, were observed in Greece (Attiki), Austria (Wien), Poland (Mazowieckie), Portugal (Lisboa), Slovakia (Bratislavsky kraj) and Finland (Etelä-Suomi).

Figure 2.20

Percentage of R&D expenditure in the top 10 EU-25 regions(1)
in million euro, all sectors - 2003



Exception to the reference year 2003: FR 2002.
(1) Ranking made for all EU-25 countries except: BE and UK.

The breakdown by institutional sector shows a different picture depending on the sector. The GOV is the sector where most of the R&D expenditure for a country is carried out predominantly by one region. It is also in the GOV where the proportions are highest. More than 50% of R&D expenditure is concentrated in the leading region of twelve EU-25 countries, the top value being reached by Ireland, with Southern and Eastern, where 84% of Irish R&D expenditure was concentrated in 2003.

The lowest concentration of R&D expenditure in the leading region by country was observed in the HES. Of the EU-25 regions, it was again Southern and Eastern (IE) which recorded the highest concentration of R&D expenditure (92% of the total in Ireland). Compared to the other two sectors, the regional R&D expenditure breakdown for the top regions seems to be better balanced in the various countries.

In general, regional concentration in the BES is less marked than in the GOV but more marked than in the HES. Despite the fact that, in some countries like Belgium, Greece, Ireland or Hungary, more than 60% of R&D expenditure is carried out by one region, the proportions spent in the second leading regions are still substantial.

In EU-25 Member States, both public and private R&D expenditure are generally concentrated in one region. This is the case for Greece with Attiki, France (Île de France), Ireland (Southern and Eastern), Hungary (Kozep-Magyarorszag), Poland (Mazowiecke), Portugal (Lisboa), Finland (Etelä-Suomi) and Norway (Oslo og Akershus).

The exceptions are the Netherlands, Germany and Italy, where the leading regions in the BES and the GOV are different in the different sectors.

2

Table 2.21

R&D expenditure in million euro in the top 2 regions of each country, by sector of performance, EU-25 and selected countries - 2003

	All sectors			Business enterprise			Government			Higher education		
	Regions by countries	Mio EUR	%	Regions by countries	Mio EUR	%	Regions by countries	Mio EUR	%	Regions by countries	Mio EUR	%
EU-25		**188 222 s**		**EU-25**	**120 581 s**			**24 480 s**		**EU-25**	**41 151 s**	
BE	Belgique / België	5 177	100	Belgium	3 608	100	Belgium	354	100	Belgium	1 150	100
		:	:	Vlaams Gewest (NUTS 1)	2 376	66	Vlaams Gewest (NUTS 1)	261	74		:	:
		:	:	Région Wallonne (NUTS 1)	932	26	Région de Bruxelles-Capitale (NUTS 1)	67	19		:	:
CZ	Czech Republic	1 013	100	Czech Republic	618	100	Czech Republic	236	100	Czech Republic	155	100
	Praha	372	37	Stredni Cechy	193	31	Praha	160	68	Praha	78	50
	Stredni Cechy	219	22	Praha	132	21	Jihovychod	31	13	Jihovychod	33	21
DK	Denmark	4 851 r	100	Denmark	3 355 r	100	Denmark	337	100	Denmark	1 126	100
DE	Germany	54 538	100	Germany	38 029	100	Germany	7 307	100	Germany	9 202	100
	Oberbayern	7 352	13	Oberbayern	5 873	15	Köln	914	13	Köln	810	9
	Stuttgart	5 996	11	Stuttgart	5 432	14	Berlin	864	12	Oberbayern	711	8
EE	Estonia	67	100	Estonia	23	100	Estonia	11	100	Estonia	32	100
EL	Greece	951 p	100	Greece	286 p	100	Greece	198	100	Greece	457	100
	Attiki (NUTS 1)	550	58	Attiki (NUTS 1)	219	77	Attiki	124	62	Attiki	199	44
	Voreia Ellada (NUTS 1)	211	22	Voreia Ellada (NUTS 1)	54	19	Kriti	35	18	Kentriki Makedonia	86	19
ES	Spain	8 213	100	Spain	4 443	100	Spain	1 262	100	Spain	2 492	100
	Comunidad de Madrid	2 346	29	Comunidad de Madrid	1 333	30	Comunidad de Madrid	592	47	Cataluña	456	18
	Cataluña	1 875	23	Cataluña	1 244	28	Cataluña	170	13	Comunidad de Madrid	412	17
FR	France	34 527	100	France – 2002	21 839	100	France	5 767	100	France	6 693	100
	Île de France	14 671	42	Île de France	10 085	46	Île de France	2 030	35	Île de France	2 355	35
	Rhône-Alpes	3 985	12	Rhône-Alpes	2 781	13	Provence-Alpes-Côte d'Azur	452	8	Rhône-Alpes	827	12
IE	Ireland	1 610 r	100	Ireland	1 076	100	Ireland	127	100	Ireland	407 r	100
	Southern and Eastern	1 392	86	Southern and Eastern	911	85	Southern and Eastern	107	84	Southern and Eastern	374 p	92
	Border, Midland and Western	231	14	Border, Midland and Western	165	15	Border, Midland and Western	20	16	Border, Midland and Western	46 p	11
IT	Italy	14 769	100	Italy	6 979	100	Italy	2 582	100	Italy	5 000	100
	Lombardia	3 263	22	Lombardia	2 159	31	Lazio	1 329	51	Lombardia	754	15
	Lazio	2 618	18	Piemonte	1 346	19	Lombardia	226	9	Lazio	600	12
CY	Cyprus	41	100	Cyprus	9	100	Cyprus	16	100	Cyprus	13	100
LV	Latvia	38	100	Latvia	13	100	Latvia	9	100	Latvia	16	100
LT	Latvia	111	100	Latvia	23	100	Latvia	29	100	Latvia	58	100
LU	Luxembourg	426 i	100	Luxembourg	379	100	Luxembourg	45	100	Luxembourg	2 ui	100
HU	Hungary	693 i	100	Hungary	255	100	Hungary	217	100	Hungary	185	100
	Kozep-Magyarorszag	454	65	Kozep-Magyarorszag	191	75	Kozep-Magyarorszag	175	81	Kozep-Magyarorszag	87	47
	Del-Alfold	52	7	Eszak-Alfold	19	7	Del-Alfold	20	9	Eszak-Alfold	27	15
MT	Malta	11	100	Malta	4 p	100	Malta	1	100	Malta	7	100
NL	Netherlands	8 376	100	Netherlands	4 804	100	Netherlands	1 213 b	100	Netherlands	2 356	100
	Noord-Brabant	1 892 be	23	Noord-Brabant	1 672 e	35	Zuid-Holland	371 be	31	Zuid-Holland	563	24
	Zuid-Holland	1 595 be	19	Noord-Holland	747 e	16	Utrecht	187 be	15	Noord-Holland	401	17
AT	Austria – 2002	4 684	100	Austria – 2002	3 131	100	Austria	266	100	Austria	1 345 s	100
	Wien	2 021	43	Wien	1 152	37	Wien	166	62		:	:
	Steiermark	907	19	Steiermark	599	19	Steiermark	34	13		:	:
PL	Poland	1 036	100	Poland	284	100	Poland	421	100	Poland	329	100
	Mazowieckie	454	44	Mazowieckie	108	38	Mazowieckie	269	64	Mazowieckie	76	23
	Malopolskie	118	11	Malopolskie	37	13	Wielkopolskie	36	9	Malopolskie	53	16
PT	Portugal	1 020	100	Portugal	338	100	Portugal	172	100	Portugal	392	100
	Lisboa	532 be	52	Lisboa	183 be	54	Lisboa	136 b	79	Lisboa	160 b	41
	Norte	246 be	24	Norte	86 be	25	Norte	11 b	7	Norte	105 b	27
SI	Slovenia	377 e	100	Slovenia	222 e	100	Slovenia	86 e	100	Slovenia	60 e	100
SK	Slovakia	169	100	Slovakia	93	100	Slovakia	53	100	Slovakia	22	100
	Bratislavsky kraj	82	48	Zapadne Slovensko	41	44	Bratislavsky kraj	41	77	Bratislavsky kraj	12	55
	Zapadne Slovensko	50	29	Bratislavsky kraj	28	30	Zapadne Slovensko	6	11	Vychodne Slovensko	4	17
FI	Finland	5 005	100	Finland	3 528	100	Finland	485	100	Finland	962	100
	Etelä-Suomi	2 933	59	Etelä-Suomi	2 022	57	Etelä-Suomi	382 i	79	Etelä-Suomi	529	55
	Länsi-Suomi	1 139	23	Länsi-Suomi	865	25	Länsi-Suomi	62 i	13	Länsi-Suomi	213	22
SE	Sweden	10 642	100	Sweden	7 886	100	Sweden	371	100	Sweden	2 344	100
	Stockholm	3 276	31	Västsverige	2 737	35	Stockholm	236	64	Stockholm	721	31
	Västsverige	3 135	29	Stockholm	2 318	29	Östra Mellansverige	81	22	Östra Mellansverige	533	23
UK	United Kingdom	25 301	100	United Kingdom	19 778	100	United Kingdom	2 906 r	100	United Kingdom	6 442	100
	South East (NUTS 1)	6 021	24	South East (NUTS 1)	5 006	25	East Anglia	353	12	London (NUTS 1)	1 545	24
	East of England (NUTS 1)	4 595	18	East of England (NUTS 1)	4 990	25	Berkshire, Buckingham-shire and Oxfordshire	325	11	South East (NUTS 1)	887	14
IS	Iceland	274	100	Iceland	142	100	Iceland	68	100	Iceland	58	4
NO	Norway	3 411	100	Norway	1 960	100	Norway	515	100	Norway	937	100
	Oslo og Akershus	1 380	40	Oslo og Akershus	730	37	Oslo og Akershus	278	54	Oslo og Akershus	372	40
	Trøndelag	559	16	Sør-Østlandet	350	18	Vestlandet	105	20	Trøndelag	212	23
EEA		**191 907 s**		**EEA**	**122 683 s**		**EEA**	**25 063 s**		**EEA**	**42 146 s**	
CH	Switzerland – 2000	6 852	100	Switzerland – 2000	5 065	100	Switzerland	95	100	Switzerland		
BG	Bulgaria	89	100	Bulgaria	18	100	Bulgaria	62	100	Bulgaria	9	100
	Yugozapaden	71	80	Yugozapaden	11	64	Yugozapaden	54	86	Yugozapaden	6	66
	Yuzhen tsentralen	6	7	Severoiztochen	2	12	Severoiztochen	3	5	Severoiztochen	0	5
HR	Croatia	292	100	Croatia	114	100	Croatia	64	100	Croatia	114	100
RO	Romania	203	100	Romania	118	100	Romania	65	100	Romania	19	100
	Bucuresti	116	57	Bucuresti	48	40	Bucuresti	55	85	Bucuresti	13	68
	Sud	28	14	Sud	28	23	Nord-Est	3	4	Nord-Vest	2	11
TR	Turkey	:	:	Turkey	455	100	Turkey	90	100	Turkey	905	100
RU	Russia	4 899 r	100	Russia	3 353	100	Russia	1 239	100	Russia	297	100

Countries classified at NUTS level 2: DK, EE, CY, LV, LT, LU, MT, SI, IS.
LU - All sectors and HES: 2001 data for HES.
HU - All sectors: Including expenditure not allocated to R&D units.
FI - GOV: PNP is included in the GOV.
SE - All sectors: Regions do not include PNP (EUR 41.3 million).

PART2

Chapter 3

R&D personnel

3.1 Introduction

As seen in Section 2.1., Research and Development (R&D) activities are often regarded as a catalyst for economic growth as they comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

The number of R&D personnel is one of the two basic R&D input indicators together with R&D expenditure.

Being a key element of knowledge, S&T dissemination and development, the R&D personnel indicator has become increasingly appreciated by policymakers. R&D personnel data measure the human resources going directly into R&D activities. R&D personnel counts all persons employed directly on R&D, as well as those providing direct services, such as R&D managers, administrators and clerical staff.

Two manuals are used as methodological references for R&D surveys:

- The Frascati Manual(1) and
- The Regional Manual(2).

They provide a model for obtaining statistics that are comparable between countries.

This chapter presents the key indicators for R&D personnel as well as the main trends for the last decade. It is divided into three sections:

- Firstly, it focuses on R&D personnel at international level, by taking a look at data on the EU-25, China, Japan and the United States.
- Secondly, the main trends at national level are highlighted, by examining the performance of the EU-25 Member States, Iceland, Norway and candidate countries.
- Finally, R&D personnel is analysed at regional level, focusing on the regions of the EU-25 Member States, Iceland and Norway.

Two main indicators are used throughout the sections of this chapter:

- Total R&D personnel, and
- Researchers.

'Researchers' is an important indicator. Based on the Frascati Manual, paragraph 301, researchers are defined as professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

As recommended by the Frascati Manual, R&D personnel data are provided in two units: full-time equivalent (FTE) and head count (HC).

- The FTE unit corresponds to one year's work by one person.
- The HC unit corresponds to the number of individuals who are employed mainly or partly on R&D.

For purposes of comparison between different regions and periods, the derived unit based on HC 'as a percentage of total employment' is often used in the present chapter.

Sectors of performance are used to calculate indicators of R&D activity:

- the business enterprise sector (BES),
- the government sector (GOV),
- the higher education sector (HES),
- the private non-profit sector (PNP),
- and all sectors, which corresponds to the sum of the four previous sectors.

In addition to sectors of performance, different breakdowns are used to present R&D data. These are, for example:

- economic activity,
- field of science,
- and gender.

The regional analysis is carried out at the NUTS 2 level. Other levels of NUTS are used in certain instances for particular countries, and this is specified in each case by means of a footnote. Readers should also note that according to the NUTS classification for Denmark, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta and Slovenia the entire national territory is considered as a NUTS 0, 1 or 2 region and therefore these countries may appear in rankings at the NUTS 2 level.

The analysis refers to the period 1994-2004. Not all countries cover the same length of time series; in general, therefore, when data for the year 2004 are not available for a particular country, the latest year available is presented.

The complete R&D personnel time series are available on Eurostat's reference database NewCronos. Data for China, Japan and the United States originate from the OECD - Main Science and Technology Indicators (MSTI).

(1) Proposed Standard Practice for Surveys on Research and Experimental Development - Frascati Manual, OECD, 2002.
(2) The Regional Dimension of R&D and Innovation Statistics - Regional Manual, Eurostat, 1996.

R&D personnel
in the 7th framework programme of the European Community

On the basis of the Commission proposal's adopted on 6 April 2005, a structure was presented in terms of four main specific programmes "Cooperation", "Ideas", "People" and "Capacities", each corresponding to a major objective of European research policy; and a further specific programme which is for the direct actions of the Joint Research Centre.

The specific programmes of the 7th Framework Programme are designed to address, in combination with the necessary national and private efforts, major weaknesses in the level, quality and impact of European research. The dissemination and transfer of knowledge is a key added value of European research actions, and measures will be taken to increase the use of results by industry, policy makers and society.

Europe needs more researchers in order to increase and improve its research efforts. Alongside other actions, such as the European Charter for Researchers and national policy measures, the 7th Framework Programme is designed to stimulate more people to embark upon and pursue research careers, and once again attract leading research talent to Europe.

Financial support at a European level offers opportunities to increase the excellence and effectiveness of research which cannot be achieved at national level. The specific programmes of the 7th Framework Programme represent further consolidation of the European Research Area, achieving critical mass and structures in new areas of research and by new means, and further supporting the free movement of ideas, knowledge and researchers. Framework Programme will contribute to this, both through direct financing but also by leveraging additional public and private investments in research.

Source: : Proposal for a Council Decision concerning the specific programme "People" implementing the 7th Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities - Brussels, 21.9.2005, COM(2005) 442 final, 2005/0187 (CNS).

3.2 A worldwide perspective: EU-25, China, Japan and the United States

R&D personnel

With almost 3 million persons employed in the field of research and development, R&D personnel in the EU-25 is on an upward trend

In 2004, 2.82 million persons, expressed in head count (HC), were employed in the field of R&D in the EU-25. When measured in full-time equivalent (FTE), the EU-25's R&D personnel amounted to more than 2 million, which represented an increase of 1.3% on the previous year.

Over the period 1999 to 2004, R&D personnel expressed in FTE in the EU-25 increased by 9.3%. During the period 1999 to 2003, Japanese R&D personnel fell by 4%: while in 1999m 0.92 million persons measured in FTE were employed in research, the number dropped to 0.88 million in 2003. In the same period, R&D personnel in China grew: in 1999, 0.82 million Chinese were registered as R&D personnel and in 2003 this number reached 1.09 million (which gives an increase over this period of more than 33%) - Figure 3.2.

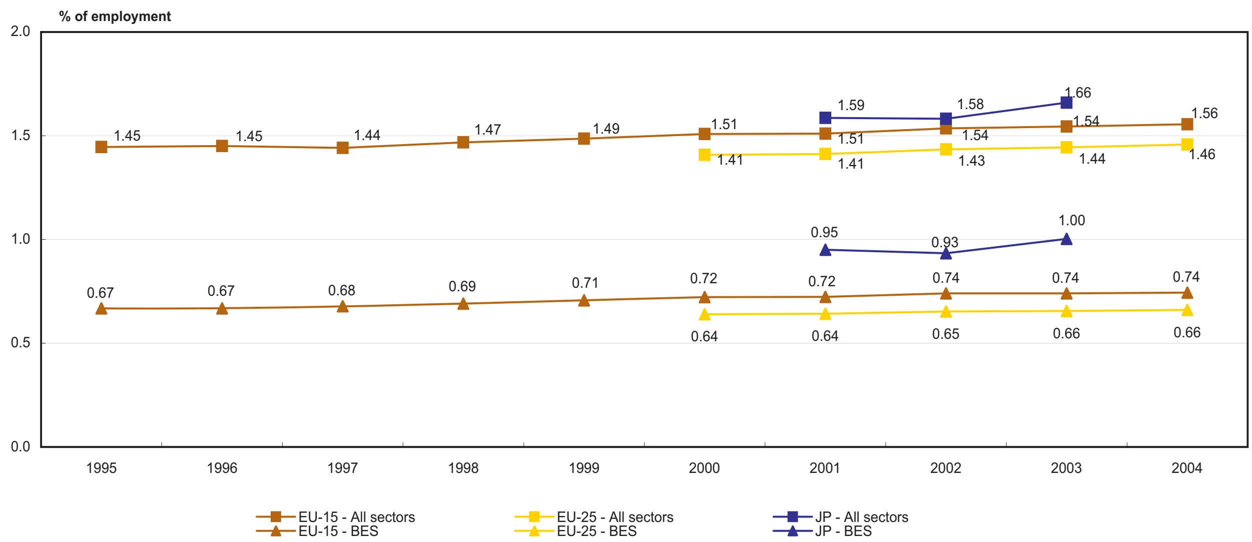
The EU-25's R&D personnel in FTE increased by 271 669 persons between 1994 and 2004, which corresponds to a 15.3% growth. The upward trend was also significant in China, where the increase in R&D personnel was close to 40% between 1994 and 2003 (or more than 300 000 persons). In Japan the situation was the opposite, with total R&D personnel falling by 6.6% between 1994 and 2003.

Looking at R&D personnel as a proportion of total employment (Figure 3.1), the EU-25 shows an increase in its share over the period 2000 to 2004. When taking into account all sectors of performance, the proportion of R&D personnel in 2000 was 1.41% and reached 1.46% in 2004. The same trend can be observed when analysing the situation for the business enterprise sector (BES).

When the distribution of R&D personnel by sector of performance (Figure 3.3) is considered, in 2004, 53.4% of R&D personnel in the EU-25 were employed in the BES, 31.1% in the higher education sector (HES) and 14.3% in the government sector (GOV). The proportion accounted for by each sector of performance varies slightly in Japan, where in 2004 the BES employed almost two thirds of total R&D personnel. The public sector therefore accounted for a lower proportion of R&D personnel: 7.0% in the government sector and 25.4% in the HES. The situation is also slightly different when looking at China, where 59.9% of R&D personnel were employed in the BES, 22.8% in the GOV and 17.3% in the HES

Figure 3.1

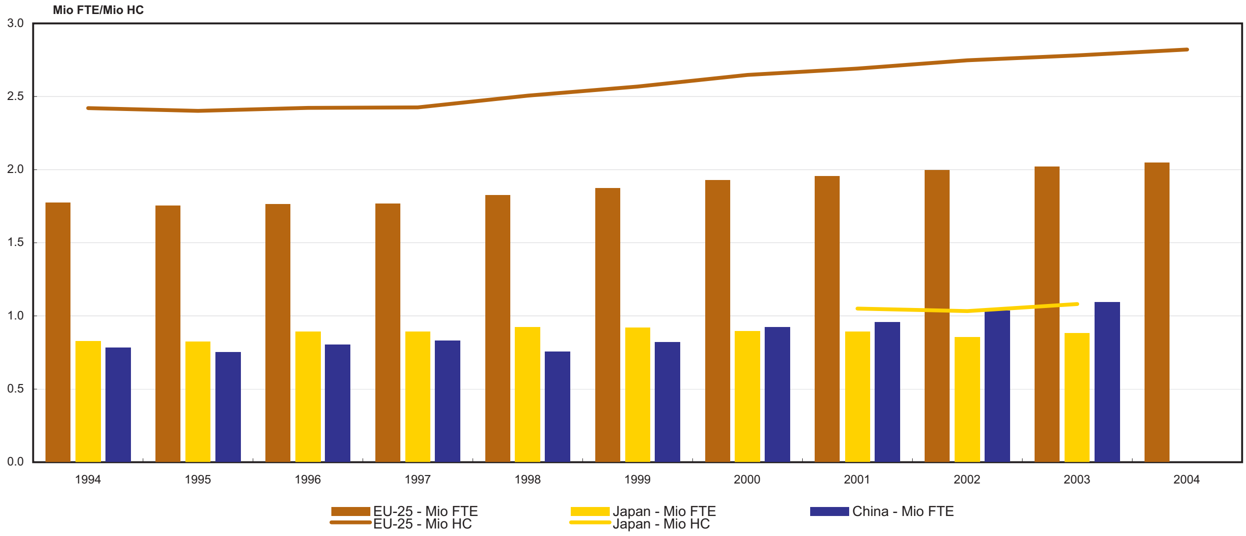
R&D personnel as a percentage of total employment, all sectors and the business enterprise sector (BES), EU-25, EU-15 and Japan - 1995 to 2004



Eurostat estimates: EU-15 and EU-25, provisional data for 2004.

Figure 3.2

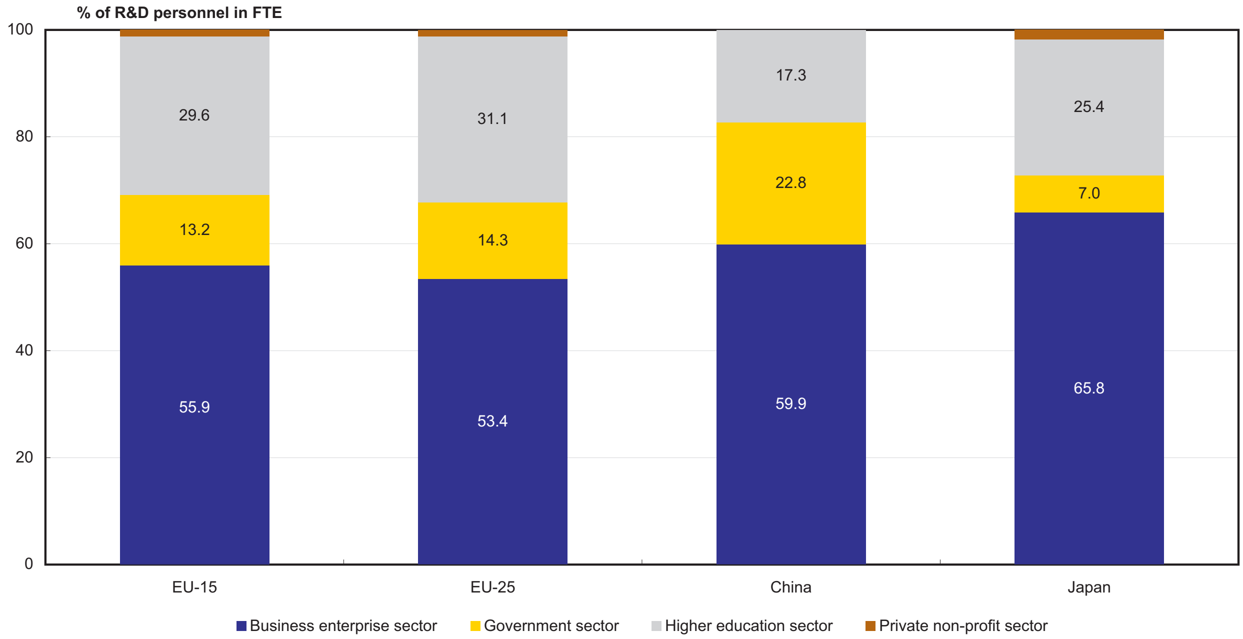
R&D personnel in FTE and in HC, all sectors, EU-25, China and Japan- 1994 to 2004



Eurostat estimates: EU-25, provisional data for 2004.
Break in series: Japan 1996 and 2002, China 2000.

Figure 3.3

Distribution of R&D personnel in FTE, by sector of performance, EU-25, EU-15, China and Japan - 2004



Exceptions to the reference year: 2003: CN, JP.
Eurostat estimates and provisional data: EU-25 and EU-15.

Researchers

The EU-25 has the highest number of researchers in the higher education sector, whereas China leads in the government sector and the United States in the business enterprise sector

3

According to the latest available data on researchers (Figure 3.5) measured in full-time equivalent (FTE), the United States employed a higher number of researchers in all sectors (1.3 million persons in 1999), than the EU-25 (1.2 million in 2004). Researchers were less numerous in China (0.86 million in 2003) and in Japan (675 330 in 2003). The number of researchers increased for all countries compared with the previous year. China grew the fastest, by 6.4%, the EU-25 by 3.5% and Japan by 4.5%.

Since 1999, the number of researchers measured in FTE in China showed a strong upward trend, which was also observed in the EU-25. Between 1994 and 1998 the annual average growth rate recorded by China was negative, with -3.2% as against the rate of 12.2% observed during the period 1998-2003. Similarly, the annual average growth rate of R&D personnel in the EU-25 was 1.6% between 1994 and 1997 and reached 3.3% between 1997 and 2004. With an annual average growth rate of 0.7% between 1998 and 2003, the trend for Japan remained positive but below that of China and the EU-25.

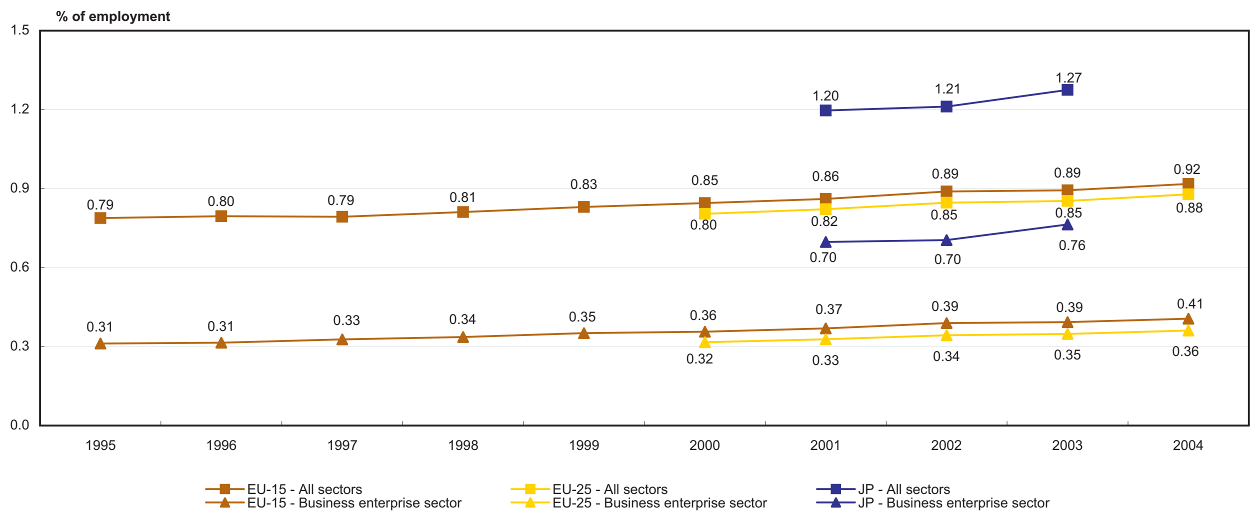
Differences across the four blocks are particularly noticeable when data are examined by sector of performance.

In the BES, the number of researchers in the United States in 2000 was twice as high as in the EU-25 or in Japan and almost three times higher than in China. The EU-25 has the highest number of researchers in the HES sector. In 2003, 421 000 researchers in the EU-25 were employed in this sector, which was more than twice the number in China. The situation is different in the GOV, where in 2003 192 000 researchers were employed in China as against 158 000 in the EU-25 and 34 000 in Japan.

In terms of trends by sector of performance, Japan's number of researchers remained relatively stable over the past decade. China and the United States were the most dynamic countries in the BES, as reflected in annual average growth rates of 5.4% for the United States between 1994 and 2000 and as much as 11.2% for China between 1994 and 2003. In the HES, China appears the most dynamic, with an annual average growth rate of 4.3% during the period 1994-2003 compared with 2.6% in the EU-25 between 1994 and 2004.

The proportion of researchers in terms of total employment (Figure 3.4) in the EU-25 in all sectors was 0.9% in 2003. At the same time, Japan achieved the highest proportion, with 1.3%. The same conclusions can be drawn when looking at the BES sector. In 2003 Japan showed a proportion of researchers in terms of total employment of 0.8%, while in the EU-25 the share was only 0.4%.

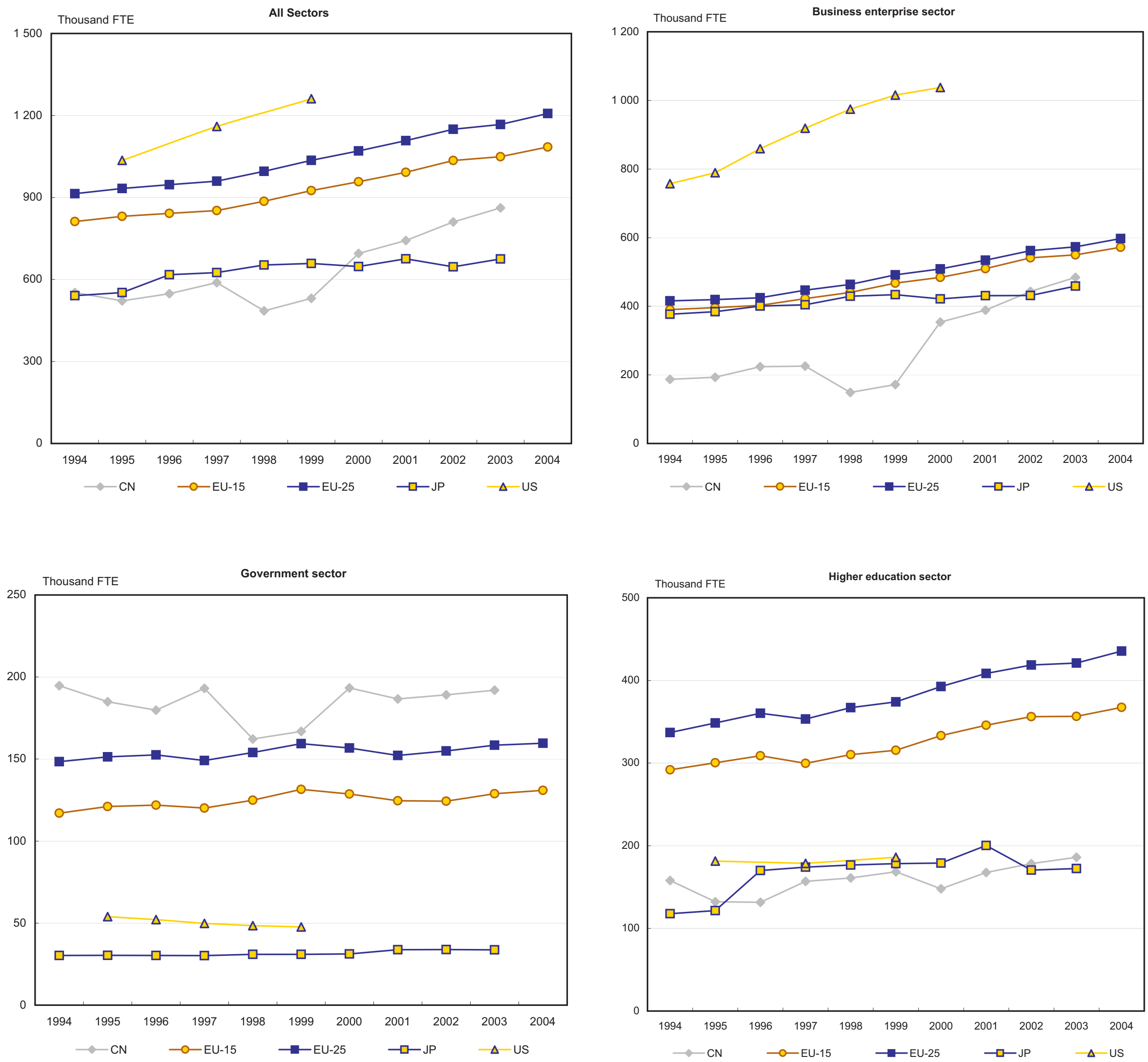
Figure 3.4 **Researchers (HC) as a percentage of total employment, all sectors and business enterprise sector, EU-25, EU-15 and Japan - 1995 to 2004**



Eurostat estimates: EU-15 and EU-25, provisional data for 2004.

Figure 3.5

Researchers in FTE, by sector of performance, EU-25, EU-15, China, Japan and United States - 1994-2004



Eurostat estimates: EU-15 and EU-25, provisional data for 2004.
Break in series:
China 2000 business enterprise sector and all sectors;
Japan 1996 business enterprise sector and all sectors;
Japan 2000 all sectors.

3.3 R&D personnel at national level

R&D personnel as a percentage of total employment

With a percentage of total employment in R&D of more than 3%, Finland is the EU-25's leading country

3

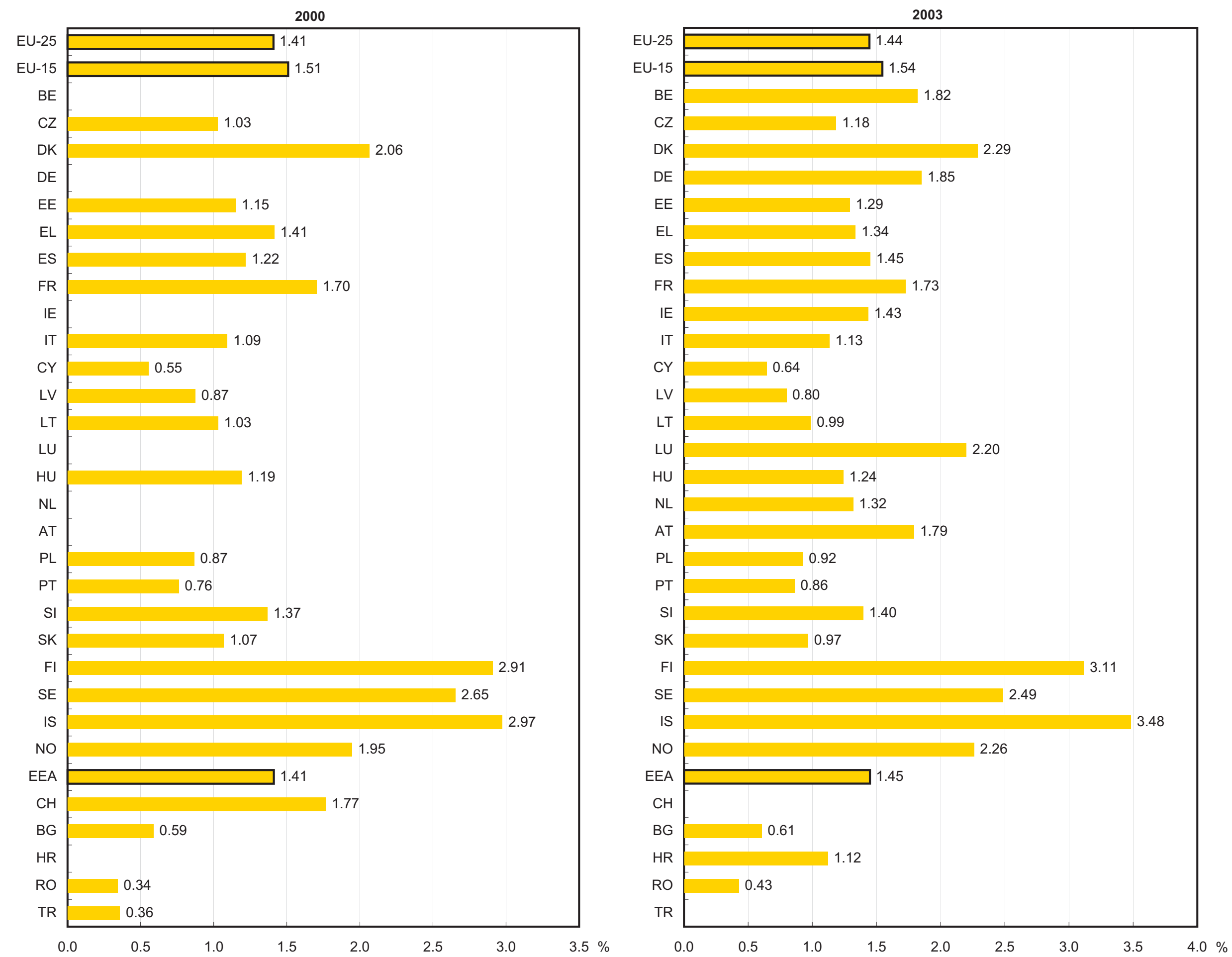
In 2003, 1.44% of the total employed in the EU-25 worked in R&D (Figure 3.6). The EU-25 gained a modest 0.03 percentage points compared with 2000.

Among the countries shown in the figure below, the top five countries in the ranking did not change between 2000 and 2003. In 2003, Iceland leads, with 3.48%, ahead of Finland (3.11%), Sweden (2.49%), Denmark (2.29%) and Norway (2.26%). The gap between the EU-25 leading country and the EU-25 average increased between the two reference years (1.7% in 2003 as against 1.5% in 2000). In 2003, at the bottom of the ranking, six EU-25 countries have less than 1% of their employed persons working in R&D, as against four countries in 2000.

Five countries stand out with particularly high increases in the proportion of R&D personnel between 2000 and 2003: in Iceland and Norway the share of R&D personnel in total employment rose by 0.5 and 0.3 percentage points respectively whereas in Denmark, Finland and Spain it moved up by 0.2 percentage points.

At the opposite end of the scale, four countries showed a decline in the share of R&D personnel in total employment. Greece, Latvia and Slovakia registered a fall of 0.1 percentage points between 2000 and 2003 and Sweden 0.2 percentage points.

Figure 3.6 — **R&D personnel (HC) as a percentage of total employment, all sectors, EU-25 and selected countries - 2000 and 2003**



Exceptions to the reference year: 1999: EL, ES, SE and NO.
Eurostat estimates: EU-15, EU-25, EEA.
Estimated data: IS.

Exception to the reference year: 2002: AT.
Eurostat estimates: EU-15, EU-25, EEA.
Estimated data: SI.
Provisional data: IE.

Table 3.7 R&D personnel (HC) as a percentage of total employment, by sector of performance, EU-25 and selected countries - 2001 to 2003

	All sectors			Business enterprise			Government			Higher education		
	2 001	2 002	2 003	2 001	2 002	2 003	2 001	2 002	2 003	2 001	2 002	2 003
EU-25	1.41 s	1.43 s	1.44 s	0.64 s	0.65 s	0.66 s	0.19 s	0.19 s	0.19 s	0.56 s	0.57 s	0.58 s
EU-15	1.51 s	1.54 s	1.54 s	0.72 s	0.74 s	0.74 s	0.19 s	0.19 s	0.19 s	0.58 s	0.59 s	0.60 s
BE	:	1.81	1.82	1.02	0.93	0.93	:	0.09	0.10	0.67 e	0.78	0.78
CZ	1.04	1.13	1.18	0.42	0.47	0.51	0.27	0.29	0.28	0.34	0.37	0.38
DK	2.20	2.27	2.29	1.26	1.38	1.37	0.37	0.18	0.19	0.56	0.69	0.72
DE	:	:	1.85	:	:	0.93	:	:	0.24	:	:	0.69 p
EE	1.18	1.19	1.29	0.20	0.20	0.26	0.16	0.17	0.19	0.81	0.81	0.82
EL	1.36	:	1.34	0.32	:	0.30	0.21	:	0.21	0.82	:	0.82
ES	1.30	1.40	1.45	0.34	0.44	0.48	0.20	0.19	0.20	0.75	0.76	0.76
FR	:	1.71	1.73	:	0.84	0.85	:	0.21	0.21	:	0.62	0.64
IE	:	1.39	1.43 p	0.72	0.68	0.67	:	0.09	0.09	:	0.62	0.67 p
IT	1.10	1.16	1.13	0.36	0.39	0.37	0.18	0.18	0.19	0.56	0.56	0.55
CY	0.56	0.61	0.64	0.16	0.16	0.17	0.22	0.24	0.22	0.13	0.16	0.18
LV	0.87	0.93	0.80	0.18	0.24	0.12	0.16	0.16	0.15	0.53	0.53	0.53
LT	1.09	0.95	0.99	0.07	0.04	0.05	0.35	0.25	0.22	0.67	0.67	0.71
LU	:	:	2.20	:	:	1.88	0.23	0.25	0.29	0.03	:	0.03
HU	1.18	1.26	1.24	0.22	0.24	0.24	0.27	0.30	0.29	0.69	0.71	0.71
MT	:	:	:	:	:	:	:	0.17	0.02	:	0.53	0.56
NL	:	1.34	1.32	0.76	0.75	0.71	0.17	0.17	0.20 b	:	0.40 e	0.41 e
AT	:	1.79	:	:	0.93	:	:	0.16	:	:	0.68	:
PL	0.87	0.89	0.92	0.16	0.08	0.11	0.14	0.21	0.19	0.57	0.60	0.63
PT	0.77	0.81 e	0.86	0.13	0.16 e	0.19	0.17	0.15 e	0.14	0.37	0.39 e	0.42
SI	1.35	1.34	1.40 e	0.55	0.58	0.63 e	0.32	0.31	0.30 e	0.46	0.44	0.43 e
SK	1.04	1.00	0.97	0.28	0.26	0.21	0.21	0.21	0.21	0.54	0.53	0.55
FI	2.90	3.04	3.11	1.58	1.63	1.67	0.43	0.42	0.41	0.90	0.96	1.00
SE	2.56	:	2.49	1.23	:	1.20	0.12	:	0.13	1.20	:	1.15
UK	:	:	:	:	:	:	:	0.09	0.08	:	:	:
IS	3.32	3.19 e	3.48	1.24	1.16 e	1.40	0.85	0.83 e	1.11	0.96	0.94 e	0.84
NO	2.14	2.23	2.26	0.93	0.98	1.00	0.28	0.29	0.29	0.93	0.96	0.97
EEA	1.42 s	1.44 s	1.45 s	0.64 s	0.65 s	0.66 s	0.19 s	0.19 s	0.20 s	0.56 s	0.57 s	0.58 s
CH	:	:	:	:	:	:	:	0.04	:	:	0.71	
BG	0.60	0.60	0.61	0.07	0.07	0.08	0.40	0.39	0.38	0.13	0.14	0.14
HR	:	1.09	1.12	:	0.17	0.15	:	0.32	0.36	:	0.60	0.62
RO	0.35	0.39	0.43	0.19	0.20	0.18	0.08	0.09	0.10	0.08	0.10	0.14
TR	0.36	0.38	:	0.04	0.04	:	0.04	0.04	:	0.28	0.30	:
JP	1.59	1.58	1.66	0.95	0.93	1.00	0.10	0.11	0.11	0.50	0.51	0.52
RU	1.37	1.32	1.30	0.91	0.86	0.85	0.40	0.39	0.39	0.07	0.07	0.07

The BES is the sector with the highest share of total employment engaged in R&D activities within the EU-25 (Table 3.7). In 2003, the proportion in the BES was 0.66%. In the HES, this share amounted to 0.58% in 2003, gaining 0.01 percentage points compared with the previous year. In the GOV, for its part, only 0.19% of total employment was R&D personnel.

Looking at the data at national level, a different pattern emerges. The share of persons employed in R&D has a different weight according to the sector of performance from one country to another. For example, in Luxembourg or Denmark the BES comes far ahead of the other sectors (with shares of 1.88% and 1.37% respectively). At the opposite end of the scale, Lithuania reached only 0.05% in the BES.

Except in Iceland, where R&D personnel as a percentage of total employment in the BES increased by 0.24 percentage points, Estonia, where it went up by 0.06 percentage points, and Slovenia, by 0.05 percentage points, figures in general showed only small changes in 2003 compared with 2002.

In the HES, the figures for Sweden (1.15%), Finland (1.00%), Estonia and Greece (both 0.82%), Norway (0.97%) and Iceland (0.84%) were well above the EU-25 average in 2003. The smallest shares of R&D personnel in terms of total employment working in the HES were registered for Luxembourg (0.03%), followed by Cyprus (0.18%).

Finally, the government sector scored the smallest proportion of R&D personnel in terms of total employment. The exception of Cyprus can be noted since, with a share of 0.22%, the GOV had the highest proportion of R&D personnel in terms of total employment compared with the BES and HES (0.17% and 0.18% respectively).

Disparities between countries appear when comparing their R&D personnel as percentage of total employment and the increase in this percentage measured with the annual average growth rate (AAGR) for the period 1999-2003 (Figure 3.8).

The EU-25 average reached a proportion of R&D personnel in terms of total employment of 1.4% and an annual average growth rate of 0.8% between 1999 and 2003.

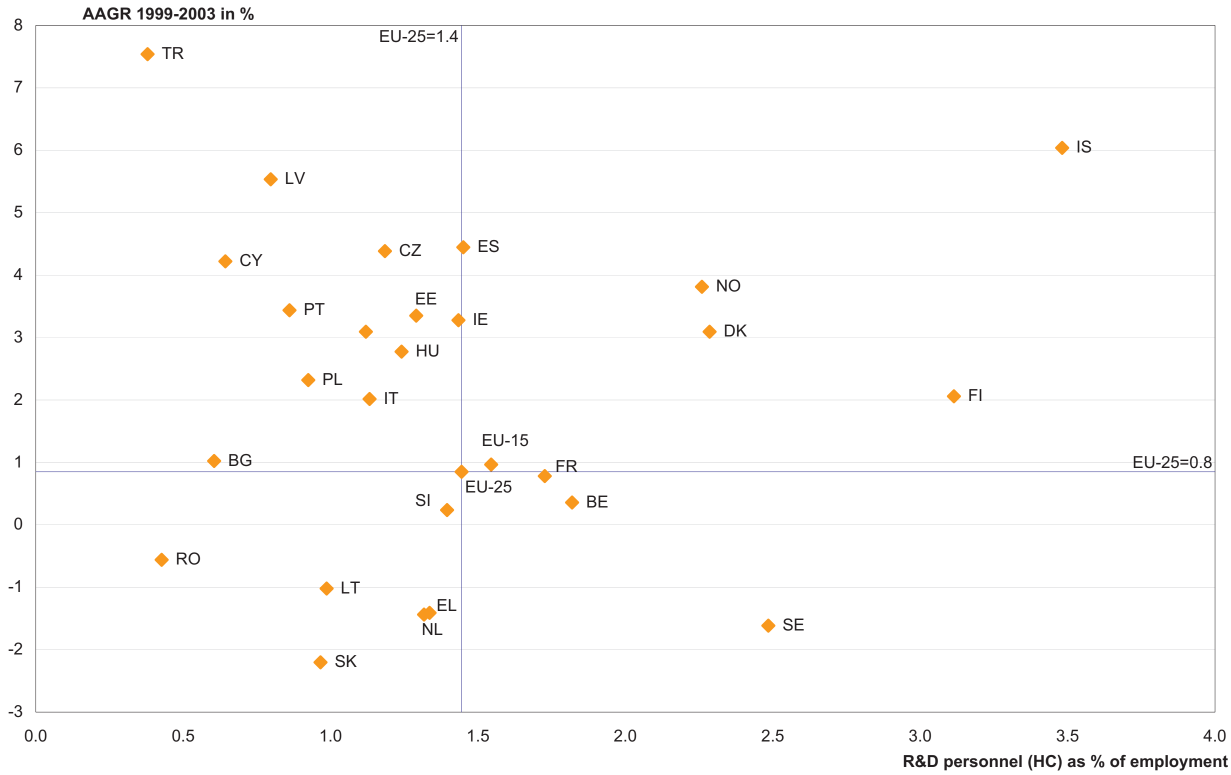
Iceland contrasts strongly, with the highest proportion of R&D personnel in terms of total employment (3.5%) in 2003. Moreover, Iceland also registered the second largest increase in this share between 1999 and 2003 (6.0%).

All countries with high shares of R&D personnel in total employment have an AAGR in excess of 2% (Norway, Denmark and Finland) except Sweden, where the proportion fell.

For most of the countries the proportion of employed persons working in R&D rose steadily between 1999 and 2003.

In contrast, only six countries showed a fall in their number of R&D personnel as a proportion of employment between 1999 and 2003. Five of those countries also have a global level of R&D personnel as a percentage of employment below the EU-25 level: Romania, Slovakia, Lithuania, the Netherlands and Greece.

Figure 3.8 **R&D personnel (HC) as a percentage of total employment in 2003 and annual average growth rate (AAGR) 1999-2003 (1), EU-25 and selected countries**



Eurostat estimates: EU-25, EU-15.
Exception to the reference year: 2002: TR.
Exception to the reference period:
2000-2003: EU-25 and BG;
2002-2003: BE, FR, IE, NL and HR;
1999-2002: TR.
(1) Calculated on R&D personnel expressed as a % of total employment.

R&D personnel in full-time equivalent - FTE

In 2004, R&D personnel in FTE in the EU-25 increased by 1.3% compared with 2003

In 2003, Germany and France employed almost half of the EU's R&D personnel measured in full-time equivalent, as their R&D personnel amounted to 472 533 and 346 078 persons respectively (Table 3.9). Italy and Spain came next, with 161 828 and 151 487 persons respectively in 2003.

Whereas Germany accounted for 23% of total R&D personnel in the EU-25, it employed 28% of the EU-25's R&D personnel in the BES and only 16% in the HES.

As can be seen in Table 3.7, where figures are shown as a proportion of total employment, Germany and France were above the EU-25 average in every sector.

In absolute terms, Germany and France also led in all sectors of performance, generally followed in third and fourth position by Spain and Italy.

Looking at the gender distribution, only two European countries had a proportion of females in R&D personnel higher than 50% (Latvia and Lithuania). This trend can be observed at the level of all sectors as well as in the detailed figures for the BES, GOV or HES.

In the candidate countries, Romania employed most R&D personnel (33 361 persons) in 2004, followed by Bulgaria (15 647 persons). Romania had 51% of R&D personnel working in the BES in 2004 whereas at the same time Bulgaria scored the highest proportion of R&D personnel in the GOV (67%).

Table 3.9 **R&D personnel in FTE and percentage of females, by sector of performance, EU-25 and selected countries - 2003 and 2004**

	All sectors			Business enterprise			Government			Higher education		
	2003		2004	2003		2004	2003		2004	2003		2004
	R&D PSL in FTE	% of women	R&D PSL in FTE	R&D PSL in FTE	% of women	R&D PSL in FTE	R&D PSL in FTE	% of women	R&D PSL in FTE	R&D PSL in FTE	% of women	R&D PSL in FTE
EU-25	2 021 395 s	:	2 047 530 sp	1 079 424 s	:	1 093 977 sp	297 688 s	:	292 414 sp	620 696 s	:	636 849 sp
EU-15	1 850 998 s	:	1 872 670 sp	1 036 159 s	:	1 047 544 sp	249 362 s	:	246 948 sp	542 689 s	:	554 700 sp
BE	52 240	30	53 938 e	31 375	22	32 004 e	3 757	33	4 039 e	16 516	44	17 302 e
CZ	27 957	32	28 765	13 711	22	15 064	7 977	43	7 422	5 987	39	6 104
DK	41 616	39	44 279 p	27 230	36	29 747 p	3 448	43	3 070 p	10 697	44	11 204 p
DE	472 533	25	469 100 e	298 072	19	298 100 p	73 867	37	72 000 e	100 594 p	37 p	99 000 e
EE	4 144	49	4 735 p	763	32	1 083 p	829	63	810	2 454	49	2 752
EL	31 822 p	35	31 843 p	11 581 p	19	10 984 p	5 101	42	5 137 p	14 947	44	15 519 p
ES	151 487	36	161 933	65 032	27	71 123	25 760	47	27 166	60 307	41	63 331
FR	346 078	:	:	193 256	:	:	51 372	:	:	95 234	:	:
IE	14 450	29	15 713 e	9 281	22	9 650 e	1 161	37	1 222	4 009	43 p	4 841
IT	161 828	33	:	67 958	18	:	31 463	42	:	59 406	44	:
CY	922	38	940 p	217	34	230 p	370	42	350 p	271	33	295 p
LV	4 858	56	5 103	886	51	881	996	65	1 013	2 976	55	3 208
LT	9 648	54	10 557	664	47	981	3 157	56	3 041	5 827	53	6 535
LU	4 010	22	4 177 e	3 500	20 e	3 556 e	476	35	576 p	34	73	45
HU	23 311 i	:	22 826 pi	7 180	:	6 704 p	7 859 i	:	7 595 pi	8 272	:	8 527 p
MT	413	:	395	93 p	:	94	36	13	17	284	33	284
NL	85 986	:	89 522 p	44 485	:	49 014 p	14 251 b	:	13 479 p	27 209	39	27 000 p
AT	38 893	22	:	26 728	14	:	2 060	41	:	9 879	38	:
PL	77 040	37	78 362	11 378	22	12 978	21 100	38	19 685	44 455	40	45 572
PT	25 529	46	:	6 124	29	6 378	4 917	58	5 149	11 147	49	11 601
SI	8 731 e	37 e	8 830 e	4 722 e	33 e	4 945 e	2 160 e	46 e	2 040 e	1 624 e	38 e	1 586 e
SK	13 354	46	14 329	3 651	37	3 473	3 842 i	55	3 493 i	5 857	45	7 286
FI	57 196	:	58 281	31 861	:	32 612	7 353	:	7 337	17 486	:	17 822
SE	72 978	18	72 459	48 113	25	47 123	3 000	34	3 056	21 495	:	21 910
UK	:	:	:	162 863	:	162 899	20 956	38	20 763 e	:	:	:
IS	2 940	39	3 050	1 352	34	1 422	775	38	794	728	46	746
NO	29 014	:	29 635	16 126	:	16 150	4 970	:	4 985	7 918	:	8 500
EEA	2 053 352 s	:	2 080 407 sp	1 096 904 s	:	1 111 731 sp	303 433 s	:	298 194 sp	629 342 s	:	646 095 sp
CH	:	:	52 250	:	:	33 085	:	:	810	:	:	18 355
BG	15 453	53	15 647	2 091	52	2 158	10 417	57	10 384	2 875	40	3 036
HR	9 148	52	:	2 165	48	1 981	3 275	54	3 458	3 708	53	3 347
RO	33 077	47	33 361	16 942	44	16 368	9 395	53	9 853	6 537	47	6 917
TR	28 964	:	:	5 918	:	:	5 502	:	:	17 544	:	:
RU	973 382	:	951 569	592 625	:	568 173	278 756	:	282 422	99 299	:	99 402

(i) HU, SK: defence excluded (all or mostly).
Exception to the reference year: AT, TR 2002.

R&D personnel in the EU-25 rose by 1.3% in 2004 compared with 2003. The annual growth rate (AGR) between 2003 and 2004 in the EU-25 was positive in two sectors of performance, with 2.6% in the higher education sector and 1.3% in the business enterprise sector, and negative in the government sector, with -1.8%. Except for the GOV, the growth rates registered in 2004 were above those of 2003. At national level, identical trends can be observed for some countries in all sectors as annual growth rates registered for these countries were higher than the previous year.

The highest annual growth rates were achieved by Estonia (14.3%), ahead of Lithuania (9.4%), Ireland and Slovakia (8.7% and 7.3% respectively). Whatever the sector, the largest increases were observed in countries with relatively low levels of R&D personnel in volume, with the exception of Spain in all sectors.

When looking at all sectors together, four Member States recorded negative growth rates between 2003 and 2004: Sweden (-0.7%), Germany (-0.7%), Hungary (-2.1%) and Malta (-4.4%).

In the BES, Estonia (41.9%) and Lithuania (47.7%), followed by Poland (14.1%) and the Netherlands (10.2%), registered the highest annual growth rates. Five EU-25 Member States had negative annual growth, with the lowest rate in Hungary (-6.6%). In the HES, Luxembourg (32%), Slovakia (24.4%) and Ireland (20.8%) recorded the highest rates. Luxembourg again scored the highest annual growth rate in the GOV, with 21%. Nevertheless, downward trends dominated this sector of performance, where the average growth rate for the EU-25 was -1.8% and the number of R&D personnel fell between 2003 and 2004 in thirteen EU-25 Member States (Table 3.10).

Table 3.10 **Annual growth rate (AGR) of R&D personnel in FTE, by sector of performance, EU-25 and selected countries - 2001 to 2004**

	All sectors			Business enterprise			Government			Higher education		
	2001-2002	2002-2003	2003-2004	2001-2002	2002-2003	2003-2004	2001-2002	2002-2003	2003-2004	2001-2002	2002-2003	2003-2004
EU-25	**2.1 s**	**1.2 s**	**1.3 sp**	**2.2 s**	**0.9 s**	**1.3 sp**	**1.0 s**	**0.9 s**	**-1.8 sp**	**2.2 s**	**1.7 s**	**2.6 sp**
EU-15	**2.5 s**	**1.2 s**	**1.2 sp**	**3.1 s**	**0.7 s**	**1.1 sp**	**-0.7 s**	**2.3 s**	**-1.0 sp**	**2.6 s**	**1.7 s**	**2.2 sp**
BE	-7.0	0.4	3.3 e	-10.7	-1.0	2.0 e	0.2	1.9	7.5 e	-0.9	2.6	4.8 e
CZ	-0.3	7.4	2.9	5.1	8.3	9.9	-5.4	8.5	-7.0	-3.3	2.4	2.0
DK	6.3	-1.9	6.4 p	10.2	-4.4	9.2 p	-39.3	1.9	-11.0 p	26.0	3.8	4.7 p
DE	-0.1	-1.6	-0.7 e	-1.5	-1.5	0.0 p	1.1	1.6	-2.5 e	3.2	-3.9 p	-1.6 e
EE	11.8	0.4	14.3 p	12.1	8.7	41.9 p	13.4	4.5	-2.3	10.6	-4.3	12.1
EL	:	:	0.1 p	1.8 p	1.8 p	-5.2 p	4.1 p	3.9 p	0.7 p	2.5 p	2.4 p	3.8 p
ES	6.8	12.8	6.9	21.2	15.4	9.4	-1.1	11.0	5.5	-0.7	11.2	5.0
FR	3.1	0.7	:	3.1 b	1.1	:	4.5	-0.5	:	2.5	1.1	:
IE	:	6.4	8.7 e	0.8	0.8	4.0 e	-31.0	-3.3	5.3	8.5	26.1	20.8
IT	6.6	-1.3	:	7.6	-3.2	:	3.9	1.7	:	2.4	-1.5	:
CY	19.3	12.1	2.0 p	30.8	15.8	6.2 p	6.4	-1.4	-5.5 p	42.8	31.9	8.7 p
LV	-3.3	-8.2	5.0	-6.6	-29.9	-0.6	2.7	-11.2	1.7	-4.0	2.3	7.8
LT	-20.2	1.2	9.4	-36.2	61.2	47.7	-27.3	-7.3	-3.7	-13.7	2.0	12.2
LU	:	:	4.2 e	1.6	1.6	1.6 e	7.1	15.8	21.0 p	-0.6	-0.6 e	32.0 e
HU	3.3	-1.7	-2.1 p	6.2	-0.2	-6.6 p	2.7	-1.5	-3.4 p	1.6	-3.0	3.1 p
MT	:	-13.1	-4.4 p	-2.6	24.0 p	1.1 p	-25.2	-73.1	-52.3	2.3	7.0	0.0
NL	-2.0	-1.6	4.1 p	-2.8	-5.4	10.2 p	-0.3	11.2 b	-5.4 p	-1.2	2.0	-0.8 p
AT	:	:	:	:	:	:	:	:	:	:	:	:
PL	-2.3	1.1	1.7	-50.8	33.9	14.1	36.2	-11.5	-6.7	1.3	1.6	2.5
PT	5.6 e	5.3 e	:	29.0 e	22.5 e	4.2	-8.8 e	-9.7 e	4.7	4.8 e	4.6 e	4.1
SI	0.1	1.3 e	1.1 e	5.9	5.0 e	4.7 e	-4.9	-4.9 e	-5.6 e	-7.4	-1.6 e	-2.3 e
SK	-5.5	-2.0	7.3	-6.0	-18.3	-4.9	-4.2	0.6	-9.1	-6.0	9.7	24.4
FI	3.0	3.9	1.9	0.8	5.1	2.4	1.3	-0.4	-0.2	8.3	3.6	1.9
SE	:	:	-0.7	-1.3	-1.4	-2.1	3.2	3.1	1.9	4.2	4.0	1.9
UK	:	:	:	9.7 b	-2.4	0.0	-9.2 b	-1.5	-0.9 e	:	:	:
IS	-3.6 e	5.1 e	3.7	-11.3 e	14.3 e	5.2	3.0 e	3.6 e	2.5	3.0 e	-4.8 e	2.5
NO	1.0	6.2	2.1	-1.1	10.0	0.1	3.2	1.1	0.3	3.7	2.0	7.4
EEA	**2.1**	**1.2**	**1.3**	**2.2 s**	**1.1 s**	**1.4 sp**	**1.1**	**0.9**	**-1.7**	**2.2**	**1.7**	**2.7**
CH	:	:	:	:	:	:	:	:	:	:	:	:
BG	0.5	2.8	1.3	-11.2	25.1	3.2	0.6	-0.7	-0.3	11.2	0.8	5.6
HR	:	-29.4	:	-11.5	-12.9	-8.5	8.1	8.1	5.6	-33.4	-50.2	-9.7
RO	0.5	0.8	0.9	-7.7	-7.9	-3.4	6.0	5.2	4.9	27.6	19.5	5.8
TR	4.6	:	:	5.5	:	:	3.9	:	:	4.4	:	:
JP	-3.9	2.9	:	-1.1	4.5	:	1.8	-3.1	:	-11.8	1.5	:
RU	-2.1	-1.4	-2.2	-2.6	-2.4	-4.1	0.4	-0.2	1.3	-4.8	1.1	0.1

R&D personnel in head count - HC

R&D personnel in head count increased at an annual average growth rate of 2% in the EU-25 during the period 1999-2003

According to Eurostat estimates, in 2003 almost 2.8 million persons measured in head count worked in R&D in the EU-25, representing an increase of more than 1% compared with 2002 (Table 3.11).

The ranking in terms of R&D personnel measured in head count matches that in FTE. The four leading countries in 2003 in all sectors were Germany (664 731), France (415 061), Spain (249 969) and Italy (249 782).

The BES employed the highest number of R&D personnel. The proportion of R&D personnel in the EU-25 in 2003 employed in the BES was 45%. For Germany, this proportion reached more than 50%. Luxembourg scored the highest proportion of R&D personnel in this sector, with a percentage of 85%.

The GOV is the sector having the least R&D personnel. 14% of European R&D personnel worked in this sector in 2003. This proportion reached 34% in Cyprus and 24% in the Czech Republic.

Table 3.11

R&D personnel in HC, by sector of performance, EU-25 and selected countries - 2001 to 2003

	All sectors			Business enterprise			Government			Higher education		
	2 001	2 002	2 003	2 001	2 002	2 003	2 001	2 002	2 003	2 001	2 002	2 003
EU-25	2 690 843 s	2 747 732 s	2 781 491 s	1 223 518 s	1 250 734 s	1 262 484 s	367 266 s	370 982 s	374 451 s	1 072 542 s	1 096 060 s	1 114 355 s
EU-15	2 436 506 s	2 498 071 s	2 529 030 s	1 167 438 s	1 203 994 s	1 211 882 s	308 859 s	306 700 s	313 662 s	933 490 s	958 227 s	974 306 s
BE	:	73 448	73 763	41 028	37 533	37 812	:	3 835	3 903	:	31 478	31 431
CZ	51 939	53 695	55 699	20 562	22 361	24 122	13 747	13 508	13 357	17 361	17 577	17 877
DK	59 811	62 202	61 809	34 134	37 837	36 953	10 128	4 946	5 018	15 122	19 029	19 455
DE	:	:	664 731	342 978	:	333 285	:	:	84 695	:	:	246 751
EE	6 818	6 921	7 600	1 153	1 164	1 529	945	980	1 145	4 647	4 694	4 813
EL	55 626	:	57 257	13 099	:	12 808	8 819	:	9 148	33 507	:	35 088
ES	209 011	232 019	249 969	54 190	73 461 1	82 327	31 645	31 536	35 306	120 918	126 275	131 725
FR	390 631 i	412 938 i	415 061 i	195 243 b	200 961	203 264	48 887 i	54 358 i	50 690 i	138 197 i	148 830 i	153 131 i
IE	:	24 486	25 704 p	12 334	11 960	12 037	:	1 609	1 657	:	10 917	12 010 p
IT	236 077	253 084	249 782	77 842	85 687	81 189	38 873	39 343	42 610	119 362	122 358	120 629
CY	1 733	1 937	2 102	481	511	567	679	750	724	405	494	601
LV	8 415	9 153	8 002	1 716	2 346	1 228	1 557	1 580	1 472	5 137	5 220	5 302
LT	14 980	13 540	14 534	954	553	781	4 820	3 504	3 301	9 206	9 483	10 452
LU	:	:	4 135	:	:	3 533	420	478	548	54	:	54
HU	45 676 i	48 727 i	48 681 i	8 672	9 428	9 438	10 461 i	11 767 i	11 474 i	26 543	27 532	27 769
MT	:	:	975	:	:	97	:	251	37	:	795	841
NL	:	109 224	106 980	61 180	61 514	57 442	13 767	13 924	15 866 b	:	32 793 e	33 581 e
AT	:	65 725	:	:	34 020	:	:	6 010	:	:	25 072	:
PL	123 840	122 987	126 241	22 470	11 312	15 035	20 209	28 543	25 390	81 087	83 011	85 745
PT	39 163	41 601 e	44 036	6 821	8 352 e	9 882	8 478	7 876 e	7 273	19 112	20 300 e	21 488
SI	12 349	12 379	12 501 e	4 991	5 330	5 676 e	2 959	2 826	2 693 e	4 204	4 013	3 868 e
SK	21 997	21 025	20 928	5 978	5 425	4 545	4 509 i	4 402 i	4 458 i	11 510	11 192	11 917
FI	69 788	73 121	74 773	37 971	39 239	40 089	9 640	10 064	9 903	21 517	23 126	24 049
SE	110 291	:	110 737	53 484	:	52 346	5 239	:	5 521	51 465	:	52 500
UK	:	:	:	:	:	:	23 131 b	23 399	22 461	:	:	:
IS	5 218	4 970	5 466	1 940	1 810	2 193	1 347	1 299	1 740	1 523	1 468	1 323
NO	48 691	51 086	51 175	21 127	22 436	22 572	6 450	6 650	6 642	21 114	22 000	21 961
EEA	2 731 605 s	2 788 978 s	2 824 794 s	1 242 428 s	1 269 457 s	1 282 929 s	374 169 s	378 109 s	381 677 s	1 087 321 s	1 111 316 s	1 129 877 s
CH	:	:	:	:	:	:	:	1 633	:	:	28 258	:
BG	16 671	16 847	17 400	1 972	1 866	2 398	10 974	11 039	10 977	3 616	3 913	3 920
HR	:	16 515	17 216	:	2 524	2 237	:	4 858	5 487	:	9 133	9 492
RO	37 696	38 433	39 985	20 642	19 088	17 232	8 595	9 111	9 641	8 459	10 234	12 859
TR	75 960	79 958	:	8 753	9 107	:	8 544	8 644	:	58 663	62 207	:
JP	1 050 414	1 032 826	1 081 099	629 487	609 694	653 380	68 887	70 342	72 367	330 654	331 499	335 983
RU	885 568	870 878	858 470	585 416	568 628	558 668	256 137	257 462	256 098	43 463	44 135	43 120

(i) FR: Underestimated or based on underestimated data.
(i) HU and SK: Defence excluded (all or mostly).

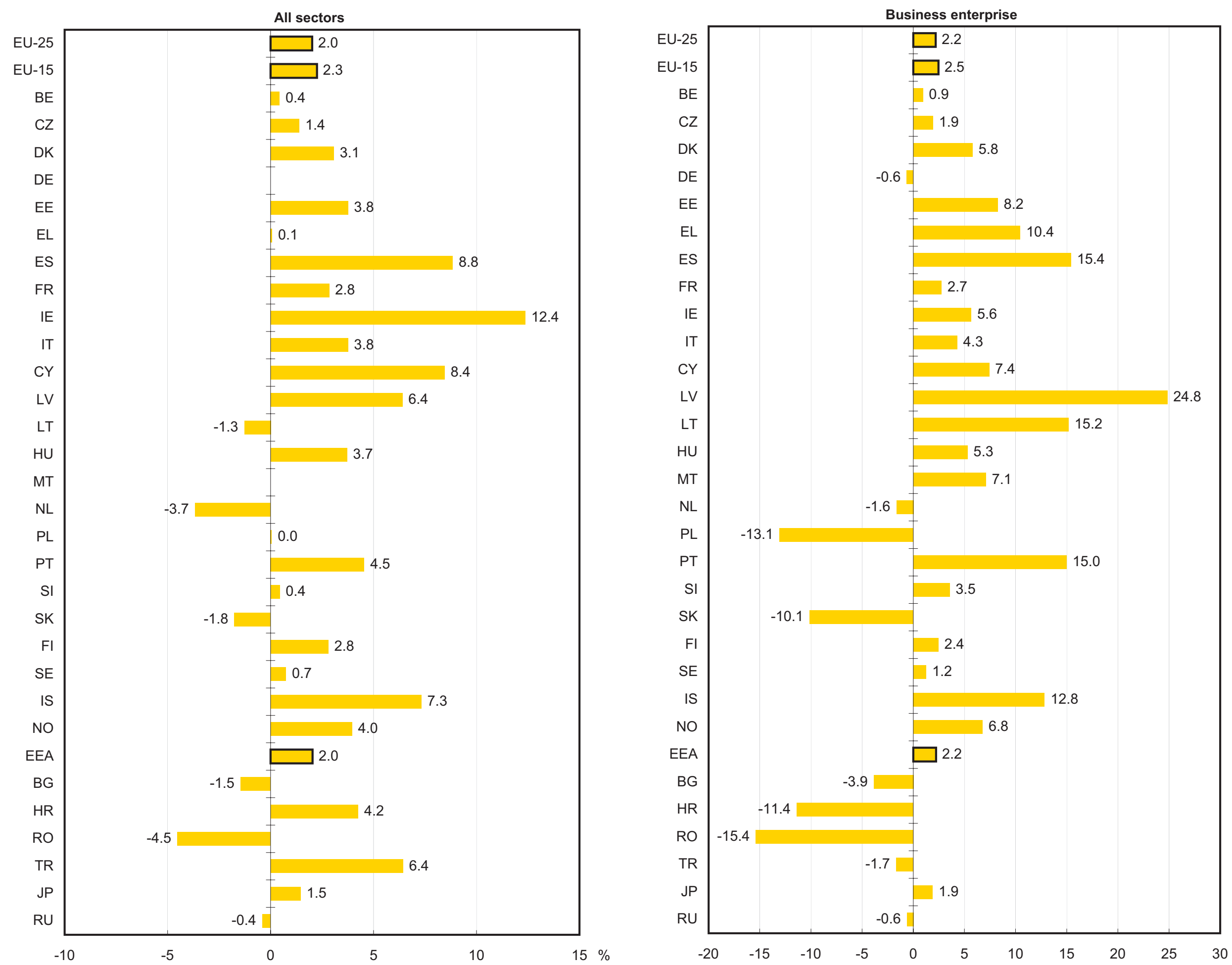
EU-25 R&D personnel increased during the period 1999-2003, with an annual average growth rate of 2.0%.

Ireland recorded the highest growth in R&D personnel, with 12.4% between 1999 and 2003. It was followed by Spain, with 8.8%, which was also the third leading country in terms of R&D personnel in HC (Table 3.11).

Annual average growth rates were below the EU-25 average but positive in six Member States: the Czech Republic (1.4%), Sweden (0.7%), Belgium (0.4%), Slovenia (0.4%), Greece (0.1%) and Poland (0.05%), whereas the rate was negative for Lithuania (-1.3%), Slovakia (-1.8%) and the Netherlands (-3.7%).

Looking at the BES, the R&D personnel increase seems higher during the period 1999-2003 compared with the situation for all sectors. Latvia had the highest growth, with 24.8%, followed by Spain (15.4%), Lithuania (15.2%) and Portugal (15.0%). Four European countries recorded a fall in the number of R&D personnel in this sector: Germany (-0.6%), the Netherlands (-1.6%), Slovakia (-10.1%) and Poland (-13.1%).

Figure 3.12 **Annual average growth rates (AAGR) of R&D personnel in HC all sectors and business enterprise sector (BES), EU-25 and selected countries - 1999-2003**



Eurostat estimates: EU-25, EU-15 and EEA.
Exceptions to the reference period:
2000-2003: FR,
2002-2003: BE and HR,
2001-2003: JP,
1999-2002: TR.

Eurostat estimates: EU-25, EU-15 and EEA.
Exceptions to the reference period:
2000-2003: FR and MT,
2002-2003: HR,
2001-2003: JP,
1999-2002: TR.

Researchers in full-time equivalent - FTE

The majority of European researchers worked in the business enterprise sector in 2004

In 2004, over 1.2 million researchers measured in full-time equivalent were employed in the EU-25, their number having increased by 58 000 since 2002 (Table 3.13). This positive trend can also be observed at national level, as most countries, with the exception of Latvia and Hungary, saw their number of researchers increase between 2002 and 2004.

In terms of volume, most researchers work in Germany (269 500), France (192 790), Spain (100 994) and Italy (70 332).

The majority of researchers were employed in the BES. In the EU-25, their proportion was even higher in 2004 than for the total R&D personnel in FTE (Table 3.9), as it reached 50%. This trend can be observed in all EU-25 Member States. For example, 62% of Danish researchers worked in the BES. This proportion reached 79% in Luxembourg.

Coming after this sector, in the EU-25, 36% of researchers were employed in the HES and only 13% in the GOV.

Table 3.13

Researchers in FTE, by sector of performance, EU-25 and selected countries - 2002 to 2004

	All sectors			Business enterprise			Government			Higher education		
	2 002	2 003	2 004	2 002	2 003	2 004	2 002	2 003	2 004	2 002	2 003	2 004
EU-25	1 149 617 s	1 166 970 s	1 207 409 sp	561 926 s	572 951 s	597 424 sp	154 925 s	158 426 s	159 660 sp	418 717 s	421 082 s	435 420 sp
EU-15	1 035 575 s	1 049 341 s	1 084 689 sp	541 347 s	549 848 s	572 009 sp	124 304 s	128 893 s	130 910 sp	356 262 s	356 554 s	367 386 sp
BE	30 652	30 901	31 880 e	16 363	16 242	16 612 e	1 980	2 026	2 133 e	12 050	12 373	12 875 e
CZ	14 974	15 809	16 300	6 191	6 558	7 297	4 429	4 833	4 661	4 283	4 318	4 274
DK	25 546	24 886	27 158 p	15 747 b	14 734	16 922 p	2 268	2 342	2 167 p	7 379	7 668	7 912 p
DE	265 812	268 942	269 500 e	155 440	161 980	162 000	39 080	38 719	40 000 e	71 292	68 243	67 500 e
EE	3 059	3 017	3 369 p	464	505	661 p	463	478	486	2 090	1 974	2 162
EL	:	15 390 p	15 680 p	:	4 053 p	4 116 p	:	2 136	2 150 p	:	9 072	9 277 p
ES	83 318	92 523	100 994	24 632 b	27 581	32 054	12 625	15 489	17 151	45 727	49 196	51 616
FR	186 420	192 790	:	95 294	100 646	:	24 140 i	24 541 i	:	63 555	64 403	:
IE	9 375	10 039	10 910 e	5 991	6 012	6 200 e	587	553	559	2 797	3 474	4 151
IT	71 242	70 332	:	28 019	26 866	:	13 565	13 976	:	28 301	27 774	:
CY	435	490	520 p	117	103	115 p	104	109	100 p	194	256	280 p
LV	3 451	3 203	3 324	675	464	448	549	517	490	2 226	2 222	2 385
LT	6 326	6 606	7 356	265	442	484	1 871	1 686	1 676	4 190	4 478	5 196
LU	:	1 949	2 107 e	:	1 594	1 665 e	285	325	398 p	:	30	45
HU	14 965 i	15 180 i	14 904 pi	4 344	4 482	4 309 p	4 622 i	4 741 i	4 693 pi	5 999	5 957	5 902 p
MT	272	276	272	47	51 p	51	22	9	4	203	216	217
NL	38 159	37 282	40 269 e	20 419	19 399	21 306 e	6 790	7 637 b	7 690 p	10 448	10 211	:
AT	24 124	:	:	16 001	:	:	999	:	:	6 977	:	:
PL	56 725	58 595	60 944	4 686	6 829	8 334	14 688	13 233	12 804	37 275	38 455	39 716
PT	18 984 e	20 242	:	3 258 e	3 794	4 136	3 543 e	3 440	3 634	9 502 e	10 062	10 381
SI	4 642	4 815 e	5 003 e	1 620	1 755 e	1 901 e	1 493	1 492 e	1 491 e	1 366	1 379 e	1 392 e
SK	9 181	9 627	10 718	2 169	1 914	1 815	2 380 i	2 436 i	2 345 i	4 629	5 273	6 509
FI	:	:	41 004 i	:	:	23 397 i	:	:	4 200 i	12 392 i	:	13 037 i
SE	:	47 836	48 784	:	28 403 i	28 295	:	2 287 i	2 345	:	17 146	17 794
UK	:	:	:	104 621	102 684	103 365	9 242	9 278	9 126 e	:	:	:
IS	:	1 917	1 987	:	836	879	:	467	479	:	562	576
NO	:	20 989	:	:	11 480	:	:	3 258	3 300	:	6 251	6 800
EEA	1 172 044 s	1 189 877 s	1 231 706 sp	574 162 s	585 268 s	610 505 sp	158 540 s	162 151 s	163 438 sp	425 218 s	427 895 s	442 796 sp
CH	:	:	25 384	:	:	12 637	461 e	:	424	11 191	:	12 323
BG	9 223	9 589	9 827	957	1 225	1 239	6 067	6 113	6 168	2 181	2 193	2 362
HR	8 572	5 861	:	1 253	913	805	2 022	2 158	2 265	5 297	2 790	2 498
RO	20 286	20 965	21 257	10 673	9 920	9 092	5 934	6 043	6 326	3 679	4 941	5 654
TR	23 995	:	:	3 697	:	:	2 754	:	:	17 544 i	:	:
JP	646 547 b	675 330	:	431 190	458 845	:	33 891	33 711	:	170 512 b	172 396	:
RU	491 944	487 477	477 647	275 333	267 850	257 621	145 646	146 370	147 896	69 441	71 174	70 844

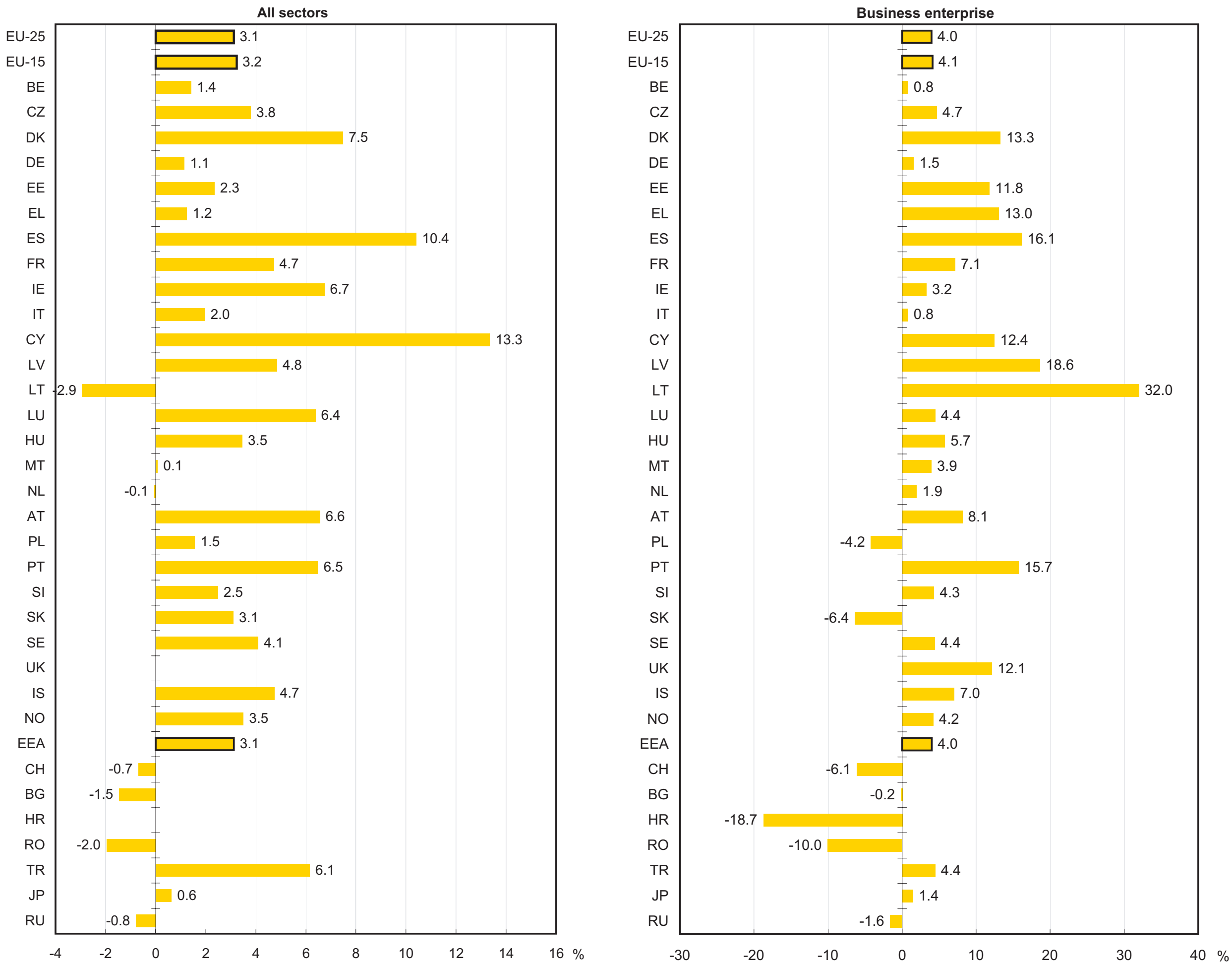
(i) FR, HU, SK: Defence excluded (all or mostly).
(i) FI, SE, TR: University graduates instead of researchers.

In terms of growth measured by annual average growth rates in all sectors, the highest increases were observed in Cyprus and Spain, with rates of 13.3% and 10.4% respectively. Germany in turn recorded a very small increase of 1.1%.

Ten EU-25 Member States had lower annual average growth rates than the EU-25 growth rate, which is 3.1%. Among these, two registered a decrease in their number of researchers between 1999 and 2004: the Netherlands (-0.1%) and Lithuania (-2.9%).

Looking at the BES, the annual average growth rate for EU-25 (4.0%) is higher than the rate registered for all sectors. This trend can also be observed at national level, as some Member States saw their number of researchers between 1999 and 2004 increase more rapidly in the BES compared with all sectors. For example, Lithuania recorded a decline in its researchers in all sectors but its proportion of researchers working in the BES sector increased, with an annual average growth rate of 32.0%.

Figure 3.14 **Annual average growth rates (AAGR) of researchers in FTE, all sectors and business enterprise sector (BES), EU-25 and selected countries - 1999-2004**



Eurostat estimates: EU-25, EU-15 and EEA.
Exceptions to the reference period:
1998-2002: AT,
1999-2003: FR, IT, PT, NO and JP,
1999-2002: TR,
2000-2004: LU,
2002-2004: MT.

Eurostat estimates: EU-25, EU-15 and EEA.
Exceptions to the reference period:
1999-2003: NO and JP.
1999-2002:TR.

Researchers by gender

Female researchers are still under-represented in the EU-25

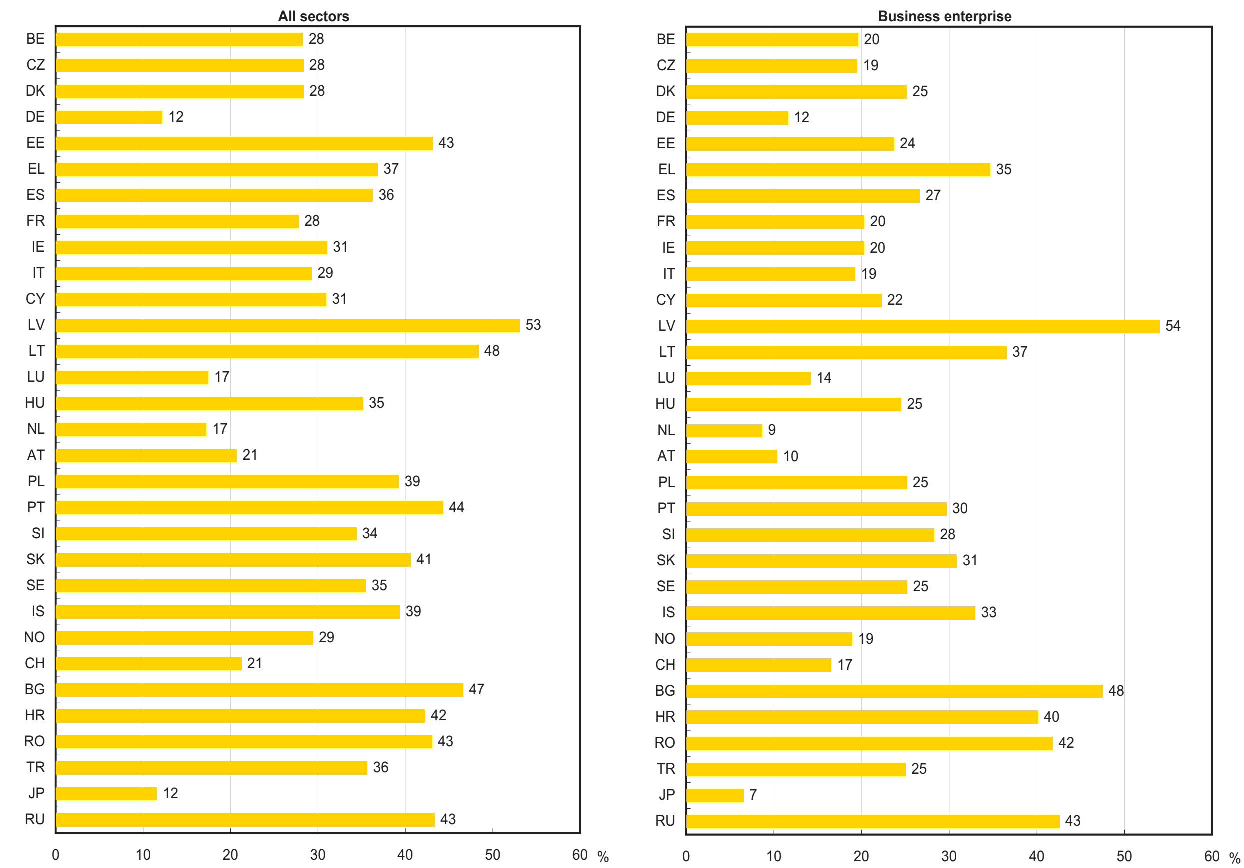
Female researchers are still under-represented in the EU-25 compared with males, especially in the business enterprise sector. In 2003, they accounted for 53% of total researchers in Latvia and 48.3% in Lithuania but these top scores hide the general trend as observed in Figure 3.15. At the bottom of the ranking for all sectors, the lowest proportions of female researchers were observed in Germany (12%), the Netherlands (17%) and Luxembourg (17%).

Female researchers are even less numerous in the business enterprise sector than for all sectors. The highest share of females among researchers in the BES was registered in Latvia (54%), also followed by Lithuania, with only 37%. With the exception of Greece, in the rest of the EU-25 countries fewer than one in three researchers were female.

The Netherlands (9%), Austria (10%) and Germany (12%) had the lowest proportion of female researchers working in the BES.

The percentage of females among researchers is in general higher among the candidate countries. In all sectors, Bulgaria (47%), Romania (43%) and Croatia (42%) were close to parity. Looking at the BES, the proportion of female researchers tends to fall compared with all sectors. This is the case in Croatia, Romania and Turkey. Nevertheless, in Bulgaria the proportion of female researchers working in the BES was higher than the proportion registered in all sectors (Figure 3.15).

Figure 3.15 **Percentage of female researchers in HC, all sectors and business enterprise sector (BES), EU-25 and selected countries - 2003**



Exceptions to the reference year:
2002: AT and TR,
2000: CH.
National estimate: SI.
Provisional data: IE.
FR: underestimated or based on underestimation.
HU: Defence excluded (all or mostly).

Exceptions to the reference year:
2002: AT and TR,
2000: CH.
National estimate: LU, SI.
SE: University graduates instead of researchers.

Researchers in the business enterprise sector by selected NACE

A large majority of the EU-25 researchers in the BES work in manufacturing

In the EU-25, 572 951 researchers measured in FTE were employed in the BES in 2003. The largest share of these business researchers worked in the manufacturing sector (413 340 persons) - Table 3.16.

This trend can also be observed in the individual EU-25 countries. In absolute terms, Germany had the highest number of BES researchers in Europe, with 161 980 persons, followed by the United Kingdom, with 102 684 persons. The proportion of these researchers working in the manufacturing sector reached 88% in Germany and 76% in Sweden. Slovenia and the United Kingdom also had a high proportion of BES researchers in this sector, with 75% and 71% respectively.

Nevertheless, seven EU Member States were an exception to this trend and had a larger proportion of researchers in the BES working in the services sector than in manufacturing: Estonia, Greece, Spain, Latvia, Luxembourg, Portugal and Slovakia. The highest proportion of BES researchers working in services is registered in Slovakia, with 68%, followed by Latvia, with 67%.

At the other end of the scale, "Construction" and "Electricity, gas and water supply" were the two sectors of activity having the least business enterprise researchers.

Table 3.16 Business enterprise researchers in FTE, by economic activity (NACE Rev. 1.1), EU-25 and selected countries - 2003

	Total	Agriculture, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Services sector
EU-25	572 951 s	:	:	413 340 s	:	:	147 649 s
EU-15	549 848 s	:	:	399 577 s	:	:	139 692 s
BE	16 242	167	31	10 637	111	377	4 920
CZ	6 558	29	1	3 440	1	119	2 968
DK	15 394	:	:	8 365	:	43	6 948
DE	161 980	215	54	142 537	421	215	18 540
EE	505	:	-	193	17	1	294
EL	4 053	9	21	1 690	4	9	2 321
ES	27 581	186	82	13 197	140	494	13 484
FR	95 294	297	133	64 260	1 664	476	27 856
IE	6 012	8	2	3 133	0	0	2 869
IT	26 866	:	133	17 045	86	43	9 559
CY	103	3	-	53	2	1	44
LV	464	:	:	149	:	2	313
LT	442	:	6	299	:	:	137
LU	1 594	:	:	756	0	:	838
HU	4 482	108	5	2 932	90	14	1 333
MT	47	:	0	30	1	0	16
NL	19 399	158	330	12 995	91	166	5 659
AT	16 001	10	9	10 741	51	41	5 150
PL	6 829	231	494	4 716	83	331	974
PT	3 794	24	2	1 414	14	56	2 283
SI	1 620	0	34	1 210	0	0	376
SK	1 914	44	0	553	:	:	1 301
FI	:	:	:	:	:	:	:
SE	28 403	98	42	21 568	122	:	6 574
UK	102 684	611	498	73 616	978	450	26 531
IS	836	:	:	:	:	:	:
NO	11 480	98	446	4 824	38	160	5 914
EEA	585 268	:	:	:	:	:	:
BG	1 225	5	0	497	0	0	723
RO	9 920	1 146	724	6 809	226	141	874
TR	3 697	61	45	2 715	20	4	852

Exceptions to the reference year: 2002: FR, MT, AT, SI and TR.

Researchers by field of science

Natural sciences is the field with the largest proportion of researchers employed in the higher education and government sectors

Taking a look at the distribution of researchers in the government sector by field of science, major disparities can be observed. Looking at different countries, the majority of researchers in the GOV sector can generally be found in the field of Natural sciences. In Latvia, 59% of researchers in the government sector are recorded in this field of science against only 2% in Humanities. The Czech Republic and Lithuania followed with a proportion of 49% of GOV researchers in the field of Natural sciences (Table 3.17).

At the other end of the scale, Humanities had for some Member States the lowest proportion of researchers in the government sector.

The situation was similar in the candidate countries where Natural sciences scored the highest proportion of GOV researchers. Bulgaria had the highest proportion in this field of science, with 43%. It is interesting to note that in Croatia, although 33% of researchers in the GOV can be found in Natural sciences, the same proportion is also registered in Medical sciences.

Table 3.17 **Researchers in the government sector by field of science, in FTE and as a percentage of total, EU-25 and selected countries - 2003**

	Total	Agriculture		Engineering and technology		Medical sciences		Natural sciences		Social sciences		Humanities	
	FTE	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
EU-25	158 426 s	:	:	:	:	:	:	:	:	:	:	:	:
EU-15	128 893 s	:	:	:	:	:	:	:	:	:	:	:	:
BE	2 026	391	19	980	48	51	3	247	12	128	6	229	11
CZ	4 833	552	11	694	14	282	6	2 371	49	351	7	583	12
DK	2 342	554	24	385	16	311	13	657	28	233	10	202	9
DE	38 719	2 364	6	11 252	29	2 562	7	16 752	43	2 436	6	3 353	9
EE	478	35	7	36	8	85	18	126	26	12	3	184	38
EL	2 136	:	:	:	:	:	:	:	:	:	:	:	:
ES	15 489	2 523	16	3 438	22	5 909	38	2 387	15	683	4	551	4
FR	24 541	:	:	:	:	:	:	:	:	:	:	:	:
IE	553	376	68	1	0	23	4	68	12	82	15	3	1
IT	13 976	1 183	8	1 615	12	2 709	19	6 423	46	1 775	13	271	2
CY	109	38	35	3	2	5	5	37	34	15	14	11	10
LV	517	82	16	34	7	15	3	307	59	67	13	12	2
LT	1 686	164	10	203	12	17	1	819	49	105	6	378	22
LU	325	:	:	:	:	:	:	:	:	:	:	:	:
HU	4 741	671	14	326	7	395	8	1 960	41	525	11	864	18
MT	9	3	33	2	22	0	0	0	0	0	0	4	44
NL	7 637	:	:	:	:	:	:	:	:	:	:	:	:
AT	999	128	13	68	7	87	9	207	21	273	27	236	24
PL	13 233	1 674	13	3 973	30	1 763	13	4 562	34	585	4	676	5
PT	3 440	859	25	497	14	606	18	877	26	435	13	165	5
SI	1 493	92	6	135	9	203	14	658	44	383	26	180	12
SK	2 436	218	9	317	13	305	13	989	41	568	23	39	2
FI	4 200 i	:	:	:	:	:	:	:	:	:	:	:	:
SE	2 287	:	:	:	:	:	:	:	:	:	:	:	:
UK	9 445	:	:	:	:	:	:	:	:	:	:	:	:
IS	423	133	31	111	26	51	12	85	20	28	7	15	4
NO	3 258	587	18	374	11	336	10	765	23	1 028	32	168	5
EEA	162 151 s	:	:	:	:	:	:	:	:	:	:	:	:
BG	6 113	893	15	1 123	18	402	7	2 656	43	286	5	753	12
HR	2 158	125	6	2	0	719	33	712	33	352	16	248	11
RO	6 043	323	5	1 406	23	701	12	2 416	40	712	12	485	8

Exceptions to the reference year:
2002: AT and SI,
2001: IS,
2004: FI.
(i) FI = University graduates instead of researchers.

As in the government sector, researchers in the higher education sector are mostly located in the Natural sciences field. For most countries, the highest proportion of researchers in the HES is found in this field of study. This is the case in Cyprus, where 46% of researchers in the HES are found in Natural sciences. The second and third highest proportions are observed in Ireland (38%) and Latvia (37%). There are nevertheless disparities between countries, as in Malta for example, where this field of science accounted for only 9% of HES researchers while 34% were registered in Medical sciences and 29% in Social sciences.

Looking at the candidate countries, the conclusions are different. The highest shares of HES researchers are scored in the Engineering and technology field.

In Romania, almost half of all HES researchers were recorded in this field of science. The trend is the same for Bulgaria and Romania. The case of Turkey has to be quoted as exception: 12% of HES researchers work in the field of Engineering and technology and 9% in Natural sciences. The highest proportion of Turkish HES researchers is found in the field of Social sciences (33%), followed by 22% in Medical sciences (Table 3.18).

Table 3.18 **Researchers in the higher education sector by field of science, in FTE and as a percentage of total, EU-25 and selected countries - 2003**

	Total	Agriculture		Engineering and technology		Medical sciences		Natural sciences		Social sciences		Humanities	
	FTE	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%	FTE	%
EU-25	421 082 s	:	:	:	:	:	:	:	:	:	:	:	:
EU-15	356 554 s	:	:	:	:	:	:	:	:	:	:	:	:
BE	12 374	1 156	9	1 994	16	2 559	21	2 944	24	2 420	20	1 300	11
CZ	4 318	244	6	1 518	35	544	13	939	22	735	17	338	8
DK	7 668	449	6	923	12	1 990	26	1 906	25	1 056	14	1 344	18
DE	68 243 p	2 585	4	13 458	20	10 654	16	21 458	31	8 432	12	11 657	17
EE	1 974	124	6	495	25	85	4	650	33	356	18	264	13
EL	9 072	:	:	:	:	:	:	:	:	:	:	:	:
ES	49 196	1 314	3	10 173	21	7 706	16	11 009	22	11 183	23	7 812	16
FR	64 403	:	:	:	:	:	:	:	:	:	:	:	:
IE	3 367 e	50 e	1 e	580 e	17 e	300 e	9 e	1 270 e	38 e	747 e	22 e	420 e	12 e
IT	27 774	:	:	:	:	:	:	:	:	:	:	:	:
CY	256	:	:	14	5	1	0	117	46	86	34	38	15
LV	2 222	162	7	310	14	156	7	820	37	423	19	351	16
LT	4 478	157	4	959	21	724	16	965	22	967	22	706	16
LU	30	:	:	:	:	:	:	:	:	:	:	:	:
HU	5 957	440	7	932	16	767	13	1 015	17	1 193	20	1 610	27
MT	216	2	1	27	13	74	34	19	9	62	29	31	14
NL	10 211	546	5	1 663	16	2 740	27	1 996	20	:	:	:	:
AT	6 977	234	3	1 091	16	1 516	22	2 279	33	975	14	882	13
PL	38 455	2 736	7	7 778	20	6 645	17	7 892	21	8 475	22	4 929	13
PT	10 062	596	6	2 147	21	718	7	3 307	33	2 321	23	973	10
SI	1 366	168	12	476	35	98	7	144	11	329	24	151	11
SK	5 272	464	9	1 384	26	719	14	1 588	30	694	13	423	8
FI	12 714 i	:	:	:	:	:	:	:	:	:	:	:	:
SE	15 851	1 008	6	3 528	22	3 341	21	2 611	16	2 343	15	1 296	8
UK	68 867	:	:	:	:	:	:	:	:	:	:	:	:
IS	519	41	8	115	22	90	17	119	23	90	17	64	12
NO	6 251	232	4	752	12	1 618	26	1 347	22	1 469	24	833	13
EEA	427 895 s	:	:	:	:	:	:	:	:	:	:	:	:
BG	2 193	164	7	919	42	304	14	169	8	485	22	152	7
HR	2 790	237	8	777	28	642	23	267	10	650	23	217	8
RO	4 941	101	2	2 370	48	1 126	23	356	7	718	15	270	5
TR	17 544	1 457	8	2 154	12	3 872	22	1 512	9	5 757	33	2 792	16

Exceptions to the reference year:
2001: AT, SI, and TR,
2002: SE and IS.
(i) FI: University graduates instead of researchers.

3.4 R&D personnel in the European regions

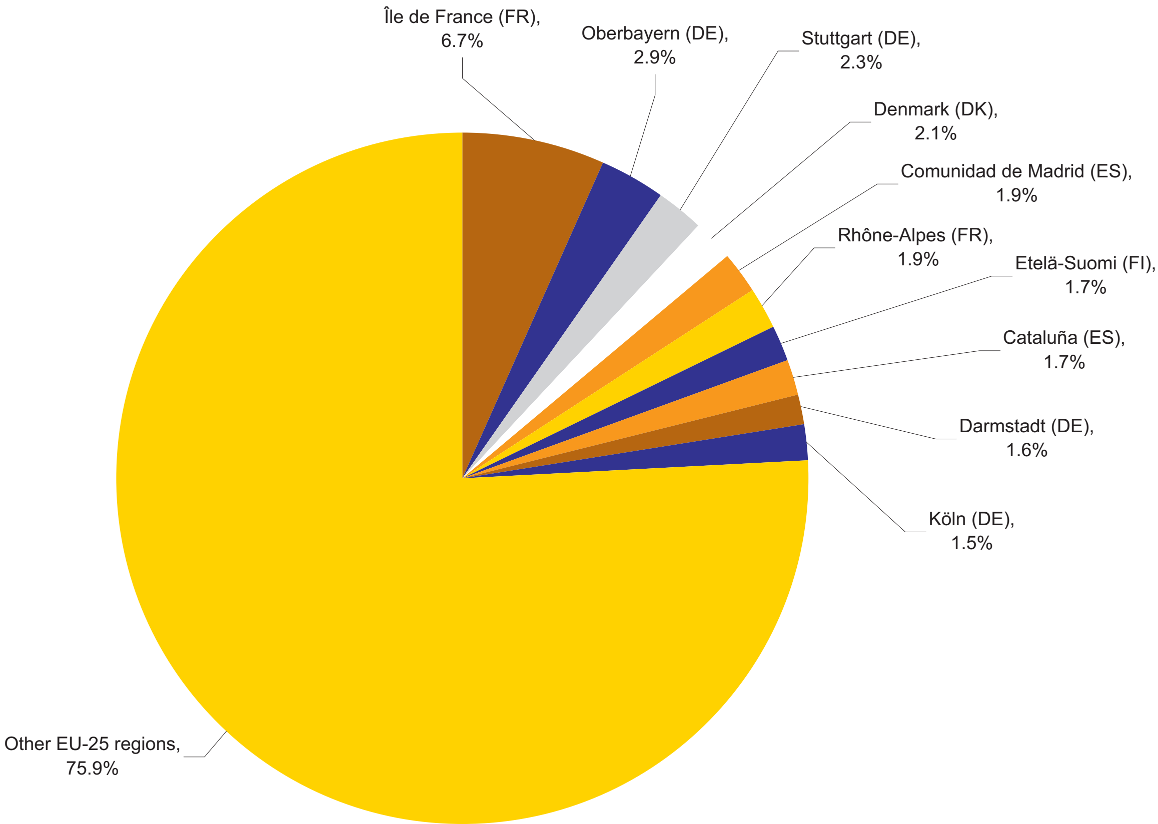
Leading regions in R&D personnel

In 2003, Île de France led in absolute terms, whereas Wien scored the highest rate as a percentage of total employment

In 2003, close to one quarter of the EU-25 R&D personnel in full-time equivalent was concentrated in the top ten regions. Accounting for 6.7% of the total, Île de France (FR) was the leading region in terms of R&D personnel in FTE. German regions were the most represented among the top ten: Oberbayern and Stuttgart ranked second and third, with 2.9% and 2.3% respectively.

Besides Germany and France, only three other countries had regions in the top ten: Denmark, which is classified as a region at NUTS level 2, Spain and Finland (Figure 3.19).

Figure 3.19 **Percentage of R&D personnel employed in the top 10 EU-25 regions, in FTE, all sectors - 2003**



No regional data for BE, EL and UK.
DK, EE, CY, LV, LT, LU, MT and SI are classified at NUTS level 2.
Exceptions to the reference year:
2002: FR and AT,
1999: SE.

Comparing the regional number of R&D personnel measured in FTE with total employment, it appears that the top 15 regions in terms of the absolute number of R&D personnel do not automatically have the highest share of R&D personnel in terms of total employment.

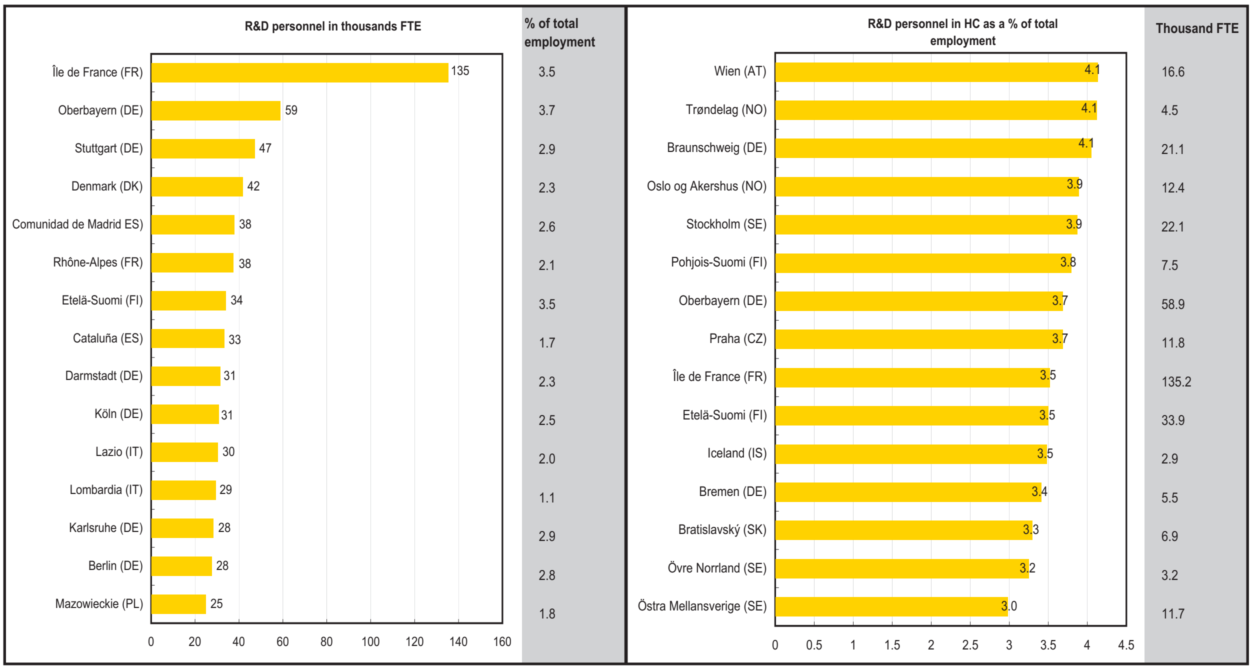
The percentage of R&D personnel in terms of total employment varies between 3.7% for Oberbayern (DE) and 1.1% for Lombardia (IT) (Figure 3.20).

The leading region as regards the share of R&D personnel in total employment was Wien (AT), with 4.1%. This region had eight times fewer persons recorded as R&D personnel than the Île de France region (FR).

The regions of Trøndelag (NO) and Braunschweig (DE) are ranked in second and third position respectively in terms of R&D personnel as a percentage of total employment. At the same time, the leading region in terms of the absolute number of R&D personnel measured in FTE, Île de France (FR), was classed only in the ninth position.

Nevertheless, German regions are still the most represented among the top 15 in terms of the share of R&D personnel as a percentage of total employment, with five regions (Figure 3.20).

Figure 3.20 Top 15 regions in terms of R&D personnel in FTE and as a percentage of total employment (HC), EU-25, Iceland and Norway - 2003



No data available for BE, UK.
Exceptions to the reference year: 2002: FR and AT.

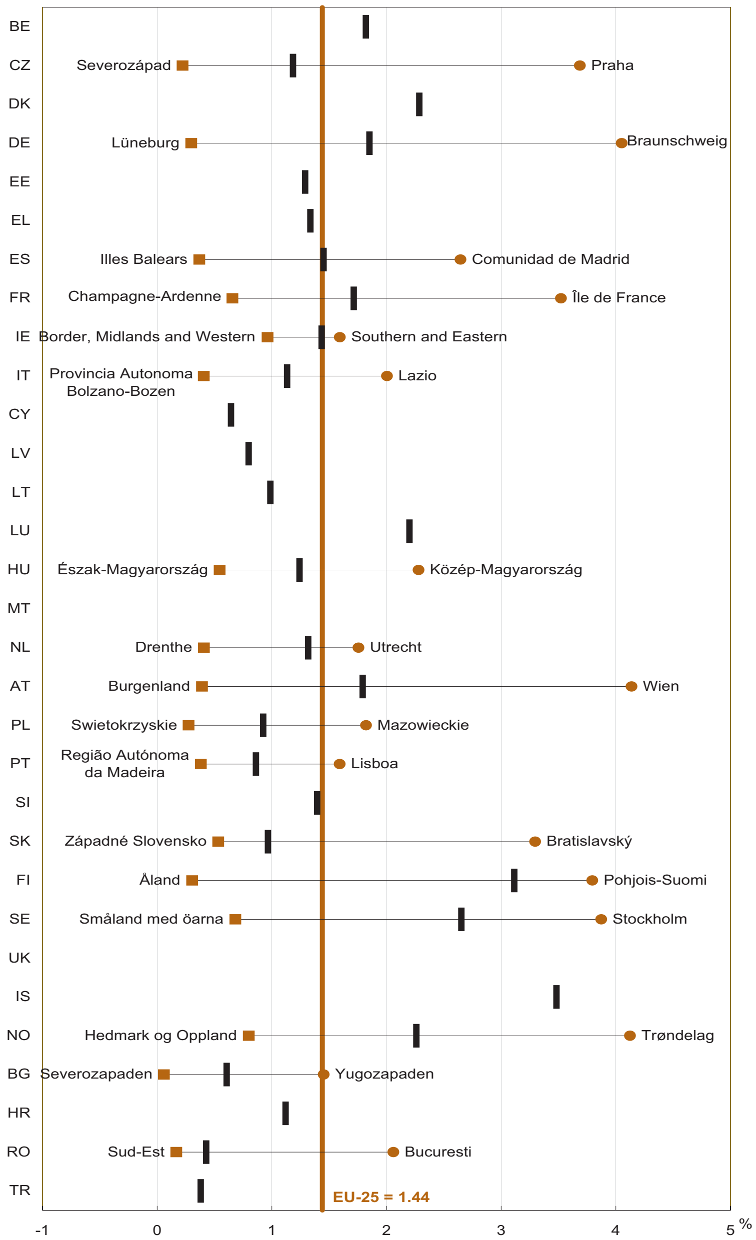
Regional disparities in R&D personnel

Wien is the EU-25 leading region with a share of 4.1% of R&D personnel in total employment

Gaps are also noticeable between countries when R&D personnel is measured as a percentage of total employment. More than 2.7 percentage points separate the top region of Austria, Wien, from the top region of Bulgaria, Yugozapaden. Besides Austria, the top region for Germany and Norway is above 4% for the share of R&D personnel in total employment. In contrast, Portugal's and Ireland's top regions are close to the EU-25 average (1.44%). Regions with the lowest proportion of R&D personnel by country show quite similar figures from one country to another. The results for these regions were below 1% (Figure 3.21).

A broader picture, for all sectors, is shown for R&D personnel as a percentage of total employment for all the EU-25 regions at NUTS level 2 in Map 3.22. Two thirds of the German regions had a share of R&D personnel in total employment greater than 1%. Three of these regions are in the top ten regions: Braunschweig (4.0%), Oberbayern (3.7%) and Bremen (3.4%). This leadership is shared with Finland (two regions).

Figure 3.21 — Regional disparities in R&D personnel as a percentage of total employment, EU-25 and selected countries - 2003

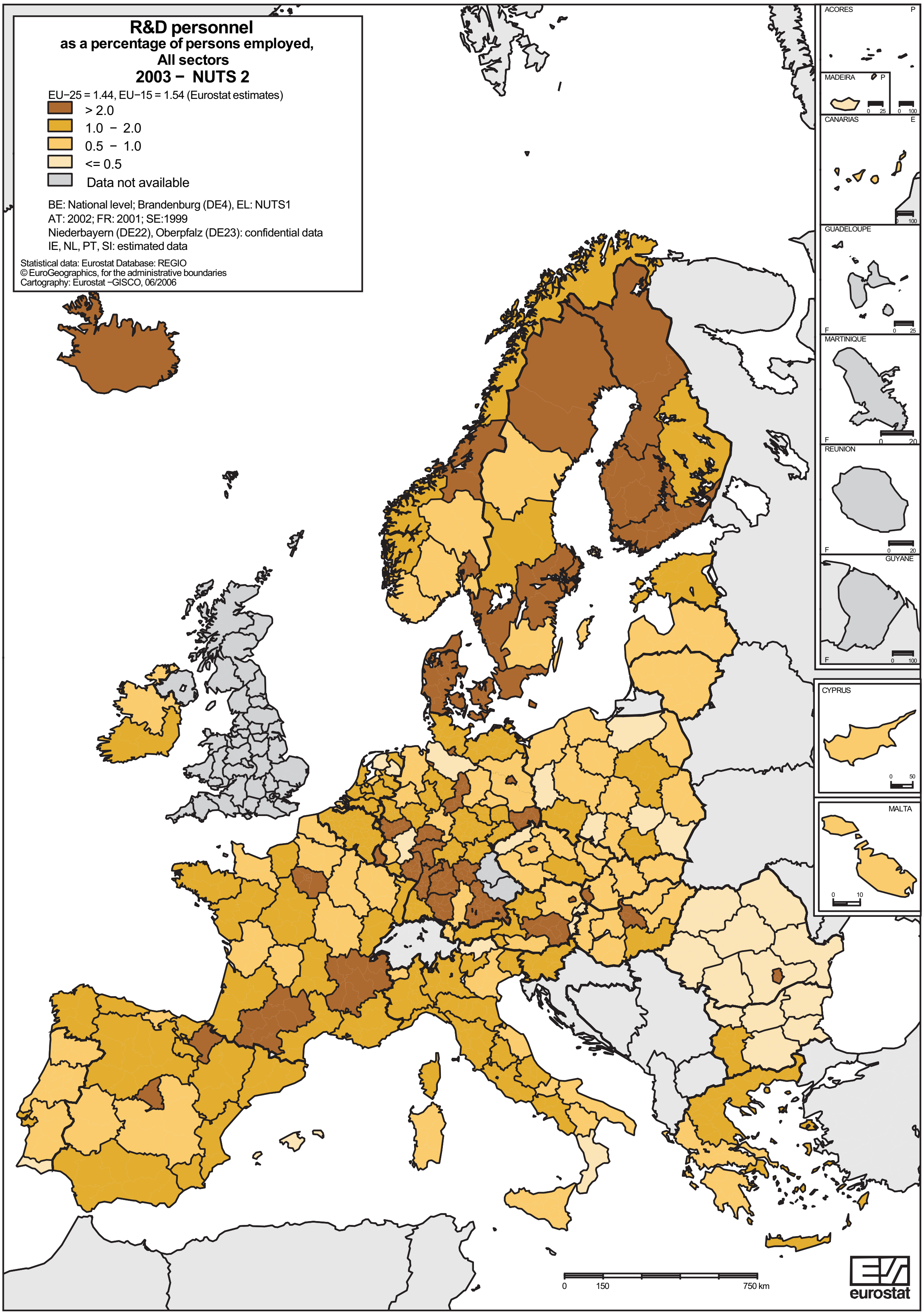


Exceptions to the reference year: FR, AT and TR 2002.
No data available for BE, MT, SE, UK.

3

Map 3.22

R&D personnel as a percentage of total employment, all sectors, EU-25, Iceland and Norway - 2003



PART2

Chapter 4
Human resources in science and technology

4.1 Introduction

Data on Human Resources in Science and Technology (HRST) contribute significantly to the measuring of the new economy. They review the supply of, and demand for, highly qualified persons in science and technology. The aim of this chapter is to examine three distinct parts in detail: education inflows, stocks of HRST and job-to-job mobility of employed HRST.

To help in the analysis of HRST, a number of

sub-categories, described in Figure 4.1, were prepared in line with the recommendations laid down in the Manual on the Measurement of Human Resources devoted to Science and Technology (S&T) - the Canberra Manual (1) - on the basis of the following internationally harmonised standards:

-The International Standard Classification of Education (ISCED), giving the level of formal education achievement
-The International Standard Classification of Occupation (ISCO), detailing the type of occupation

HRST are defined as persons fulfilling at least one of the following conditions:

- Human resources in terms of education - HRSTE: Individuals having successfully completed tertiary level education in a S&T field of study - ISCED 97 version levels 5a, 5b or 6,

and/or

- Human resources in terms of occupation - HRSTO: Individuals working in a S&T occupation as professionals and technicians - ISCO-88 COM codes 2 or 3.

To define the S&T field of study more precisely, according to the Canberra Manual (§ 71), the seven broad S&T fields of study are used: Natural Sciences, Engineering and Technology, Medical Sciences, Agricultural sciences, Social sciences, Humanities and Other fields.

Furthermore, even though the official definition of HRST as set out in the Canberra Manual contains the terms "S&T" (Science and Technology), the definition is not restricted by these terms: HRSTE covers all fields of study, while HRSTO refers to two specific major ISCO classes: ISCO 2 'Professionals' and ISCO 3 'Technicians and associate professionals' - see methodological notes.

An HRST sub-population of particular interest is 'Scientists and Engineers' (SE). Those more likely to be involved in leading-edge technology professions are 'Physical, mathematical and engineering' occupations (ISCO-88 COM code 21), and 'Life science and health' occupations (ISCO-88 COM code 22) (2).

Data are calculated from two main sources:

- The inflows, at present, use data from Eurostat's education database, collected via the joint Unesco/OECD/Eurostat - UOE - questionnaire on education statistics.

- The European Union Labour Force Survey - EU LFS - is used for elaborating data on stocks of HRST and job-to-job mobility data.

The education inflows detailed in Chapter 4.2 are a useful measure of the current and future supply of HRST, because by completing tertiary level education the individual will move into the stock of HRST.

Inflows can be sub-divided into various groups, each providing a different level of focus. Indeed, measurements can be divided into participation in tertiary education (used to estimate potential future inflow rates into the labour market) and graduation from tertiary education (actual inflows).

Information on participation in tertiary education also includes data on foreign students. These data give an idea of the proportion of internationally mobile students in Europe. Lastly, there is an additional focus on doctorate students, entering the most highly educated section of the work force.

Data on stocks of Human Resources in S&T in Chapter 4.3, meanwhile, provide an indication of the number of HRST at a particular point in time. These can then be broken down to provide information on socio-economic categories of interest, such as the gender ratio, age distribution or the sector of economic activity in which people are working.

Finally, data on job-to-job mobility of employed HRST in Chapter 4.4 are built up by considering the number of HRST employed in years t and t-1 and who have changed jobs during the past 12-month period.

(1) **Manual on the Measurement of Human Resources devoted to S&T, Canberra Manual**, OECD, Paris, 1994.

(2) Scientists and engineers however differ from the Frascati Manual definition of researchers, which includes persons in ISCO-88 Major Group 2 Professional Occupations, Research and Development Department Managers ISCO-88 1237 and members of the armed forces with similar skills who perform R&D; Standard method for surveys on R&D and experimental development, Frascati Manual, OECD 2002, paragraph 302.

European Union Labour Force Survey and Joint UOE questionnaire

The **European Union Labour Force Survey (EU-LFS)** is a quarterly large sample survey covering the population in private households in the EU, EFTA (except Liechtenstein) and candidate countries. The main statistical objectives of the Labour Force Survey are to divide the population of working age (15 years and above) into three mutually exclusive and exhaustive groups - ***employed persons, unemployed persons*** and ***inactive persons*** - and to provide descriptive and explanatory data on each of these categories.

The concepts and definitions used in the survey are based on those contained in the Recommendation of the 13th International Conference of Labour Statisticians, convened in 1982 by the International Labour Organisation (hereinafter referred as the 'ILO guidelines'). To further improve comparability within the EU, Commission Regulation (EC) No 1897/2000, gives a more precise definition of unemployment. This definition remains fully compatible with the International Labour Organisation standards.

The EU-LFS micro data collection starts in 1983 (one reference quarter per year). Since 1998, the EU-LFS has gradually become a continuous quarterly survey. The national statistical institutes are responsible for selecting the sample, preparing the questionnaires, conducting the direct interviews among households, and forwarding the results to Eurostat using a common coding scheme. The sampling rates range between 0.2% and 3.3% across the countries. The questionnaires are drawn up by each Member State in the national language or languages, taking into account the requirements set out in the Regulation. Thirty-one Labour Force Surveys are conducted by the National Statistical Institutes across Europe and processed centrally by Eurostat.

Data collection methods

The data are acquired by interviewing the sampled individuals directly. Proxy interviews via a responsible person in the household are permitted. In most countries, at least the first wave interview is conducted in person, while subsequent follow-up interviews can be conducted by telephone. Participation in the survey is compulsory in Belgium, Germany, Greece, Spain, France, Italy, Cyprus, Malta, Austria, Portugal and Norway.
Some of the data can be supplied by obtaining equivalent information from alternative sources, including administrative registers, provided that the data obtained are of equivalent quality. Typically, the Nordic countries supply demographic information directly from the population registers.

Sample designs

The EU-LFS is a rotating random sample survey of persons in private households. The sampling units are dwellings, households or individuals, depending on the sampling frame. The sample design and rotation patterns are not fully harmonised. Different schemes are used to sample the units, from the simple random sampling method to complex stratified multi-stage sampling methods of clusters. Most countries use a variant of a two-stage stratified random sampling of household units. All of the Member States apply a rotating pattern, so that part of the observations can be directly paired to the observations from the previous survey.

Source: LFS website.

The objective of the **Joint UNESCO-UIS/OECD/EUROSTAT (UOE)** questionnaire on education statistics is to provide internationally comparable data on key aspects of education systems, specifically on the participation in and completion of education programmes, as well as the cost and type of resources dedicated to education.
The UOE data collection on education statistics is based on the International Standard Classification of Education (ISCED) and covers the 25 EU Member States, the EFTA/EEA countries, candidate countries, South-East European countries, OECD Member States outside Europe and other countries.

The statistics refer to education in the ordinary school and university system, as defined in ISCED-97. The basic unit of classification is the ***Educational programme***. The other terms used are: ***Student***: any individual participating in educational services covered by this data collection, and ***Graduates***: persons who successfully complete an educational programme during the reference calendar year.

Data sources used and Type of survey

The results of the UOE data collection on education statistics are compiled from national administrative sources, reported by Ministries of Education or National Statistical Offices. In most countries the national data collections on enrolments, graduates, personnel etc are census surveys or, in some cases, extractions from administrative registers. Moreover, auxiliary indicators from statistics on demography (e.g. population) or the National Accounts (e.g. Gross Domestic Product, Total Public Expenditure) are used to calculate some of the indicators disseminated.

Techniques of data collection

Data are compiled according to the concepts and definitions of the UOE data collection on education statistics. Data are collected through data collection tables and electronic questionnaires that are returned by countries. The international organisations process and verify the data received. Data are reported on a voluntary basis from countries (under the so-called "gentlemen's agreement").

Source: Eurostat website.

Figure 4.1 Definitions of human resources in science and technology (HRST) categories

			HRSTE – **HRST in terms of Education** –			
			Tertiary education			*Lower than tertiary education*
			ISCED 6	*ISCED 5a*	*ISCED 5b*	*ISCED < 5*
HRSTO – **HRST in terms of Occupation** –	*ISCO 2*	Professionals	HRST Core – **HRSTC**			HRST without tertiary education
	ISCO 3	Technicians				
	ISCO 1	Managers	HRST non-core			Non-HRST employed
	ISCO 0, 4-9	All other occupations				
		Unemployed	HRST unemployed – HRSTU			Non-HRST unemployed – NHRSTU
		Inactive	HRST inactive			Non-HRST inactive

4.2 Education inflows

Participation in tertiary education

In 2003, over 14 million persons in EU-25 were in tertiary education, and more than 20% of them were aged between 20-29 - Table 4.2. In Finland, nearly one person in two aged 20-29 was studying in tertiary education. At 44.6%, this EU country registered the highest proportion of participation in tertiary education as a percentage of the 20-29 year-old population. The situation is different in the other EU countries, with rates down to 14.1% in Malta and 16.9% in Hungary.

Nevertheless, the overall number of tertiary level students is growing - Figure 4.3. This tendency is true of both genders. Between 1998 and 2003, the number of people in tertiary education in EU-25 grew at an annual average rate of 5% for male students, and of up to 6% for female students. Cyprus had the highest growth in the EU over this period for male students (18%), while Latvia scored the highest EU growth for female students, at 12%. At the other end of the scale, Austria saw a decrease in its number of both male and female students during the same period (-7% for male students and -3% for female students).

Meanwhile, the new Member States had the highest growth rates in comparison to the other EU countries. All of the new Member States had growth rates for male and female students that were higher than or equal to the EU-25 annual growth rate. Lastly, the growth in student numbers was higher for female students than for male students - the exceptions were Cyprus and, to a lesser extent, Latvia and Finland.

One student in four was following courses either in "science, mathematics and computing" or in "engineering, manufacturing and construction" in the EU-25 in 2003, as shown in Table 4.2. Nevertheless, engineering courses were marginally more popular (14.3%) than science (10.6 %). This trend was reflected in most EU countries for which data were available, the exceptions being Ireland, Cyprus, the UK, Iceland and Norway. Furthermore, Ireland had one of the highest proportions of students studying science (14.1%), while the highest proportion was in Germany (14.6%). For engineering courses, Finland had the highest proportion of students (26.6%), followed by Portugal and Czech Republic (21.1% and 20.4%, respectively).

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Table 4.2

Students participating in tertiary education, total and in selected fields of study, by gender and as proportion of the population aged 20-29, EU-25 and selected countries - 2003

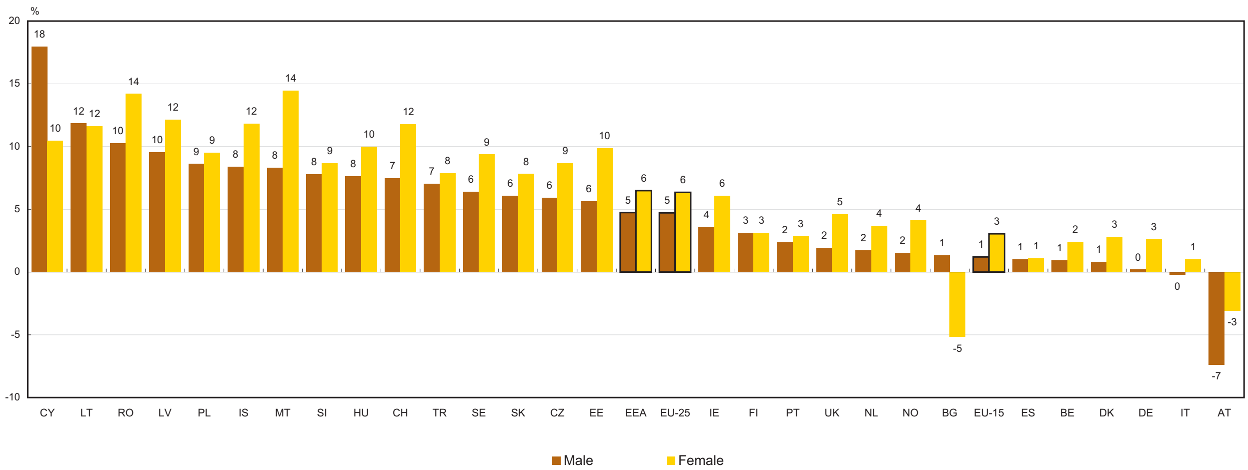
	Students participating in tertiary education, 2003						
	In any field			In science, mathematics and computing		In engineering, manufacturing and construction	
	Total	% population aged 20-29	% Female	Total	% of all students	Total	% of all students
EU-25	14 203 511 s	22.5 s	54.7 s	1 500 918 s	10.6 s	2 036 957 s	14.3 s
EU-15	10 905 745 s	21.7 s	53.9 s	1 271 019 s	11.7 s	1 553 828 s	14.3 s
BE	374 532	28.1	53.3	30 956	8.3	39 729	10.6
CZ	287 013	16.6	50.7	29 475	10.3	58 661	20.4
DK	201 746	29.6	57.9	17 946	8.9	21 771	10.8
DE	2 242 397	24.8	49.5	328 029	14.6	341 652	15.2
EE	63 625	31.5	61.5	6 399	10.1	7 357	11.6
EL	:	:	:	:	:	:	:
ES	1 840 607	25.5	53.1	247 891	13.5	322 932	17.5
FR	:	:	:	:	:	:	:
IE	181 557	27.2	55.7	25 647	14.1	20 310	11.2
IT	1 913 352	22.4	56.2	146 897	7.7	312 170	16.3
CY	18 272	18.9	49.5	2 379	13.0	637	3.5
LV	118 944	34.3	61.7	8 371	7.0	11 764	9.9
LT	167 606	33.1	60.0	9 684	5.8	33 099	19.8
LU	:	:	:	:	:	:	:
HU	390 453	16.9	56.7	26 389	6.8	55 476	14.2
MT	8 946	14.1	56.9	467	5.2	674	7.5
NL	526 767	24.8	51.0	31 597	6.0	53 084	10.1
AT	229 802	23.4	53.0	26 727	11.6	31 158	13.6
PL	1 983 360	30.5	57.8	128 145	6.5	269 726	13.6
PT	400 831	24.8	56.6	31 685	7.9	84 526	21.1
SI	101 458	30.9	56.2	4 877	4.8	17 456	17.2
SK	158 089	16.5	53.1	13 713	8.7	28 279	17.9
FI	291 664	44.6	53.5	33 937	11.6	77 596	26.6
SE	414 657	37.7	59.6	41 924	10.1	71 736	17.3
UK	2 287 833	31.7	55.9	307 783	13.5	177 164	7.7
IS	13 347	32.3	63.7	1 424	10.7	870	6.5
NO	212 395	35.1	59.7	24 223	11.4	13 395	6.3
EEA	14 429 693 s	22.6 s	54.7 s	1 526 609 s	10.6 s	2 051 333 s	14.2 s
CH	185 965	20.7	44.2	21 457	11.5	25 384	13.7
BG	230 513	20.5	52.8	11 677	5.1	50 948	22.1
RO	643 911	18.2	54.3	34 105	5.3	138 909	21.6
TR	1 256 629	:	40.4	134 537	10.7	259 069	20.6

Eurostat estimations excluding EL, FR and LU: EU-15, EU-25 and EEA.

Although females accounted for more than half of all students in practically every country - with the exception of Turkey, Switzerland and, to a lesser extent, Cyprus and Germany - this was not the case when it came to analysing the specific fields of study, "science, mathematics and computing" and "engineering, manufacturing and construction". As shown in Figure 4.4, parity in science fields in the EU was only achieved in Portugal, a country where student participation in science was well below the EU average (7.9% in Table 4.2). At EU level, nearly four in ten students in science in 2003 were female, while the corresponding proportion in the Netherlands was as low as one in four. In Romania and Bulgaria, however, half of the tertiary students in science were female (respectively 59% and 52%).

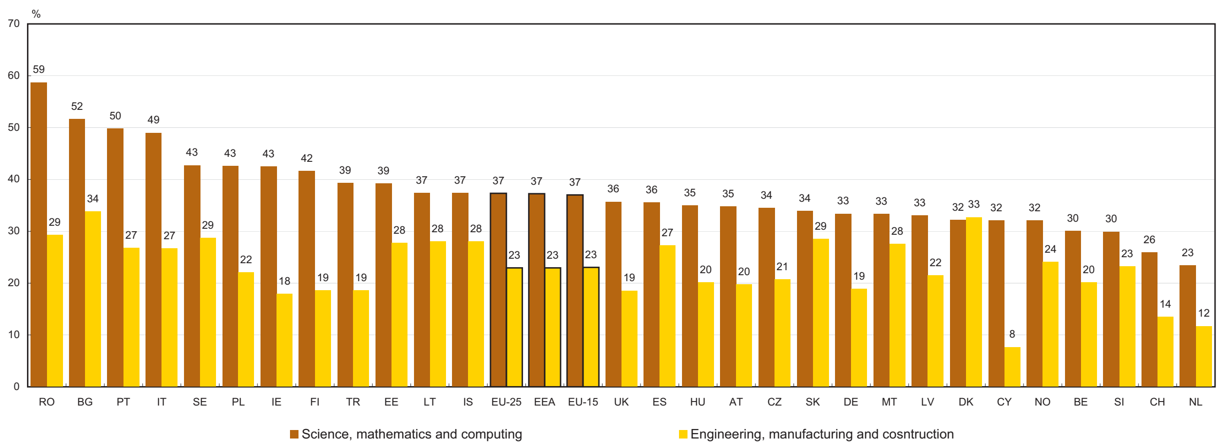
"Engineering, manufacturing and construction" courses have even more problems attracting female students. Bulgaria, with 34%, had the highest ratio of female engineering students. In the EU, Denmark had the highest proportion of female tertiary students in engineering fields, with a rate of 33% (even higher than the 32% in science fields), followed by Sweden and the Slovak Republic on 29%. At the other end of the scale, Cyprus scored the lowest percentage of female students in engineering, with a rate of only 8%.

Figure 4.3 Annual average growth rates of the number of students participating in tertiary education, by gender, EU-25 and selected countries - 1998 to 2003



Exceptions to the reference period 1998/2003: BE 2000/2003, CY 1999/2003, MT 1999/2003, PL 1999/2003, CH 2002/2003, TR 2000/2003.
Eurostat estimations excluding EL, FR and LU: EU-15, EU-25 and EEA.

Figure 4.4 Proportion of female students participating in tertiary education in science and engineering (S&E), EU-25 and selected countries - 2003



Eurostat estimations excluding EL, FR and LU: EU-15, EU-25 and EEA.

Student mobility

National figures for overall participation in tertiary education also include foreign students, defined according to the citizenship of the individual.

Although overestimation of non-national students may exist in some countries where permanently resident second generation migrants with foreign nationalities constitute an important group of students, foreign students can otherwise be interpreted as internationally mobile students.

Figure 4.5 shows foreign students participating in tertiary education and choosing to study subjects related to science and engineering (S&E) in 2003.

The proportion of foreign students in comparison to the total student population in any field varied greatly from an EU country to another. Cyprus, with a 28.9% share, was the leading EU country with the highest proportion of foreign students, followed by Austria with a smaller share of 13.5%. This proportion fell to as low as 0.4% in Poland and Lithuania.

One third of all internationally mobile students in Finland, Germany and Sweden followed science and engineering related disciplines (39.6%, 32.9% and 32.8%, respectively). Overall, this proportion exceeded the popularity of S&E programmes at national level - see Table 4.2.

A closer look at the S&E fields in Denmark, Germany, Austria, the UK and Cyprus shows that 10% or more of all students studying S&E in 2003 were foreign. The proportion of foreign students in Cyprus was 21.6%.

Furthermore, this country also had one of the highest annual growth rates between 1998 and 2003, with an annual increase of 40% in the number of foreign S&E students. Next in line for the EU countries came the Czech Republic with an annual average growth rate of 33% and Lithuania with 32%. Despite a general trend towards growth, a few EU countries registered negative rates. This was the case for Latvia (-19%), Austria (-3%) and Poland (-2%).

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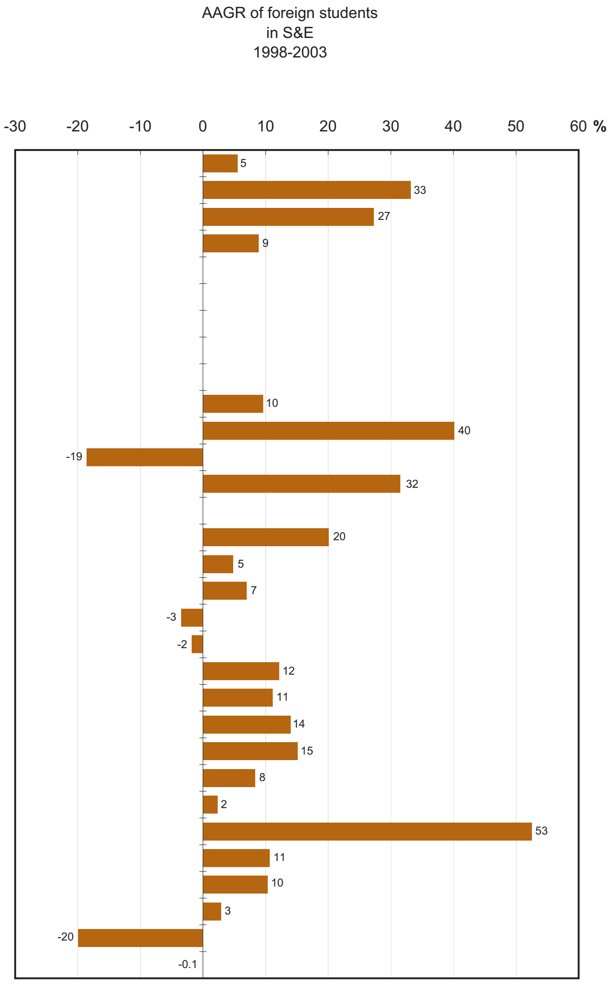
Figure 4.5 **Foreign students participating in tertiary education, total and in proportion of S&E students, EU-25 and selected countries - 2003**

	Foreign students			
	In any field		In S&E	
	Total	as % of all student population	Total	as % of all student population
BE	41 856	11.2	6 333	9.0
CZ	12 474	4.4	3 308	3.8
DK	18 120	9.0	5 243	13.2
DE	240 619	10.7	79 101	11.8
EE	1 090	1.7	:	:
EL	:	:	:	:
ES	:	:	:	:
FR	:	:	:	:
IE	10 201	5.6	:	:
IT	36 137	1.9	7 172	1.6
CY	5 282	28.9	650	21.6
LV	2 390	2.0	131	0.7
LT	689	0.4	181	0.4
LU	:	:	:	:
HU	12 226	3.1	2 458	3.0
MT	409	4.6	35	3.1
NL	20 531	3.9	3 717	4.4
AT	31 101	13.5	7 445	12.9
PL	7 617	0.4	600	0.2
PT	15 483	3.9	:	:
SI	963	1.0	252	1.1
SK	1 651	1.0	339	0.8
FI	7 361	2.5	2 891	2.6
SE	32 469	7.8	10 367	9.1
UK	255 233	11.2	75 205	15.5
IS	580	4.4	99	4.3
NO	11 060	5.2	2 847	7.6
CH	32 847	17.7	9 713	20.7
BG	8 025	3.5	1 225	2.0
RO	9 730	1.5	923	0.5
TR	15 719	1.3	3 496	0.9



Exception to the reference year: PT 2002.
Exceptions to the reference period 1998/2003: MT, NL, SE and UK 1999/2003 ; SK and TR 2000/2003 ; BE and CY 2001/2003 ; CH 2002/2003 ; PT 2000/2002.

International mobility of highly skilled Indian students

Article extract: "One of the indicators of international mobility is provided by the number of Indian students entering the United States during the 1990s. The analysis shows that this number has gone up considerably, from around 15 000 Indian students in 1990 to almost 50 000 in 2001. That the United States is the most favoured and attractive destination is proven by the fact that almost 80% of the Indian students who enrolled in tertiary education in OECD countries in 2001 went to the United States. Another indicator shows that in 1999, there were 165 000 Indian residents in the United States with a science and engineering (S&E) highest degree. They accounted for 13% of the total number of foreign-born US residents with S&E highest degrees. India also accounted for a high share of foreign-born residents residing in the United States in 1999 with a science and engineering doctorate, 16% or 30 000 people, second only to China."

Source: "Human resources in science and technology in India and the international mobility of highly skilled Indians" by Binod Khadria, STI Working Paper 2004/7, DSTI/DOC(2004)7

Doctorate students

Doctorate students are in general following second stage of tertiary education programmes (ISCED level 6), which lead to the award of an advanced research degree, e.g. a doctorate in economics, in sociology or in physics. The programmes are therefore devoted to advanced study and original research and are not based on course-work only. They usually require 3-5 years of research and course work, generally after a Master's degree. Indicators of the number of doctorate students therefore provide an idea of the degree to which countries will have researchers at the highest level of education.

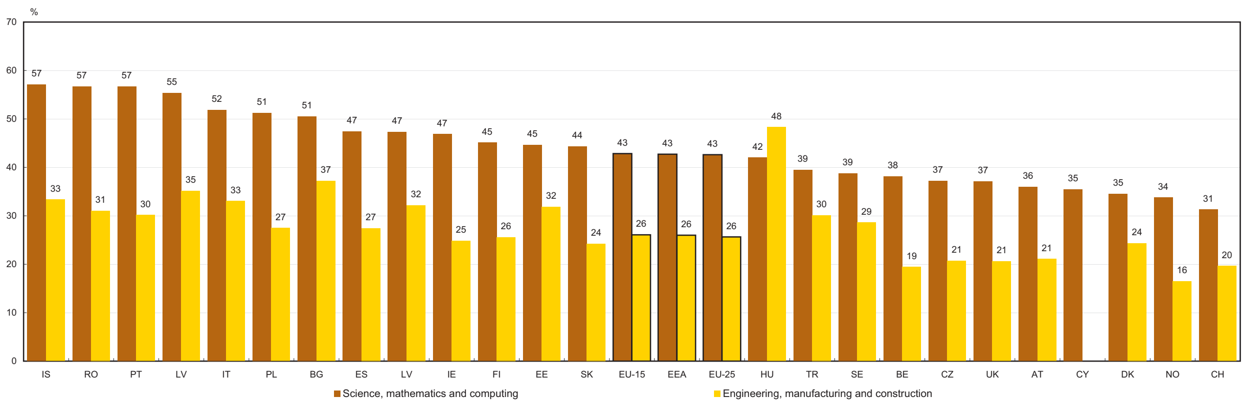
Even excluding Germany, Greece, France, Luxembourg and Slovenia - for which no data were available - there were over 350 000 doctorate students in the EU-25 in 2003 - Table 4.7.

As shown in Table 4.2, "science, mathematics and computing" are relatively more popular subjects than "engineering, manufacturing and construction", even when looking at the participation of doctorate students. In the EU, Hungary and Ireland had the highest proportion of their doctoral students taking science courses, at 76.4% and 41.4% respectively; next came Belgium and Cyprus (32.5% and 31.6% respectively). Engineering was less popular, in the EU at least, where it ranged from close to one in three in the Czech Republic (28.4%) and one in four in Finland (25.2%) to one in 20 in Malta as a proportion of all doctorate students.

Figure 4.6 shows that, in general in the EU countries, females account for a higher proportion of engineering doctorate students than is the case when all tertiary level courses are taken into account - see Figure 4.4. For example, in Hungary the proportion of total female S&E tertiary students in engineering was only 20%, whereas the proportion of female doctorate students in the same courses was up to 48%. Nevertheless, in the majority of the EU countries the share of female doctorate students did not reach half of the total population, being closer to 30%.

For science, the results follow the same trend. Overall, the proportion of female doctorate students in science was higher than the figure taking all female S&E tertiary students into account. Portugal - the country which, at 50%, had the highest rate of female S&E tertiary students in science - scored 57% of female doctorate students in science. At 35%, Denmark had the smallest share of female doctorate students in science.

Figure 4.6 **Proportion of female doctorate-students (ISCED level 6) in S&E, EU-25 and selected countries - 2003**



Eurostat estimations: EU-15, EU-25 and EEA.

Table 4.7

Doctorate students (ISCED level 6), total and in selected fields of study, by gender, as proportion of the population aged 20-29, EU-25 and selected countries - 2003

	Doctorate students (ISCED level 6), 2003						
	In any field			In science, mathematics and computing		In engineering, manufacturing and construction	
	Total	per 1 000 population aged 20-29	% Female	Total	% of all doctorate students	Total	% of all doctorate students
EU-25	**357 304 s**	**5.6 s**	**46.5 s**	**76 505 s**	**21.4 s**	**57 834 s**	**16.2 s**
EU-15	**282 310 s**	**5.6 s**	**47.3 s**	**58 831 s**	**20.8 s**	**40 257 s**	**14.3 s**
BE	6 424	4.8	39.0	2 085	32.5	880	13.7
CZ	21 097	12.2	36.1	4 969	23.6	5 999	28.4
DK	4 758	7.0	42.2	950	20.0	875	18.4
DE	:	:	:	:	:	:	:
EE	1 587	7.9	55.0	419	26.4	179	11.3
EL	:	:	:	:	:	:	:
ES	72 973	10.1	51.0	10 917	15.0	6 051	8.3
FR	:	:	:	:	:	:	:
IE	3 786	5.7	46.8	1 566	41.4	491	13.0
IT	29 939	3.5	50.9	7 762	25.9	5 662	18.9
CY	98	1.0	41.8	31	31.6	:	:
LV	1 319	3.8	58.3	188	14.3	202	15.3
LT	2 183	4.3	58.2	316	14.5	518	23.7
LU	:	:	:	:	:	:	:
HU	7 430	3.2	43.6	5 676	76.4	1 679	22.6
MT	42	0.7	38.1	2	4.8	1	2.4
NL	6 585	3.1	41.0	:	:	:	:
AT	15 438	15.7	44.6	2 524	16.3	1 995	12.9
PL	31 072	4.8	46.7	4 596	14.8	7 011	22.6
PT	15 877	9.8	54.6	2 795	17.6	2 302	14.5
SI	:	:	:	:	:	:	:
SK	10 166	10.6	42.8	1 477	14.5	1 988	19.6
FI	19 846	30.4	49.7	2 885	14.5	5 001	25.2
SE	21 623	19.7	46.5	4 423	20.5	4 855	22.5
UK	85 061	11.8	43.0	22 924	27.0	12 145	14.3
IS	45	1.1	53.3	7	15.6	3	6.7
NO	4 170	6.9	41.9	1 176	28.2	595	14.3
EEA	**361 519 s**	**5.7 s**	**46.5 s**	**77 688 s**	**21.5 s**	**58 432 s**	**16.2 s**
CH	14 957	16.6	38.3	4 079	27.3	1 585	10.6
BG	4 440	3.9	50.9	780	17.6	941	21.2
RO	27 355	7.7	49.9	3 796	13.9	7 466	27.3
TR	23 228	0.0	37.4	3 384	14.6	4 002	17.2

Eurostat estimations: EU-15, EU-25 and EEA.

Graduation from tertiary education

Though participation rates are a useful proxy for future expectations of the national stocks of HRST, because drop-out rates differ from country to country and from system to system, they should be complemented by data on the actual number of people becoming HRST. Data on tertiary graduates measure this.

In 2003, there were more than 2.5 million new tertiary graduates in the European Union - see Table 4.8. This compares with just over 1 million new tertiary level graduates in Japan and over 2.3 million in the United States.

Table 4.8

Graduates from tertiary education, total and in selected fields of study, by gender, as proportion of the population aged 20-29, EU-25 and selected countries - 2003

	Graduates from tertiary education, 2003						
	In any field			In science, mathematics and computing		In engineering, manufacturing and construction	
	Total	per 1 000 population aged 20-29	% Female	Total	% of all graduates	Total	% of all graduates
EU-25	**2 576 749 s**	**47.7 s**	**59.7 s**	**251 016 s**	**7.9 s**	**313 750 s**	**12.8 s**
EU-15	**1 868 042 s**	**49.6 s**	**57.8 s**	**219 055 s**	**9.6 s**	**249 212 s**	**14.9 s**
BE	74 367	53.9	57.0	6 750	9.1	7 601	10.2
CZ	47 178	27.2	55.2	3 467	7.3	7 244	15.4
DK	42 637	62.9	58.0	3 632	8.5	4 800	11.3
DE	304 773	33.4	53.0	28 562	9.4	51 718	17.0
EE	9 877	49.8	69.5	776	7.9	914	9.3
EL	:	:	:	:	:	:	:
ES	299 401	40.8	57.2	33 411	11.2	50 663	16.9
FR	:	:	:	:	:	:	:
IE	53 808	79.4	57.6	9 463	17.6	6 281	11.7
IT	218 041	27.8	57.3	16 286	7.5	32 144	14.7
CY	3 213	32.8	61.3	288	9.0	98	3.1
LV	20 763	61.6	69.0	1 307	6.3	1 484	7.1
LT	34 454	67.7	65.4	1 735	5.0	5 983	17.4
LU	:	:	:	:	:	:	:
HU	67 606	32.6	62.2	1 969	2.9	5 617	8.3
MT	2 048	32.3	54.7	84	4.1	98	4.8
NL	89 341	41.0	56.0	4 965	5.6	9 590	10.7
AT	29 176	28.3	50.9	2 028	7.0	6 246	21.4
PL	477 785	72.2	65.1	19 050	4.0	36 110	7.6
PT	68 511	42.6	67.2	4 086	6.0	8 926	13.0
SI	13 931	43.6	61.0	476	3.4	2 120	15.2
SK	31 852	33.3	55.8	2 809	8.8	4 870	15.3
FI	36 898	58.9	61.1	2 689	7.3	8 195	22.2
SE	49 345	43.5	61.2	4 748	9.6	10 319	20.9
UK	601 744	82.8	57.0	102 435	17.0	52 729	8.8
IS	2 195	54.0	61.5	301	13.7	98	4.5
NO	30 127	50.4	61.1	2 841	9.4	2 540	8.4
EEA	**2 609 071 s**	**48.0 s**	**59.8 s**	**254 158 s**	**8.2 s**	**316 388 s**	**12.3 s**
CH	57 524	62.6	42.7	5 795	10.1	6 811	11.8
BG	47 277	39.4	58.5	2 132	4.5	7 432	15.7
RO	136 580	38.9	57.3	7 632	5.6	24 912	18.2
TR	253 051	0.0	44.5	23 311	9.2	46 331	18.3
JP	1 040 354	:	49.0	30 272	2.9	199 405	19.2
US	2 352 271	:	57.4	245 970	10.5	184 740	7.9

Exceptions to the reference year: IT 2001 and IS 2002.
Eurostat estimations excluding FR, EL and LU: EU-15, EU-25 and EEA.

Balancing these new graduates against the young population, for every thousand people aged 20-29 in the EU there were, on average, close to 48 new graduates. However, this proportion varies from around 80 new graduates per thousand 20-29 year olds in the UK and Ireland, to between 27 and 28 new graduates in the Czech Republic, Italy and Austria.

The annual average growth rates by gender for each EU country and other selected country are illustrated in Figure 4.9. The Slovak Republic had the highest EU increase (13%) in the number of males graduating from tertiary education between 1998 and 2003. Poland had the highest EU increase (18%) in the number of females graduating from tertiary education, followed by Latvia (17%).

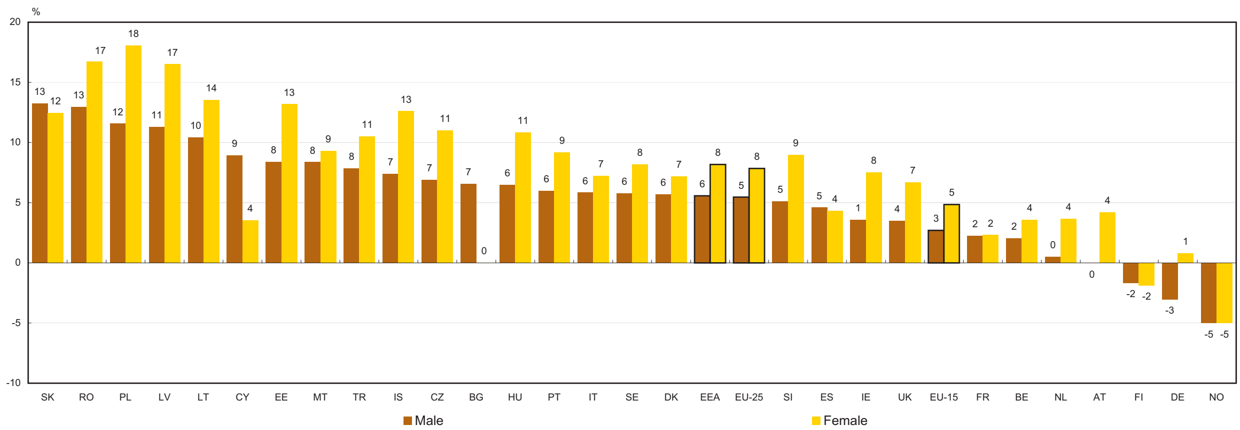
The EU average increase ranges from 5% for male graduates to 8% for female graduates. Nevertheless, even if the majority of the EU countries recorded an increase in numbers of graduates in tertiary education, three countries experienced a fall in their number of new graduates between 1998 and 2003. The countries with negative annual average growth rates were Germany, Finland and Norway. Numbers were down 2% in Finland and 5% in Norway for both genders, and down 3% in Germany for male graduates.

When comparing the proportion of female graduates out of the total in Table 4.8 to their participation as shown in Table 4.2, except for a few countries, a clear trend emerges. Female graduates accounted for a higher proportion of all graduates compared to the proportion they achieved in terms of participation. On average, in 2003, 59.7% of all graduates in the EU were female compared to a rate of participation of only 54.7%. In comparison, the proportion of female graduates from tertiary education in Japan was 49.0% and in the United States 57.4%.

In the EU this seems to be a trend that does not extend to science and engineering related disciplines. Whilst females accounted for 37% of science students and 23% of engineering students in the European Union - recall Figure 4.4 - the corresponding percentages for females at graduate level were marginally higher, i.e. 41% in science and 25% in engineering - see Figure 4.10. It is also worth underlining the fall in the proportion of science and engineering subjects amongst the total when graduation rates in Table 4.8 are compared with participation rates in Table 4.2.

Nevertheless, graduation rates in the EU (7.9% for science and 12.8% for engineering) compared favourably with Japan for science, accounting for 2.9% of all new graduates and with the United States for engineering, at 7.9%.

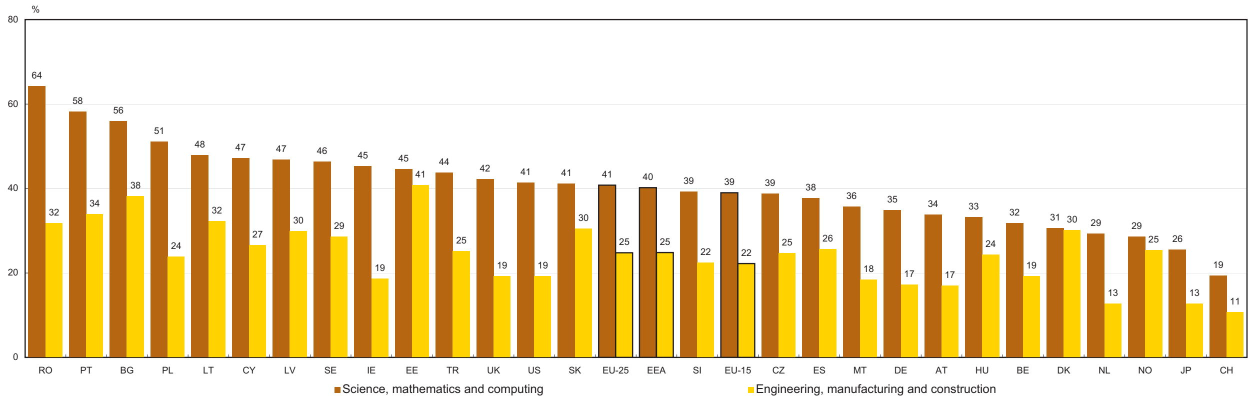
Figure 4.9 **Annual average growth rates of graduates from tertiary education, by sex, EU-25 and selected countries - 1998 to 2003**



Exceptions to the reference period 1998/2003: FR, IT and FI 1998/2001 ; IS 1998/2002 ; CY and TR 1999/2003 ; BE 2000/2003.
Eurostat estimations: EU-15, EU-25 and EEA.

Figure 4.10

Proportion of female graduates from tertiary education in S&E, EU-25 and selected countries - 2003



Eurostat estimations: EU-15, EU-25 and EEA.

4

Doctorate graduates

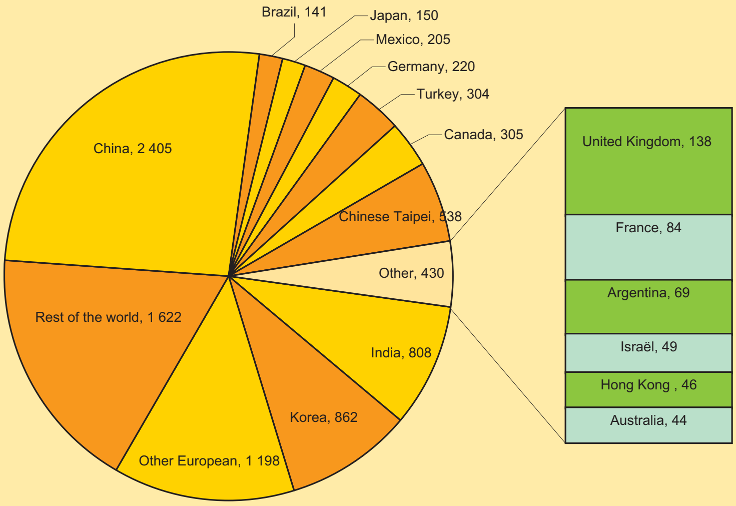
Whereas in Japan more than 14 000 people obtained their doctoral degree and in the United States nearly 46 000, the number of doctorate graduates in EU-25 reached over 70 000 people in 2003 - Table 4.12. Germany was the leading EU country in terms of the absolute number of doctorate graduates - as around one in three doctorate graduates in Europe graduated in Germany - followed by the UK (with a total of 14 935 doctorate graduates in 2003).
In "engineering, manufacturing and construction", however, the share of German doctorate graduates in comparison to the total number of EU graduates (close to 9 500 EU doctorate graduates) is lower. Indeed, the proportion fell to one in four doctorate graduates in Germany. At the same time, with a total of 2 239, the UK achieved a higher number of doctorate graduates than Germany.

In the EU countries, the number of doctorate graduates in science as a proportion of total doctorate graduates in 2003 - Table 4.12 - was slightly higher than science doctorate students as a proportion of total doctorate students - see Table 4.7 - with 21.9% compared to 20.8% at EU level.

As far as representation of females is concerned (shown in Figure 4.11), in science there were five EU countries which had at least as many female doctorate graduates as male. In order of size, they were: Portugal (58%), the Slovak Republic (57%), Latvia (57%), Ireland (57%) and Poland (50%). For engineering, the proportion of female doctorate graduates in all countries is smaller in comparison to the number of male doctorate graduates. The closest to parity was registered in Lithuania, where 44% of all doctorate graduates in engineering were females. But this fell to as low as 14% in Belgium or 11% in Germany.

Extract from the Science and Technology Statistical Compendium - Meeting of the OECD committee for scientific and technological policy at ministerial level - OECD 29-30 January 2004

Distribution of the number of S&E doctorates awarded to foreign citizens in the United States by citizenship or origin, in 2001

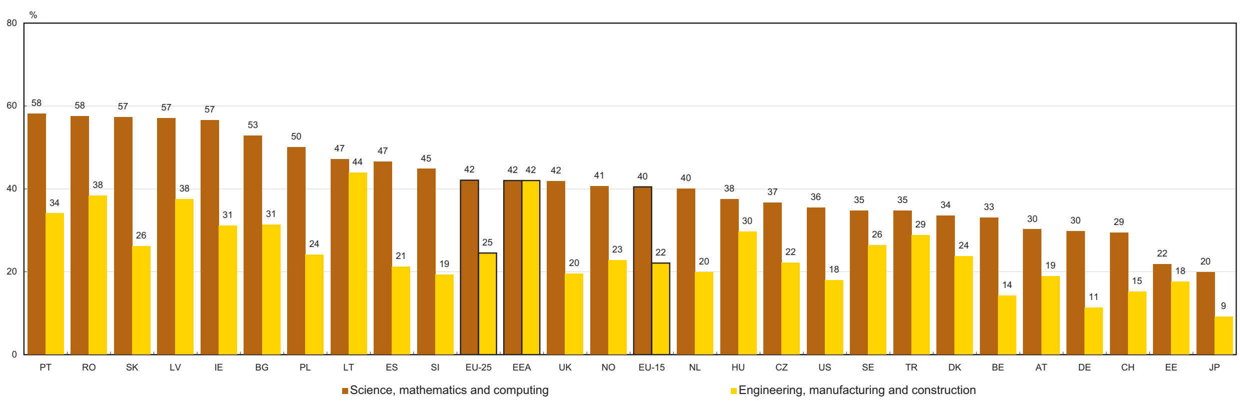


In 2001, 9 188 S&E doctorates or 36% were awarded to foreign citizens in the United States. The number of S&E doctorates awarded to foreign citizens more than doubled over the period 1985-1996 and the increase was particularly steady in the first half of the 1990s. A peak of 10 844 was reached in 1996, but the number of foreign citizens receiving S&E doctorates has been decreasing since.

Among S&E doctorates awarded to foreigners in the United States, a little more than a quarter went to Chinese citizens, 9% to Koreans or Indians, 6% to citizens from Chinese Taipei and the rest to foreigners from a wide diversity of countries. Asian students are therefore those who represent the bulk of doctorates awarded to foreigners in the United States, although their numbers have diminished over the decade in the case of India, Korea, Chinese Taipei and Hong Kong, China. S&E doctorates granted to Koreans in the United States represent nevertheless 20% of those delivered in the country of origin. This percentage reaches 25% in the case of Turkey but is only 1% or 2% for other OECD countries.

Source: OECD, based on data from US National Science Foundation, 2003.

Figure 4.11 **Proportion of female doctorate graduates in S&E, EU-25 and selected countries - 2003**



Eurostat estimations: EU-15, EU-25 and EEA.

Table 4.12

Doctorate graduates (ISCED level 6), total and in selected fields of study, by gender, as proportion of the population aged 25-29, EU-25 and selected countries - 2003

	Doctorate graduates (ISCED 6 level), 2003						
	In any field			In science, mathematics and computing		In engineering, manufacturing and construction	
	Total	per 1 000 population aged 25-29	% Female	Total	% of doctorate graduates	Total	% of doctorate graduates
EU-25	**71 584 s**	**2.6 s**	**45.9 s**	**18 996 s**	**23.1 s**	**9 433 s**	**16.0 s**
EU-15	**60 478 s**	**3.5 s**	**42.8 s**	**16 993 s**	**27.6 s**	**7 748 s**	**16.1 s**
BE	1 432	2.1	35.5	626	43.7	84	5.9
CZ	1 546	1.6	35.3	401	25.9	413	26.7
DK	859	2.3	36.7	131	15.3	336	39.1
DE	23 043	5.0	37.9	6 088	26.4	2 213	9.6
EE	226	2.3	58.4	32	14.2	17	7.5
EL	:	:	:	:	:	:	:
ES	7 479	1.9	45.2	2 131	28.5	545	7.3
FR	:	:	:	:	:	:	:
IE	668	2.1	50.6	304	45.5	77	11.5
IT	:	:	:	:	:	:	:
CY	:	:	:	:	:	:	:
LV	64	0.4	67.2	7	10.9	16	25.0
LT	252	1.0	61.5	36	14.3	41	16.3
LU	:	:	:	:	:	:	:
HU	1 067	0.8	42.9	208	19.5	37	3.5
MT	8	0.3	37.5	:	:	:	:
NL	2 584	2.4	41.1	506	19.6	453	17.5
AT	2 197	4.4	40.6	440	20.0	322	14.7
PL	5 450	1.7	44.7	904	16.6	928	17.0
PT	3 723	4.4	56.0	645	17.3	522	14.0
SI	367	2.4	41.4	87	23.7	88	24.0
SK	2 126	4.5	55.1	328	15.4	145	6.8
FI	:	:	:	:	:	:	:
SE	3 558	6.2	42.8	870	24.5	957	26.9
UK	14 935	4.1	41.5	5 252	35.2	2 239	15.0
IS	6	0.3	33.3	1	16.7	:	:
NO	714	2.2	40.1	177	24.8	127	17.8
EEA	**72 304 s**	**2.5 s**	**45.0 s**	**19 174 s**	**22.9 s**	**9 560 s**	**15.3 s**
CH	2 742	5.8	36.4	751	27.4	277	10.1
BG	401	0.7	51.6	89	22.2	51	12.7
RO	21 841	12.2	57.7	945	4.3	2 533	11.6
TR	2 815	0.0	37.5	425	15.1	381	13.5
JP	14 512	0.0	24.9	2 258	15.6	3 212	22.1
US	45 994	0.0	47.1	10 761	23.4	5 488	11.9

Eurostat estimations excluding EL, FR, CY, IT, LU and FI: EU-15, EU-25 and EEA

4.3 Stocks of human resources in science and technology

In general, the supply in Human Resources in Science and Technology (HRST) has increased as inflows of graduates from tertiary education have grown. This section looks at the demand side by analysing the labour markets in the EU Member States. The measurement of stocks of HRST and of its various sub-categories - named "HRST in terms of occupation" (HRSTO), "HRST in terms of education" (HRSTE), "HRST core" (HRSTC) and "Scientists and Engineers" (SE) - provides broad indicators on the state of the labour markets for knowledge workers in European countries.

HRST stocks at the national level

Table 4.14 shows the stocks of human resources in S&T (HRST) in 2004 and the growth in the number of persons employed in S&T over time. In order, Germany, the UK and France had the highest number of HRST in 2004, with more than 10 million HRST in each country. These three EU countries together accounted for nearly half of the EU's 76 million total HRST. Looking at the proportion of the female HRST, the EU-25 average in 2004 was close to parity, with a rate of 49.1%. Nevertheless, the situation differs from one EU country to another. For example, while Estonia and Latvia scored the highest proportion of female HRST in the EU (respectively 64.0% and 63.4%), this proportion was down to 38.9% in Malta. Parity was however achieved in 13 out of the 25 EU countries.

As shown in Table 4.13, in almost all the EU countries (i.e. except for Latvia, Estonia and Finland) the number of persons employed in S&T (HRSTO) increased between 1999 and 2004. The highest growth rates in the number of males working in S&T occupations were found in Austria and Portugal (respectively 6.5% and 6.2%). By looking at the growth rates of females employed in an S&T occupation, the situation was different as the highest rates were found in Spain and Cyprus, with a biggest rate of 9.0%. In the majority of the EU countries (20 countries out of 25), growth in the number of human resources having an S&T occupation (HRSTO) was higher for females than for males. The EU-25 average showed a growth of 2.5% for females against only 1.4% for males. The biggest differences between growth in the number of male and female HRSTO tend to be found in the countries where the disparity between existing stocks of the two is the greatest. The proportion of HRSTO excluding HRSTC females in Cyprus, for example, was one of the lowest in the EU (37.5% in 2004). However, the gender growth rates between 1999 and 2004 show large differences between males and females: while male growth was 5.1%, for female the rate was one of the highest, at 9.0%.

At the contrary, for some countries, where males are under-represented, the opposite situation tends to prevail. For example, in 2004 the Czech Republic had a lower stock of male HRSTO excluding HRSTC compared to females (44.0% against 56.0%), and in the same period, the growth rate for male HRSTO including HRSTC was higher than for females (3.2% against 2.0%). This is true for Estonia as well.

In 2004, France was one of the three EU countries with the highest number of HRST. However, the proportion of the French population aged 25-64 years having a tertiary education was just above the EU-25 average. Indeed, Figure 4.14 shows that in 2004 France scored a proportion of 23% for males and 25% for females, while EU-25 had 23% for males and 21% for females. Disparities exist between the EU countries according to gender. While Cyprus headed the EU countries with almost one third (31%) of 25-64 year old males having a tertiary education, Finland and Estonia, on the other hand, had the highest proportion of 25-64 year-old tertiary educated females in the EU (38%).

Human resources in science and technology in Brazil

In 2001, Brazilian HRST totalled 11.2 million people, with 33% of the total or 3.6 million living in São Paulo State. The number of professionals with tertiary-level education (HRSTE) in São Paulo State exceeded 2 million in 2001, corresponding to one-third of the national total (6 million). The number in S&T occupations (HRSTO) was 2.8 million in São Paulo and 8.7 million in Brazil. Thus core human resources in science and technology (HRSTC, the intersection of HRSTE and HRSTO) amounted to 1.2 million in São Paulo and 3.6 million in Brazil.
A closer examination of these indicators shows that, in 2001 about 57% (2 million) of the 3.6 million people classified as HRST in São Paulo were there because of their education. The proportion for Brazil was about 54%. The similarity is surprising, given the intense regional concentration of these resources and the strenuous efforts devoted to higher education in São Paulo State. Still more surprising is that in 1999 the figures were 60% for São Paulo and 54% for Brazil, showing a drop in HRSTE as a proportion of total HRST in São Paulo between 1999 and 2001 while the proportion remained unchanged for Brazil overall. In fact, the numbers of HRST expanded 12.6% in Brazil and 18.8% in São Paulo State between 1999 and 2001. All components expanded, more intensely in São Paulo than in Brazil overall, but HRSTO grew most of all, expanding 23% in São Paulo and 14% in Brazil."

Source: "Science, Technology & Innovation Indicators in the state of São Paulo/Brazil, 2004" by the State of São Paulo Research Foundation (FAPESP - www.fapesp.br).

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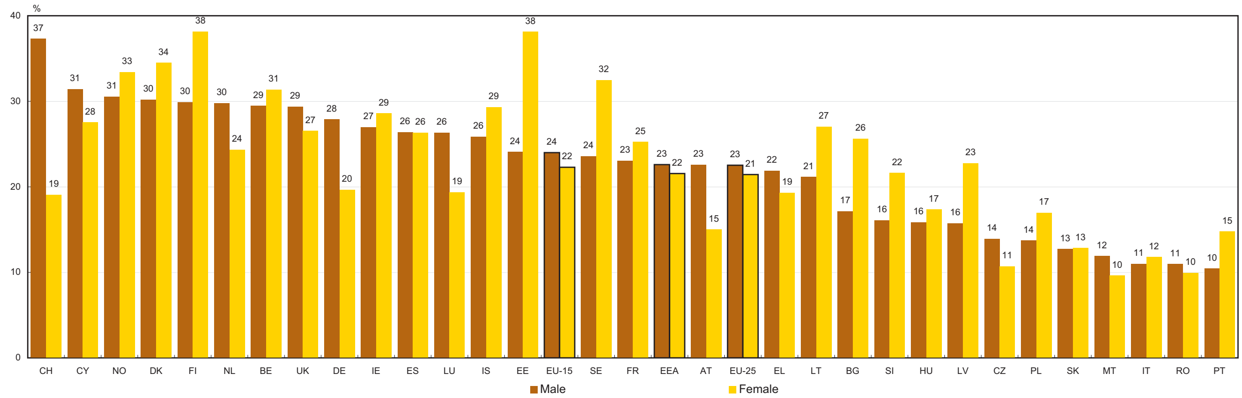
Table 4.13

Human resources in science and technology (S&T) stocks, 25-64 year old, by country and sex, and growth in S&T occupations (HRSTO), 1999 to 2004, EU-25 and selected countries - 2004

	HRST Human resources in S&T		HRSTC Human resources in S&T core		HRSTE Human resources in S&T in terms of education excluding HRSTC		HRSTO Human resources in S&T in terms of occupation excluding HRSTC		Annual average growth rate of HRSTO including HRSTC 1999-2004	
	1 000s	% Female	1 000s	% Female	1 000s	% Female	1 000s	% Female	% Male	% Female
EU-25	**76 050 s**	**49.1 s**	**29 527 s**	**50.4 s**	**24 679 s**	**47.5 s**	**21 844 s**	**49.2 s**	**1.4 s**	**2.5 s**
EU-15	**66 277 s**	**47.9 s**	**25 817 s**	**49.4 s**	**22 051 s**	**47.1 s**	**18 409 s**	**46.8 s**	**1.6 s**	**3.0 s**
BE	2 035	48.8	868	51.9	823	50.4	344	37.3	0.5	1.7
CZ	1 585	50.3	475	44.7	244	41.3	866	56.0	3.2	2.0
DK	1 254	50.9	627	55.9	334	46.4	293	45.5	1.0	3.4
DE	16 249	46.4	6 028	43.3	4 740	37.9	5 481	57.2	0.6	1.8
EE	268	64.0	84	69.2	139	61.1	44	62.9	1.0	-0.7
EL	1 395	47.3	703	47.7	500	46.6	192	47.4	4.2	5.9
ES	7 166	48.1	3 046	49.7	3 232	49.8	888	36.8	5.5	9.0
FR	10 198	49.7	4 073	52.0	3 373	54.4	2 753	40.6	2.1	3.5
IE	688	50.7	287	51.9	299	50.8	102	47.4	5.0	6.1
IT	7 576	48.2	2 429	49.9	1 239	56.4	3 909	44.7	4.7	7.1
CY	131	46.5	60	45.7	52	50.8	19	37.5	5.1	9.0
LV	329	63.4	117	65.7	122	57.9	90	67.9	-1.0	-0.3
LT	544	62.9	219	65.6	215	51.5	110	79.8	1.4	2.0
LU	85	43.9	41	39.7	17	47.6	28	47.8	2.9	4.4
HU	1 337	57.9	541	57.1	377	49.2	418	66.7	2.6	2.9
MT	37	38.9	15	45.8	8	44.1	14	28.9	3.2	1.5
NL	3 611	46.9	1 483	45.9	952	42.2	1 175	52.0	0.8	3.3
AT	1 464 p	42.8 p	431 p	43.9 p	415 p	36.2 p	618 p	46.5 p	6.5	5.5
PL	4 504	58.5	1 838	59.5	1 250	50.9	1 417	63.8	0.1	0.5
PT	1 028	51.7	498	61.3	228	55.5	302	33.1	6.2 b	6.5 b
SI	336	56.1	137	60.4	76	50.0	123	55.1	2.0	7.5
SK	703	58.0	223	55.4	146	44.2	334	65.7	0.2	1.9
FI	1 180	53.7	528	56.9	437	54.3	216	44.8	1.6	-0.8
SE	1 994	51.3	923	59.9	411	51.3	660	39.4	2.0	3.8
UK	10 757	47.0	4 482	50.2	4 207	46.4	2 068	41.2	0.6	1.8
IS	56	52.4	28	55.6	12	45.9	16	51.5	2.8	3.8
NO	1 032	49.6	508	54.3	273	46.5	252	43.5	2.9	3.7
EEA	**77 138 s**	**49.1 s**	**30 062 s**	**50.5 s**	**24 964 s**	**47.4 s**	**22 112 s**	**49.2 s**	**1.4 s**	**2.5 s**
CH	1 798	41.7	697	34.9	466	32.3	635	56.0	0.5	3.5
BG	1 081	58.8	466	64.9	443	56.2	172	49.2	-0.5	-1.5
RO	1 915	54.2	800	51.7	414	41.3	702	64.6	-0.8	1.5
TR	:	:	:	:	:	:	:	:	:	:

Exception to the reference year 2004: NL 2003.
Exceptions to the reference period 1999-2004: MT, BG, EU-25 and EEA 2000/2004, NL 1999/2003.
Eurostat estimations: EU-15, EU-25 and EEA.
Break in series: PT.

Figure 4.14 Proportion of the population with an age of 25-64 years with tertiary education, by gender, EU-25 and selected countries - 2004



Provisional data: AT. Exception to the reference year NL: 2003. Eurostat estimations: EU-15, EU-25, EEA.

Employment rates - evaluating the level and quality of employment

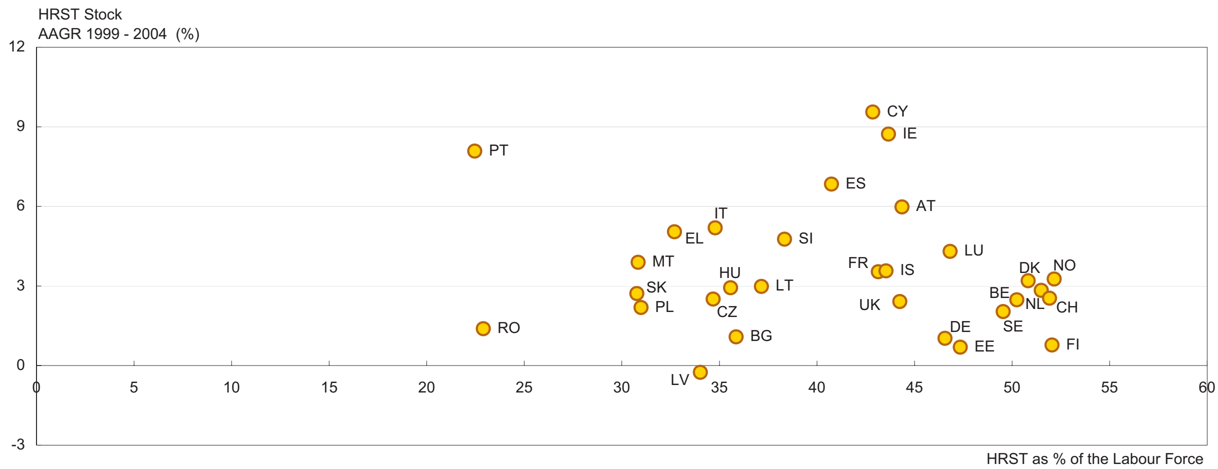
Figure 4.15 illustrates the evolution of the HRST stock between 1999 and 2004, as well as their proportion of the total labour force. Large differences between the countries are apparent. For example, Cyprus had the largest growth in HRST, with over 9%. At the other end of the scale, Latvia registered a fall in the number of HRST during the same period with an annual average reduction close to -0.25%. Looking at HRST as a proportion of the total labour force, Romania and Portugal had low percentages - between 20% and 25% - while Belgium, Finland, Sweden, Norway, Denmark, the Netherlands and Switzerland reached proportions between 50% and 55%.

Figure 4.16 illustrates the breakdown of employment in S&T in 2004. A distinction is made between persons employed in S&T with tertiary level education (HRSTC) and those working in a S&T occupation without tertiary level education (HRSTO excluding HRSTC) and lastly those employed, but not in a S&T occupation.

Sweden had one of the highest proportions of its working population in S&T occupations having completed tertiary level education in 2004 (some 923 000 persons or around 21%). When those working in S&T without tertiary education are included, the figures rose almost 1.6 million (37% of the total workforce). Luxembourg, Denmark and the Netherlands followed, with proportions ranking between 37% and 33%, all of which were well above the EU average of 26.5%.

At the other end of the EU scale, Portugal had the lowest proportions of people working in an S&T occupation, and this applied both to people with tertiary level education and to those without. The 498 000 HRSTCs reached a proportion of less than 10 % of the total labour force. If the people working in S&T without tertiary level education are included, this proportion only goes up to 15%.

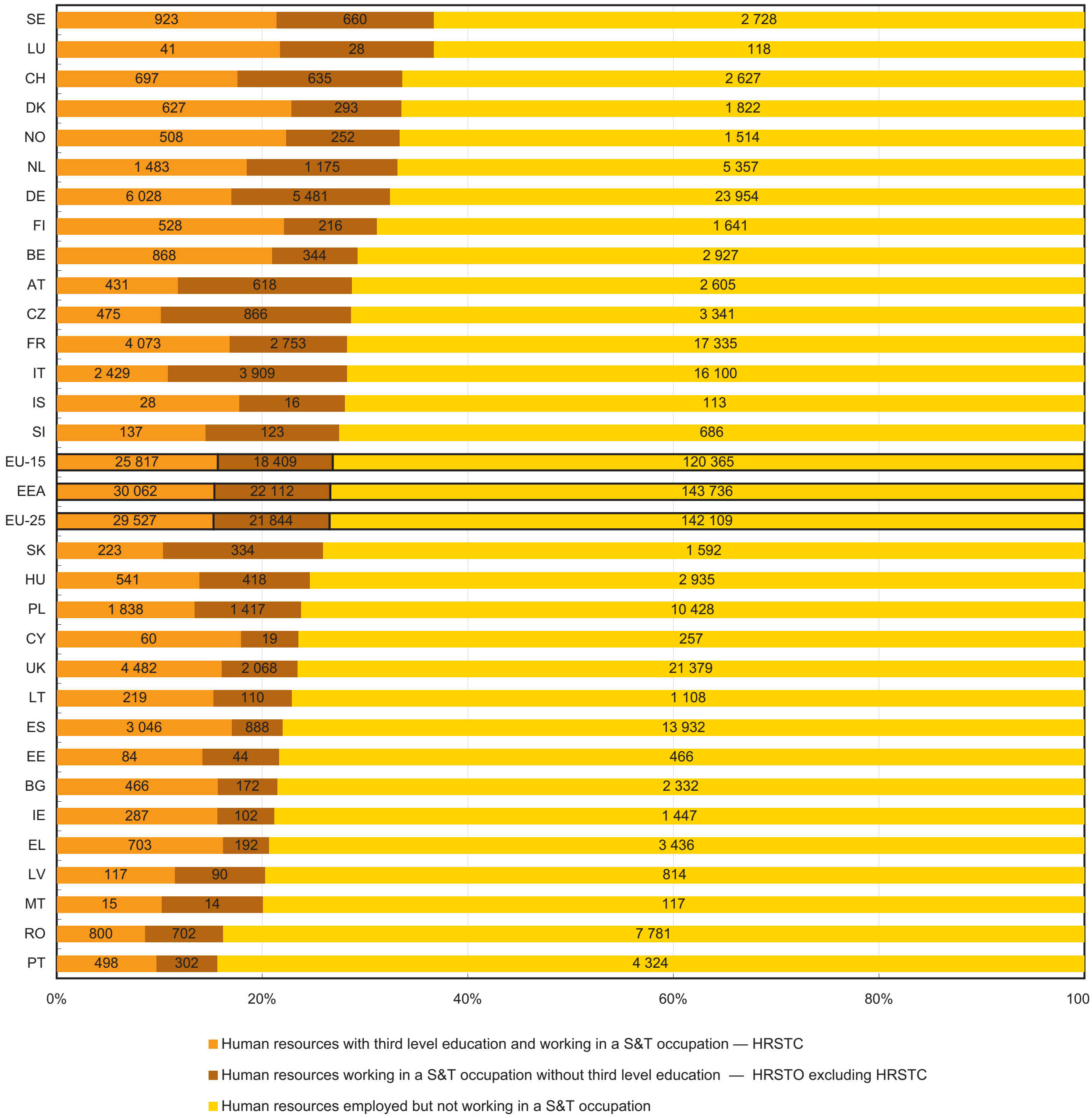
Figure 4.15 Annual average growth rates of HRST, 1999 to 2004, and proportion of HRST in terms of the labour force, EU-25 and selected countries - 2004



Exceptions to the reference period 1999-2004: NL 2003/1999, IE, IS and BG 2000/2004, LT and MT 2002/2004.
Provisional data: AT 2004, RO 1999, SE 1999.

Figure 4.16

Breakdown of total employment, 25-64 years old, in thousand and proportion of human resources working in S&T (HRSTC and HRSTO), EU-25 and selected countries - 2004



Exception to the reference year: NL 2003.
Eurostat estimations: EU-15, EU-25 and EEA.
Provisional data for HRSTC and HRSTO: AT 2004.

The age distribution of the human resources employed in S&T

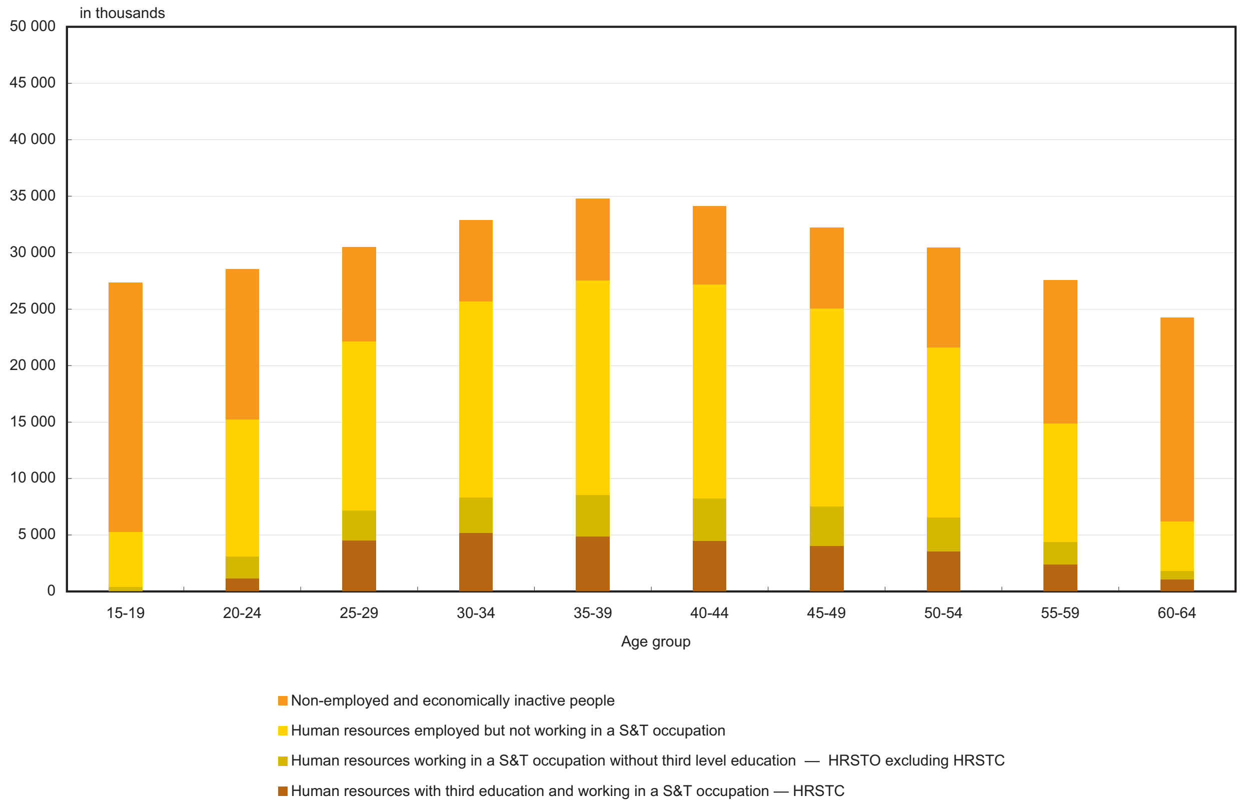
To develop the information given in Figure 4.16 for persons employed in S&T, Figure 4.17 details the age distribution of this specific population in EU-25 and relates it to the age distribution of the total population.

The age hump at 35-39 for the total population is less marked for the HRSTO - people who are occupied in an S&T occupation - and even less for the HRSTC - i.e. people occupied in S&T who also have a tertiary education - the bulk of whom are found in the next age group down. This age group, 30-34, contains both the highest number (around 5 million), and the highest share (around 16 %) of HRSTC of all age groups.

Looking at HRSTO excluding HRSTC, the 40-44 age group is the largest (more than 3.7 million) and also, with close to 15%, has the highest proportion of all age groups.

When looking at HRSTO without tertiary education as a proportion of total employment, the rates are not particularly constant and variations between the age groups are apparent. Two peaks can be highlighted. The first is for the 20-24 age group, with a proportion of HRSTO in terms of total employment equal to 13%. The second is for the 45-49 age group, which has a 14% share. In the age groups below and above, HRSTO as a proportion of total employment are diminishing.

Figure 4.17 **Age distribution of human resources employed in S&T (HRSTO and HRSTC), other employed population and the total population, EU-25 - 2004**



Exception to the reference year: NL 2003.
Eurostat estimation: EU-25.

Scientists and engineers

Scientists and Engineers - SE - are an HRST sub-set of particular interest. With our definition they encompass all people working in specific occupations listed in 'Physical, mathematical and engineering' occupations (ISCO-88 COM code 21), and in 'Life science and health' occupations (ISCO-88 COM code 22).

The gender distribution of Scientists and Engineers as a percentage of the total labour force in 2004 is illustrated in Figure 4.18. In the majority of EU countries, scientists and engineers were male.

Notable exceptions are Lithuania and Latvia, where scientists and engineers were more likely to be female. Nevertheless, in most countries, the tendency was for SE to be male rather than female. In 2004, the gender ratio in Germany, Luxembourg and Finland was close to four male to one female scientist or engineer. Even if the proportion of scientists and engineers as a percentage of the total labour force is small in these countries (around 3%), Portugal and Estonia were the only EU countries to achieve gender parity in the distribution of male and female SE in 2004.

The highest representation of scientists and engineers in 2004 is found in Belgium, where 7.5% of the labour force declared that they had an occupation qualifying them as SE. At the other end of the scale is Slovakia, where the proportion of scientists and engineers is only 2.6% of the total labour force.

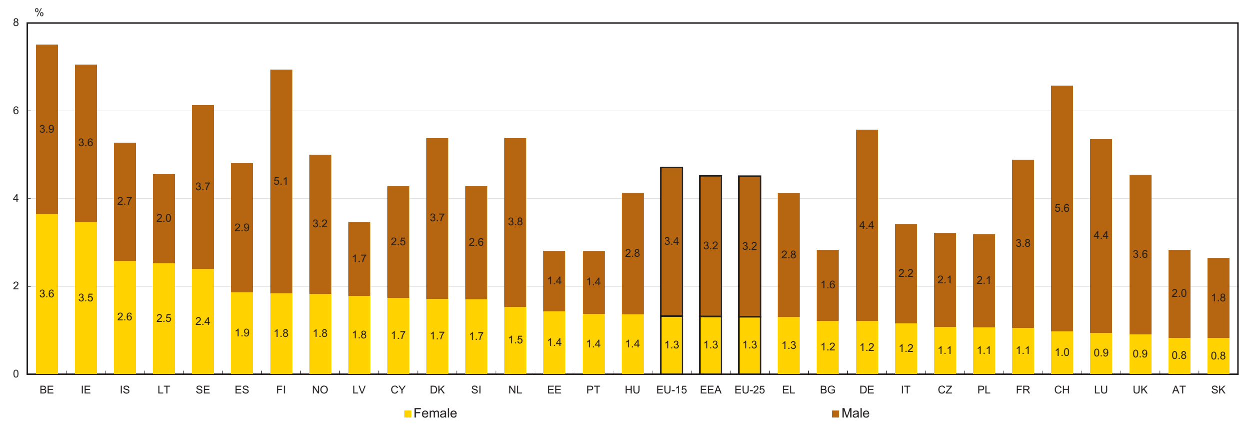
UNESCO definition of scientists and engineers

"Scientists and Engineers refer to persons who, working in those capacities, use or create scientific knowledge and engineering and technological principles, i.e. persons with scientific or technological training (usually completion of third level education) who are engaged in professional work on S&T activities, high-level administrators and personnel who direct the execution of S&T activities. In the case of R&D activities, "scientists" are synonymous with researchers and assistant researchers engaged both in the natural sciences and in social sciences and humanities."

Source: Manual on the measurement of human resources devoted to S&T - Canberra Manual, OCDE, §3221.

Figure 4.18

Breakdown of scientists and engineers (SE), 25-64 years old, by gender, as a percentage of the total labour force, EU-25 and selected countries - 2004



Exception to the reference year: NL 2003.
Eurostat estimations: EU-15, EU-25 and EEA.
Provisional data: AT.
Unreliable data: EE.

HRST intensity by sector of economic activity

HRST intensity in a specific sector of economic activity can be defined as the share of employed people in that sector that have successfully completed tertiary education - employed HRSTE. In turn, this can be used as a proxy for the knowledge intensity in each sector of economic activity.

Table 4.19 illustrates the manufacturing sectors classified according to NACE Rev.1.1. in also using the aggregations used for the sectors according to R&D intensity.

Table 4.20 shows results for the knowledge intensive employment services as well according to NACE Rev.1.1.

Not surprisingly, High-technology manufacturing - which includes 'Manufacture of office machinery and computers' NACE Rev.1.1 code 30, 'Manufacture of radio, television and communication equipment and apparatus' NACE Rev.1.1 code 32 and 'Manufacture of medical, precision and optical instruments, watches and clocks' NACE Rev.1.1 code 33 - was the most knowledge-intensive of the manufacturing industries in the EU in 2004, where around one third of all employed people had tertiary S&T education - Table 4.19. Finland posted the highest EU rate at 59.5%, followed by Spain (53.9%). The lowest rates were in Hungary and the Czech Republic (respectively 9.1% and 9.3%).

As expected, 'Medium-low technology manufacturing' and 'Low technology manufacturing' scored lowest, with EU rates reaching only 13.7% and 13.5% respectively. Nevertheless, the 'Agriculture, hunting, forestry, fishing, mining and quarrying' sector accounted for the lowest rate in the EU, with only 7.8% in 2004.

Table 4.19 **HRST intensity of employed people with S&T education (HRSTE) as a percentage of total employment, 25-64 years old, in selected sectors of economic activity, EU-25 and selected countries - 2004**

	HRST intensity — share of employed 25-64 years old HRSTE to total employment — in sectors of economic activity					
	Agriculture, hunting, forestry, fishing, mining and quarrying	Utilities and construction	Manufacturing: High-tech	Manufacturing: Medium high-tech	Manufacturing: Medium low-tech	Manufacturing: Low-tech
EU-25	**7.8 s**	**13.8 s**	**32.6 s**	**24.0 s**	**13.7 s**	**13.5 s**
EU-15	**9.8 s**	**14.2 s**	**35.1 s**	**25.5 s**	**14.5 s**	**14.7 s**
BE	13.7	16.0	46.5	32.2	21.6	20.9
CZ	7.4	8.6	9.3	10.8	5.9	5.7
DK	7.7 u	13.9	36.3	34.9	13.4	22.4
DE	20.1	23.8	35.6	28.3	16.2	17.2
EE	19.2 u	20.4	: u	38.8 u	: u	23.8
EL	1.5	6.7	: u	20.6	12.1	12.8
ES	9.2	16.2	53.9	37.7	23.8	20.2
FR	10.0	10.7	37.7	26.9	14.5	14.8
IE	9.5	16.4	43.8	39.8	19.2	21.1
IT	2.2	2.1	13.5	8.2	3.9	5.1
CY	8.5 u	12.9	: u	33.7 u	8.3	17.1
LV	6.8	14.1	: u	26.4 u	13.7 u	13.9
LT	6.8 u	15.7	: u	: u	: u	17.7
LU	: u	6.7	: u	: u	17.1	12.8 u
HU	9.0	9.8	9.1	12.4	9.0	6.7
MT	:	:	:	:	:	:
NL	9.0	9.5	45.8	24.9	12.8	15.9
AT	11.5 p	21.1 p	25.3 p	18.1 p	15.0 p	15.5 p
PL	2.9	13.2	24.8 u	18.6	12.7	9.5
PT	: u	4.4	: u	10.3	: u	3.2
SI	6.6 u	11.6	16.2 u	13.0 u	9.9 u	9.6 u
SK	7.0	8.6	15.1 u	6.8	9.3	4.5
FI	18.7	21.6	59.5	36.4	21.2	24.1
SE	11.9	8.7	35.6	15.9	8.1	11.6
UK	19.6	16.7	37.2	29.2	19.9	19.4
IS	: u	8.8	: u	: u	: u	12.1
NO	20.8	11.5	50.7	24.2	13.7	16.0
EEA	**8.0 s**	**13.8 s**	**32.8 s**	**24.0 s**	**13.7 s**	**13.6 s**
CH	20.7	21.7	37.6	35.0	19.3	19.1
BG	6.5	14.9	:	19.2	13.5	12.4
RO	2.0	14.3	25.6 u	10.0	11.6	5.7
TR	:	:	:	:	:	:

Exception to the reference year: NL 2003.
Eurostat estimations: EU-15, EU-25 and EEA.

By looking at the knowledge-intensive services in the EU - see Table 4.20 - close to half of the people working in the other knowledge-intensive services, which include 'Education' and 'Health' and 'Social work', had completed tertiary S&T education in 2004. Differences between countries are noted for this sector of economic activities too. In Cyprus, the proportion of employed people with tertiary education in this sector was almost 73%, whereas the corresponding proportion in the Czech Republic was only 32.2%.

Obviously, the sector of economic activity in EU with the lowest proportion of HRSTE in 2004 was less-knowledge-intensive market services, with 13.9%.

Table 4.20

HRST intensity of employed persons with S&T education (HRSTE) as a percentage of total employment, 25-64 years old, in services sectors, EU-25 and selected countries - 2004

	HRST intensity — share of employed 25-64 years old HRSTE to total employment — in sectors of economic activity					
	Knowledge-intensive services (KIS)				Less knowledge-intensive services (LKIS)	
	Financial	High-tech	Market (excl. Financial intermediation and high tech services)	Other KIS	Market	Other LKIS
EU-25	**37.9 s**	**41.3 s**	**38.2 s**	**49.4 s**	**13.9 s**	**28.6 s**
EU-15	**37.2 s**	**41.7 s**	**38.4 s**	**50.0 s**	**14.2 s**	**28.4 s**
BE	63.6	50.5	54.4	61.8	20.4	31.7
CZ	33.3	28.4	29.9	32.2	7.3	20.8
DK	29.3	46.7	45.6	55.9	17.5	39.6
DE	27.3	38.1	34.0	47.3	14.4	32.6
EE	: u	47.6 u	48.1	52.9	27.4	58.1
EL	43.3	41.1	51.6	68.8	12.3	32.4
ES	54.9	61.4	47.4	68.0	19.8	33.2
FR	52.3	43.2	39.3	44.8	18.5	21.4
IE	55.4	53.9	49.0	56.5	18.5	30.6
IT	23.4	24.2	29.1	39.6	5.2	14.0
CY	59.7	58.1	59.2	72.8	23.7	33.6
LV	71.7	35.1	38.7	43.3	17.4	29.7
LT	62.1 u	56.2 u	53.7 u	52.0	28.4	35.1
LU	41.5	41.1	41.3	45.5	11.5	28.2
HU	39.0	38.3	38.6	47.8	10.4	26.7
MT	: u	: u	34.0 u	48.8	5.4 u	14.2 u
NL	39.6	45.8	42.7	49.0	13.3	35.6
AT	15.9 p	31.1 p	30.9 p	41.8 p	12.2 p	21.7 p
PL	49.0	40.9	33.5	48.5	12.7	33.4
PT	34.3	30.4	30.1	48.8	5.9	15.5
SI	36.6 u	38.1 u	37.4	50.9	12.9	41.3
SK	37.5	36.1	35.4	34.0	7.4	24.1
FI	65.2	55.0	45.8	51.8	26.5	49.2
SE	32.8	41.9	31.8	49.2	13.1	42.0
UK	34.6	44.0	41.1	51.6	14.1	35.2
IS	34.9	46.5	43.9	46.7	19.2	35.9
NO	39.8	51.7	44.2	54.5	15.4	43.1
EEA	**37.9 s**	**41.5 s**	**38.2 s**	**49.5 s**	**14.0 s**	**28.7 s**
CH	39.8	38.9	44.3	40.2	18.3	35.9
BG	66.9	43.2	51.3	63.4	20.2	32.9
RO	51.8	28.6	32.2	37.0	12.1	27.1
TR	:	:	:	:	:	:

Exception to the reference year: NL 2003.
Eurostat estimations: EU-15, EU-25 and EEA.

Unemployment

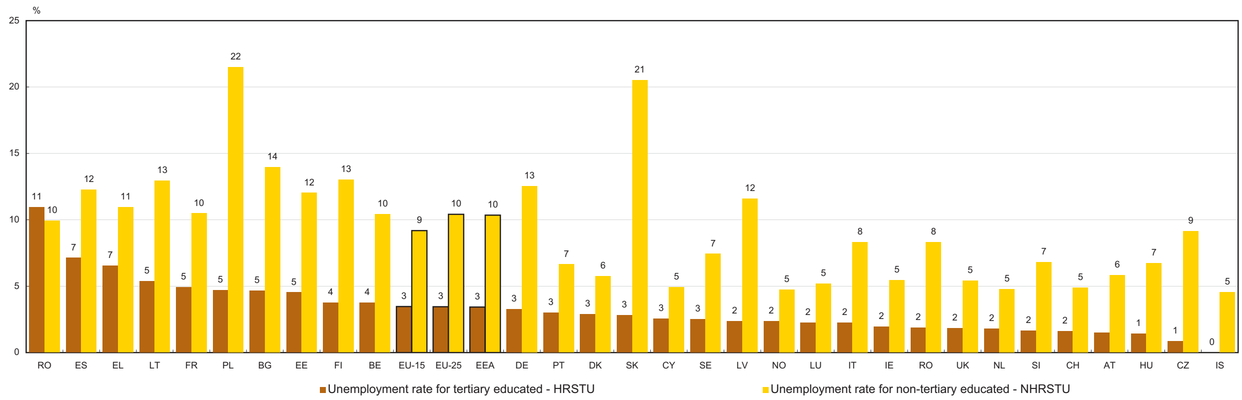
This section provides results on the unemployment rates for human resources in S&T tertiary educated (HRSTU) and human resources without S&T education (NHRSTU).

As Figure 4.21 shows, unemployment rates in 2004 for those with tertiary level education were much lower than the unemployment rates for those without S&T education in all countries shown, except Romania. In EU-25, the proportion of tertiary educated unemployed only reached 3%, while the rate of unemployment for non-tertiary educated climbed to 10%.

For the tertiary educated population, smaller deviations can be seen between the individual Member States and the EU average. The highest unemployment rate was in Spain, with 7%, while the lowest rate was recorded in the Czech Republic (1%).

However, finding and keeping a job when you do not possess tertiary level education is more difficult. The EU average unemployment rate in 2004 was 10%, and over 20% in Poland or Slovakia. The lowest unemployment rate for non tertiary educated persons was found in Cyprus or the Netherlands (5%), which compares with an unemployment rate for persons with tertiary education of only 2%.

Figure 4.21 **Unemployment rates for tertiary and non-tertiary educated population, 25-64 years old, EU-25 and selected countries - 2004**



Exception to the reference year: NL 2003.
Eurostat estimations: EU-15, EU-25 and EEA.
Provisional data: AT.
Unreliable value: SI for HRSTU.

HRST stocks at the regional level

Particular attention needs to be paid to the reliability of regional results. The size of the samples, which are intended to provide a representative estimate of the population of that region, can become too small and be prone to sampling error. This is especially true when the data are also disaggregated by sector of economic activity. For this reason, data by sector of economic activity are presented at the NUTS 1 regional level only, whilst totals are presented at the NUTS 2 level.

In any case, a strict adherence to the guidelines provided by the European Union Labour Force Survey vis-à-vis the minimum levels at which data can be considered reliable has been employed. In most cases, data are well above the minimum sample size guidelines set for using the European Union Labour Force Survey. Data are flagged as unreliable when this is not the case.

The top 30 HRST regions in the European Union

Table 4.22 ranks the first 30 regions in Europe according their proportion of HRST and also gives regional results for the other HRST sub-categories, i.e. people having completed tertiary level education (HRSTE), persons employed in an S&T occupation (HRSTO) and the intersection of the two (HRSTC).

Ranked according to the share of HRST in the labour force, Brabant Wallon (BE) was the leading region in 2004. More than half (67%) of the total labour force either was employed in S&T or had a tertiary education. This region was followed by Utrecht (NL) where 65.3% of the labour force was employed in S&T.

However, most of the regions listed in Table 4.22 are capitals. Indeed, 12 capital regions out of the 25 EU capital regions are found in this figure, of which seven (capitals of the United Kingdom, Sweden, Belgium, the Netherlands, France, the Czech Republic and Finland) are in the first ten positions.

A high proportion of HRST does not necessarily mean that these people have a tertiary education. For example, looking at two German regions - Köln and Berlin - both had a high proportion of persons employed in S&T of close to 40% in 2004 (respectively 38.0% and 38.5%). However, looking at the number of persons employed in S&T and having a tertiary level of education shows up differences. In Köln, only 19.5% of the persons employed in S&T had a tertiary education (HRSTC) compared to over 24.1% in Berlin.

Map 4.23 shows the regional distribution of the human resources employed in an S&T occupation (HRSTO) as a percentage of the total labour force, at the NUTS 2 level, in 2004.

Differences between the regions can be seen. The highest concentration of HRSTO as a share of the labour force is found in capital regions, in regions in central Europe and in the Nordic countries. For example, a majority of Swedish regions had a proportion of HRSTO higher than 30% in 2004.

In Germany, the majority of the Western regions have a proportion of HRSTO in relation to the total labour force higher than 30%, when at the same time the Eastern regions ("die neuen Länder") had the lowest proportions, with rates below 30%.

Table 4.22

The top 30 EU-25 regions ranked according to the proportion of human resources in S&T (HRST) in the labour force - 2004

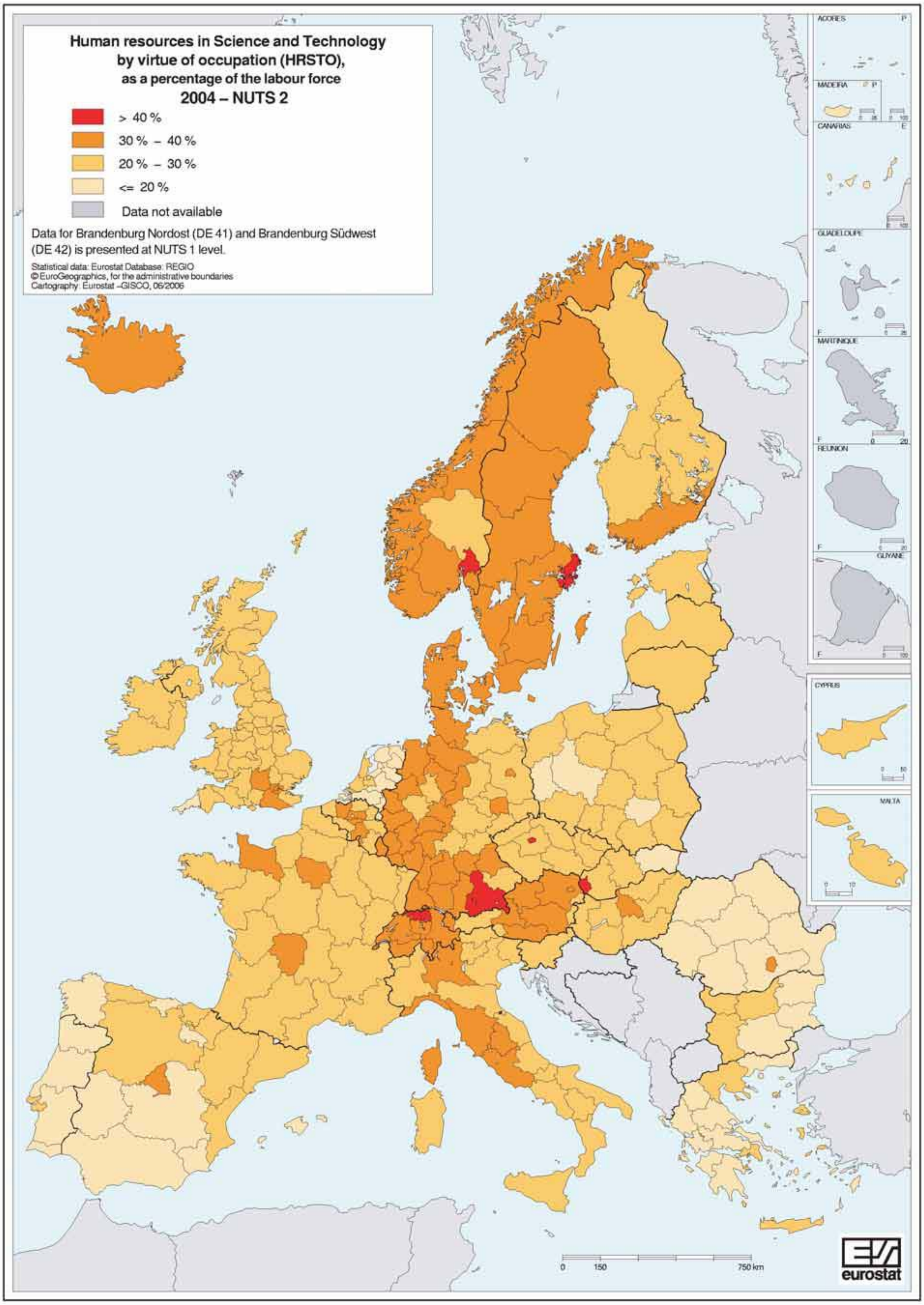
Country (Ranking)		Region - NUTS 2	HRST		HRSTE		HRSTO		HRSTC	
			1 000s	as % of labour force	1 000s	as % of labour force	1 000s	as % of labour force	1 000s	as % of labour force
		EU-25	76 050 s	41.0 s	54 205 s	29.3 s	51 371 s	27.7 s	29 527 s	15.9 s
1	BE	Brabant Wallon	97	67.0	84	57.9	55	38.1	42	29.0
2	NL	Utrecht	334	65.3	240	46.9	240	46.9	146	28.5
3	UK	Inner London	752	63.5	625	52.8	444	37.5	317	26.8
4	SE	Stockholm	564	63.0	374	41.7	450	50.3	260	29.1
5	BE	Bruxelles-Capitale	240	61.9	218	56.1	116	29.8	93	24.0
6	BE	Vlaams-Brabant	266	61.2	223	51.3	152	34.9	109	24.9
7	NL	Noord-Holland	681	59.2	493	42.9	487	42.4	299	26.0
8	FR	Île de France	2 832	58.9	2 181	45.4	1 785	37.1	1 134	23.6
9	CZ	Praha	326	57.5	182	32.2	277	48.8	133	23.5
10	FI	Etelä-Suomi	674	57.3	540 u	46.0 u	431	36.7	298	25.3
11	DE	Berlin	877	57.2	656	42.8	589	38.5	369	24.1
12	FI	Åland	7	55.6	4	34.7	5	38.8	: u	: u
13	DE	Oberbayern	1 044	55.1	684	36.1	769	40.6	409	21.6
14	ES	País Vasco	501	54.3	452	49.0	248	26.9	199	21.6
15	SK	Bratislavsky kraj	155	54.2	94	33.0	116	40.5	55	19.2
16	NL	Groningen	122	53.4	81	35.4	90	39.3	49	21.3
17	AT	Wien	364 p	53.2 p	246 p	35.9 p	243 p	35.5 p	125 p	18.2 p
18	NL	Zuid-Holland	770	52.9	511	35.1	573	39.3	314	21.6
19	DE	Darmstadt	866	52.6	566	34.4	644	39.1	344	20.9
20	UK	Berks., Bucks. & Oxfords.	512	52.3	417	42.7	307	31.4	213	21.7
21	ES	Comunidad de Madrid	1 323	51.2	1 155	44.7	801	31.0	633	24.5
22	DK	Danmark	1 254	50.8	961	39.0	920	37.3	627	25.4
23	DE	Rheinhessen-Pfalz	416	50.5	279	33.9	293	35.5	157	19.0
24	DE	Leipzig	243	50.4	202	41.9	147	30.5	106	22.0
25	DE	Köln	878	50.3	556	31.8	664	38.0	341	19.5
26	UK	Surrey, East and West Sussex	545	50.1	440	40.5	329	30.2	224	20.6
27	UK	Outer London	971	49.9	752	38.6	607	31.2	388	19.9
28	DE	Hamburg	382	49.8	235	30.7	296	38.6	150	19.6
29	NL	Gelderland	409	49.6	273	33.1	303	36.7	167	20.2
30	DE	Hannover	446	49.3	276	30.5	323	35.7	153	16.9

Exception to the reference year: NL 2003.
Eurostat estimation: EU-25.

4

Map 4.23

Human resources in terms of occupation (HRSTO) as a percentage of the labour force - 2004



Regional differences by sector of economic activities

Tables 4.24 shows the regional "top 30", where for each region the proportion of employed HRST having tertiary education (HRSTE) in manufacturing is detailed at the NUTS 1 regional level in 2004.

Île de France (FR) had the highest proportion of employed HRSTE for the manufacturing industry as a whole (40.2%). This proportion rose to 46.8% in the sub-sector of high and medium-high technology manufacturing.

IIn Bruxelles-Capitale - the second region of the top 30 - this proportion was even higher, as almost more than half of tertiary educated people where working in this sub-sector of economic activities. Some way back, Wales (UK) had a rate of HRSTE people in high and medium-high technology of only 22.7% and in manufacturing as a whole of 21.2%.

In the manufacturing sectors, the leading EU countries in 2004 were Germany and the UK, each with eight regions in the top 30.

Table 4.24 **The top 30 EU-25 regions ranked according to the proportion of employed human resources in terms of education (HRSTE), in manufacturing industries, in thousand and as a percentage of total employment - 2004**

Country (Ranking)		Region — NUTS 1	Total manufacturing		High and medium-high technology		Medium-low technology		Low-technology	
			1 000s	as % of total employment	1 000s	as % of total employment	1 000s	as % of total employment	1 000s	as % of total employment
		EU-25	5 804 s	18.0 s	3 037 s	25.4 s	1 058 s	13.7 s	1 709 s	13.5 s
1	FR	Île de France	201	40.2	122	46.8	17 u	28.1 u	62	34.7
2	BE	Bruxelles-Capitale	8	39.6	4 u	55.2 u	: u	: u	3 u	26.3 u
3	UK	London	91	37.9	34	37.9	: u	: u	48	38.6
4	ES	Noreste	163	34.0	75	43.4	52	31.2	35	25.4
5	ES	Communidad de Madrid	113	31.5	57	42.5	9	16.2	47	27.8
6	UK	South East	141	30.0	82	36.6	17	19.6	41	26.5
7	ES	Canarias	11	28.6	3 u	44.8 u	3 u	30.6 u	6	23.8
8	DE	Berlin	43	28.5	27	33.1	: u	: u	14	25.4
9	IE	Ireland	79	28.1	47	39.7	9	17.8	23	20.2
10	FI	Manner-Suomi	123	27.7	65	39.9	19	19.0	40	21.6
11	UK	Scotland	73	26.1	38	35.3	15	26.2	20	17.3
12	DE	Brandenburg	37	25.6	19	32.7	9	20.8	9	21.3
13	ES	Noroeste	74	25.2	29	39.0	23	26.9	22	16.4
14	BE	Vlaams Gewest	130	24.7	62	31.1	27	21.3	41	20.5
15	UK	North West	113	24.1	64	31.7	23	20.0	26	17.2
16	DE	Sachsen	87	24.1	43	28.9	19	21.5	25	20.2
17	BE	Région Wallonne	41	23.7	20	34.9	10	18.2	11	17.7
18	DK	Danmark	101	23.3	54	32.8	11	12.2	37	20.1
19	ES	Este	272	23.2	120	36.0	52	18.3	100	18.1
20	DE	Baden-Württemberg	377	23.1	267	28.5	48	15.8	61	15.9
21	EE	Eesti	33	23.1	10	34.3	: u	: u	21	22.0
22	DE	Hessen	132	22.5	90	28.3	21	15.9	22	15.4
23	FR	Méditerranée	48	22.4	27	32.7	12 u	24.0 u	9 u	10.9 u
24	DE	Thüringen	51	22.3	26	29.7	11	15.2	13	20.6
25	UK	East Midlands	80	22.0	39	26.5	18	23.8	23	16.4
26	DE	Mecklenburg-Vorpommern	14	21.9	8	37.6	: u	: u	: u	: u
27	UK	South West	69	21.7	39	27.6	: u	: u	21	18.2
28	DE	Rheinland-Pfalz	89	21.2	58	28.3	14	14.4	18	14.8
29	UK	Wales	39	21.2	19	22.7	: u	: u	10	18.7
30	UK	Northern Ireland	18	21.0	11	31.7	: u	: u	: u	: u

Exception to the reference year: NL 2003.
Eurostat estimation: EU-25.

4

Ranked according to the number of employed HRST with tertiary education (HRSTE) working in services - Table 4.25 - the leading region in the EU was Bruxelles-Capitale (BE) with 51.7%, followed by Noreste (ES) with 46.0% and Communidad de Madrid (ES) with 42.8%. Moreover, six Spanish regions were placed in the top 30, as well as five German and four British.

Table 4.25

The top 30 EU-25 regions ranked according to the proportion of employed human resources in terms of education (HRSTE), in services in thousand and as a percentage of total employment - 2004

Country (Ranking)		Region - NUTS 1	Total services		Knowledge-intensive high-tech services		Knowldge-intensive financial services		Knowledge-intensive market services		Other knowledge-intensive services	
			1 000s	as % of total employment	1 000s	as % of total employment	1 000s	as % of total employment	1 000s	as % of total employment	1 000s	as % of total employment
		EU-25	36 716 s	32.2 s	2 437 s	41.3 s	2 019 s	37.9 s	5 207 s	38.2 s	16 438 s	49.4 s
1	BE	Bruxelles-Capitale	167	51.7	12	65.4	11	64.7	34	56.3	54	67.0
2	ES	Noreste	511	46.0	30	68.0	25	61.3	70	52.4	182	68.6
3	ES	Comunidad de Madrid	859	42.8	107	67.7	58	60.1	179	51.6	249	66.6
4	FR	Île de France	1 679	41.7	218	59.8	145	58.0	330	46.5	496	52.7
5	BE	Vlaams Gewest	744	41.6	49	50.4	58	64.6	105	53.2	340	59.9
6	EE	Eesti	147	41.5	8 u	53.0 u	6 u	71.7 u	18	45.0	53	52.2
7	BE	Région Wallonne	370	40.3	20	41.9	27	60.8	38	54.0	192	62.5
8	LT	Lietuva	320	40.2	16 u	55.7 u	9 u	63.4 u	25	51.3	139	52.2
9	DE	Sachsen	464	40.2	21	36.8	17	44.1	53	39.7	235	67.7
10	UK	London	1 175	40.0	102	49.5	117	46.6	240	45.8	452	53.4
11	FI	Manner-Suomi	647	39.8	56	51.2	30	62.6	87	39.8	281	48.6
12	CY	Kypros	95	39.5	4	56.2	9	57.3	13	56.6	31	71.3
13	DE	Berlin	448	39.1	33	49.3	14	35.3	65	36.6	202	54.4
14	ES	Noroeste	375	37.6	18	55.7	18	54.8	48	45.1	143	66.5
15	IE	Ireland	452	37.3	35	53.4	44	53.8	64	48.3	185	55.7
16	UK	Scotland	679	37.2	39	46.1	41	43.1	86	43.8	319	52.4
17	UK	Northern Ireland	182	36.4	: u	: u	: u	: u	19	46.7	88	56.9
18	DE	Thüringen	233	36.3	9	34.7	8 u	36.1 u	19	35.0	110	55.0
19	DK	Danmark	719	36.0	49	43.6	22	28.5	83	40.9	397	51.8
20	DE	Brandenburg	275	35.9	7 u	25.3 u	14	46.2	25	32.0	121	59.2
21	EL	Attiki	437	35.8	21	44.3	31	44.9	76	49.2	164	66.1
22	ES	Centro	421	35.7	13	46.4	23	56.5	45	43.2	182	66.3
23	ES	Este	1 213	35.1	69	56.7	57	50.5	204	44.3	458	66.0
24	NL	West-Nederland	1 036	34.7	79	45.6	62	40.0	213	42.4	429	48.0
25	ES	Sur	729	34.5	27	47.8	31	50.0	102	46.0	302	69.0
26	HU	Kozep-Magyarorszag	307	34.4	32	49.3	16	46.7	51	42.2	121	51.7
27	UK	South East	1 078	34.2	104	43.8	61	32.7	194	40.8	465	49.9
28	EL	Voreia Ellada	262	33.8	6	35.5	9	44.0	36	57.6	126	68.0
29	DE	Mecklenburg-Vorpommern	167	33.7	: u	: u	6 u	43.1 u	20	33.9	75	53.4
30	SE	Sverige	1 079	33.3	81	39.5	30	33.0	131	29.4	591	46.1

Exception to the reference year: NL 2003.
Eurostat estimation: EU-25.

4.4 Mobility

This last section - through Table 4.26 and Figures 4.27 and 4.28 - develops data and analysis on the mobility of highly qualified individuals.

Data on job-to-job mobility can be defined as the movement of employed HRST from one job to another, within a one-year period. These criteria do not include inflows into the labour market from unemployment or inactivity.

Employed HRST are those who have:

- successfully completed tertiary level education in a S&T field of study and are employed in any type of occupation

Or

- are not formally qualified as above but are employed in an S&T occupation.

Table 4.26

Job-to-job mobility of employed HRST, 25-64 years old by gender, in thousand and as a percentage of employed HRST population, EU-25 and selected countries - 2002 and 2004

	2 002						2 004					
	Job mobile HRST											
	Total		Female		Male		Total		Female		Male	
	in 1000s	as % of HRST total	in 1000s	as % of HRST total	in 1000s	as % of HRST total	in 1000s	as % of HRST total	in 1000s	as % of HRST total	in 1000s	as % of HRST total
EU-25	:	:	:	:	:	:	4 165	5.5	1 992	5.3	2 173	5.6
BE	86	7.1	36	6.5	50	7.6	92	5.2	40	4.9	52	5.5
CZ	68	5.4	34	5.6	33	5.1	67	4.5	33	4.5	34	4.5
DK	101	11.3	47	10.4	55	12.2	106	9.4	49	8.7	57	10.1
DE	719	6.9	350	7.0	369	6.7	730	5.1	327	5.0	402	5.2
EE	13	8.2	6 u	6.3 u	7 u	11.3 u	14	6.2	9 u	6.6 u	5	5.5
EL	:	:	:	:	:	:	59	5.0	30	5.7	29	4.4
ES	208	6.0	105	7.0	103	5.2	447	7.4	230	8.5	217	6.6
FR	564	8.1	245	7.8	320	8.3	571	6.5	273	6.5	298	6.5
IE	:	:	:	:	:	:	:	:	:	:	:	:
IT	:	:	:	:	:	:	320	4.6	177	5.5	143	3.9
CY	4	5.7	2	5.0	3	6.3	8	7.1	4	7.8	4	6.5
LV	17	6.6	9	5.6	8	8.1	17	5.8	6	3.1	11	10.3
LT	24	6.9	14	5.9	10	8.9	27	5.6	14 u	4.5 u	13 u	7.5 u
LU	3	5.4	1 u	5.8 u	2	5.0	3	4.2	1 u	4.2 u	2	4.2
HU	33	3.6	18	3.4	15	3.8	50	4.3	23	3.5	27	5.2
MT	2 u	6.2 u	: u	: u	: u	: u	2	5.4	: u	: u	: u	: u
NL	:	:	:	:	:	:	222	6.8	101	6.7	121	6.9
AT	:	:	:	:	:	:	90 p	6.8 p	40 p	7.2 p	50 p	6.5 p
PL	137	4.3	59	3.1	79	6.0	180	4.6	86	3.8	94	5.6
PT	41	6.0	20	5.8	20	6.2	50	5.3	26	5.4	24	5.2
SI	11	4.7	7 u	5.1 u	5 u	4.2 u	20	6.6	11	6.5	9 u	6.8 u
SK	11	1.9	5	1.4	6	2.5	25	3.9	15	4.0	10	3.8
FI	83 b	10.6 b	44 b	11.5 b	39 b	9.8 b	92	8.9	51	9.5	40	8.2
SE	32 p	4.9 p	17 p	5.2 p	15 p	4.6 p	50	2.8	23	2.5	27	3.0
UK	804	11.4	342	11.5	463	11.3	925	9.5	422	9.5	503	9.6
IS	6	13.3	3	13.0	3	13.5	5	9.5	3	9.8	2	9.2
NO	49 p	6.6 p	24 p	6.8 p	25 p	6.4 p	63	6.7	30	6.6	33	6.9
CH	125	10.3	63	11.9	62	9.1	127	7.6	55	8.1	72	7.2
BG	:	:	:	:	:	:	:	:	:	:	:	:
RO	46	4.5	23	3.9	24	5.2	133	7.7	69	7.3	64	8.1
TR	:	:	:	:	:	:	:	:	:	:	:	:

Exception to the reference year 2004: NL 2003.
Provisional value: AT 2004, SE 2002 and NO 2002.
Break in series: FI 2002.
Eurostat estimation: EU-25 2004.

Table 4.26 shows, the number of employed HRST aged 25-64 years that have changed job during 2004, by country and by gender.

In absolute numbers, countries with a large population reach the top positions. The United Kingdom registered the highest number of HRST job-to-job mobility, with 925 000 individuals, followed by Germany (730 000 persons), France (571 000 persons) and Spain (447 000 persons).

When these results are expressed as a proportion of the total number of HRST employed, the highest proportion is likewise found in the United Kingdom (9.5%). Nevertheless, Denmark and Finland came in second and third positions (with 9.4% and 8.9% respectively). The proportion in Germany (5.1%) is however lower than the EU average of 5.5%. The lowest proportion of job-to-job mobility of employed HRST in terms of total HRST is found in Sweden, with less than 2.8%.

Looking now at the gender distribution, differences appear on job mobility. In few countries, females tend to be more mobile than males. A notable example is Spain where between 2003 and 2004 around 230 000 employed HRST who changed job were females. This gives a female job mobility rate of 8.5% against only 6.6% for male. At the other end of the scale, the results of Latvia can be quoted. In this case the male mobility is larger than for female as the male job mobility rate reached 10.3% for male against only 3.1% for female.

European Researcher's Mobility Portal

The European Researcher's Mobility Portal launched in 2003, is a joint initiative of the European Commission and the 33 countries participating in the European Union's Sixth Framework Programme for Research. Information access is a priority issue for researchers and administrators dealing with researcher mobility. The purpose of this portal is to create a more favourable environment for career development and job vacancies for researchers in the European Research Area by providing the necessary structured information as proposed in the Communication "A Mobility Strategy for the European Research Area".
The portal provides access via links to a selection of international, European, national, regional and sectoral web resources covering:

- General information about **research fellowships and grants**;
- **Research job vacancies and job offers** published by the different actors within the European research community (universities, industry, research organisations, foundations...);
- P**ractical information** about administrative and legal issues when moving from one country to another, as well as up to-date information about cultural and family-related aspects (housing, schooling, day-care, language courses, etc..);
- General information about r**esearch policies** relevant to the career development of researchers in Europe.

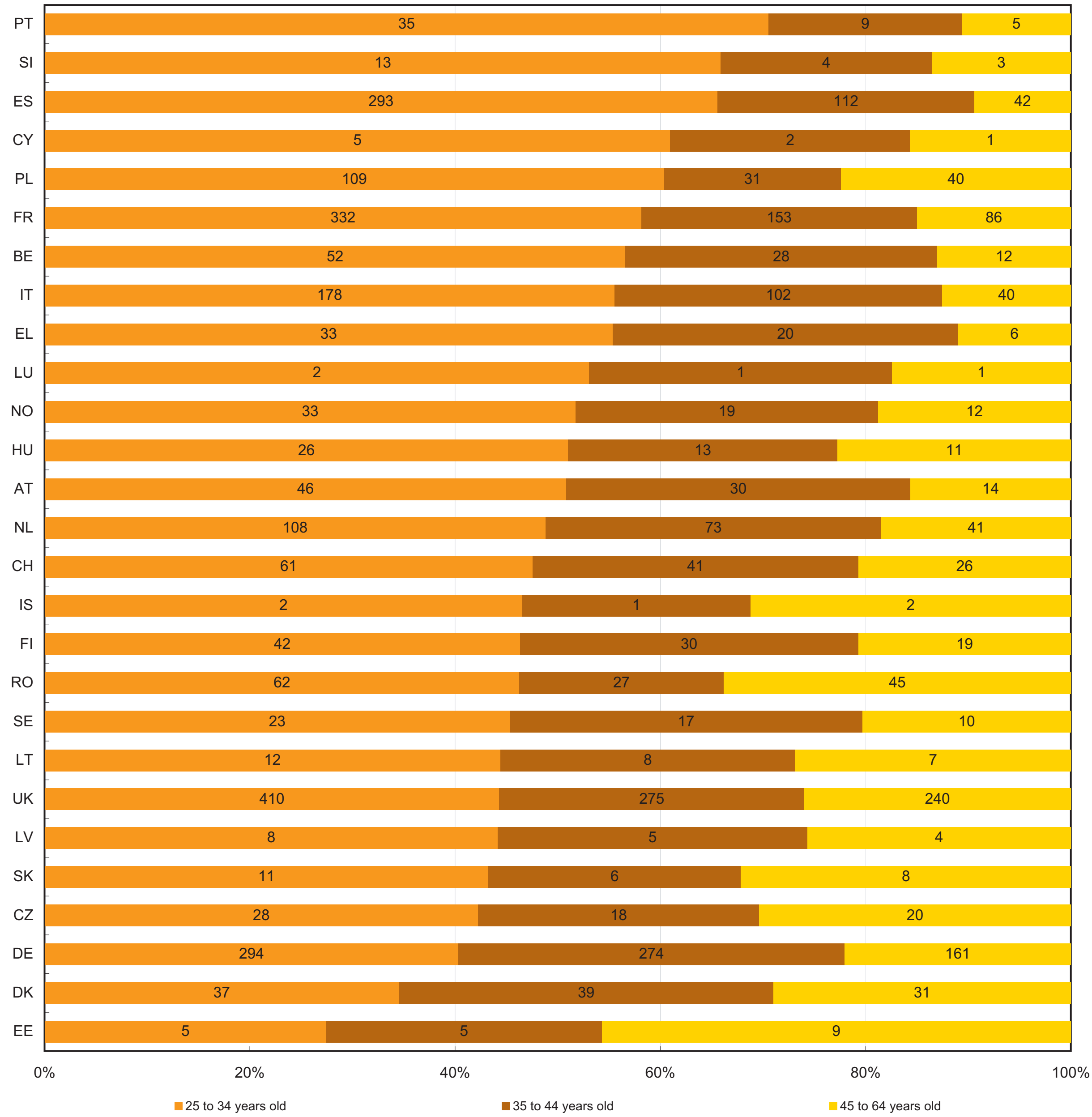
In addition to the information provided through the above-mentioned links, the Portal also offers the following services:

- Research organisations may advertise their research jobs and search for suitable candidates to recruit.
- Researchers may add their CVs to the Researchers' Mobility Job Database
- Practical information about administrative and legal issues when moving from one country to another, as well as up-to-date information about cultural and family-related aspects (housing, schooling, day-care, language courses, etc.);
- The European network of mobility centres offers customised assistance to researchers and their families in all matters concerning their professional and daily lives.
- Access to the National Researcher's Mobility Portals
- Access to other training or career resources for researchers.

Source: Web Portal http://europa.eu.int/eracareers.

Figure 4.27

Number of HRST who have changed employer during the last year, by age groups, in thousand and in percentage of total, EU-25 and selected countries - 2004



Exception to the reference year: EE and NL 2003.
Provisional value: AT.
Unreliable data for 25-34 year old: EE and LT.
Unreliable data for 35-44 year old: LT, LU and SI.
Unreliable data for 45-64 year old: CY, LT, LV, LU and SI.

Figure 4.27 shows the age distribution for three main age groups (25-34, 35-44 and 45-64 years old) of employed HRST who have changed job between 2003 and 2004.

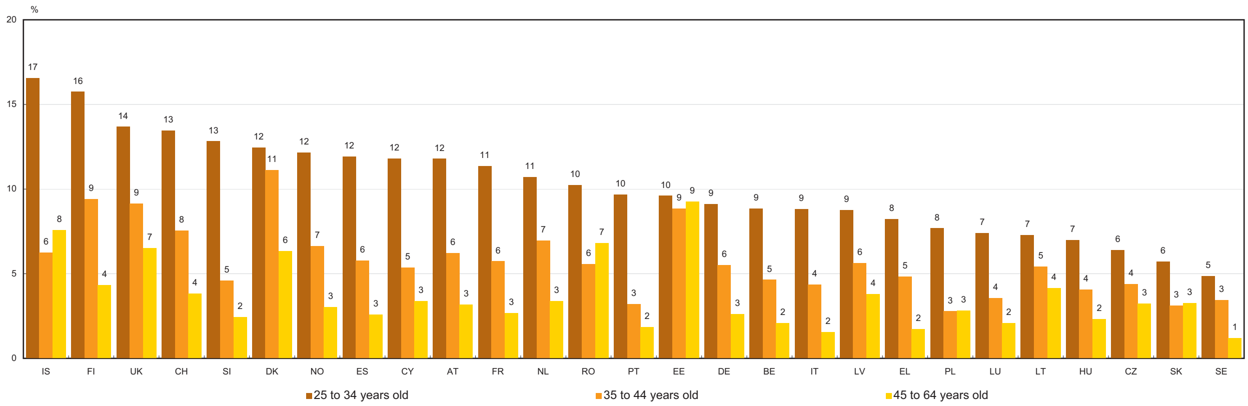
Clearly, the 25-34 year olds are more likely to be the group that is going to move from one job to another. Out of a total of 27 countries analysed for this figure, 25 have a higher number of mobile employed HRST in this age group than in the others.

Portugal, with 71%, had the highest proportion of mobile 25-34 year-old HRST employed, while the 35-44 age group reached 19% and the 45-64 age group 11%.

There are notable exceptions. In Denmark, for example, the proportion of 25-34 year-olds fell to 35%, while 35-44 and 45-64 year-olds reached 36% and 29% respectively. Estonia and Romania had a high proportion of mobile employed HRST in the 45-64 age bracket (46% and 34% respectively).

Figure 4.28

Job-to-job mobility of employed HRST, broken down by age groups, as a percentage of the total employed HRST population
EU-25 and selected countries - 2004



Exception to the reference year: EE and NL 2003.
Provisional value: AT.
Unreliable data for 25-34 year old: EE and LT.
Unreliable data for 35-44 year old: LT, LU and SI.
Unreliable data for 45-64 year old: CY, LT, LV, LU and SI.

Extending the analysis of job-to-job mobility related to the age of the persons concerned, Figure 4.28 shows the number of employed HRST who have changed job between 2003 and 2004 as a proportion of the total number of HRST employed.

This figure reveals that the number of employed HRST that are changing job compared to the total employed HRST population is not particularly large. Indeed, the highest proportion, which is found in Iceland, is less than 20%.

It appears - as shown in Figure 4.28 - that the 25-34 age group still registered the highest mobility rate. Iceland and Finland scored the largest proportion for this age group, with 17% and 16% respectively.

At the other end of the scale, Sweden reached only 5% of the total employed HRST population.

The other age groups scored much lower. For the 35-44 age group, the results range from 11% in Denmark to 3% in Portugal or Poland, for example.

These proportions are even lower when looking at the 45-64 age group. The highest proportion for this group is found in Estonia with 9%, and the lowest with 1% in Sweden.

PART3

Chapter 5
Innovation

5.1 Introduction

The Lisbon and Barcelona European Councils signalled to the European Union the important role of R&D and innovation. One of the goals set by the European Union was to raise overall research investment in the EU from 1.9% of GDP to approaching 3% by 2010.

In March 2005 the European Council decided to relaunch the Lisbon Strategy. Knowledge and innovation for growth became one of three main areas for action in the new Lisbon partnership for growth and jobs. Research and innovation should be put at the heart of EU policies, EU funding and business.

European studies on innovation apply a series of instruments to obtain data on innovation indicators and to assess national innovation performance. The two main instruments are the Community Innovation Survey (CIS) and the European Innovation Scoreboard (EIS). Both are interlinked; the EIS uses - inter alia - data collected from Eurostat within the framework of the CIS.

For several years the CIS has been conducted in all EU Member States and candidate countries, plus Norway and Iceland and some other non-EU countries. The aim of this survey is to collect statistics on innovation activities at company level, defining "innovation" as a new or significantly improved product (good or service) or the introduction of a new or significantly improved process. Organisational and marketing innovations are also measured. Up to 2001 three Community Innovation Surveys were carried out.

5.2 The Third Community Innovation Survey and the Community Innovation Survey 2002/2003

The last broad Community Innovation Survey (CIS 3) was prepared by Eurostat on the basis of a harmonised questionnaire and a harmonised survey method. This survey was implemented by the countries concerned, taking 2000 or 2001 as the reference years. Aggregated data from this survey were disseminated in 2003.

In order to obtain fresh data on the most important indicators more frequently, an additional survey (CIS 2002/2003) covering just a limited number of innovation indicators was conducted two years after CIS 3.

5.3 The Fourth Community Innovation Survey (CIS 4)

CIS 4 is collecting information about both product and process innovation and organisational and marketing innovation. Most of the questions cover new or significantly improved goods or services or the introduction of new or significantly improved processes, logistics or distribution methods. Organisational and marketing innovation is covered by one specific question.

The CIS 4 survey is based on Commission Regulation No 1450/2004, which establishes the legal basis for innovation statistics and makes it compulsory to deliver data on a number of basic variables.

The CIS 4 questionnaire not only focuses on product and process innovation, but also looks at the effects of innovation, the sources of information about innovation activities and innovation expenditure and examines the factors hampering innovation and use of intellectual property rights. It is shorter than the CIS 3 questionnaire and is perceived as less difficult by the countries participating.

CIS 4 was launched in 2005 in nearly all countries concerned and uses a harmonised questionnaire and survey method which define the structure of the questions to be asked and the statistical methods to be used by the countries participating.

The observation period to be covered by the survey will be 2002-2004 inclusive, i.e. the three years from the beginning of 2002 to the end of 2004. The reference period for CIS 4 will be the year 2004. CIS 4 data from more than 30 European countries will become available in the second half of 2006. At a later stage the CIS 4 micro-data will also be disseminated to researchers in accordance with the underlying European legislation.

5.4 European Innovation Scoreboard 2005 (EIS 2005) - Comparative analysis of innovation performance

The EIS is the policy instrument developed by the European Commission, under the Lisbon Strategy, to evaluate and compare the innovation performance of the EU Member States. It uses a limited number of indicators and results, most of them produced within the European Statistical System.

EIS 2005 covers the EU-25 Member States, the EFTA Member States (excluding Liechtenstein), the candidate countries (excluding Croatia), Japan and the United States.

Results of the European Innovation Scoreboard 2005

The scoreboard calculates the Summary Innovation Index (SII) to measure the innovation performance of European countries, but also to compare EU-25 with Japan and the United States. The SII is based on the 26 indicators listed in Table 5.3.

The scoreboard divides European countries into four groups, depending on their innovation performance (see Figure 5.1):

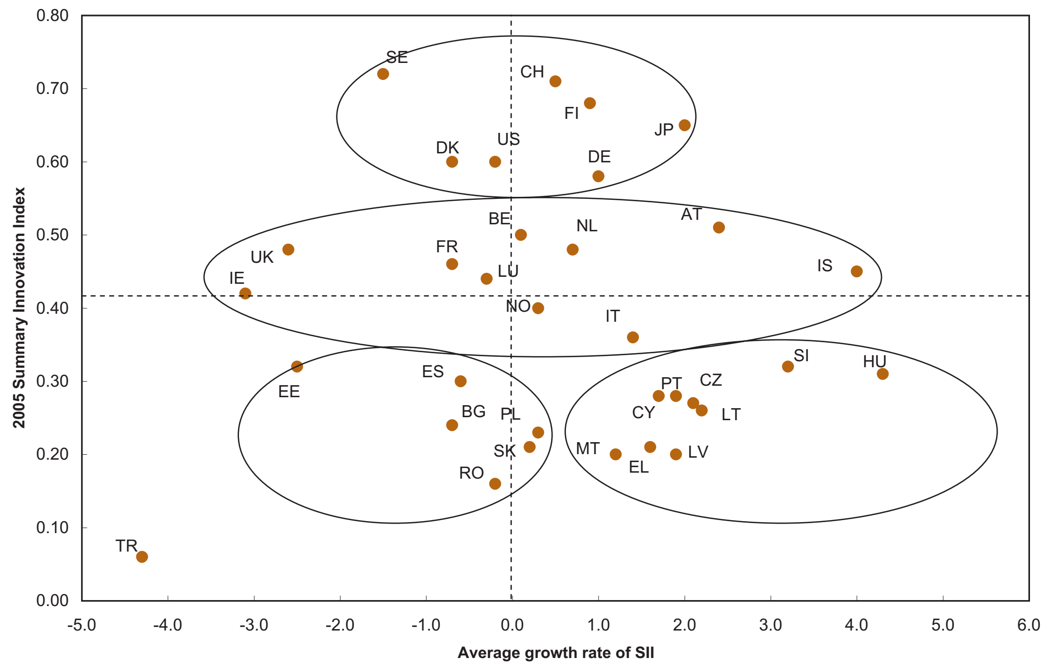
- Leading countries: Switzerland, Finland, Sweden, Denmark and Germany
- Average performance: France, Luxembourg, Ireland, United Kingdom, Netherlands, Belgium, Austria, Norway, Italy and Iceland
- Catching up: Slovenia, Hungary, Portugal, Czech Republic, Lithuania, Latvia, Greece, Cyprus and Malta
- Losing ground: Estonia, Spain, Bulgaria, Poland, Slovakia, Romania and Turkey

None of the new Member States is among the top two groups, but two "old" Member States (Portugal and Greece) are in the "catching up" group and one (Spain) is in the "losing ground" group.

For most of the countries little convergence is expected in the short term (by 2010). Some countries could reach the EU-25 average within 20 years, but for many convergence might take longer.

5

Figure 5.1 Summary Innovation Index (SII) in 2005 and annual average growth rate 2003-2005, EU-25 and selected countries



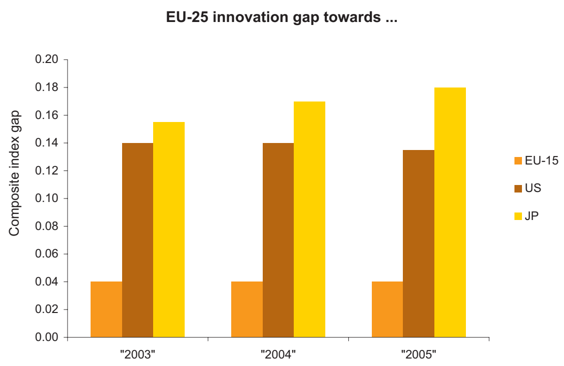
Dotted lines show EU25 mean performance.

Source: European Innovation Scoreboard 2005.

Notes: The circles in Figure 5.1 identify the four main country groupings: top = leading countries, middle = average performers, bottom right = catching up, and bottom left = losing ground.

Figure 5.2 shows the innovation gap between EU-25, the United States, Japan and EU-15. The innovation gap with Japan is widening, but the gap with the United States is stable. A closer look at the individual indicators that make up the SII gives some explanations for the gaps, for example the differences in the number of USPTO patents or in the share of the population with tertiary education.

Figure 5.2 Innovation gap between EU-25 and the United States, Japan and EU-15 (1)



Source: European Innovation Scoreboard 2005.

EU25 equal to 0.00.
(1) The years shown in Figure 5.2 have quotation marks because the data do not refer to the year shown but to the EIS of the year, "2003" means EIS 2003.

The Summary Innovation Index is made up of two main blocks of indicators: input and output. The input indicators are divided into three sub-groups:

- Innovation drivers, to measure the structural conditions required for innovation potential.
- Knowledge creation, to measure investment in human factors and on R&D activities, considered as the key elements for a successful knowledge-based economy.
- Innovation & entrepreneurship, to measure the efforts on innovation at microeconomic level.

The output indicators are split into two sub-groups:

- Application, to measure performance in terms of labour and business activities and the value added in innovative sectors.
- Intellectual property, to measure the results achieved in terms of successful know-how, especially in high-tech sectors.

Each sub-group is made up of five or six indicators. All 26 indicators are based on data produced within the European Statistical System, except two which are collected by the Office of Harmonisation for the Internal Market (OHIM). Seven of the indicators are collected from the results produced within the CIS.

For reasons of simplicity and continuity with previous scoreboards, four rules were adopted for the EIS 2005 method:

1. Equal weighting for all indicators.

2. Normalisation based on EU-25 data.

3. Relative to EU-25, data are calculated as the ratio between the most recent data for a country and the value for EU-25 in the same year.

4. No entry for missing data.

The input/output approach is new in EIS 2005 and reveals some very interesting aspects. For many countries the input and output performance are correlated, but some countries (Switzerland, Germany, Luxembourg, Ireland and Malta) perform better on outputs than on inputs. For others the opposite is the case. Iceland, Estonia, Lithuania, Cyprus and Norway show better input than output performance. This analysis measures the efficiency of the national innovation efforts and of converting the related resource inputs into measurable innovation results.

Another interesting analysis made by EIS 2005 is of innovation performance by economic sector. This analysis was introduced for the first time in EIS 2004 and has been expanded to a total of 25 sectors in 15 European countries using only 12 indicators (for data availability reasons). The top three sectors in the ranking by average innovation performance were: Electrical and optical equipment, Information and communication technologies and Computer and related activities.

EIS 2005 also shows the top three countries for each of the 25 sectors investigated. The vast majority of the top ranking countries at sector level are from the "leading countries" group or the "average performance" group. But not all countries which are performing so well at national level are leaders at sector level.

Conversely, two countries from the "catching up" group are leaders in certain sectors: Portugal in the Electricity, gas and water supply and in the Financial intermediation sectors and Greece in the Computer and related activities sector.

Where to obtain further information:

The European Innovation Scoreboard 2005, its annexes, accompanying thematic papers and the indicators database are available at: www.trendchart.org.

Table 5.3 **EIS 2005 indicators by sub-group**

INPUT – Innovation drivers			
1.1		S&E graduates per 1000 population aged 20-29	Eurostat
1.2		Population with tertiary education per 100 population aged 25-64	Eurostat, OECD
1.3	*new*	Broadband penetration rate (number of broadband lines per 100 population)	Eurostat
1.4		Participation in life-long learning per 100 population aged 25-64	Eurostat
1.5	*new*	Youth education attainment level (% of population aged 20 -24 having completed at least upper secondary education)	Eurostat
INPUT – Knowledge creation			
2.1		Public R&D expenditures (% of GDP)	Eurostat, OECD
2.2		Business R&D expenditures (% of GDP)	Eurostat, OECD
2.3	*new*	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	Eurostat, OECD
2.4	*new*	Share of enterprises receiving public funding for innovation	Eurostat (CIS)
2.5	*new*	Share of university R&D expenditures financed by business sector	Eurostat, OECD
INPUT – Innovation & entrepreneurship			
3.1		SMEs innovating in-house (% of all SMEs)	Eurostat (CIS)
3.2		Innovative SMEs co-operating with others (% of all SMEs)	Eurostat (CIS)
3.3		Innovative expenditures (% of total turnover)	Eurostat (CIS)
3.4		Early-stage venture capital (% of GDP)	Eurostat
3.5		ICT expenditures (% of GDP)	Eurostat
3.6		SMEs using non-technological change (% of all SMEs)	Eurostat (CIS)
OUTPUT – Application			
4.1		Employment in high-tech services (% of total workforce)	Eurostat
4.2	*new*	Exports of high technology products as a share of total exports	Eurostat
4.3		Sales of new-to-market products (% of total turnover)	Eurostat (CIS)
4.4		Sales of new-to-firm not new-to-market products (% of total turnover)	Eurostat (CIS)
4.5		Employment in medium-high and high-tech manufacturing (% of total workforce)	Eurostat
OUTPUT – Intellectual property			
5.1		EPO patents per million population	Eurostat
5.2		USPTO patents per million population	Eurostat
5.3	*new*	Triadic patent families per million population	Eurostat, OECD
5.4	*new*	New community trademarks per million population	OHIM
5.5	*new*	New community designs per million population	OHIM

Source: European Innovation Scoreboard 2005.

5

PART3

Chapter 6

Patents

Part 1 - Total patents

6.1 Introduction

Converting technological knowledge into economic growth and welfare is one of the keys to boosting the competitiveness of any country in the modern economy. This is a complex phenomenon, and evaluating how countries perform in developing and commercialising technology is no easy task.

Patents statistics are widely used as one of the indicators that help to measure a country's technological output, as they represent one outcome of technologically oriented inventive activity. An invention has to meet several conditions if it is to be patentable. It must be new, involve an inventive step, be capable of industrial application and not be "excluded". "Excluded" inventions means discoveries, scientific theories or mathematical methods, aesthetic creations such as literary, dramatic or artistic works, schemes or methods for performing a mental act, playing a game or doing business, presentations of information or computer programs.

A patent is an intellectual property right for inventions of a technical nature. A patent is valid for one country if it is granted by a national patent office and generally for 20 years. A patent application to the European Patent Office (EPO) can be valid in several countries, at most in all the 30 countries that have signed the European Patent Convention.

Although patents do not cover every kind of innovation, they do include a large proportion. There are good reasons why patents have become one of the most widely used sources of data to construct indicators of inventive output, for example because they provide detailed information for a relatively long time series or are closely linked to invention.

Nevertheless, patent indicators also have several shortcomings and should therefore be combined with other S&T output indicators in order to obtain a full picture of innovation activities in individual countries and regions. One major drawback is that not all inventions are patented and not all patents have the same value. Instead, it is widely recognised that the value distribution of patents is skewed: a few patents have a high value, whereas many have lower values. However, as there are no generally recognised, easy applicable methods for measuring the value of patents, this chapter does no more than count the number of patents meeting various criteria. Another drawback is that only some of the patents granted are applied commercially and/or lead to major technological improvements.

This chapter analyses the structure and development of patenting in EU-25, Iceland, Liechtenstein, Norway, the candidate countries, Japan and the United States and is divided into two parts: the first deals with all patents and the second focuses only on high-tech patents.

Each part is split into three sections: the first studies the worldwide perspective of EU-25, Japan and the United States, looking at patent applications to the EPO, patents granted by the United States Patent and Trademark Office (USPTO) and the "triadic patent families". The second section focuses on performance at national level, using EPO and USPTO data. Finally, this chapter provides insight into the patenting activities of the EEA regions, in terms of applications to the EPO. The analysis covers the period from 1992 to 2002 for the EPO data, whereas the USPTO and triadic patent family data cover the time series from 1989 to 1999. Patents statistics are very sensitive to the type of data collected and to the method used to count the patents. Data from the period after the reference years mentioned have been published by Eurostat, but are not comparable because they are incomplete. The EPO data refer to patent applications by priority year, whereas the USPTO data are for patents granted by priority year. The "priority year" is the year when the first application was submitted. In general, inventors first apply for a patent from their national patent office. They then have 12 months to apply at another patent office, such as the EPO, USPTO, etc., as well.

Although not all applications are granted, each application nevertheless represents technical efforts by the inventor. Patent applications can therefore be considered an appropriate indicator of inventive activities. It takes, on average, just over four years for a patent to be granted by the EPO. In an effort to provide data promptly, Eurostat has therefore chosen patent applications in preference to patents granted. In the United States, until recently only information on patents granted was published and therefore no data on applications are presented in this chapter. The USPTO takes from two to five years to grant patents. Triadic patent families are counted on the basis of the earliest priority year, i.e. the year in which a patent was first applied for at any patent office. They refer to applications to the EPO and to the Japanese Patent Office (JPO) and patents granted by the USPTO.

When interpreting the data at international level, readers should bear in mind that, due to "home advantage", European countries dominate the European patent system, whereas the United States dominates the US patent system. At the same time, figures can also be influenced by the countries' industrial structures, as different industries have a different propensity to patent. Some of these problems are less visible in the triadic patent family indicators, as they take into account only patents that have been applied for from the EPO and the JPO and granted by the USPTO. Besides improving international comparability of patent indicators, triadic patent family data also balance the differences in the value of the patents associated with the other indicators. This is because patenting in all three offices is very costly due not only to administrative fees but also to translation costs. Under these circumstances, patentees will proceed with such applications only if they deem it worthwhile, i.e. if the expectation of having the patent granted and the expected return from protection through sales or licences in the designated countries are high enough. Due to differences in data processing methods, direct comparisons between the EPO, the USPTO and triadic patent family data are not advisable.

For further explanations on the methodology used, refer to the methodological notes or to the Eurostat webpage under patent statistics.

6.2 A worldwide perspective: EU-25, Japan and the United States

A comparison at international level of patent data from the EPO and the USPTO and triadic patent family data

Total patent applications to the EPO

EU ahead in absolute terms, but also in terms of business enterprise R&D expenditure

Patent data can be calculated in relation to different economic indicators, such as labour force, population, etc. Figure 6.1 shows the number of patent applications to the EPO in relation to business enterprise R&D expenditure for the two periods covered: 1993 to 1997 and 1998 to 2002. EU-25 was far ahead of both the US and Japan in both periods (on 0.47 and 0.54) and was moving upwards. The figures for Japan were lower, but also increasing. The figure for the United States (0.26) was higher than for Japan (0.18) for 1993-1997, but the same as for Japan (0.23) for 1998-2002.

PATSTAT

Since 2004 the inter-institutional Patent Statistics Task Force has been developing a world-wide patent statistics database (PATSTAT). PATSTAT has to be understood as a single raw patent statistics database, held by the European Patent Office (EPO) and developed in cooperation with the World Intellectual Property Organisation (WIPO), the OECD and Eurostat. PATSTAT should meet the needs of the various international organisations, which will use this raw database for production of their own statistics. With the objective of being sustainable over time, PATSTAT will come into operation in 2006 and will concentrate on raw data, leaving indicator production mainly to its users, such as the OECD, Eurostat or others. PATSTAT will be produced twice a year (on 30 March and 30 September) and made available to the users represented in the Task Force.

Figure 6.1 Patent applications to the EPO per million euro of business enterprise R&D expenditure, EU-25, Japan and the United States - 1993 to 1997 and 1998 to 2002

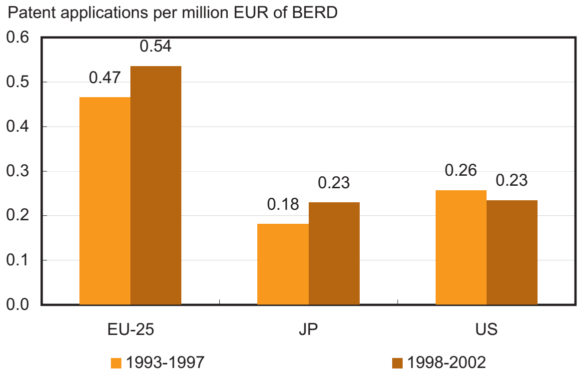
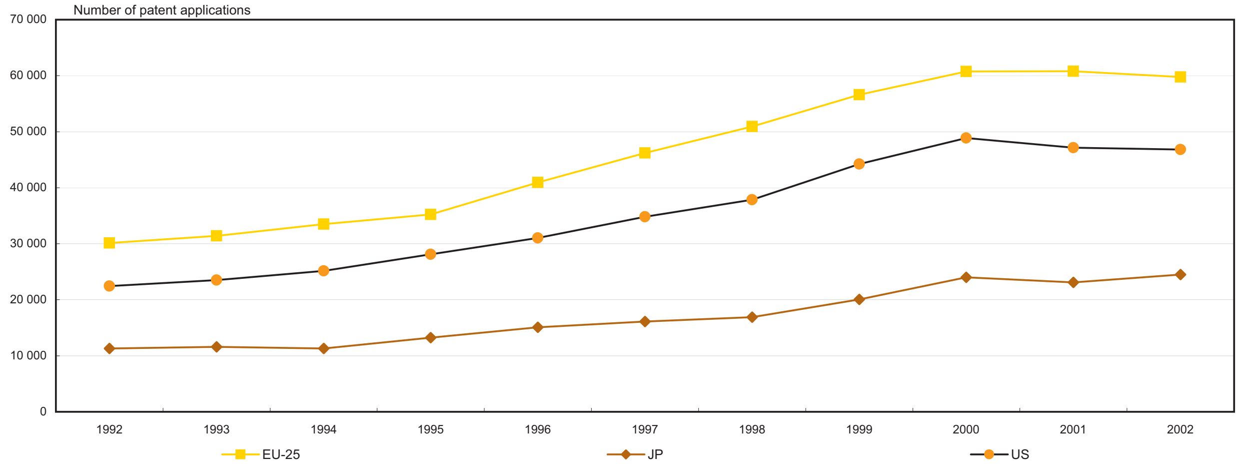


Figure 6.2 illustrates the trend in the total number of patent applications to the EPO from EU-25, Japan and the United States from 1992 to 2002. The overall trend was upward until 2000 for all three economies. However, for the last two years applications have been stagnating, with even a slight downturn. The absolute figures for patent applications differ widely. In 1992 Japan submitted 11 299 patent applications to the EPO, whereas the United States generated 22 441 and EU-25 a total of 30 144. By 2002 the number of patent applications to the EPO had nearly doubled from all three economies.

Figure 6.2 **Patent applications to the EPO, total number, EU-25, Japan and the United States - 1992 to 2002**



Patents are classified in accordance with the *International Patent Classification* (IPC). The IPC is based on an international multilateral treaty administered by the World Intellectual Property Organisation (WIPO), i.e. the Strasbourg Agreement concerning the International Patent Classification.

In the IPC, each invention is assigned to an IPC class, depending on its function, intrinsic nature or field of application. The IPC is therefore a combined function/application classification system in which the function takes precedence. A patent may cover several technical aspects and therefore be assigned to several IPC classes. If a patent spans several fields of technology, it is assigned to the first IPC code indicated on the patent.

The IPC is divided into sections, classes, sub-classes, groups and sub-groups. The eighth edition of the IPC, which entered into force on 1 January 2006, divides technology into eight sections with approximately 70 000 sub-divisions. In this publication only the eight IPC sections are shown. Further details on the contents of the various sections are available in the methodological notes.

The breakdown of patent applications to the EPO by IPC section in 2002 (see Table 6.3) shows very different distributions for the three major economies observed. Whereas in EU-25 the largest proportion of patent applications (20.3%) were in IPC section B - Performing operations; transporting - in Japan section H - Electricity - is the largest section (24.4%) and in the United States section G - Physics (22.4%). For all three economies sections G - Physics - and H - Electricity - were, however, always among the top three IPC sections.

Table 6.3 **Breakdown of patent applications to the EPO by IPC section, as a percentage of total, EU-25, Japan and the United States - 2002**

IPC section		EU-25	JP	US
A	Human necessities	15.1	9.4	22.1
B	Performing operations; transporting	20.3	15.6	12.5
C	Chemistry; metallurgy	14.4	17.9	16.4
D	Textiles; paper	2.1	1.1	1.1
E	Fixed constructions	4.2	0.7	2.0
F	Mechanical engineering; lighting; heating; weapons; blasting	10.2	7.5	4.9
G	Physics	16.7	23.4	22.4
H	Electricity	17.0	24.4	18.6
		100.0	100.0	100.0
Total		59 755	24 494	46 819

Based on the IPC classes, patent applications can be grouped into several fields of technology. One of these aggregations is Information and Communication Technology (ICT).

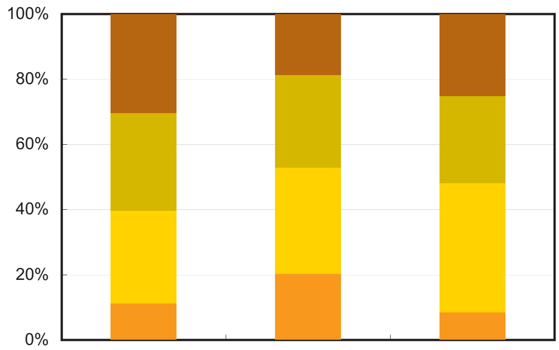
In 2002 the United States applied to the EPO for 16 122 ICT patents, followed by EU-25 with 15 723 ICT patents and Japan with 9 183.

ICT is divided into four subcategories:

- Consumer electronics,
- Computers, office machinery,
- Other ICT,
- Telecommunications.

The largest share of ICT patent applications from EU-25 is taken by telecommunications (30.4%). In Japan and the United States the largest subcategory is computers and office machinery with 32.4% and 39.7% respectively.

Figure 6.4 **ICT patent applications to the EPO broken down by subcategory, as a percentage of total, EU-25, Japan and the United States - 2002**



OECD: STATISTICAL DEFINITION OF BIOTECHNOLOGY (2005)

Defining biotechnology

The single definition
The single definition of biotechnology is deliberately broad. It covers all modern biotechnology but also many traditional or borderline activities. For this reason, the single definition should always be accompanied by the list-based definition which operationalises the definition for measurement purposes. The single definition is:
The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.

The list based definition
The following list of biotechnology techniques functions as an interpretative guideline to the single definition. The list is indicative rather than exhaustive and is expected to change over time as data collection and biotechnology activities evolve.

The list based definition of biotechnology techniques:

DNA/RNA: Genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology.

Proteins and other molecules: Sequencing/synthesis/engineering of proteins and peptides (including large molecule hormones); improved delivery methods for large molecule drugs; proteomics, protein isolation and purification, signaling, identification of cell receptors.

Cell and tissue culture and engineering: Cell/tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation.

Process biotechnology techniques: Fermentation using bioreactors, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurisation, bioremediation, biofiltration and phytoremediation.

Gene and RNA vectors: Gene therapy, viral vectors.

Bioinformatics: Construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology.

Nanobiotechnology: Applies the tools and processes of nano/microfabrication to build devices for studying biosystems and applications in drug delivery, diagnostics, etc.

Source: OECD.

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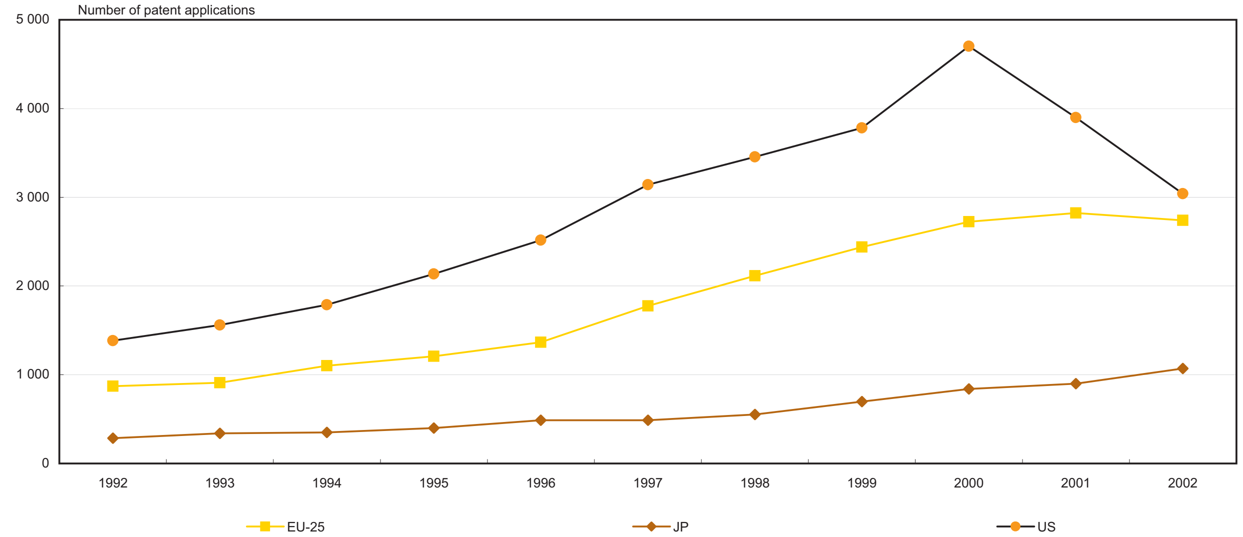
With regard to biotechnology patent applications to the EPO, until 2000 the United States led by far over EU-25 and Japan. Whereas the United States reached a turning point in 2000, the upward trend continued for Japan and EU-25. By 2002 EU-25 was approaching the US level of biotechnology patenting in absolute terms (see Figure 6.5).

Figure 6.5 Biotechnology patent applications to the EPO, total number, EU-25, Japan and the United States - 1992 to 2002



Patent applications to the EPO can also be broken down by economic activity, based on the NACE classification. This breakdown is based on the concordance tables between the IPC and the NACE created by the Fraunhofer Institute for Systems and Innovation Research in Karlsruhe (Germany).

As one criterion for patents is usability for industrial application, all NACE codes to which patent applications are allocated concern manufacturing industries.

In 2002 the two main manufacturing activities concerned by patenting were DL - Manufacture of electrical and optical equipment - followed by DG - Manufacture of chemicals, chemical products and man-made fibres. Two other sections (DM - Manufacture of transport equipment - and DK - Manufacture of machinery and equipment n.e.c.) took nearly the same shares of patent output with around 10%. Patenting activity in all the other branches of manufacturing was less significant (see Table 6.6).

Table 6.6 Breakdown of patent applications to the EPO by economic activity (NACE), total number and as a percentage of total, EU-25, Japan and the United States - 2002

NACE classification		Total			% of total		
		EU-25	JP	US	EU-25	JP	US
DA	Manufacture of food products, beverages and tobacco	1 424	446	1 127	2.4	1.8	2.4
DB	Manufacture of textiles and textile products	281	103	209	0.5	0.4	0.4
DC	Manufacture of leather and leather products	101	24	49	0.2	0.1	0.1
DD	Manufacture of wood and wood products	62	15	31	0.1	0.1	0.1
DE	Manufacture of pulp, paper and paper products; publishing and printing	742	251	609	1.2	1.0	1.3
DF	Manufacture of coke, refined petroleum products and nuclear fuel	924	358	691	1.5	1.5	1.5
DG	Manufacture of chemicals, chemical products and man-made fibres	13 546	5 204	13 045	22.7	21.2	27.9
DH	Manufacture of rubber and plastic products	1 304	383	688	2.2	1.6	1.5
DI	Manufacture of other non-metallic mineral products	1 042	414	677	1.7	1.7	1.4
DJ	Manufacture of basic metals and fabricated metal products	2 976	980	1 539	5.0	4.0	3.3
DK	Manufacture of machinery and equipment n.e.c.	7 325	2 305	3 728	12.3	9.4	8.0
DL	Manufacture of electrical and optical equipment	21 072	11 105	20 164	35.3	45.3	43.1
DM	Manufacture of transport equipment	7 862	2 633	3 571	13.2	10.7	7.6
DN	Manufacturing n.e.c.	1 074	273	687	1.8	1.1	1.5
		59 736	24 494	46 816	100.0	100.0	100.0

Total patents granted by the USPTO

The United States are the undeniable leaders in terms of patents granted by the USPTO

As explained in the introduction, patenting procedures are different in Europe and in the United States. The USPTO statistics are based on patents granted and the EPO statistics on applications for patents. Due to the different underlying methodologies, data related to these two patent offices should not be compared.

Figure 6.7 compares the patents granted by the USPTO with business enterprise R&D expenditure for 1993 to 1996 and 1996 to 1999. The United States recorded the highest ratios with 0.69 for the first period and 0.60 for the second. The trend was downward, but the ratio was still well above those for Japan and EU-25. For Japan the ratio increased from 0.39 to 0.42, while for EU-25 it held steady on 0.29 for both periods.

Figure 6.7 **Patents granted by the USPTO per million euro of business enterprise R&D expenditure, EU-25, Japan and the United States - 1993 to 1996 and 1996 to 1999**

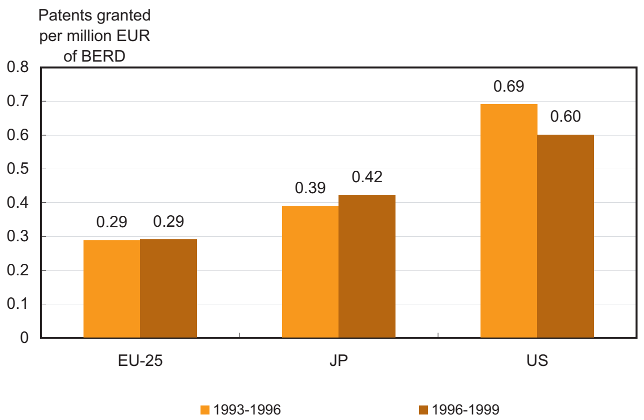


Figure 6.8 **Patents granted by the USPTO, total number, EU-25, Japan and the United States - 1989 to 1999**

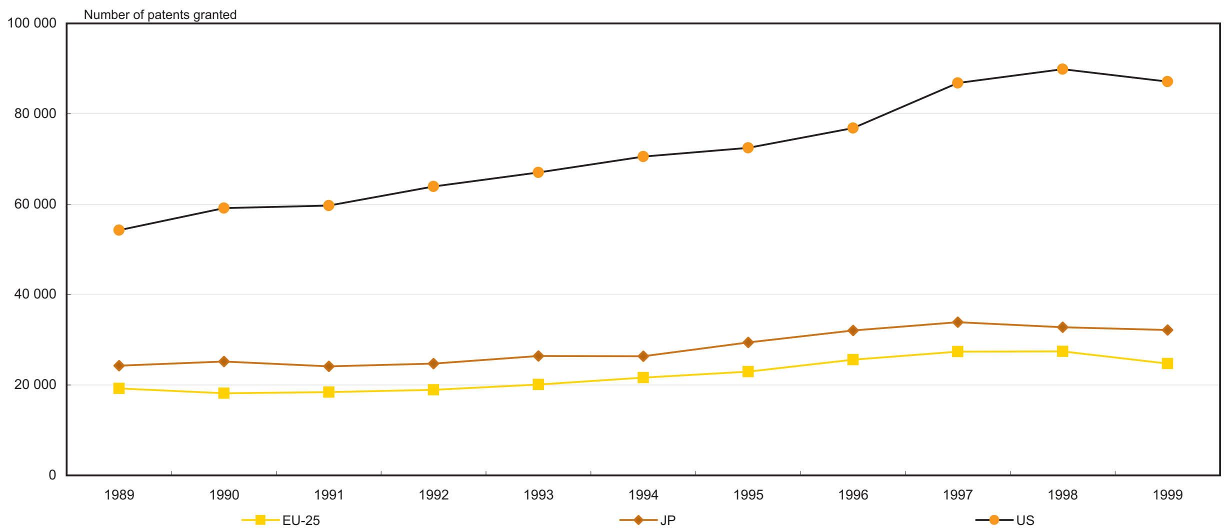


Figure 6.8 charts the trends in patents granted by the USPTO to EU-25, Japan and the United States from 1989 to 1999. The US figure was much higher during the whole period than the Japanese and European figures (1999 figures: EU-25 24 733, JP 32 178, US 87 116). The USPTO granted slightly more patents to Japan than to Europe, but the trend over the whole period was the same. For the United States the upward trend is more marked than for the other two economies. The USPTO is, however, the national patent office for the United States and an American inventor is therefore more likely to apply for a patent to the USPTO than a foreign inventor. The whole patenting procedure is in English and no translation is needed. Conversely, inventors who apply to the EPO for a patent have to use one of the three official languages: English, French or German. In the second step, EPO rules often involve high translation costs, as the claims have to be submitted in three languages, which makes the patent procedure much more expensive for the applicant. For further details, see the methodological notes.

A closer look at the breakdown of patents granted by the USPTO by IPC section (see Table 6.9) clearly shows that sections G - Physics - and H - Electricity - were the most frequently used IPC sections in Japan and in the United States in 1999. 32.0% of the Japanese patents, 25.8% of the American patents and 16.9% of the European patents concerned IPC section G - Physics. IPC section H - Electricity - accounted for 28.2% of all patents granted to Japan, 19.6% in the case of the United States and 17.6% for EU-25. In EU-25 the main IPC section used is B - Performing operations; transporting - on 22.0%.

United States Patent and Trademark Office Issues 7 Millionth Patent
Patent Assigned to DuPont for Novel Fibers

WASHINGTON, D.C.- The Department of Commerce's United States Patent and Trademark Office (USPTO) today issued patent No 7 million to DuPont senior researcher John P. O'Brien for "polysaccharide fibers" and a process for their production. The fibers have cotton-like properties, are biodegradable and are useful in textile applications.

It took 75 years to get from patent No1 to patent 1 million. It has taken less than one tenth of that time to go from 6 million to 7 million patents.

- Patent No 1 million was issued on August 8, 1911, for a tubeless vehicle tire.

- Twenty-four years later, on April 30, 1935, patent No 2 million issued for a vehicle wheel to increase the safety and longevity of pneumatic tires.

- Patent No 3 million issued 26 years later on September 12, 1961, to an inventor at the General Electric Co., for an automated system that translated letters, numbers and symbols to data processing code.

- Patent No 4 million issued 15 years later on December 28, 1976 for a process for recycling asphalt aggregate compositions.

- Fifteen years later, on March 19, 1991, Patent No 5 million issued to a University of Florida inventor, for a more efficient way to produce fuel ethanol.

- Only eight years later, patent No 6 million issued on December 7, 1999, to 3Com Corporation's Palm Computing for its HotSync® technology.

- And now just a little more than six years later, patent No 7 million issues.

Patent No 1 was issued in 1836. Earlier patents were not numbered, although the first US patent was issued in 1790. Approximately 10 000 patents were issued between 1790 and 1836. The USPTO issued 151 079 utility patents in fiscal year 2005.

Source: Press release of USPTO, February 14, 2006.

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Table 6.9 **Breakdown of patents granted by the USPTO by IPC section, as a percentage of total, EU-25, Japan and the United States - 1999**

IPC section		EU-25	JP	US
A	Human necessities	13.9	5.2	17.9
B	Performing operations; transporting	22.0	16.5	16.9
C	Chemistry; metallurgy	13.1	8.7	9.2
D	Textiles; paper	2.1	0.7	0.7
E	Fixed constructions	2.6	0.5	3.0
F	Mechanical engineering; lighting; heating; weapons; blasting	11.7	7.9	6.6
G	Physics	16.9	32.0	25.8
H	Electricity	17.6	28.2	19.6
	Unknown	0.2	0.2	0.2
		100.0	100.0	100.0
Total		**24 733**	**32 178**	**87 116**

In 1999 the USPTO granted nearly 32 thousands ICT patents to American applicants, more than 14 thousands to Japanese applicants and over 6 thousands to residents of EU-25.

Looking at the ICT patents granted by the USPTO in 1999 (see Figure 6.10) a difference can be seen between EU-25 and the two other economies. In the United States and Japan the largest subcategory was "computers and office machinery" with 44% and 41% respectively, whereas in EU-25 this subcategory accounted for only 31%. Most of the patents granted to Europe by the USPTO fell into the subcategory "other ICT".

Figure 6.10 **ICT patents granted by the USPTO broken down by subcategory, as a percentage of total, EU-25, Japan and the United States - 1999**

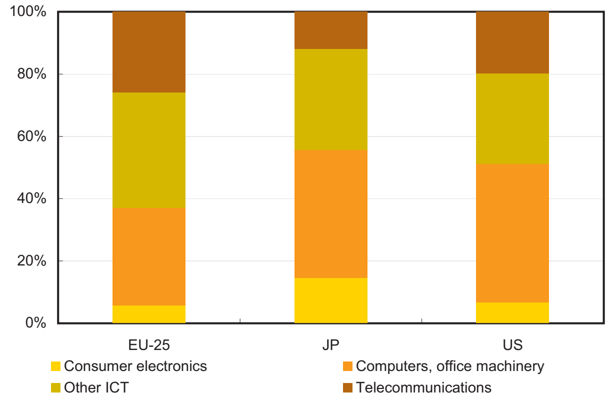
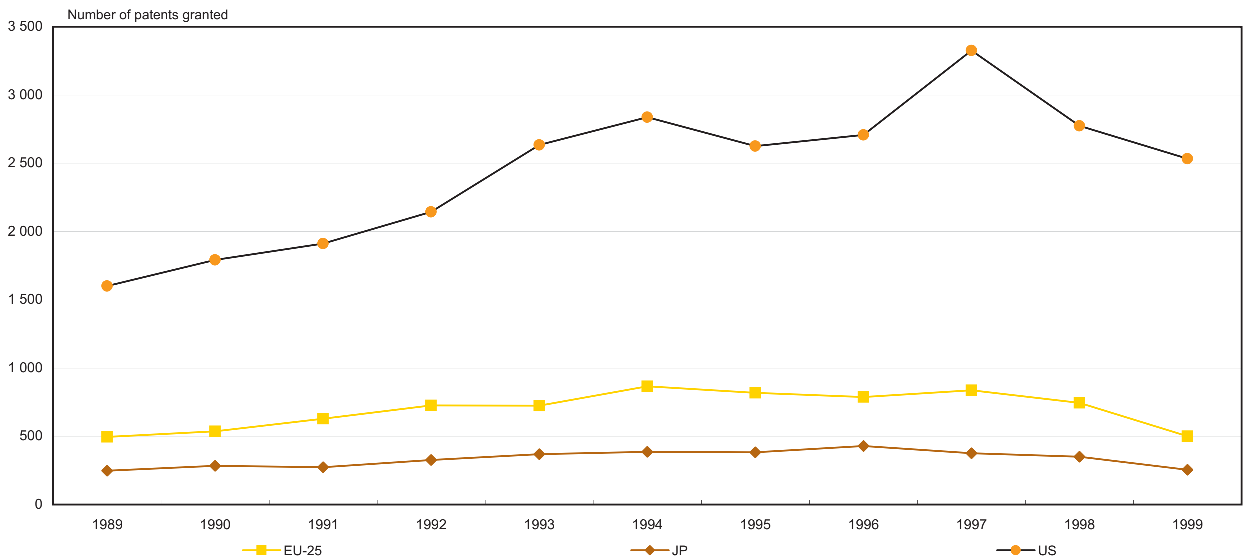


Figure 6.11 **Biotechnology patents granted by the USPTO, total number, EU-25, Japan and the United States - 1989 to 1999**



Up until 1997 the number of biotechnology patents granted by the USPTO to American applicants grew rather steadily (see Figure 6.11). From 1997 on the trend changed direction and headed downwards. In 1999, 2 533 biotechnology patents were granted to US inventors, but only 501 to inventors from EU-25 and 255 to Japan. In other words, in 1999 the number of biotechnology patents granted by the USPTO to the United States was five times higher than for EU-25 and even ten times higher than for Japan.

The upward trend was less significant for EU-25 and Japan. In 1999 both were still being granted nearly the same number of biotech patents by the USPTO as 10 years before.

Table 6.12

Breakdown of patents granted by the USPTO by economic activity (NACE), total number and as a percentage of total, EU-25, Japan and the United States - 1999

NACE classification (ISIC code)		Total			% of total		
		EU-25	JP	US	EU-25	JP	US
DA	Manufacture of food products, beverages and tobacco (D 15 + D 16)	509	350	1 739	2.1	1.1	2.0
DB	Manufacture of textiles and textile products (D 17 + D 18)	118	126	421	0.5	0.4	0.5
DC	Manufacture of leather and leather products (D 19)	38	32	137	0.2	0.1	0.2
DD	Manufacture of wood and wood products (D 20)	20	17	80	0.1	0.1	0.1
DE	Manufacture of pulp, paper and paper products; publishing and printing (D 21 + D 22)	285	277	993	1.2	0.9	1.1
DF	Manufacture of coke, refined petroleum products and nuclear fuel (D 23)	468	368	1 209	1.9	1.1	1.4
DG	Manufacture of chemicals, chemical products and man-made fibres (D 24)	5 302	4 144	15 781	21.6	12.9	18.2
DH	Manufacture of rubber and plastic products (D 25)	507	451	1 463	2.1	1.4	1.7
DI	Manufacture of other non-metallic mineral products (D 26)	452	661	1 534	1.8	2.1	1.8
DJ	Manufacture of basic metals and fabricated metal products (D 27 + D 28)	1 247	1 305	3 720	5.1	4.1	4.3
DK	Manufacture of machinery and equipment n.e.c. (D 29)	3 240	3 199	9 510	13.2	10.0	11.0
DL	Manufacture of electrical and optical equipment (D 30 - D 33)	8 698	17 101	39 280	35.4	53.4	45.4
DM	Manufacture of transport equipment (D 34 + D 35)	3 304	3 536	8 324	13.4	11.1	9.6
DN	Manufacturing n.e.c. (D 36 + D 37)	406	432	2 407	1.7	1.4	2.8
		24 595	31 998	86 599	100.0	100.0	100.0

Patenting activities are more essential for certain economic sectors, as can be seen from Table 6.12. For EU-25, Japan and the United States more than half of all patents granted by the USPTO went to two NACE sections: DL - Manufacture of electrical and optical equipment - and DG - Manufacture of chemicals, chemical products and man-made fibres. For US inventors, these two economic activities account for 63.6% of all USPTO patents granted while the corresponding figures for Japan and EU-25 are 66.3% and 57.0% respectively.

6

Triadic patent families

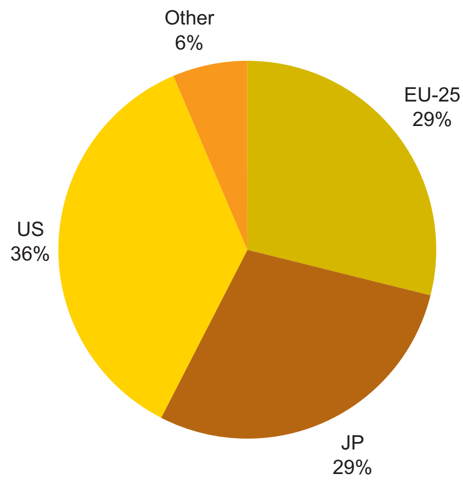
High concentration of triadic patent families

A patent is a member of the triadic patent family if and only if it has been applied for and filed at the European Patent Office (EPO) and at the Japanese Patent Office (JPO) and if it has been granted by the US Patent and Trademark Office (USPTO). Data on patent families are generally less biased, as the "home advantage" disappears to a certain extent. These data also emphasise the value of such triadic patents, which is supposedly higher than the value of other patent applications or patents granted.

Looking at the geographical distribution of triadic families (see Figure 6.13), the shares of the EU and Japan in 1999 were exactly the same on 29% of all triadic patent families counted. The biggest share was held by the United States with 36% and the smallest (only 6%) by the rest of the world. Triadic patent family applications and grants are therefore concentrated in the three main economies.

Figure 6.13

Distribution of triadic patent families, as a percentage of total, EU-25, Japan and the United States - 1999

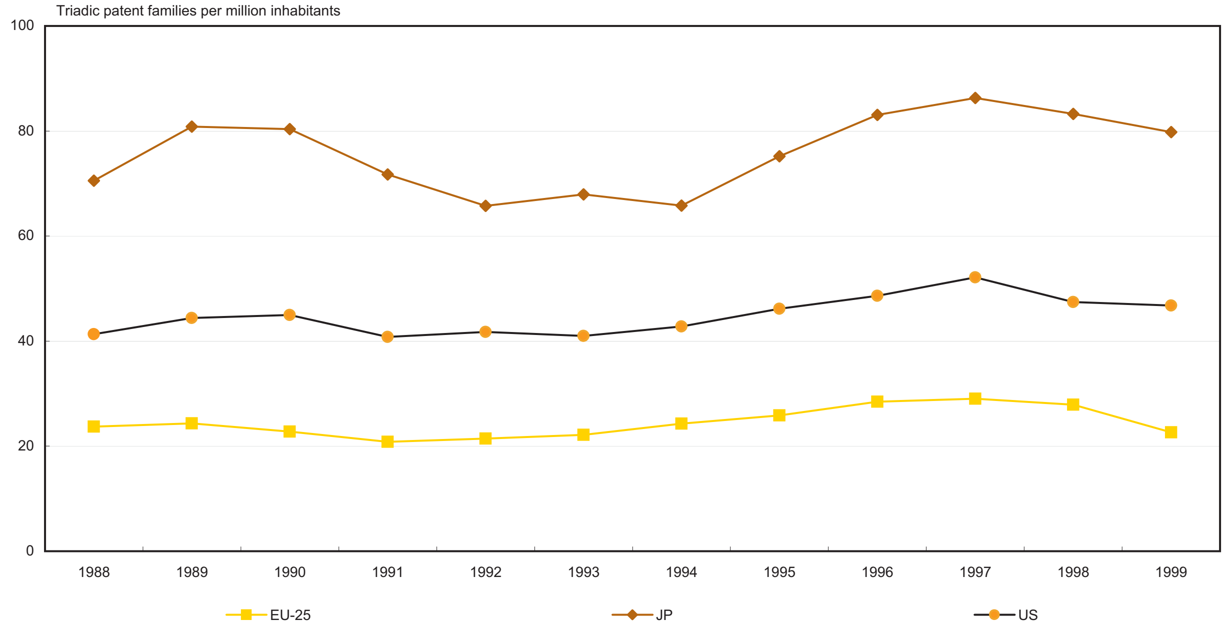


The picture is quite different when the triadic patenting activity is set in relation with the population (see Figure 6.14). Per million inhabitants Japan led by far in the 1988-1999 observation period. The United States ranked second followed by EU-25. Whereas the trend is nearly stable for the United States and EU-25, the figures for Japan fell in the early nineties before bouncing back.

In 1999 EU-25 registered 22.6 triadic patent families per million inhabitants, Japan 79.8 and the United States 46.8.

Figure 6.14

Triadic patent families per million inhabitants, EU-25, Japan and the United States - 1988 to 1999



6.3 Performance at national level in Europe

Total patent applications to the EPO

Finland is the best performing country in terms of patent applications per million inhabitants

The intensity of patenting activity is very different for EU and related countries. Looking at the 1992, 1997 and 2002 data, almost all European countries significantly increased national patenting per million inhabitants. The only exception is Sweden where the number of patent applications per million inhabitants rose strongly from 155 in 1992 to 299 in 1997, but then slipped back slightly to 290 in 2002. Compared with 1997, Sweden lost first place in 2002. Amongst the EU-25 countries, Finland ranked first in 2002 with 307 patent applications to the EPO per million inhabitants, followed by Germany with 297 and Sweden with 290. The number was even higher in Switzerland with 412 patent applications to the EPO per million inhabitants (see Figure 6.15).

Most of the new EU Member States remain at a rather low level of national patenting, measured as EPO patent applications per million inhabitants. Slovenia is an exception to the rule with 52 patent applications per million inhabitants in 2002.

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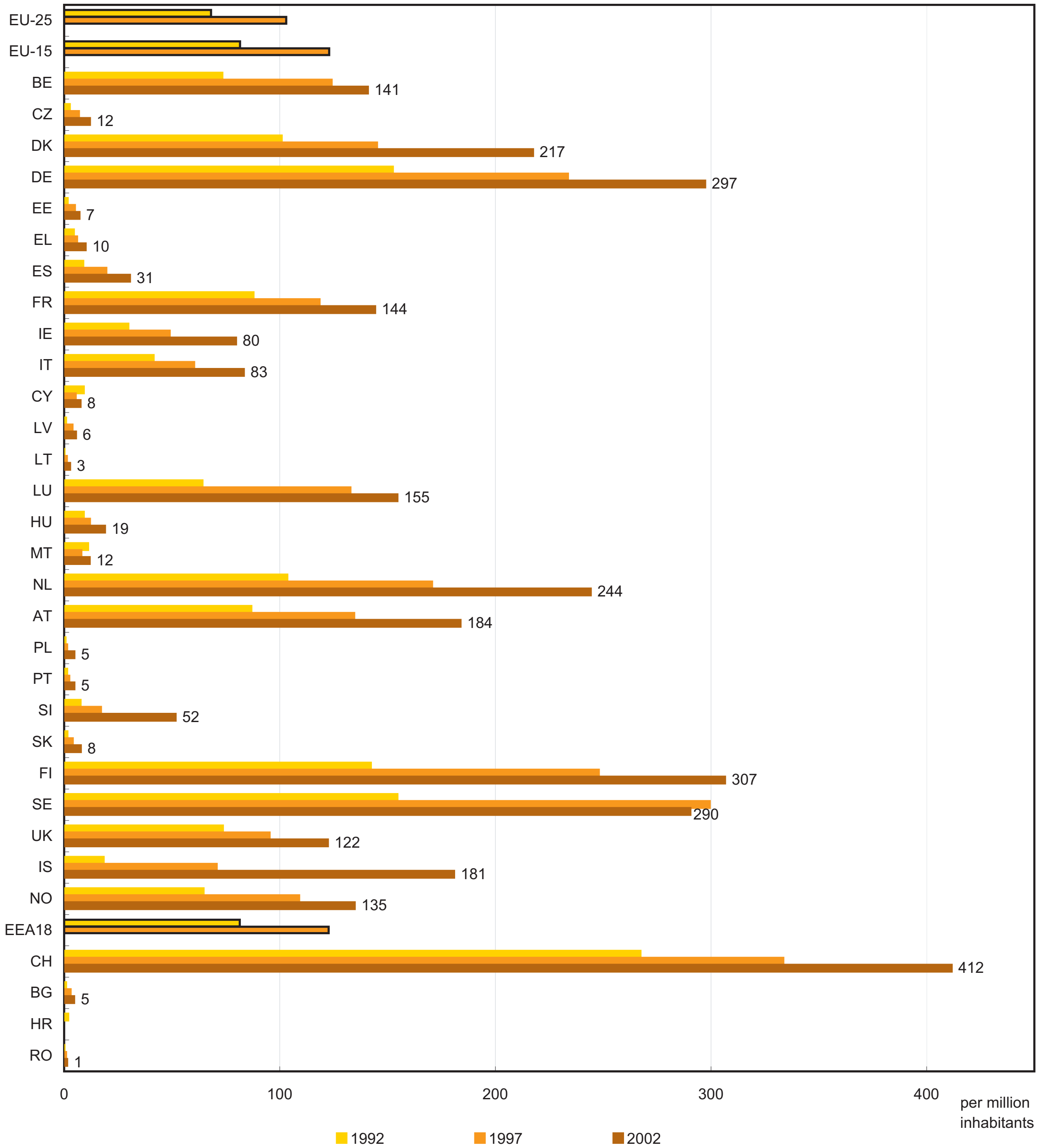
Figure 6.15

Patent applications to the EPO per million inhabitants, EU-25 and selected countries - 1992, 1997 and 2002



Patenting in the European Union is highly concentrated in just a few Member States. In 2002 Germany was undeniably the Member State generating the largest number of patent applications (see Table 6.16). More than 40% of all patent applications by EU-25 were from a German inventor. France followed in second place with about 14% and the United Kingdom ranked third with 12% (see Figure 6.17). These three countries accounted for two thirds of all patent applications to the EPO from EU-25.

The EU-25 aggregate is highly influenced by the German figures. Table 6.16 shows the patent applications by IPC sections. In many countries one IPC section accounted for 20% to 30% of all national applications. Slovenia, Denmark and Hungary specialise in patenting linked to IPC section A - Human necessities. Section B - Performing operations; transporting - was the most important IPC section for the Czech Republic, Germany, Spain, Italy, Austria and Sweden. Belgium and Poland lodged nearly 26% of their national patent applications in IPC section C - Chemistry; metallurgy.

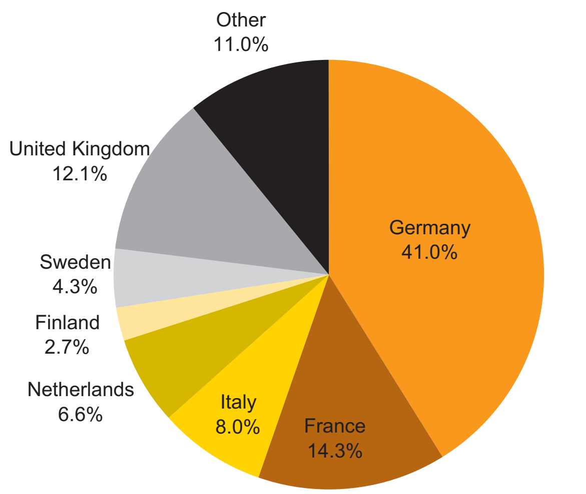
By contrast, patenting is less frequent in the EU in IPC sections D - Textiles; paper -, E - Fixed constructions - and F - Mechanical engineering; lighting; heating; weapons; blasting.

Germany always had the highest absolute number of patent applications in all IPC sections, followed by France and the United Kingdom. Section D - Textiles; paper - was an exception with Italy more prominent, with the second highest score of all European countries in this IPC section. For the Netherlands and the United Kingdom IPC section G - Physics - was the most significant. France, Ireland and Finland lodged their highest national shares of all patent applications to the EPO in IPC section H - Electricity.

Table 6.16 **Patent applications to the EPO by IPC section, total number and as a percentage of total, EU-25 and selected countries - 2002**

	Total	Distribution by IPC section as a percentage							
		Human necessities	Performing operations; transporting	Chemistry; metallurgy	Textiles; paper	Fixed constructions	Mechanical engineering; lighting; heating; weapons; blasting	Physics	Electricity
EU-25	**59 755**	**15.1**	**20.3**	**14.4**	**2.1**	**4.2**	**10.2**	**16.7**	**17.0**
EU-15	**59 074**	**15.0**	**20.3**	**14.3**	**2.1**	**4.2**	**10.2**	**16.7**	**17.1**
BE	1 452	15.5	18.0	25.9	3.9	3.9	5.0	13.6	14.1
CZ	122	19.0	24.3	14.6	3.5	6.5	15.0	11.4	5.7
DK	1 167	25.7	13.4	19.2	0.6	5.0	9.9	14.1	12.2
DE	24 514	11.4	22.9	14.8	2.1	3.7	13.7	15.7	15.8
EE	10	25.9	10.4	23.4	0.0	0.0	0.0	40.4	0.0
EL	10	0.0	0.0	0.0	9.6	0.0	0.0	90.4	0.0
ES	1 265	21.7	28.4	13.7	2.2	6.3	7.0	10.2	10.6
FR	8 567	16.8	18.9	14.0	1.3	3.8	8.8	17.5	19.0
IE	327	21.1	10.7	9.0	0.1	1.5	4.5	22.4	30.7
IT	4 753	20.9	27.5	10.9	3.1	6.0	10.9	9.6	11.2
CY	35	90.6	4.0	0.7	0.0	0.0	0.0	2.3	2.3
LV	29	12.2	3.4	59.7	3.4	0.0	9.4	5.1	6.8
LT	10	20.7	5.2	10.4	10.4	0.0	20.7	32.7	0.0
LU	69	11.0	23.0	21.6	1.9	4.4	16.9	12.4	8.7
HU	193	25.5	17.1	18.4	0.0	8.2	4.1	15.2	11.5
MT	5	21.5	0.0	0.0	0.0	7.1	0.0	50.0	21.5
NL	3 934	13.8	12.9	12.4	1.0	3.0	3.8	28.0	25.1
AT	1 483	15.6	23.0	10.6	4.3	9.2	9.5	12.9	14.7
PL	179	21.3	12.6	25.9	0.0	9.5	7.1	15.1	8.5
PT	49	18.9	22.4	13.4	6.1	15.3	6.1	9.2	8.7
SI	103	31.5	12.9	12.6	1.9	2.9	3.9	17.3	17.0
SK	41	14.5	16.9	27.1	0.0	4.8	25.4	6.5	4.8
FI	1 593	8.6	12.4	8.9	6.9	2.8	4.2	17.2	39.0
SE	2 587	19.0	21.1	9.9	2.2	4.5	7.4	17.0	18.8
UK	7 258	18.4	14.4	17.1	1.1	4.8	7.4	20.6	16.3
IS	52	45.1	9.3	17.6	1.9	3.9	3.7	15.9	2.6
LI	28	40.6	13.4	10.8	0.0	0.0	21.7	8.2	5.3
NO	610	19.2	17.2	13.4	0.9	11.0	10.1	20.1	8.2
EEA	**60 445**	**15.2**	**20.2**	**14.4**	**2.0**	**4.3**	**10.2**	**16.7**	**16.9**
CH	2 987	19.6	20.6	14.8	2.4	3.5	7.6	18.9	12.6
BG	36	28.4	22.0	2.4	0.3	0.0	16.5	15.2	15.1
HR	87	25.2	15.5	24.0	1.1	11.5	8.0	11.5	3.2
RO	30	16.9	4.1	4.1	0.0	27.1	24.5	12.6	10.7
TR	118	24.8	14.9	8.8	7.7	5.9	21.6	5.3	11.0
CN	1 480	21.5	8.9	15.1	1.4	3.8	7.6	13.8	27.8
JP	24 494	9.4	15.6	17.9	1.1	0.7	7.5	23.4	24.4
KR	3 921	14.1	10.6	11.1	2.2	1.9	6.0	24.8	29.3
US	46 819	22.1	12.5	16.4	1.1	2.0	4.9	22.4	18.6

Figure 6.17 **Patent applications to the EPO, as a percentage of all applications, EU-25 Member States - 2002**



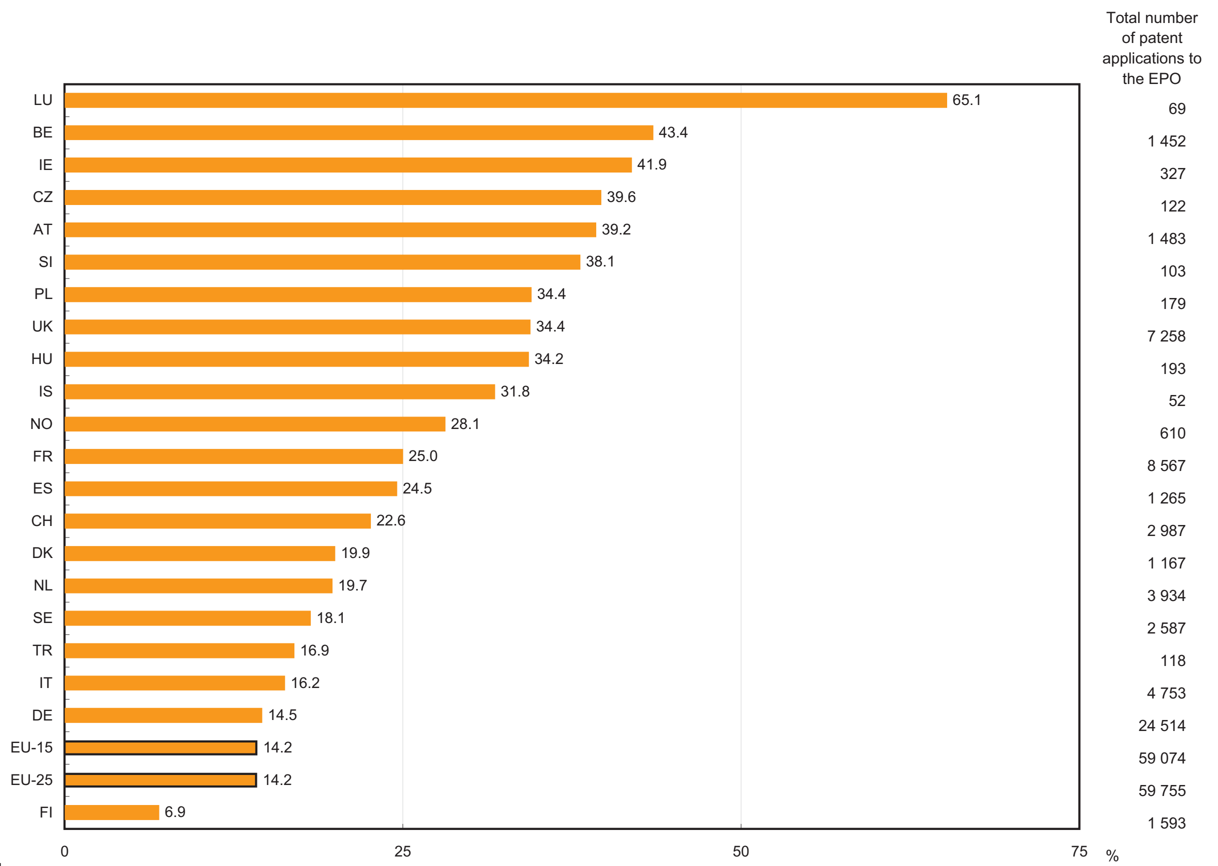
Foreign ownership of domestic inventions in patent applications is one of three indicators for international cooperation in patenting. The two others are domestic ownership of foreign inventions in patent applications and patent applications with foreign co-inventors. These indicators simply count each patent application from both the inventor country or countries and the applicant country or countries. The total number of patent applications from each country therefore consists of all applications in which the country is involved, whether as applicant or as inventor.

Therefore, the total number of cases of international cooperation is not equal to the sum of the number of cases per partner country since several partner countries can be involved in any case of cooperation. Also these patent indicators should not be compared with previous ones, where fractional counting rather than simple counting is applied. Furthermore, these indicators should not be added across countries, as this would mean counting the same patent more than once.

Data on foreign ownership measure the number of patents invented within (or applied for by) a given country that involve at least one foreign applicant (or a foreign inventor).

Figure 6.18 shows foreign ownership of domestic inventions in patent applications to the EPO, as a percentage of all applications to the EPO from countries which submitted more than 50 patent applications in 2002. In general, the countries with rates over 35% are small and open economies. Luxembourg has by far the highest rate with 65.1%, followed by Belgium with 43.4% and Ireland with 41.9%. The lowest rate was recorded in Finland with only 6.9%.

Figure 6.18 **Foreign ownership of domestic inventions in patent applications to the EPO, as a percentage of all national applications, selected countries (1) - 2002**



(1) with more than 50 patent applications.

Total patents granted by the USPTO

More than 40% of patents granted to the EU-25 by the USPTO are German

Comparing the number of patents granted by the USPTO per million inhabitants for 1989, 1994 and 1999 (see Figure 6.19), most countries increased their national figures over the observation period. Leaving aside countries with very few patents, only three EU-25 Member States were granted fewer patents in 1999 than in 1994. This was the case for Belgium, Denmark and the United Kingdom. The EU-25 Member States with the highest number of patents per million inhabitants in 1999 were Sweden (157), Finland (143) and Germany (129). The three leading countries were far above the 1999 EU-25 average of 55.

As in the case of patent applications to the EPO, Switzerland was granted the highest number of patents by the USPTO per million inhabitants, although this figure fell over the whole observation period. In 1989 Switzerland was granted 192 patents per million inhabitants, but in 1994 the figure was down to 183 and in 1999 to 180.

Figure 6.19

Patents granted by the USPTO per million inhabitants, EU-25 and selected countries - 1989, 1994 and 1999

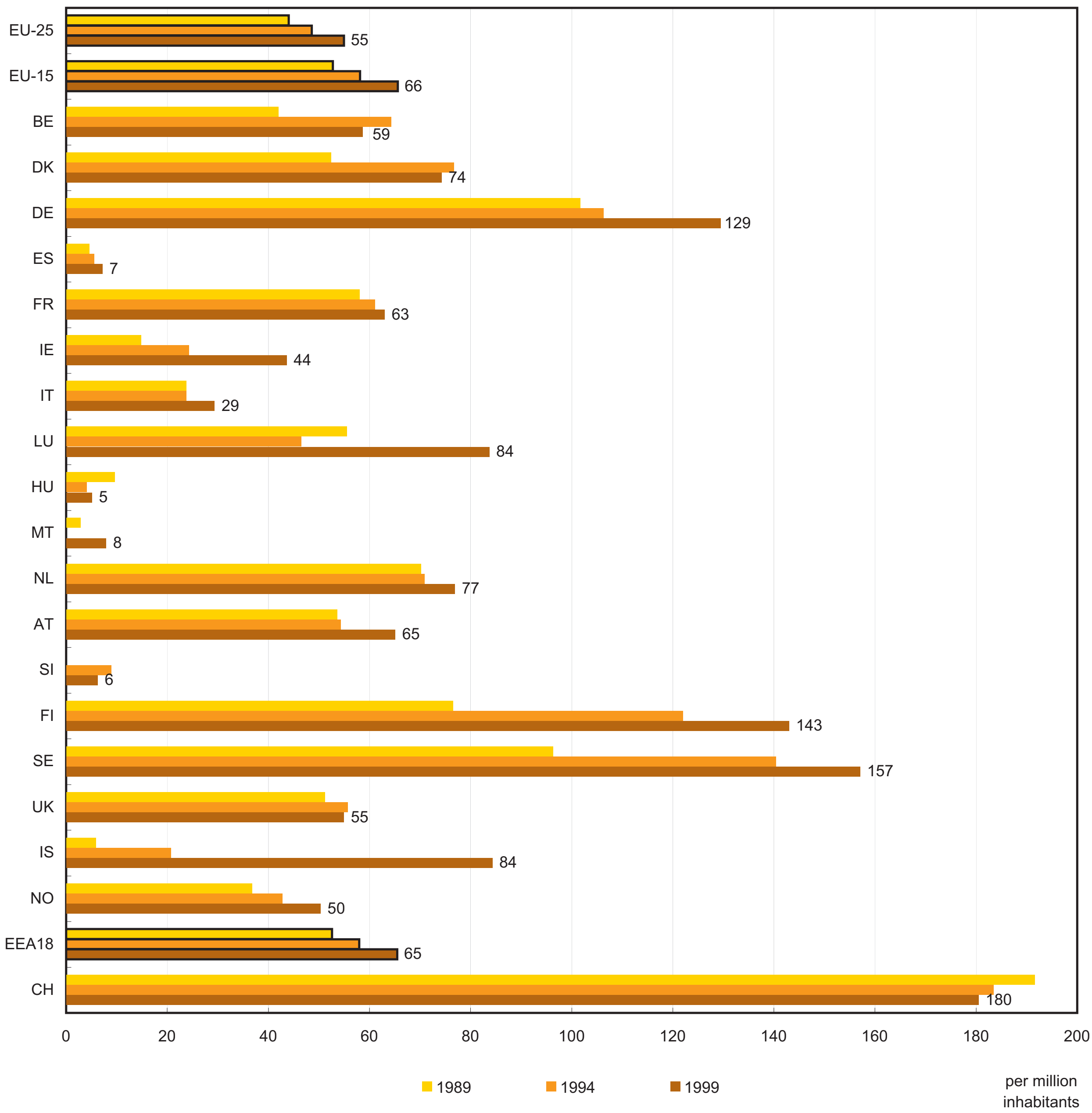


Table 6.20

Patents granted by the USPTO by IPC section, total number and as a percentage of total, EU-25 and selected countries - 1999

	Total	Distribution by IPC section as a percentage							
		Human necessities	Performing operations; transporting	Chemistry; metallurgy	Textiles; paper	Fixed constructions	Mechanical engineering; lighting; heating; weapons; blasting	Physics	Electricity
EU-25	**24 733**	**13.9**	**22.0**	**13.1**	**2.1**	**2.6**	**11.7**	**16.9**	**17.6**
EU-15	**24 602**	**13.9**	**22.0**	**13.1**	**2.1**	**2.6**	**11.7**	**16.9**	**17.6**
BE	599	11.8	20.1	24.9	3.5	3.1	5.5	19.9	11.1
CZ	29	6.8	10.2	24.4	0.0	6.8	10.1	23.9	14.3
DK	395	25.0	14.2	20.2	0.8	3.2	10.1	12.2	13.8
DE	10 622	10.9	25.0	13.6	2.2	2.0	15.4	15.7	15.0
EE	3	0.0	0.0	17.7	0.0	0.0	35.3	47.0	0.0
EL	10	39.0	5.0	18.2	6.7	0.0	0.0	21.1	10.0
ES	285	25.1	28.7	10.7	3.2	4.9	7.6	7.4	12.3
FR	3 685	17.3	20.6	13.3	1.0	2.0	9.3	17.3	19.0
IE	163	20.4	11.9	6.6	0.1	1.8	4.5	23.8	30.6
IT	1 670	17.4	27.8	10.7	2.0	3.0	10.1	13.8	14.8
CY	2	50.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0
LV	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LT	1	0.0	0.0	0.0	0.0	37.6	0.0	62.4	0.0
LU	36	8.4	49.9	15.2	0.0	0.0	15.4	9.3	1.8
HU	52	25.8	3.8	31.7	0.0	1.9	10.2	6.7	19.9
MT	3	66.7	0.0	0.0	0.0	0.0	0.0	0.0	33.3
NL	1 213	12.9	15.8	15.6	1.0	2.7	6.3	21.6	23.9
AT	520	16.0	24.2	11.5	2.9	3.8	15.9	13.7	11.7
PL	21	23.7	16.1	24.2	0.0	7.2	0.0	13.6	15.2
PT	12	34.4	16.4	9.6	2.7	8.2	8.2	10.9	9.6
SI	12	21.6	0.0	24.3	0.0	16.2	0.0	25.7	12.2
SK	6	21.7	34.8	17.4	0.0	0.0	17.4	8.7	0.0
FI	738	9.3	16.1	8.4	8.3	1.4	5.1	14.3	36.7
SE	1 391	14.6	21.6	7.0	3.2	2.5	8.8	13.2	29.1
UK	3 264	16.1	15.5	12.5	1.2	5.0	9.4	23.2	17.0
IS	23	12.2	4.3	17.9	0.0	0.0	4.3	25.1	36.2
LI	14	17.6	39.7	26.7	0.0	0.0	7.1	0.0	5.3
NO	224	20.0	19.8	10.6	0.2	11.4	11.8	17.7	8.5
EEA	**24 994**	**13.9**	**21.9**	**13.1**	**2.0**	**2.7**	**11.7**	**16.9**	**17.5**
CH	1 286	20.7	23.5	13.9	3.6	1.7	6.7	16.4	13.0
BG	9	15.0	0.0	13.1	0.0	0.0	33.8	11.3	26.9
HR	7	50.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0
RO	5	0.0	47.0	10.4	0.0	0.0	0.0	6.0	36.6
TR	10	27.3	15.4	4.1	10.3	0.0	14.9	22.1	6.0
CN	264	17.6	13.0	11.0	1.1	3.8	7.6	23.4	22.4
JP	32 116	5.3	16.6	8.7	0.7	0.5	7.9	32.1	28.2
KR	3 707	5.4	8.5	7.9	0.7	1.2	5.8	30.7	39.7
US	86 905	17.9	16.9	9.2	0.7	3.0	6.6	25.9	19.7

Taking the absolute numbers, Germany led in 1999 with more than 10 thousands or 42.9% of all EU-25 patents granted by the USPTO. France ranked second with 3 685 or 14.9% and the United Kingdom came third with 3 264 or 13.2% (see Figure 6.21).
The Scandinavian countries ranked fifth (Sweden), seventh (Finland) and ninth (Denmark) in absolute terms.

Looking at the individual IPC sections for the patents granted by the USPTO, EU-25 countries generally specialised in certain areas (as was the case for patent applications to the EPO). For example, one out of four Danish patents refers to IPC section A - Human necessities. The most important IPC section for Europe was section B - Performing operations; transporting. This was also the most important section for Germany, Spain, France, Italy and Austria. Belgium is more specialised in section C - Chemistry; metallurgy. Section G - Physics - accounted for the highest proportion of patents granted to the United Kingdom. A large share of the patents granted to Ireland, the Netherlands, Finland and Sweden were taken by IPC section H - Electricity.

Figure 6.21 **Patents granted by the USPTO, as a percentage of total, EU-25 Member States - 1999**

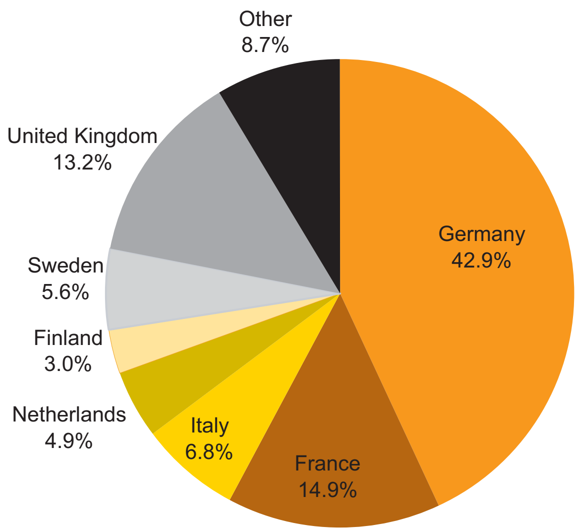
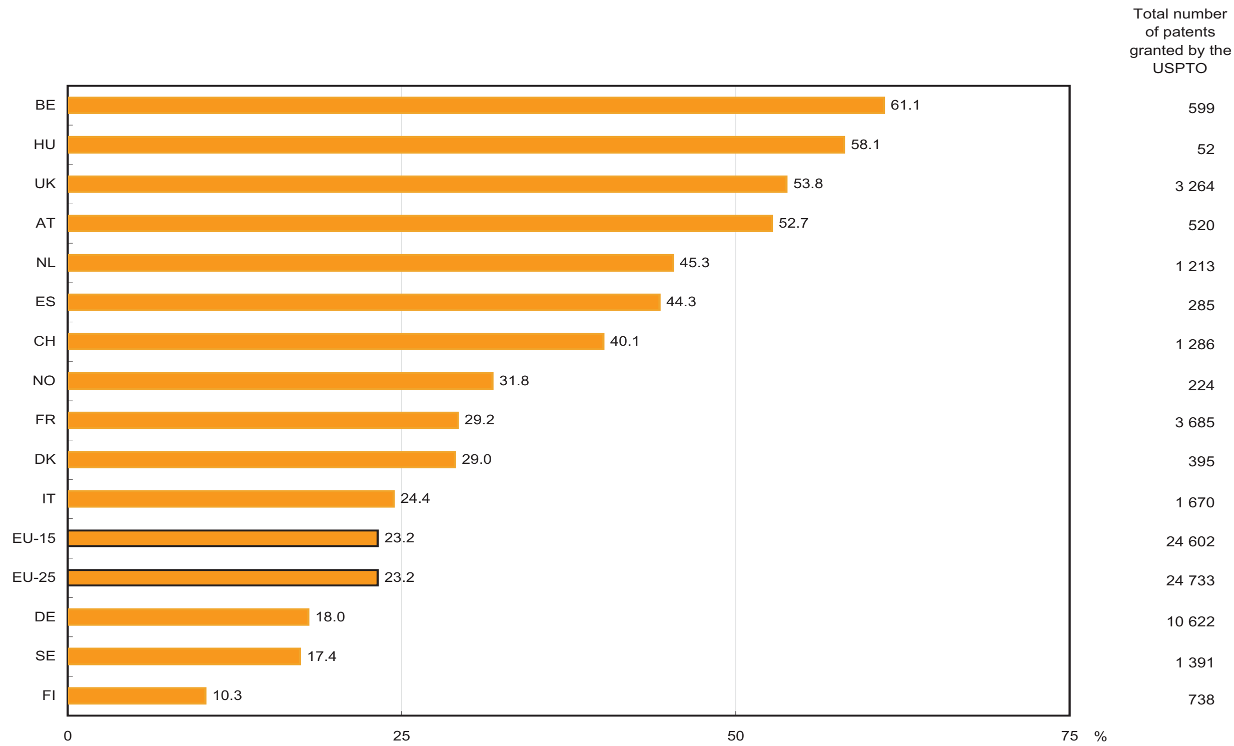


Figure 6.22 **Foreign ownership of domestic inventions in patents granted by the USPTO, as a percentage of total, selected countries (1) - 1999**



(1) granted more than 50 patents.

Figure 6.22 ranks selected countries (countries granted more than 50 USPTO patents) by the percentage of foreign ownership of domestic inventions in patents granted by the USPTO.

The highest percentages are for Belgium (58.5%) and Hungary (58.1%).

In general, countries with high patenting activity fall back on foreign ownership for their patents less often. However, this is not true for the United Kingdom, which ranked third with 52.8%.

At the other end, less than 20% of all USPTO patents granted to Finland, Sweden and Germany involved foreign ownership.

6.4 Performance at regional level in Europe

Total patent applications to the EPO

High concentration of patenting activity at regional level

Map 6.24 illustrates the regional patenting activities in the EU. In most EU-25 countries, national patenting is concentrated in certain regions. Often the regions more active in patenting are situated geographically close together, i.e. they form economic clusters. This is the case, for example, in the southern part of Germany, the south-east of France and the north-west of Italy. The most active patenting regions (with 100 to 300 applications and with more than 300 applications per million inhabitants) are in Scandinavia and in the centre of EU-25.

As no population data were available for the United Kingdom this information is missing from the map.

In relative terms, Noord-Brabant (NL) led with 885 patent applications per million inhabitants, followed by seven German regions.

The two first German regions were Stuttgart with 736 patent applications per million inhabitants and Oberbayern with 669. The region ranked ninth (Stockholm, SE) scored less than half the total of the region in first place.

In absolute terms, Île de France (FR) ranked first with 3 282 patent applications followed by two German regions (Stuttgart with 2 918 and Oberbayern with 2 769) which also took second and third place in relative terms. The region ranked fifth - Lombardia (IT) - accounted for 1 612 patent applications, which is already less than half of the 3 282 from Île de France.

Figure 6.23 **Top fifteen EU-25 regions in terms of patent applications to the EPO, total number and per million inhabitants - 2002**

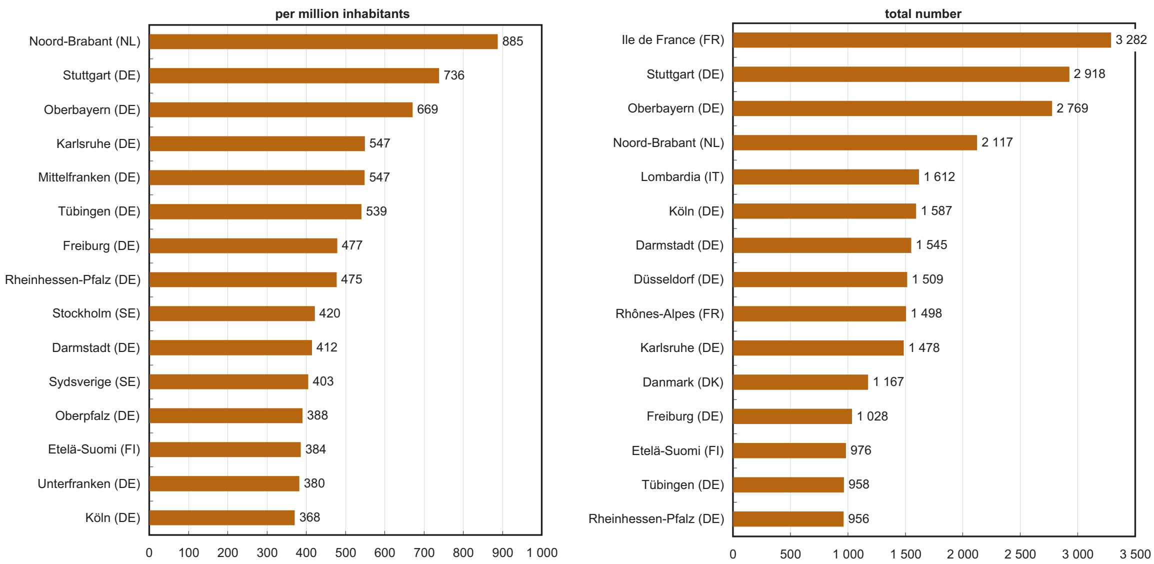


Table 6.25 looks at regional patenting from a different perspective. On the one hand, the table shows the number of NUTS 2 regions and the average number of patent applications per region. Several small countries are considered as a single NUTS 2 region. Looking at these average figures, Denmark (1 167) ranked first, followed by Germany (598) and France (329). The Netherlands (328), Sweden (323) and Finland (319) came close behind France.

Alongside this, the table provides data on the leading region in each country in terms of total number of patent applications. Based on this criterion, as in Figure 6.23 Île de France (FR) was the leader. Stuttgart (DE) came second, followed by Noord-Brabant (NL). Ranking the same regions by "EPO patent applications per million labour force", Noord-Brabant (NL) came first, Stuttgart (DE) second and Stockholm (SE) third.

Finally, the last column of Table 6.25 shows the share of the total national patents taken by the leading region in each country. Four regions with quite low percentages are identified. Stuttgart (DE) and East Anglia (UK) accounted for just 12% of all patent applications from their country. For Wien (AT) and Prov. Antwerpen (BE) the percentages were also rather low, on 21% and 24% respectively.

Map 6.24

Total patent applications to the EPO per million inhabitants, by EU-25 region (NUTS 2) - 2002

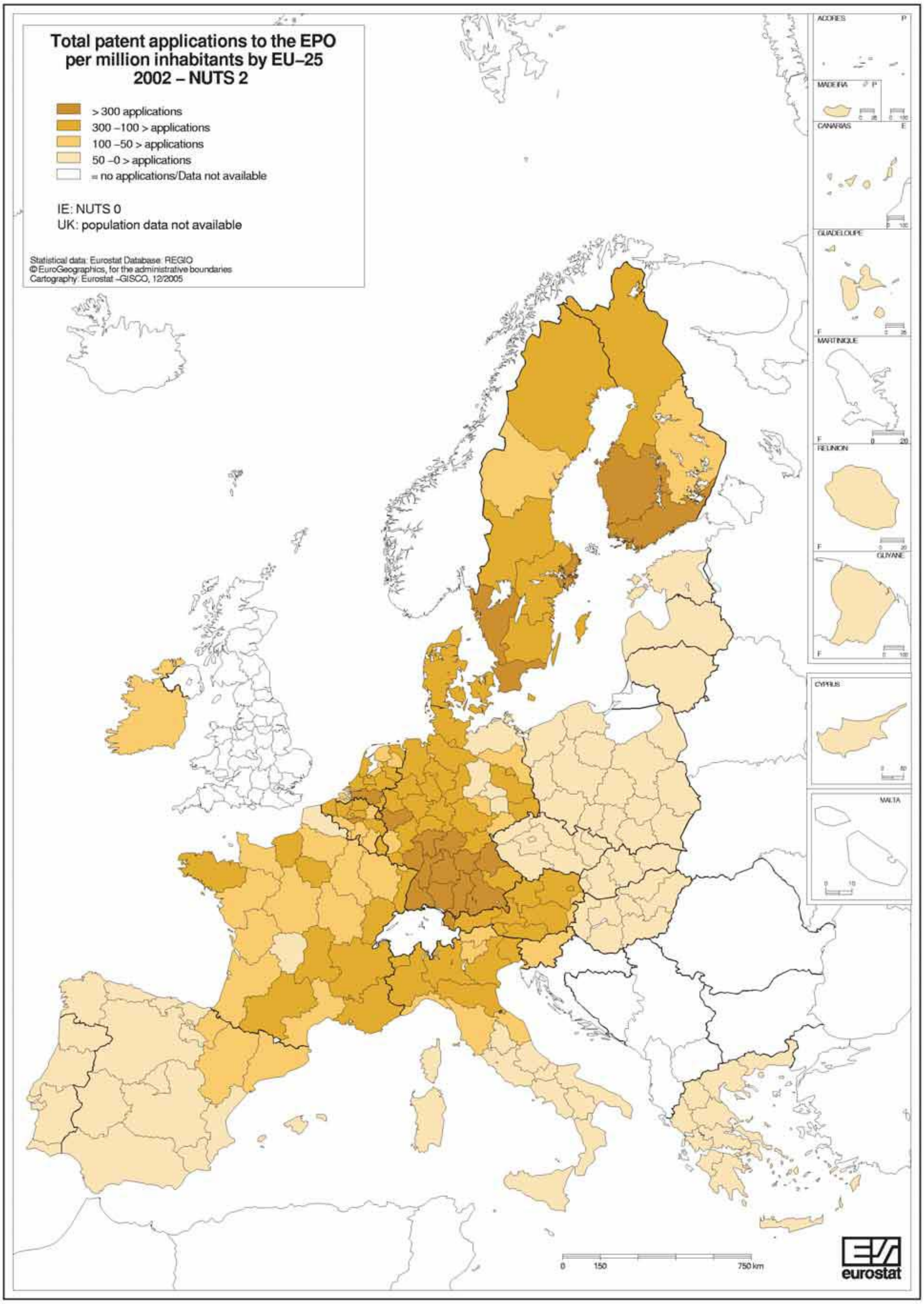


Table 6.25

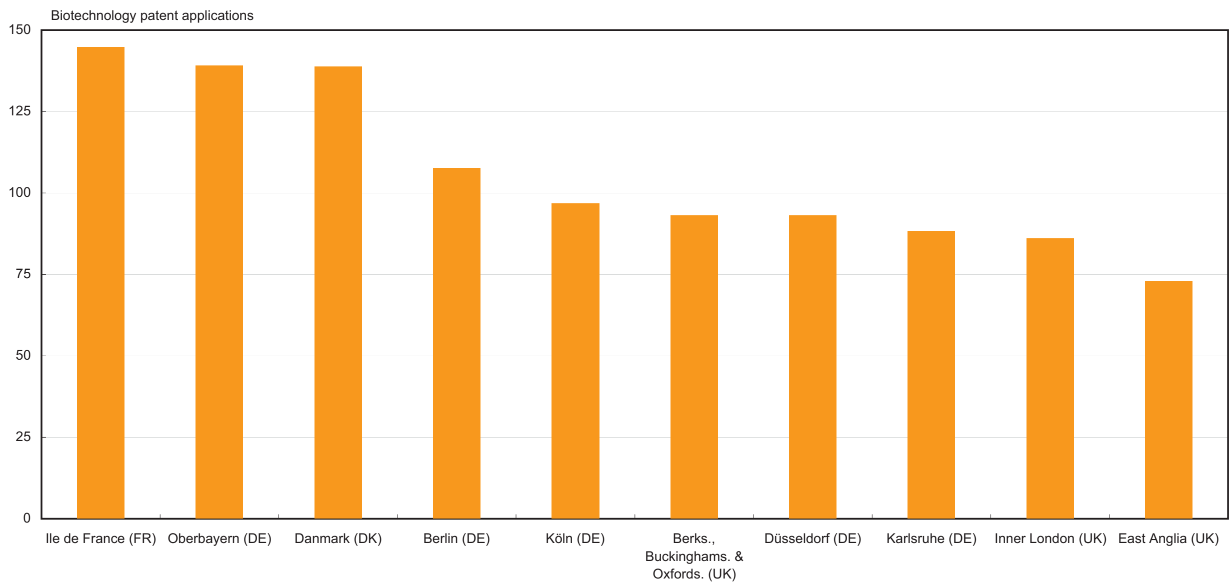
Leading regions by EU-25 Member States in terms of patent applications to the EPO, total number, per million inhabitants and as a percentage of total - 2002

	Number of NUTS 2 regions	Average total number per region	Region with the highest level	per million labour force	**Total number**	as percentage of total number at national level
BE	11	132	Prov. Antwerpen (BE)	492	**349**	24
CZ	8	15	Praha (CZ)	52	**33**	27
DK	1	1167	Danmark (DK)	408	**1 167**	100
DE	41	598	Stuttgart (DE)	1 479	**2 918**	12
EE	1	10	Estonia (EE)	15	**10**	100
EL	13	8	Attiki (EL)	42	**73**	67
ES	19	66	Cataluna (ES)	151	**462**	37
FR	26	329	Ile de France (FR)	599	**3 282**	38
IE	2	155	Ireland (IE)	169	**311**	100
IT	21	226	Lombardia (IT)	385	**1 612**	34
CY	1	5	Cyprus (CY)	16	**5**	100
LV	1	13	Latvia (LV)	11	**13**	100
LT	1	10	Lithuania (LT)	6	**10**	100
LU	1	69	Luxembourg (LU)	356	**69**	100
HU	7	28	Kozep-Magyarorszag (HU)	106	**132**	68
MT	1	5	Malta (MT)	29	**5**	100
NL	12	328	Noord-Brabant (NL)	1 663	**2 117**	54
AT	9	165	Wien (AT)	392	**315**	21
PL	16	11	Mazowieckie (PL)	27	**63**	35
PT	7	7	Norte (PT)	10	**19**	38
SI	1	103	Slovenia (SI)	105	**103**	100
SK	4	10	Mazowieckie (SK)	58	**19**	46
FI	5	319	Etelä-Suomi (FI)	723	**976**	61
SE	8	323	Stockholm (SE)	764	**772**	30
UK	37	196	East Anglia (UK)	756	**866**	12

Biotechnology patenting can also be measured at regional level. Five of the top ten regions in biotech patenting in the EU are German, three are British, one is French and one Danish. Half of the top ten regions in biotechnology are also in the overall top ten patenting regions (see Figure 6.23). Stuttgart (Germany) which was highly placed in the previous ranking was not in the top ten regions in terms of biotechnology patent applications to the EPO.

Figure 6.26

Top ten EU-25 regions in terms of biotechnology patent applications to the EPO, total number - 2002



eurostat

Figure 6.27 shows the top ten regions in terms of ICT patent applications to the EPO. In each case the absolute number is broken down into the four subcategories:

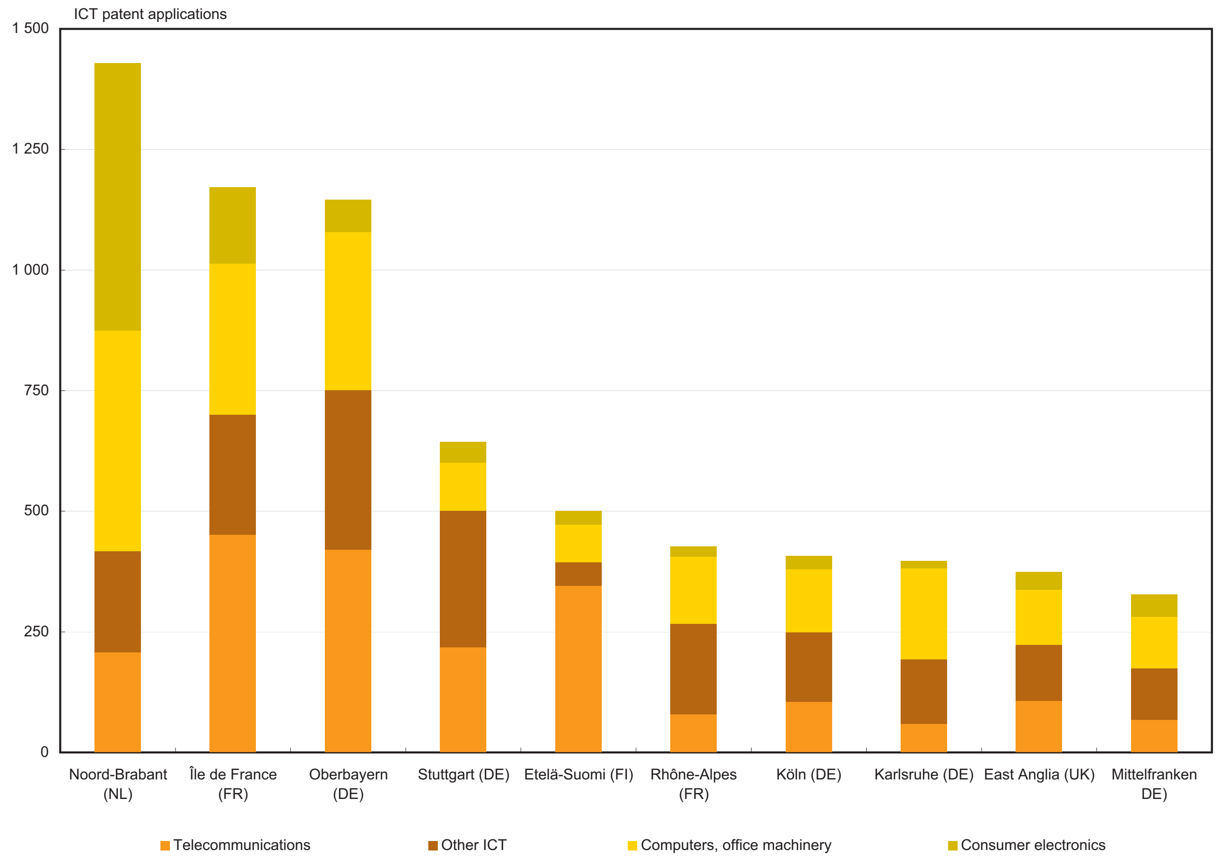
- Telecommunications,
- Other ICT,
- Computers, office machinery,
- Consumer electronics.

Noord-Brabant (NL) led, followed by Île de France (FR) and Oberbayern (DE). Whereas the top three regions each accounted for more than 1 000 ICT patent applications to the EPO, the next regions produced around 600 applications or less.

The breakdown by subcategory often varies widely in each of the top ten regions. While 39% of all ICT patents from Noord-Brabant (NL) were in the "Consumer electronics" subcategory, in Île de France (FR) and Oberbayern (DE) 39% and 37% respectively were accounted for by "Telecommunications". The Finnish region Etelä-Suomi is most active in the "Telecommunications" subcategory, with 69% of all ICT patent applications.

Figure 6.27

Top ten EU-25 regions in terms of ICT patent applications to the EPO, total number and breakdown by subcategory - 2002



Part 2 - High-tech patents

6.5 Introduction

Patents are classified in accordance with the International Patent Classification (IPC), which assigns each invention an IPC class, depending on its function or intrinsic nature, or its field of application. The IPC is therefore a combined function/application classification system in which the function takes precedence.

The IPC makes it possible to aggregate patents allocated to certain IPC classes into fields of technology. One of these fields is "high technology".

The aggregation "high-tech patents" is made up as follows in the IPC:

- AVI Aviation;
- CAB Computer and automated business equipment;
- CTE Communication technology;
- LSR Lasers;
- MGE Micro-organism and genetic engineering;
- SMC Semi-conductors.

Software patenting - legal position

Patents are not the only way to protect intellectual property. There are also other possibilities, for example copyrights, trademarks and licences. The expression of an original computer program in any form is protected by copyright as a literary work (see Council Directive 91/250/EEC of 14 May 1991 on the legal protection of computer programs). However, ideas and principles which underlie any element of a computer program are not protected by copyright.

Nevertheless patents are limited to technical inventions. For this reason Article 52(2)(c) of the European Patent Convention (EPC) states that programs for computers shall not be regarded as inventions. But Article 52(3) adds that "The provisions of paragraph 2 shall exclude patentability of the subject-matter or activities referred to in that provision only to the extent to which a European patent application or European patent relates to such subject-matter or activities as such."

The term "as such" caused considerable confusion and ambiguity.
To solve this problem, the EPC was revised, but in the 2006 version this Article remains unchanged.
With the objective of harmonising and clarifying the situation with computer program patenting, the European Commission made a proposal for a Directive of the European Parliament and of the Council on the patentability of computer-implemented inventions.
This proposal contained two definitions:
(a) "computer-implemented invention" means any invention the performance of which involves the use of a computer, computer network or other programmable apparatus and having one or more prima facie novel features which are realised wholly or partly by means of a computer program or computer programs;
(b) "technical contribution" means a contribution to the state of the art in a technical field which is not obvious to a person skilled in the art.

The proposal was rejected by the European Parliament (EP) on 6 July 2005 at the second reading. The directive rejected by the EP would have concerned only inventions using computer technology, whereas a Community patent would apply to all areas of technological innovation.

In January 2006 the European Commission started a consultation on a project that, if everything goes according to plan, will result in the legalisation of software patents - the Community patent project.

In detail, the Commission's consultation focused on three major issues: the Community patent, how to improve the current patent system in the EU and possible areas for harmonisation. Interested parties had until 12 April 2006 to reply to the questionnaire. After analysing the results, the Commission will organise a seminar in Brussels to discuss the outcome in June. If the Commission decides that it needs to present new legislation, such as a revised version of the Community patent, it would do so after the summer.

6.6 A worldwide perspective: EU-25, Japan and the United States

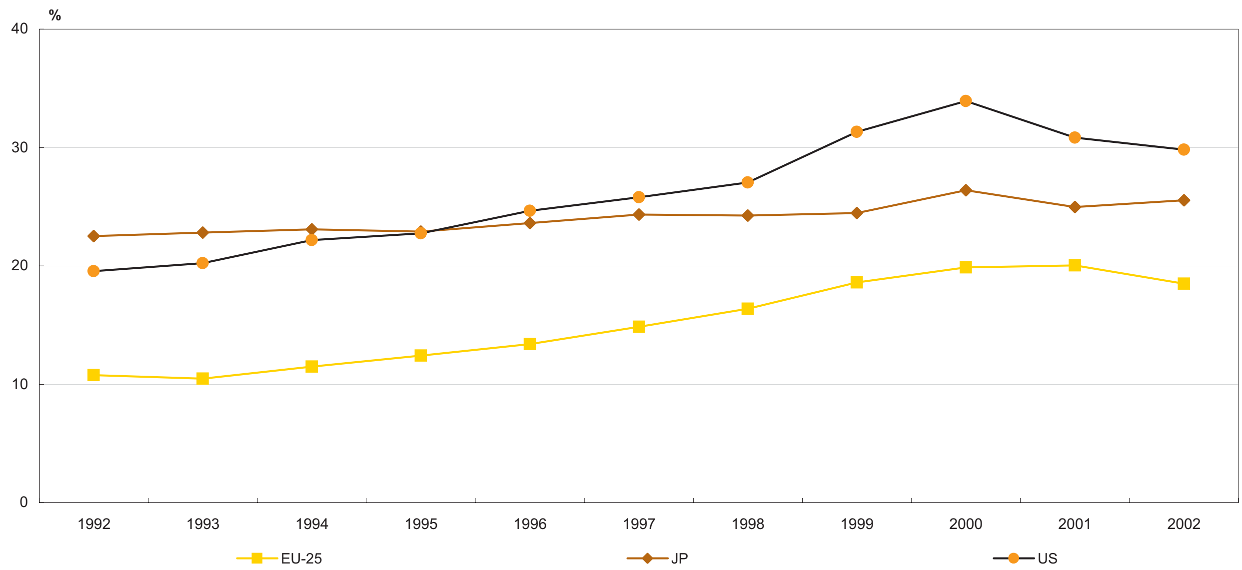
High-tech patent applications to the EPO

Figure 6.28 charts the trends for high-tech patent applications to the EPO from the three main economies from 1992 to 2002 as a percentage of total patent applications to the EPO. All three economies showed an upward trend over the whole period, with high-tech patents increasing continuously as a proportion of total patent applications to the EPO. Whereas the slope was similar for the United States and EU-25, it was different for Japan, with less significant growth in Japan's share of high-tech patents.

In 1992 Japan ranked first with the highest proportion of high-tech patent applications to the EPO, ahead of the United States. But in 1996 the United States took over first place. Japan ranked second followed by EU-25.

Figure 6.28

High-tech patent applications to the EPO, as a percentage of total, EU-25, Japan and the United States - 1992 to 2002



In terms of the total number of high-tech patent applications to the EPO per million labour force, the United States ranked first of the three main economies in 2002 (see Figure 6.29). EU-25 ranked second when looking at the total number, but only third when calculating patent applications to the EPO per million labour force.

EU-25 generated the second highest number of high-tech patents in absolute terms, but not in relative terms. In 2002 high tech accounted for only 18.5% of total patent applications from EU-25 to the EPO, whereas in Japan and the United States the shares of high-tech patents were 25.5% and 29.8% respectively.

The annual average growth rates for high-tech patents are always higher than the rates for total patents. The growth rates in the first observation period (1992 to 1997) were generally higher than those in the second (1997 to 2002). Only Japan shows the opposite trend.

However, EU-25 had the highest growth rates for high-tech patents compared with Japan and the United States in both observation periods.

Table 6.29 High-tech patent applications to the EPO and annual average growth rates, EU-25, Japan and the United States - 1992 to 2002

	EU-25	JP	US
High-tech patent applications in 2002			
Total	11 052	6 255	13 958
Per million labour force	53	94	95
As % of all applications	18.5	25.5	29.8
Annual average growth rates in %			
High-tech patents 1992-1997	16.2	9.0	15.4
High-tech patents 1997-2002	10.0	9.8	9.2
All patents 1992-1997	8.9	7.3	9.2
All patents 1997-2002	5.3	8.7	6.1

The breakdown of high-tech patent applications to the EPO by group is very different for each of the three main economies (see Figure 6.30). "Communication technology" was the most important high-tech group for EU-25 and Japan in 2002, with 45.1% and 36.5% respectively, but came second in the United States.

"Communication technology" includes electrical communication systems, such as telephones or televisions, where the two main economies mentioned have a degree of strength.

The largest group for American high-tech patent applications to the EPO was "Computer and automated business equipment" with 39%.

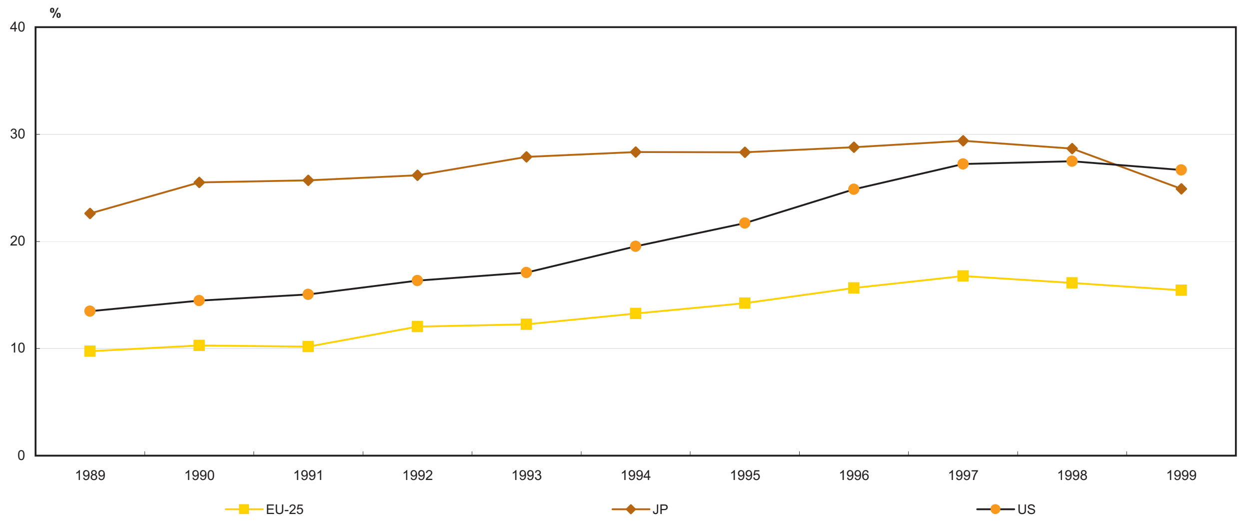
Table 6.30 Breakdown of high-tech patent applications to the EPO by high-tech group, as a percentage of total, EU-25, Japan and the United States - 2002

High-tech group	EU-25	JP	US
Aviation	1.6	0.2	1.1
Computer and automated business equipment	29.1	31.4	39.0
Communication technology	45.1	36.5	30.8
Lasers	1.5	1.4	1.3
Micro-organism and genetic engineering	13.8	11.9	17.5
Semi-conductors	8.9	18.6	10.3
	100.0	100.0	100.0
Total	11 052	6 255	13 958

High-tech patents granted by the USPTO

Figure 6.31 shows the trends in high-tech patents granted by the USPTO, as a percentage of the total patents granted by the USPTO to EU-25, Japan and the United States from 1989 to 1999. Up until 1998 Japan took the highest share of high-tech patents granted (23%-29%). In 1999 Japan was overtaken by the United States. EU-25 has always been the economy granted the smallest share of high-tech patents by the USPTO (10%-17%). This is the opposite of the picture with patent applications to the EPO.

Figure 6.31 — **High-tech patents granted by the USPTO, as a percentage of total, EU-25, Japan and the United States - 1989 to 1999**



The number of high-tech patents granted by the USPTO to EU-25 in 1999 was small, with a total of only less than 4 thousands patents (see Figure 6.32). The number of comparable high-tech patents granted to Japan by the USPTO was more than twice the EU-25 total, on more than 8 thousands, while the number granted to the US - with "home advantage" - was almost six times as high, with more than 23 thousands patents granted.

Looking at relative figures, the differences were even more extreme with 22 patents granted per million labour force to EU-25, 118 to Japan and 165 to the US.

The annual average growth rates are again higher for high-tech patents than for total patents granted by the USPTO. The first observation period, from 1989 to 1994, showed higher growth rates than the second, from 1994 to 1999. The United States always recorded higher growth rates than EU-25 and Japan. The only exception was Japan's figure for total patents for the second observation period, which was higher than for the first period and higher than for high-tech patents.

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Table 6.32 — **High-tech patents granted by the USPTO and annual average growth rates, EU-25, Japan and the United States - 1989 to 1999**

	EU-25	JP	US
High-tech patents granted in 1999			
Total	3 820	8 013	23 224
Per million labour force(1)	22	118	165
As % of all patents granted	15.4	24.9	26.7
Annual average growth rates in %			
High-tech patents 1989-1994	8.9	6.4	13.5
High-tech patents 1994-1999	5.9	1.4	11.0
All patents 1989-1994	2.4	1.7	5.4
All patents 1994-1999	2.7	4.1	4.3

(1) data for EU-15.

The breakdown of high-tech patents granted by the USPTO by group shows that in 1999 "Computer and automated business equipment" was the largest group for all three main economies. "Communication technology" ranked second for EU-25 and the United States, whereas "Semi-conductors" came second for Japan.

High-tech patenting was strongly concentrated in certain high-tech groups. The first two - "Computer and automated business equipment" and "Communication technology" - accounted for 62.8% (Japan), 69.5% (EU-25) and 74.8% (US).

Table 6.33 High-tech patents granted by the USPTO by high-tech group, as a percentage of total, EU-25, Japan and the United States - 1999

High-tech group	EU-25	JP	US
Aviation	2.7	0.2	1.2
Computer and automated business equipment	36.3	42.5	49.9
Communication technology	33.2	20.3	24.9
Lasers	2.7	3.2	1.5
Micro-organism and genetic engineering	8.9	2.5	7.1
Semi-conductors	16.2	31.4	15.5
	100.0	100.0	100.0
Total	3 820	8 013	23 224

6.7 Performance at national level in Europe

High-tech patent applications to the EPO

Most of the high-tech patent applications to the EPO came from Germany (3 683), followed by France (1 828) and the United Kingdom (1 635).

In terms of high-tech patent applications per million inhabitants, Finland led by far with 135 applications. The Netherlands ranked second with 68 and Sweden third with 63.

Countries with fewer than 100 high-tech patent applications are not taken into consideration in the analysis set out below.

18.5% of all patent applications by EU-25 concerned high technology. The leaders were Finland (44.1%), Ireland (29.7%) and the Netherlands (28.0%).

The annual average growth rates were always higher for high-tech patent applications than for total patent applications. This is true for both observation periods (1992 to 1997 and 1997 to 2002) and also for many EU countries.

Some countries performed better than others, however, and surpassed the EU-25 average. The Scandinavian countries had particularly high growth rates for high-tech patent applications in the first period (Denmark 20.8%, Finland 27.0% and Sweden 32.0%). In the second observation period Spain (19.8%) and Austria (20.7%) caught up. By contrast, Sweden was the only Member State with a negative growth rate (-1.3%) in the second observation period.

Looking at the annual average growth rates for total patent applications to the EPO, Belgium (11.4%), Spain (17.6%), the Netherlands (11.1%), Finland (12.2%) and Sweden (14.7%) recorded rates significantly higher than the EU-25 average (8.9%) for 1992 to 1997. In the second period (1997 to 2002) only Spain (10.0%) and the Netherlands (8.2%) continued to perform well above the EU-25 average (5.3%) which also slipped back considerably.

Table 6.34 **High-tech patent applications to the EPO and annual average growth rates, EU-25 and selected countries - 1992 to 2002**

	High-tech patent applications in 2002			Annual average growth rates in %			
				High-tech patents		All patents	
	Total	Per million inhabitants	As % of all patents	1992-97	1997-2002	1992-97	1997-2002
EU-25	**11 052**	**:**	**18.5**	**16.2**	**10.0**	**8.9**	**5.3**
EU-15	**10 976**	**:**	**18.6**	**16.2**	**9.9**	**8.9**	**5.2**
BE	274	27	18.8	17.2	10.7	11.4	2.9
CZ	8	1	6.2	-1.7	29.0	21.2	11.7
DK	210	39	18.0	20.8	10.1	8.0	8.8
DE	3 683	45	15.0	18.1	10.6	9.4	5.0
EE	3	2	25.9	-8.0	49.9	23.1	6.4
EL	22	2	20.1	10.3	25.3	6.9	11.0
ES	160	4	12.8	17.7	19.8	17.6	10.0
FR	1 828	31	21.4	10.4	10.7	6.5	4.4
IE	92	24	29.7	26.2	20.4	11.1	11.7
IT	478	8	10.1	12.6	10.8	7.8	6.7
CY	1	1	12.4	-8.0	-	-8.2	8.3
LV	3	1	19.3	-	-	34.2	6.9
LT	-	-	-	-	-	63.5	15.6
LU	4	9	5.6	-	-5.0	17.3	4.4
HU	27	3	14.0	18.5	18.3	5.4	9.4
MT	-	-	-	-	-	-5.6	9.3
NL	1 102	68	28.0	15.7	13.2	11.1	8.2
AT	217	27	14.6	14.7	20.7	9.6	6.7
PL	22	1	12.5	32.4	34.6	16.4	26.8
PT	4	0	7.8	21.9	1.8	12.3	15.9
SI	9	5	9.0	32.4	24.9	17.3	25.0
SK	4	1	10.3	11.7	27.9	21.5	14.4
FI	703	135	44.1	27.0	8.1	12.2	4.6
SE	565	63	21.8	32.0	-1.3	14.7	-0.5
UK	1 635	28	22.5	10.6	9.1	5.6	5.3
IS	12	43	23.7	37.0	20.6	32.1	22.1
LI	2	45	5.3	-	70.3	5.6	6.6
NO	90	20	14.7	36.3	5.8	11.6	4.9
EEA	**11 156**	**:**	**18.5**	**16.3**	**10.0**	**8.9**	**5.3**
CH	393	54	13.1	11.3	14.8	5.3	4.8
BG	6	1	16.0	37.1	18.5	27.2	7.6
HR	6	:	6.3	24.4	94.0	21.2	30.5
RO	2	0	7.8	5.9	-10.3	54.4	7.9
TR	10	:	8.8	112.0	20.8	128.5	31.6

Figure 6.35 shows the high-tech patent applications to the EPO per million inhabitants in 1992, 1997 and 2002 and confirms the upward trends mentioned previously for all countries, except Sweden, in 2002.

In 1992 the three best performers in terms of high-tech patent applications per million inhabitants were Finland (29), the Netherlands (19) and Sweden (17).

Five years later Finland (93) was still in the lead, but Sweden (68) ranked second and the Netherlands (38) third.

In 2002 Finland (135) was still first, but Sweden (63) had lost second place to the Netherlands (68) once again.

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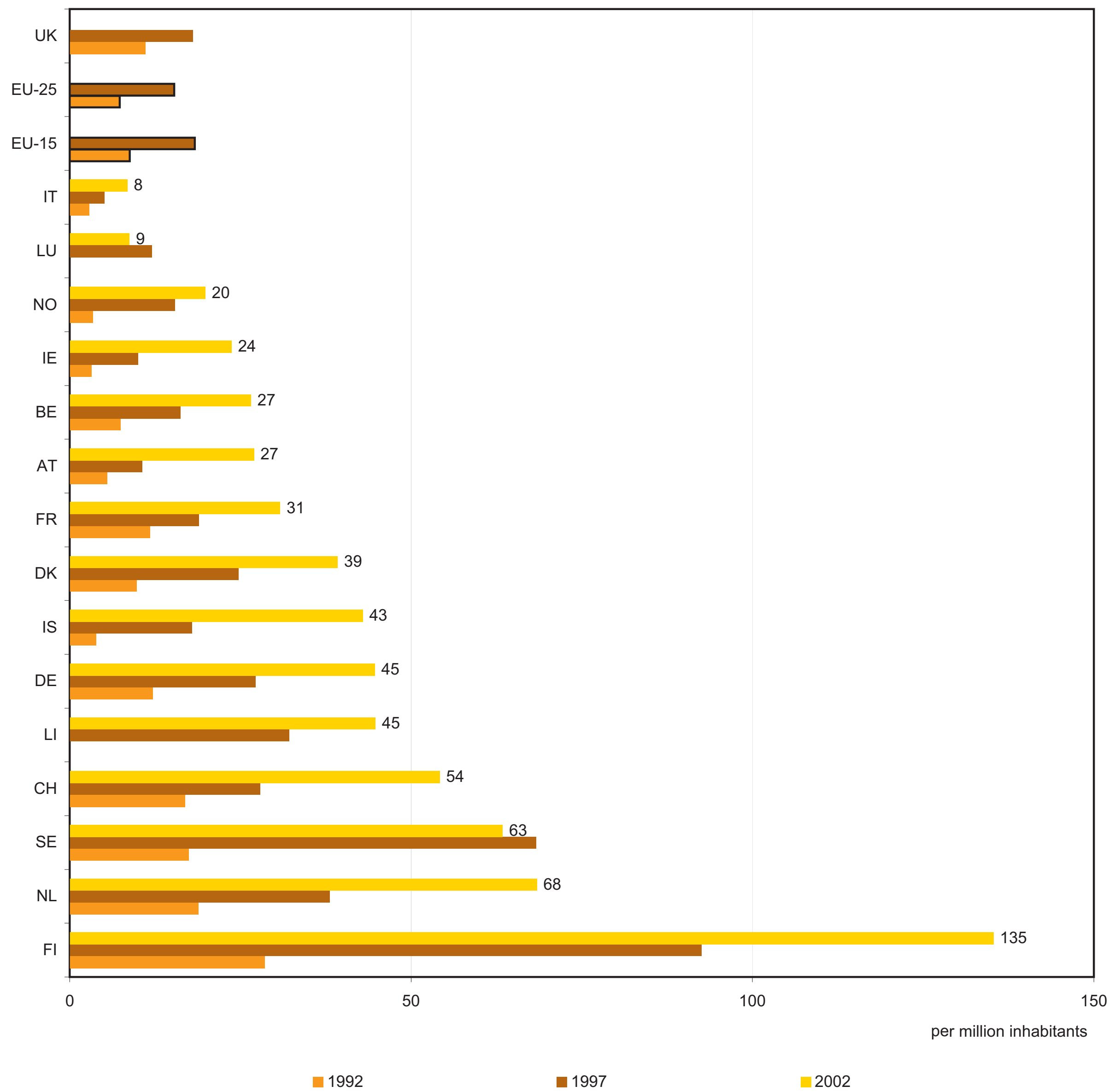
Figure 6.35

High-tech patent applications to the EPO per million inhabitants, selected countries (1) (2)- 1992, 1997 and 2002



(1) with more than five high-tech patents per million inhabitants in 2002.
(2) No 2002 population data were available on the cut-off date for the United Kingdom; for this reason, also no European aggregates were available for 2002.

Taking into account only countries with 100 or more high-tech patent applications to the EPO, in every EU Member State except Denmark 40% or more of the high-tech patent applications were concentrated in the "Communication technology" group.

Finland was the most specialised in this area with 73.6% of its high-tech patent applications linked to this group. Only 38.8% of Danish high-tech patent applications were on "Communication technology", but Denmark was also very active in another group - "Micro-organism and genetic engineering". Spain, with 28.0%, was also above the EU-25 average for this group (13.8%).

In "Aviation" Spain scored 3.8%, whereas the EU-25 average was only 1.6%.

Italy and the United Kingdom were more dynamic than the other countries in patenting activities related to "Lasers".

Germany and Italy surpassed the EU-25 average (8.9%) in the "Semi-conductors" group, with 12.1% and 13.0% respectively.

Table 6.36

High-tech patent applications to the EPO by high-tech group, total number and as a percentage of total, EU-25 and selected countries - 2002

	Total	High-tech group (as % of all high tech applications)					
		Aviation	Computer and automated business equipment	Communication technology	Lasers	Micro-organism and genetic engineering	Semi-conductors
EU-25	**11 052**	**1.6**	**29.1**	**45.1**	**1.5**	**13.8**	**8.9**
EU-15	**10 976**	**1.6**	**29.0**	**45.2**	**1.5**	**13.7**	**8.9**
BE	274	1.5	30.6	41.6	0.1	17.5	8.7
CZ	8	13.1	26.1	49.0	0.0	11.8	0.0
DK	210	0.5	19.6	38.8	1.0	37.4	2.8
DE	3 683	1.7	28.1	40.2	1.6	16.2	12.1
EE	3	0.0	60.0	0.0	0.0	40.0	0.0
EL	22	9.2	14.1	51.9	0.0	22.5	2.3
ES	160	3.8	21.3	43.4	0.6	28.0	2.9
FR	1 828	3.1	29.6	46.6	1.1	10.6	8.9
IE	92	0.0	33.9	33.6	8.7	11.9	11.9
IT	478	1.7	30.4	40.3	2.7	11.9	13.0
CY	1	0.0	50.0	50.0	0.0	0.0	0.0
LV	3	40.0	60.0	0.0	0.0	0.0	0.0
LT	-	-	-	-	-	-	-
LU	4	0.0	57.0	0.0	0.0	34.5	8.5
HU	27	0.0	35.6	50.5	0.0	10.2	3.7
MT	-	-	-	-	-	-	-
NL	1 102	0.6	30.0	49.0	0.4	10.6	9.3
AT	217	0.6	29.6	46.0	1.3	10.7	11.9
PL	22	0.0	42.0	23.3	5.3	20.2	9.2
PT	4	0.0	13.1	58.9	0.0	28.0	0.0
SI	9	0.0	31.7	37.8	0.0	30.5	0.0
SK	4	0.0	0.0	23.4	0.0	76.6	0.0
FI	703	0.1	21.9	73.6	0.6	2.5	1.2
SE	565	0.8	32.3	51.2	0.9	12.3	2.5
UK	1 635	1.5	32.8	41.4	2.7	15.0	6.7
IS	12	0.0	36.6	0.0	0.0	63.4	0.0
LI	2	0.0	0.0	0.0	0.0	66.7	33.3
NO	90	0.0	37.8	32.2	0.0	27.7	2.2
EEA	**11 156**	**1.6**	**29.2**	**45.0**	**1.5**	**14.0**	**8.8**
CH	393	0.3	32.8	36.5	1.5	17.8	11.2
BG	6	0.0	22.8	68.6	0.0	0.0	8.6
HR	6	18.2	54.5	27.3	0.0	0.0	0.0
RO	2	0.0	49.4	29.0	0.0	0.0	21.6
TR	10	0.0	19.3	50.9	0.0	29.9	0.0

High-tech patents granted by the USPTO

Due to the low total number of high-tech patents granted by the USPTO to applicants from the EU, this analysis considers only seven EU Member States, each of which had at least 100 high-tech patents granted by the USPTO: Germany, France, Italy, the Netherlands, Finland, Sweden and the United Kingdom.

Germany led in terms of the absolute number of high-tech patents granted by the USPTO with 1 136, followed by France (718) and the United Kingdom (694).

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Measured per million inhabitants, Finland (45) ranked first, Sweden (37) second and Germany (14) third.

In 1999, 31.3% of the patents granted to Finland by the USPTO concerned high technology. For Sweden the figure was 23.5%, whereas the EU-25 average was 15.4%.

Again, the annual average growth rates were higher for high-tech patents than for total patents. Very often they were also higher in the first observation period (from 1989 to 1994) than in the second (from 1994 to 1999).

By contrast, in Italy from the first to the second observation period the growth rates fell for high-tech patents but rose for total patents. The same is true for the Netherlands, where the growth rate for high-tech patents in the second observation period was even negative.

In Germany the growth rates for high-tech patents and for total patents showed an upward trend from the first to the second period. The 1994-1999 growth rate of 10.0% for high-tech patents granted by the USPTO significantly surpassed the EU-25 average of 5.9% which again was considerably lower for the second observation period than for the first.

Table 6.37 **High-tech patents granted by the USPTO and annual average growth rates, EU-25 and selected countries - 1989 to 1999**

	High-tech patents granted in 1999			Annual average growth rates in %			
	Total	Per million inhabitants	As % of all patents	High-tech patents 1989-1994	High-tech patents 1994-1999	All patents 1989-1994	All patents 1994-1999
EU-25	**3 820**	**8.5**	**15.4**	**8.9**	**5.9**	**2.4**	**2.7**
EU-15	**3 804**	**10.1**	**15.5**	**8.8**	**5.9**	**2.4**	**2.7**
BE	71	7	11.9	36.2	-4.4	9.3	-1.6
CZ	3	0	10.2	-	-	-0.9	7.4
DK	70	13	17.7	13.2	3.2	8.2	-0.2
DE	1 136	14	10.7	5.0	10.0	1.6	4.2
EE	-	-	0.0	-	-	-	13.5
EL	3	0	32.3	-	-4.2	9.2	-13.6
ES	53	1	18.7	15.8	19.6	4.2	5.7
FR	718	12	19.5	5.1	5.4	1.5	0.9
IE	50	13	30.7	19.8	32.3	10.8	13.3
IT	219	4	13.1	9.5	5.0	0.1	4.3
CY	-	-	0.0	-	-	11.4	-7.8
LV	-	-	0.0	-	-	-	-
LT	-	-	0.0	-	-	-	-7.8
LU	0	1	0.9	-	-	-2.2	13.9
HU	8	1	16.2	20.0	17.0	-15.9	4.3
MT	-	-	0.0	-	-	-	-
NL	175	11	14.4	6.4	-3.8	0.9	2.2
AT	55	7	10.6	5.9	10.0	1.1	3.8
PL	4	0	21.2	23.3	31.1	5.4	10.4
PT	1	0	9.6	58.5	-21.8	-6.4	41.5
SI	-	-	0.0	-	-	-	-7.1
SK	-	-	0.0	-	-	-	20.2
FI	231	45	31.3	35.8	7.0	10.3	3.6
SE	327	37	23.5	24.2	7.9	8.6	2.5
UK	694	12	21.3	7.6	2.6	2.1	0.1
IS	13	47	55.6	-	38.9	29.7	33.4
LI	-	-	0.0	-	-	-0.2	0.4
NO	14	3	6.1	-2.7	7.7	3.5	3.9
EEA (1)	**3 846**	**10.1**	**15.4**	**8.8**	**5.9**	**2.4**	**2.7**
CH	122	17	9.5	7.9	3.1	0.2	0.1
BG	-	-	0.0	17.8	-	-5.3	13.0
HR	-	-	0.0	-	-	-	-1.9
RO	1	0	18.2	-	24.8	11.4	9.8
TR	1	-	15.2	-8.0	17.5	-6.9	22.7

(1) EEA18 for data per million inhabitants.

Figure 6.38 shows the high-tech patents granted by the USPTO per million inhabitants for 1989, 1994 and 1999.

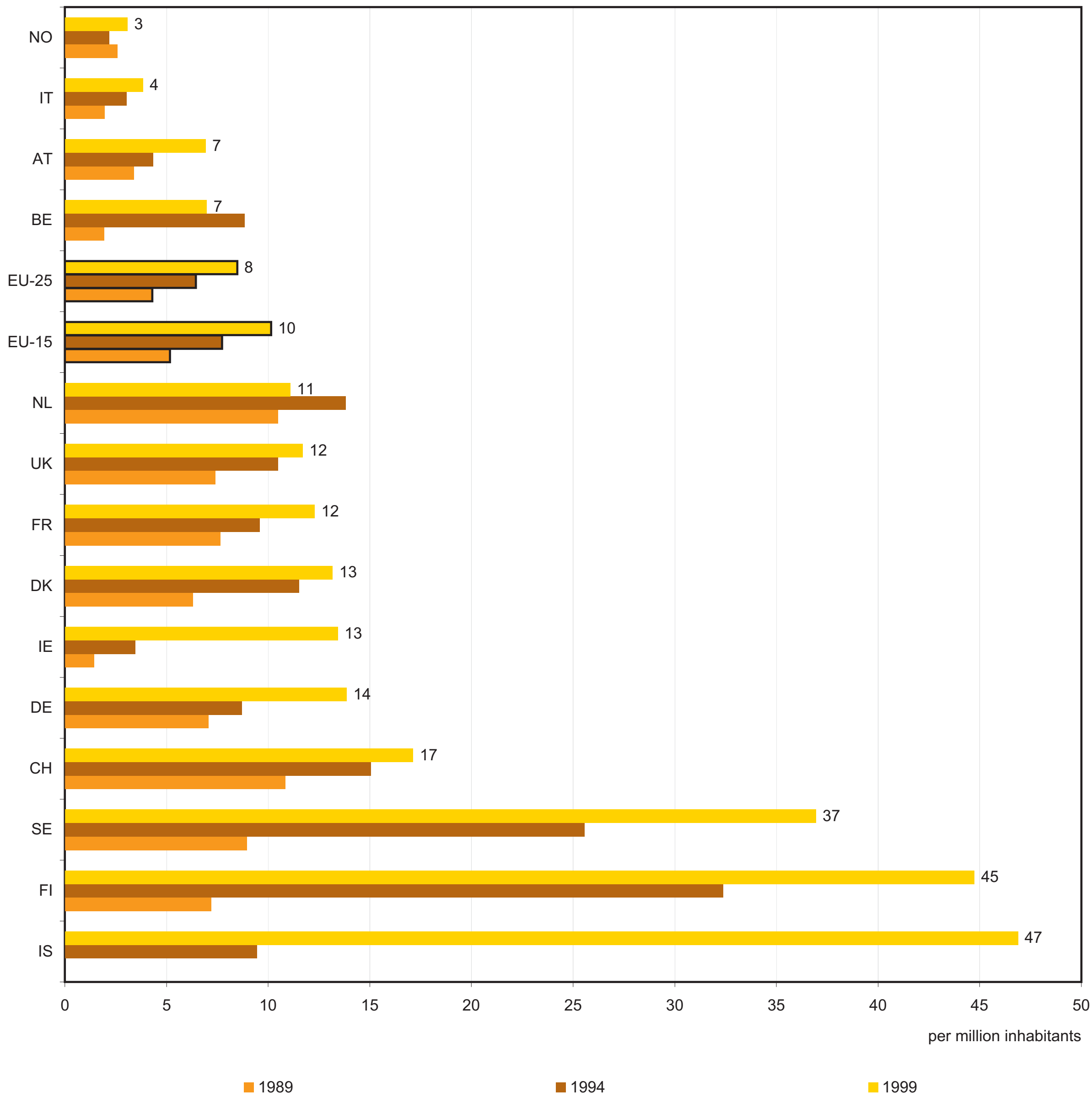
In 1989 the Netherlands led (10 high-tech patents per million inhabitants), followed by Sweden (9) and France (8), but five years later the Netherlands had lost first place and France was not even in the top three any more.

In 1994 Finland ranked first with 32 high-tech patents granted per million inhabitants, Sweden came second with 26 and the Netherlands was third with 14.

Five years later Finland was still first with 45 high-tech patents granted per million inhabitants. Sweden also managed to keep second place with 37 high-tech patents. Third place was taken over by Germany with 14 high-tech patents granted per million inhabitants, well above Germany's previous rates.

Figure 6.38

High-tech patents granted by the USPTO per million inhabitants, selected countries (1) - 1989, 1994 and 1999



(1) with at least three high-tech patents per million inhabitants in 1999.

Remembering that the analysis includes only countries granted more than 100 high-tech patents by the USPTO, "Computer and automated business equipment" was the biggest high-tech group for Germany, France, Italy and the United Kingdom. Between 36.2% and 44.4% of all high-tech patents granted to those countries concerned this group. Finland and Sweden were highly specialised in generating patents related to "Communication technology", which took 79.3% and 63.2% of all high-tech patents granted to them respectively. In the Netherlands high-tech patenting is more diversified, with three groups each accounting for about 30% of all high-tech patents granted by the USPTO: "Semi-conductors", "Communication technology" and "Computer and automated business equipment".

With 5.9% in the "Lasers" group, Germany recorded more than twice the EU-25 average of 2.7%.

In the "Semi-conductors" group Italy (34.0%) far surpassed the EU-25 average of 16.2%.

Table 6.39

High-tech patents granted by the USPTO by high-tech group, total and as a percentage of total, EU-25 and selected countries - 1999

	Total	High - tech group (as % of all high tech patents granted)					
		Aviation	Computer and automated business equipment	Communication technology	Lasers	Micro-organism and genetic engineering	Semi-conductors
EU-25	**3 820**	**2.7**	**36.3**	**33.2**	**2.7**	**8.9**	**16.2**
EU-15	**3 804**	**2.8**	**36.3**	**33.3**	**2.7**	**8.8**	**16.3**
BE	71	1.4	38.2	31.7	0.9	14.9	12.8
CZ	3	0.0	66.7	29.0	0.0	4.3	0.0
DK	70	0.0	21.9	35.6	1.4	38.2	2.9
DE	1 136	3.3	36.2	22.4	5.9	10.4	21.8
EE	-	-	-	-	-	-	-
EL	3	0.0	59.1	30.8	0.0	10.2	0.0
ES	53	3.8	57.0	27.9	0.0	4.8	6.6
FR	718	4.5	40.9	28.8	1.3	8.1	16.3
IE	50	0.0	37.4	42.2	4.0	1.4	15.0
IT	219	2.3	46.2	10.1	1.4	6.0	34.0
CY	-	-	-	-	-	-	-
LV	-	-	-	-	-	-	-
LT	-	-	-	-	-	-	-
LU	0	0.0	100.0	0.0	0.0	0.0	0.0
HU	8	0.0	29.5	29.5	0.0	41.0	0.0
MT	-	-	-	-	-	-	-
NL	175	0.6	30.0	30.3	0.6	6.7	31.8
AT	55	0.0	26.3	36.7	4.5	13.9	18.6
PL	4	0.0	22.7	18.8	0.0	28.3	30.2
PT	1	0.0	0.0	100.0	0.0	0.0	0.0
SI	-	-	-	-	-	-	-
SK	-	-	-	-	-	-	-
FI	231	0.9	16.3	79.3	0.0	2.6	0.9
SE	327	0.3	20.4	63.2	1.7	5.5	8.9
UK	694	3.4	44.4	33.5	1.5	8.7	8.6
IS	13	0.0	21.9	57.4	0.0	20.7	0.0
LI	-	-	-	-	-	-	-
NO	14	0.0	35.4	47.6	0.0	17.1	0.0
EEA	**3 846**	**2.7**	**36.2**	**33.4**	**2.7**	**8.9**	**16.1**
CH	122	0.8	26.5	38.0	4.5	13.4	16.8
BG	-	-	-	-	-	-	-
HR	-	-	-	-	-	-	-
RO	1	0.0	0.0	100.0	0.0	0.0	0.0
TR	1	0.0	60.8	16.9	0.0	0.0	22.3

6.8 Performance at regional level in Europe

Regional-level patent statistics are limited to applications to the EPO. The data are regionalised by linking postcodes or city names to the Nomenclature of Territorial Units for Statistics (NUTS). NUTS was established to provide a single, uniform breakdown of territorial units for the production of regional statistics for the European Union. It is a five-level hierarchical classification comprising three regional and two local levels. NUTS subdivides each Member State into a number of NUTS 1 regions, each of which is in turn subdivided into a number of NUTS 2 regions and so on.

All data in this chapter are presented at NUTS 2 level based on the 2003 version of the NUTS classification. Denmark, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Slovenia and Iceland are each classified as a single NUTS 2 region, which explains why these countries appear amongst the regional data set out below. Data for Ireland are available only at NUTS 0 or country level.

High-tech patent applications to the EPO

The top fifteen EU-25 regions in terms of high-tech patent applications to the EPO are very similar in both absolute and relative terms. The comparison of the top fifteen rankings in Figure 6.40 is biased, because no relative data (i.e. per million inhabitants) are available for the United Kingdom, for which population data for 2002 were missing at the time of data extraction.
Whereas in terms of the total number of high-tech patent applications Oberbayern (DE) ranked first, Île de France (FR) second and Noord-Brabant (NL) third, the relative figures (per million inhabitants) put Noord-Brabant (NL) in the lead followed by Oberbayern (DE) and Etelä-Suomi (FI).
German, French, Dutch, Finnish and Swedish regions appear in both rankings. By contrast, Italian and Danish regions feature only in the rankings by absolute number of applications. On the other hand, Belgian and Austrian regions appear only in the relative chart (high-tech patent applications per million inhabitants).

Although there is little difference between the absolute totals for the three best performers and, therefore, leading EU regions in terms of high-tech patenting, the absolute numbers of patents decrease rapidly from fourth place downwards.

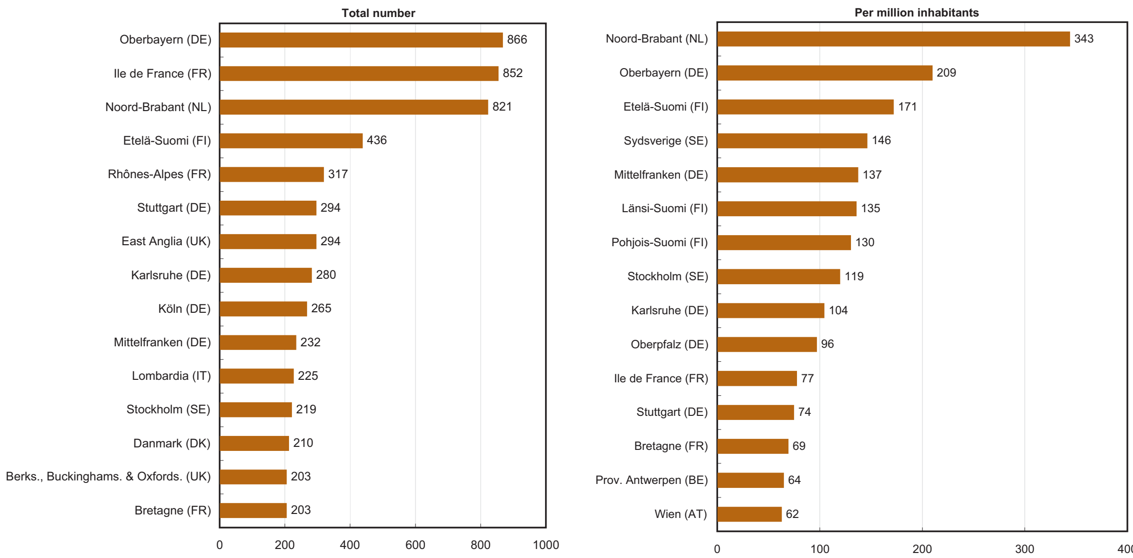
In the ranking per million inhabitants the first region - Noord-Brabant (NL) - was well ahead with 343 patent applications per million inhabitants, while the next (Oberbayern) was already well behind (209).

Map 6.41 shows fairly low high-tech patenting activity in regions in the southern and eastern European countries. By contrast, Finland and Germany are the only countries with more than two regions which made more than 100 high-tech patent applications to the EPO per million inhabitants.

Whereas in Germany the most active high-tech patenting regions are in the south of the country, in France the most active regions are far away from each other: Bretagne, Île de France and Rhône-Alpes.
The Scandinavian countries are very active in high-tech patenting. Three out of four Finnish regions generated more than 100 high-tech patent applications to the EPO per million inhabitants in 2002.

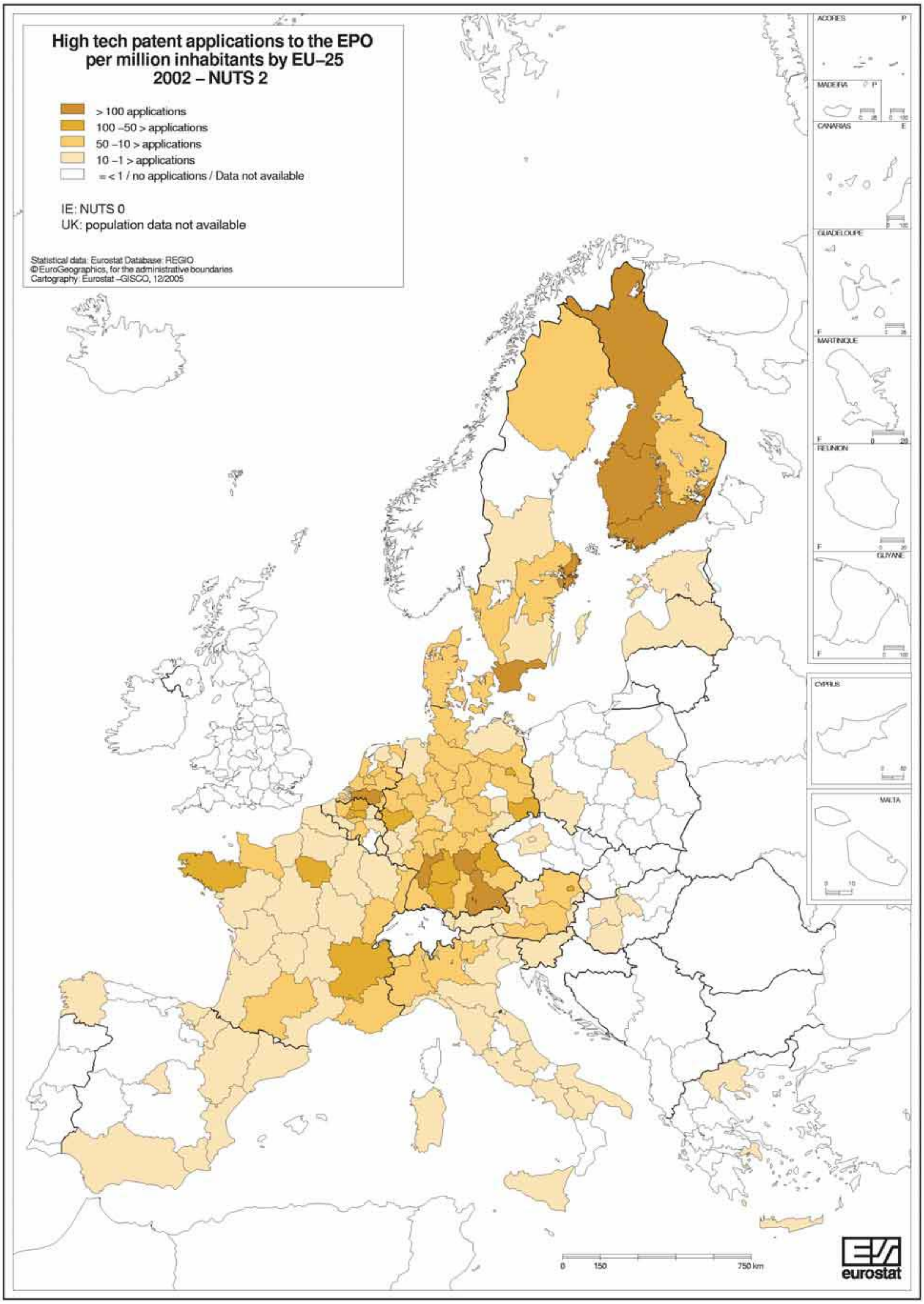
6

Figure 6.40 **Top fifteen EU-25 regions in terms of high-tech patent applications to the EPO, total number and per million inhabitants - 2002**



Map 6.41

High-tech patent applications to the EPO per million inhabitants by EU-25 region (NUTS 2) 2002



PART3

Chapter 7
High-tech industries and knowledge based services

7.1 Introduction

Creating, exploiting and commercialising new technologies is vital if a country is to stay competitive in the modern marketplace. This is because high-technology sectors are key drivers for economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment.

Firms which are technology-intensive are known as high-technology - or high-tech - firms. They are vital to the competitive position of nations because:

- They are associated with innovation and hence tend to gain a larger market share, create new product markets, and use resources more productively.
- They are linked to high value-added production and success in foreign markets, which helps to support higher returns to the workers they employ.
- The industrial R&D they perform has spill-over effects which benefit other commercial sectors by generating new products and processes, often leading to productivity gains, business expansion, and the creation of high-wage jobs.

This chapter analyses Europe's performance in high-technology industries and knowledge-intensive services by looking at statistics on enterprises (value added, labour productivity, etc.), venture capital investments, high-tech trade, employment and R&D personnel and expenditure.

Sub-chapter 7.2 looks at structural statistics on enterprises by analysing the performance of high-tech industry and knowledge-intensive service sectors in 2002. The indicators presented in this chapter are: value added, labour productivity, production value and gross investments.

Next, sub-chapter 7.3 presents Venture Capital Investment (VCI) both at the early stage and at the expansion and replacement stage. All data are for the reference year 2004.

Sub-chapter 7.4 goes on to describe the pattern of international high-tech trade, which makes up a considerable proportion of total trade in many advanced economies. The data generally cover the reference period 1994 to 2004. Data for the EU, Japan and the United States are compared. High-tech trade data include imports and exports from and to Member States and third countries as reported by the EU countries. The EU aggregated data refer to extra-EU trade, i.e. they exclude intra-EU trade. By contrast, data for individual EU Member States cover both intra- and extra-EU trade, unless otherwise stated.

Sub-chapter 7.5 analyses the employment situation in high-tech and knowledge-intensive sectors, at both national and regional levels. Covering the period 1999 to 2004, national data are provided for the EU-25 Member States, candidate countries, Iceland, Norway and Switzerland. Regional data are analysed at the NUTS 2 level.

Finally, sub-chapter 7.6 focuses on R&D in the high-tech manufacturing sectors. 2003 data are presented for the EU-25 Member States, candidate countries and Norway. Both R&D expenditure and R&D personnel data are shown.

For detailed definitions of high-tech products, high-tech industries and knowledge-intensive service sectors please refer to the methodological notes.

7.2 Enterprises in high-tech industries and knowledge-intensive services

Higher productivity per person employed in the high-tech manufacturing sector

In 2002, the EU-25 manufacturing sector generated a value added in excess of EUR 1 500 billion. With more than 25% of EU-25 value added, Germany was well ahead, followed by the United Kingdom, France and Italy (see Table 7.1).

In relative terms, labour productivity per person employed in the manufacturing sector reached EUR 45 000 in EU-25 and EUR 52 000 in EU-15. The highest labour productivity in the manufacturing sector as a whole was EUR 149 000 in Ireland.

In the high-tech manufacturing sector, labour productivity was EUR 63 000 for EU-25 and EUR 70 000 for EU-15, well above total manufacturing. This structural difference was true of all EU-25 Member States except Estonia, Luxembourg and Slovakia.

For high-tech manufacturing, Finland and Belgium had the highest labour productivity, with value added per person employed over EUR 100 000, respectively.

In medium-high-tech manufacturing the value added per person employed EU-25 was EUR 53 000. Leaving aside the Irish outlier (EUR 333 000, see also the methodological notes) all other Member States were below EUR 80 000.

The high-tech knowledge-intensive sector (KIS), consisting of post and telecommunication, computer services and R&D, created a value added of EUR 364 billion in 2002. The highest share was generated in the United Kingdom (almost EUR 91 billion), ahead of Germany (EUR 72 billion) and France (EUR 54 billion).

Labour productivity per person employed in the EU-25 high-tech KIS sector was EUR 65 000. The two leading countries were Ireland and Luxembourg, with EUR 136 000 and 115 000 respectively.

Table 7.1 **High-tech value added in million euro and labour productivity in thousand euro, in manufacturing and services sectors, EU-25 and selected countries - 2002**

Country	Manufacturing						Services			
	Total		High Technology		Medium High Technology		High Technology KIS		Market KIS	
	Value added Mio EUR	Labour Product. 1000s EUR	Value added Mio EUR	Labour Product. 1000s EUR	Value added Mio EUR	Labour Product. 1000s EUR	Value added	Labour Product. 1000s EUR	Value added Mio EUR	Labour Product. 1000s EUR
EU-25	1 533 907 s	45 s	195 521 s	63 s	476 155 s	53 s	363 823 s	65 s	834 462 s	46 s
EU-15	1 450 220 s	52 s	188 463 s	70 s	456 113 s	59 s	355 107 s	68 s	823 151 s	48 s
BE	44 271 (1)	65 (1)	5 761 (1)	104 (1)	13 652 (1)	76 (1)	9 261 (1)	67 (1)	18 526 (1)	44 (1)
CZ	18 120	13	1 316	15	5 885	14	2 701 (1)	23 (1)	3 099 (1)	9 (1)
DK	25 495	56	3 915 (1)	87 (1)	6 221	55	6 502	65	21 725	75
DE	401 497	55	43 734	63	177 389	62	71 669	68	194 638	56
EE	1 136	9	64 (2)	7 (2)	106 (2)	11 (2)	285	24	532	12
EL	8 371 (3)	34 (3)	519 (3)	37 (3)	1 203 (3)	34 (3)	:	:	:	:
ES	109 038	41	6 279	52	27 661	49	23 857	64	62 503	33
FR	207 984	52	35 419	68	57 687	58	53 966	59 (1)	127 401	48 (1)
IE	35 989	149	:	:	14 902	333	7 394	136	:	:
IT	203 014	42	19 340	56	53 925	47	42 982	65	69 250	34
CY	960	26	37	34	76	25	429	82	630	36
LV	1 635 (1)	11 (1)	:	:	140 (1)	9 (1)	491	21	479	8
LT	1 540	6	125	9	:	:	422	20	440	9
LU	2 309	67	75	37	301	64	1 211	115	2 063	48
HU	12 320	14	1 744	19	3 866	18	2 805	22	3 564	9
MT	808	25	354 (2)	72 (2)	58 (2)	26 (2)	230	49	557	37
NL	54 467	64	:	:	14 829	:	20 045	73	51 766	43
AT	37 516	59	3 706	69	10 637	67	6 973	65	17 794	61
PL	38 673	16	2 498	19	7 498	16	:	:	:	:
PT	18 208	20	1 065	39	3 280	27	4 053	74	7 070	22
SI	4 478	17	622	29	:	:	507	23	976	19
SK	4 018	10	207 (1)	9 (1)	1 236	10	846	18	1 035	15
FI	29 655	69	7 034	127	5 736	57	4 735	57	8 804	53
SE	43 364	55	6 518	62	:	:	11 506	54	26 926	54
UK	229 042 (1)	59 (1)	38 136 (1)	78 (1)	54 947 (1)	58 (1)	90 951	73	208 946	55
BG	1 795	3	146	6	398 (1)	3 (1)	783	12	321	3
RO	6 620	4	320	7	1 558	4	1 583	11	1 111	6

Exceptions to the reference year: (1)=2001, (2)=2000, (3)=1999.

An average enterprise in high-tech manufacturing generated a higher production value than an average enterprise in total manufacturing

Looking at production value per enterprise for both manufacturing and high-tech manufacturing gives a very varied picture of the situation in the individual Member States - Figure 7.2.

In 2002, an EU-25 manufacturing firm generated an average production value of EUR 2.5 million, whereas an enterprise in high-tech manufacturing achieved a value of EUR 4.4 million.

This relation confirms data calculated for labour productivity per person employed shown in Table 7.1.

At Member State level, though, Germany, Latvia, Luxembourg, Poland and Slovakia showed an inverse relation, with a higher average production value per enterprise in total manufacturing.

Malta (EUR 21 million), Finland (EUR 14.7 million) and Greece (EUR 12.2 million) were the countries with the highest production values per enterprise in high-tech manufacturing.

Structural Business Statistics

Structural Business Statistics describe the economy by observing the activity of units engaged in an economic activity. They answer such questions as:

- How much wealth is created in a particular economic activity?
- What workforce is needed to create this wealth?
- How is this economic activity developing?
- Is this activity playing a part in the growth of the economy?
- Is investment taking place in this activity?

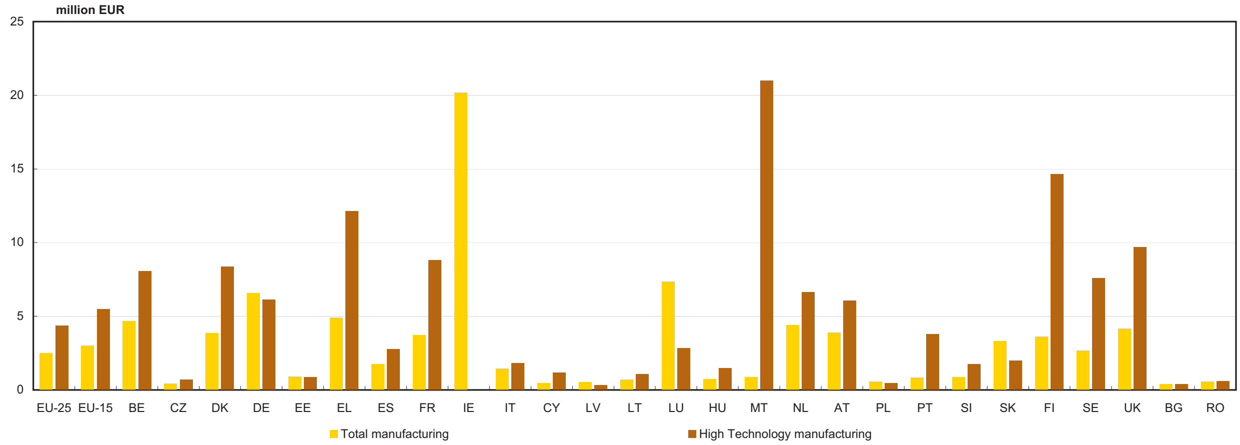
The main variables collected in the context of structural business statistics are:

- **Demographic variables** such as number of enterprises, etc.
- **"Input related"** variables such as number of employees, gross investment in tangible goods, etc.
- **"Output related"** variables such as turnover, production value, value added, etc.

Source: Eurostat, SDDS metadata.

7

Figure 7.2 **Production value per enterprise in million euro, total manufacturing and high-tech manufacturing, EU-25 and selected countries - 2002**



Exceptions to the reference year:
2001: BE, UK; DK and SK in HT,
2000: MT; EE in HT,
1999: LV,
1998: EL ,
1997: NL in HT.
Eurostat estimates: EU-15 and EU-25.

Investments in tangible goods are generally higher in the medium-high-tech manufacturing sector

Gross investment in tangible goods in the EU-25 manufacturing sector amounted to approximately EUR 235 billion in 2002.

Germany and Italy led the field, with EUR 52 billion and 35 billion respectively. They were followed by France and the United Kingdom, with close to EUR 32 billion in each case.

These four countries, together with Spain, accounted for more than 70% of EU-25 gross investment in tangible goods in total manufacturing.

An EU-25 manufacturing enterprise invested on average EUR 108 000 in tangible goods. In 2002, the level of investment was highest by far in Ireland, with EUR 770 000 (see also the methodological notes). Manufacturing enterprises in five other Member States invested more than EUR 200 000 in tangible goods: Germany, Slovakia, Belgium, Denmark and Austria.

In high-tech manufacturing, the highest absolute investment in tangible goods was recorded in the United Kingdom (EUR 5.9 billion), closely followed by Germany and France, with EUR 5.8 billion and 4.8 billion respectively.

Denmark was the leader in relative terms in high-tech manufacturing, with EUR 512 000 invested per enterprise. The United Kingdom ranked second with EUR 493 000 and Austria third with EUR 420 000.

With the exception of Poland, Slovakia and Bulgaria, gross investment in tangible goods per enterprise was higher in high-tech manufacturing than in total manufacturing. In a number of countries, the level of investment was also higher in medium-high-tech manufacturing.

In the high-tech KIS sector, the United Kingdom led again in absolute investment in tangible goods with EUR 17 billion, followed by France with EUR 12 billion and Germany with close to EUR 10 billion. Measured per enterprise, the level of investment was outstanding in Portugal and Cyprus, with EUR 497 000 and 419 000 respectively.

Austria, with EUR 181 000, led in terms of investment per enterprise in knowledge-intensive market services. In all other countries the average investment per enterprise was below EUR 100 000.

In all EU Member States apart from Austria, investment per enterprise was higher in high-tech KIS than in market KIS.

Table 7.3 **Gross investment in tangible goods, total in million euro and per enterprise in thousand euro, by sector, EU-25 and selected countries - 2002**

7

Country	Manufacturing						Services			
	Total		High Technology		Medium High Technology		High Technology KIS		Market KIS	
	Total mio EUR	by enterprise 1000s EUR	Total mio EUR	by enterprise 1000s EUR	Total mio EUR	by enterprise 1000s EUR	Total mio EUR	by enterprise 1000s EUR	Total mio EUR	by enterprise 1000s EUR
EU-25	235 420 s	108 s	:	:	:	:	:	:	:	:
EU-15	217 838 s	129 s	:	:	:	:	:	:	:	:
BE	8 483 (1)	223 (1)	671 (1)	349 (1)	2 637 (1)	679 (1)	2 362 (1)	214 (1)	7 116 (1)	87 (1)
CZ	4 228	27	256	28	1 738	65	1 496 (1)	79 (1)	1 486 (1)	8 (1)
DK	4 274	222	579 (1)	512 (1)	801	212	1 407	176	4 705	88
DE	52 073	265	5 847	302	24 564	840	9 641	183	36 371	73
EE	291	66	19 (2)	90 (2)	28 (1)	85 (1)	66	79	312	45
EL	:	:	:	:	:	:	:	:	:	:
ES	19 037	86	1 064	138	5 407	232	5 081	157	19 956	46
FR	32 701 (1)	131 (1)	4 754	294	8 685	335	12 340	269	25 342	57
IE	3 797	770	:	:	1 207	1 588	755	171	:	:
IT	34 914	64	2 642	76	8 745	123	8 710	89	14 005	17
CY	174	28	11	140	8	18	97	419	59	20
LV	383 (1)	77 (1)	:	:	27 (1)	67 (1)	178	195	269	20
LT	484	51	49	134	:	:	176	137	319	43
LU	:	:	:	:	:	:	:	:	:	:
HU	3 414	47	549	90	1 128	110	825	35	2 400	16
MT	139	37	:	:	10 (2)	58 (2)	67	99	53	8
NL	7 657	165	:	:	:	:	:	:	:	:
AT	5 712	207	694	422	1 359	419	1 430	118	9 559	181
PL	6 142	29	378	25	1 715	81	:	:	:	:
PT	3 980	51	186	161	667	116	1 458	497	3 629	62
SI	983	51	122	123	:	:	259	93	128	8
SK	1 343	239	47 (1)	115 (1)	504	471	295	275	275	50
FI	4 207	163	463	356	722	156	1 030	208	2 607	65
SE	6 768	124	947	282	:	:	2 736	97	13 709	87
UK	32 210 (2)	192 (2)	5 930 (2)	493 (2)	9 701 (2)	367 (2)	17 149	120	40 166	94
BG	994	39	38 (1)	33 (1)	154	50	348	107	256	13
RO	2 963	64	93	69	644	196	728	101	866	35

Exceptions to the reference year: (1)= 2001, (2)= 2000.

Medium-high-tech manufacturing leads in gross investment in machinery and equipment

Gross investment in machinery and equipment in manufacturing in the EU-25 amounted to almost EUR 182 billion in 2002. It therefore took the largest share of total investment in tangible goods.

Germany led the field, with nearly EUR 46 billion invested. Italy, the United Kingdom and France followed with around EUR 25 billion each.

Measured per manufacturing enterprise, Ireland ranked first, Greece second and Germany third, with EUR 481 000, 246 000 and 233 000 invested per enterprise respectively.

In terms of high-tech manufacturing, investment in machinery and equipment per enterprise was EUR 163 000 in EU-25, which is well above investment per enterprise in total manufacturing (EUR 92 000).

In absolute terms, Germany and the United Kingdom invested most in machinery and equipment in high-tech activities, with EUR 5.1and 4.4 billion respectively.

For EU-25, investment in machinery and equipment was highest in medium-high-tech manufacturing, where an average of EUR 244 000 per enterprise was spent. Outstanding countries in this respect were Ireland (EUR 964 000), Germany (EUR 755 000) and Belgium (EUR 586 000).

German medium-high-tech manufacturing enterprises were the biggest investors in machinery and equipment in absolute terms with EUR 22 billion. This represents more than 90% of those enterprises' total investment in tangible goods in Germany.

Table 7.4 **Gross investment in machinery and equipment, total in million euro and per enterprise in thousand euro, in the manufacturing sectors, EU-25 and selected countries - 2002**

Country	Total manufacturing		High Technology manufacturing		Medium High Technology manufacturing	
	Total Mio EUR	Per enterprise 1000s EUR	Total Mio EUR	Per enterprise 1000s EUR	Total (mio EUR)	Per enterprise 1000s EUR
EU-25	181 923 s	92 s	:	163 s	:	244 s
EU-15	172 899 s	103 s	:	182 s	:	280 s
BE	7 047 (1)	186 (1)	535 (1)	278 (1)	2 277 (1)	586 (1)
CZ	2 915	18	178	20	1 285	48
DK	2 905	151	439 (1)	387 (1)	545	144
DE	45 825	233	5 051	261	22 097	755
EE	161	37	6 (2)	29 (2)	12 (2)	31 (2)
EL	1 144 (4)	246 (4)	44 (4)	433 (4)	140 (4)	248 (4)
ES	15 267	69	871	113	4 738	203
FR	24 623 (3)	98 (3)	3 485 (3)	208 (3)	7 851 (3)	299 (3)
IE	2 375	481	:	:	733	964
IT	26 096	47	1 893	55	6 511	92
CY	136	22	5	58	6	14
LV	242 (2)	48 (2)	3 (3)	14 (3)	18 (2)	42 (2)
LT	187	20	8	22	:	:
LU	:	:	:	:	:	:
HU	2 469	34	402	66	892	87
MT	226 (2)	60 (2)	167 (2)	1 855 (2)	9 (2)	54 (2)
NL	6 298 (3)	136 (3)	552 (3)	193 (3)	2 030 (3)	320 (3)
AT	4 465	162	497	303	1 101	339
PL	:	:	:	:	:	:
PT	3 392	43	161	139	590	102
SI	681	35	81	81	:	:
SK	863	154	32 (1)	78 (1)	323	302
FI	3 238	125	386	297	555	120
SE	5 168	95	639	190	:	:
UK	25 821 (1)	156 (1)	4 370 (1)	368 (1)	8 048 (1)	310 (1)
BG	474 (2)	19 (2)	13 (2)	12 (2)	79 (2)	27 (2)
RO	1 910	41	71	52	386	117

Exceptions to the reference year:
(1) = 2001,
(2) = 2000,
(3) = 1999,
(4) = 1998.

7.3 Venture Capital Investment

Highest venture capital investment in Sweden and in the United Kingdom, both at the earlier stage and at the expansion and replacement stage

Venture capital investment (VCI) is defined as private equity raised for investment in companies (management buy-outs, management buy-ins; venture purchase of quoted shares is excluded). For smaller and medium-sized enterprises, having access to venture capital investment is regarded as crucial for their growth and employment.

The venture capital investment data are broken down into two investment stages: earlier stage, and expansion and replacement stage (please see also the methodological notes).

Venture capital investment at the earlier stage is made at the seed and start-up stages of a business, i.e. before or when a business is launched.

For EU-15, venture capital investment at the earlier stage amounted to 0.023% of GDP in 2004. However, the European average conceals major differences between Member States.

With 0.085% of GDP, Denmark was in 2004 the country where earlier-stage VCI was highest. It was closely followed by Sweden, with 0.083% of GDP. Both countries have well-developed venture capital markets.

All other countries showed ratios below 0.05% of GDP. Only three other Member States had an earlier-stage VCI above the EU-15 average (0.023%): France (0.025%), Portugal (0.027%) and Finland (0.027%).

The Czech Republic, Greece, Spain, Italy, the Netherlands, Austria and Slovakia reported early-stage venture capital investment ratios lower than 0.01% of GDP.

Figure 7.6 shows venture capital investment at the expansion and replacement stage expressed as a percentage of GDP. These investments support enterprises at a later stage of their business development. Expansion capital helps fund the growth and expansion of a company, which may or may not break even or trade profitably, whereas replacement capital means the purchase of existing shares in a company from another private equity investment organisation or from other shareholder(s).

In 2004, VCI at the expansion and replacement stage amounted to 0.09% of GDP in EU-15. This was three times higher than VCI at the earlier stage.

Again the differences between Member States were large. The United Kingdom was ahead, with 0.18% of GDP and a ratio twice as high as the EU-15 average.

Four other Member States were above or equal to the EU-15 average (0.09%): Sweden, Spain, Hungary and Portugal, with VCI at expansion and replacement stage of 0.16%, 0.15%, 0.12% and 0.09% of GDP respectively.

In 2004, VCI at the expansion and replacement stage was lower than 0.05% of GDP in the Czech Republic, Germany, Greece, Ireland, Italy, Austria, Slovakia and Switzerland.

Figure 7.5 **Venture capital investment at earlier stage as a percentage of GDP, EU-15 and selected countries - 2004**

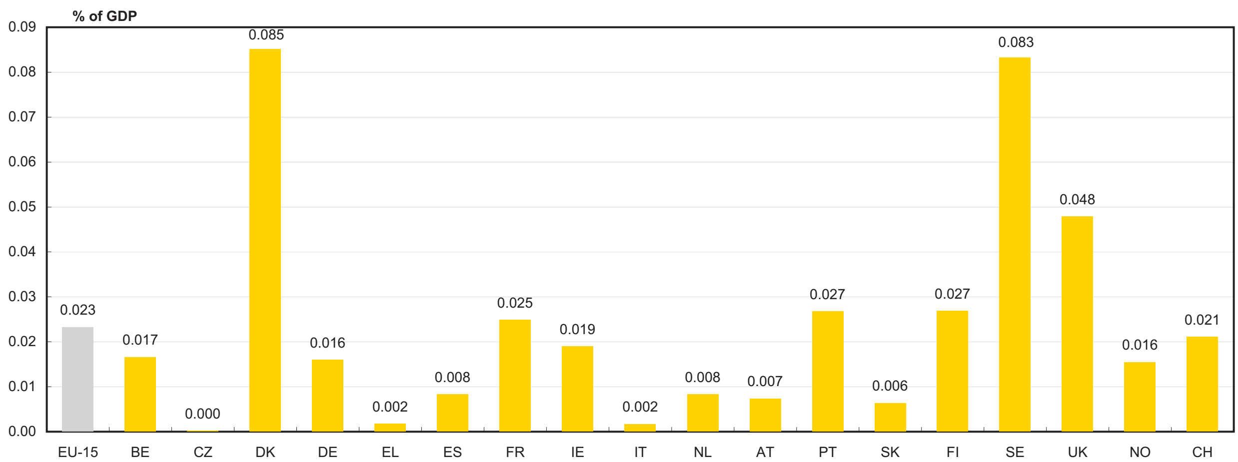
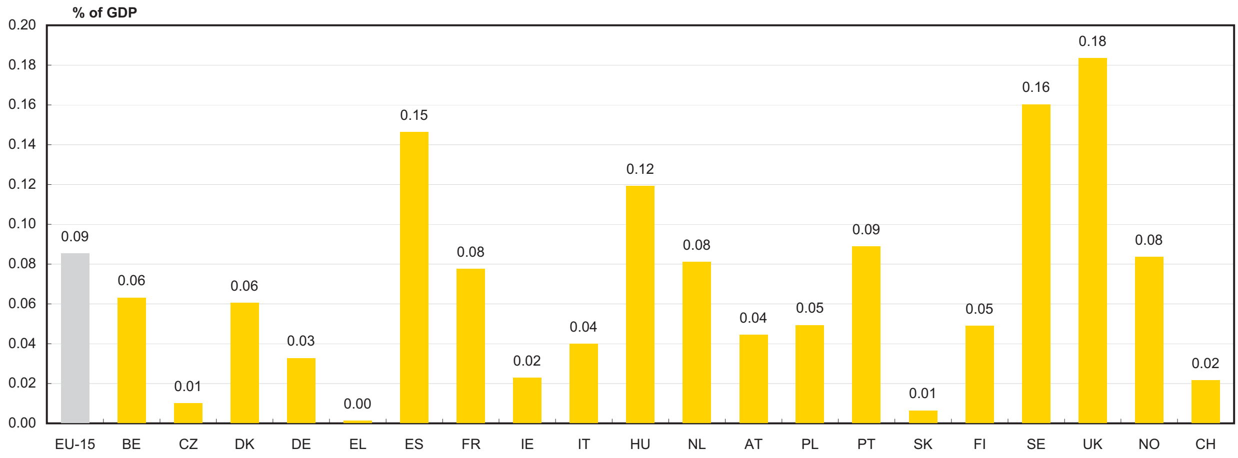


Figure 7.6 Venture capital investment at expansion and replacement stage as a percentage of GDP, EU-15 and selected countries - 2004



EVCA Public Policy priorities

The objective of the EVCA Public Policy Priorities is to recommend nine essential measures that policymakers can take at European, national and regional levels to provide a full "entrepreneurial and technological eco-system" through private equity and venture capital to help achieve the goals outlined in the EU Lisbon agenda.

Summary of recommendations

Foster Europe's entrepreneurial environment, culture and education:

I. Entrepreneurship through an adequate regulatory framework.
II.Entrepreneurship through Education and support programmes.

Boost innovation and research and development (R&D):

III. Innovation through a favourable environment for world class research in Europe.
IV. Innovation through a specific European status for Young Innovative Companies.
V. Innovation through an integrated, clear and efficient system for intellectual property rights.

Ease the raising and deployment of private equity and venture capital funds to drive a high-growth entrepreneurial economy:

VI. Enhance finance by enabling investors with an appropriate profile to invest in private eq-uity and venture capital without restrictions.
VII. Enhance finance by deploying public efforts to facilitate the economic environment in spe-cific sectors, stages or geographies.
VIII. Enhance finance through the creation of a specific pan-European fund structure for private equity and venture capital investment funds to facilitate cross-border investment deci-sions.
IX. Enhance finance through the emergence (preferably by mergers) of efficient integrated pan-European trading platform(s) and quoted market(s) for high-potential companies.

Source: EVCA, Public Policy Priorities 2005.

7

7.4 High-tech trade

Highest share of high-tech trade in Malta, Ireland and Luxembourg

Of the world's three leading economies, the United States achieved the highest share of high-tech exports related to the total exports.

In 2004, the respective ratios were 28.6%, 22.4% and 18.2% for the United States, Japan and EU-25 (see Figure 7.7).

During the period 1994 to 2004, high-tech exports as a share of total exports in the United States and in the European Union followed similar trends. From 1996 to 2000, the share exports increased. In the subsequent period, between 2000 and 2003, the ratio went down for both the United States and the European Union.

In Japan, the share of high-tech exports decreased between 1994 and 2004, from 24.5% to 22.4%.

Malta had in 2004 the highest share of high-tech trade, with exports of high-tech products accounting for 56% of total exports, whereas high-tech imports represented 33%.

Malta was followed by Ireland and Luxembourg. These three countries with Hungary were, in 2004, the only countries for which both high-tech exports and imports represented more than one fifth of the respective national total.

Moreover, for these countries the share of high-tech exports was higher than the share of high-tech imports. This was also the case for France, Cyprus, the Netherlands, Finland and the United Kingdom.

In absolute terms (Table 7.9), only eight EU-25 Member States had a positive balance of high-tech products: Germany, Ireland, France, Finland, Sweden, the Netherlands, Denmark and Malta.

Conversely, the high-tech trade balance was markedly unfavourable for Spain (EUR -12.8 billion), Italy (EUR -11.9 billion) and the United Kingdom (EUR -9.2 billion).

At the European level, the high-tech trade balance was also negative (EUR -38.5 billion). It should be noticed that EU-25 aggregates (imports, exports and balance) do not correspond to the sum of Member States since only extra European trade is taken into account.

At the European level, high-tech exports and high-tech imports grew between 1999 and 2004 at annual average rates of 4.9% and 3.4% respectively.

The highest growth rates of high-tech exports between 1999 and 2004 were in Cyprus (50.5%), the Czech Republic (31.1%) and Lithuania (21.1%). During the same period, high-tech exports decreased only in France, Ireland, Sweden and the United Kingdom.

With the exception of Ireland and Malta, high-tech imports rose for all Member States and candidate countries between 1999 and 2004.

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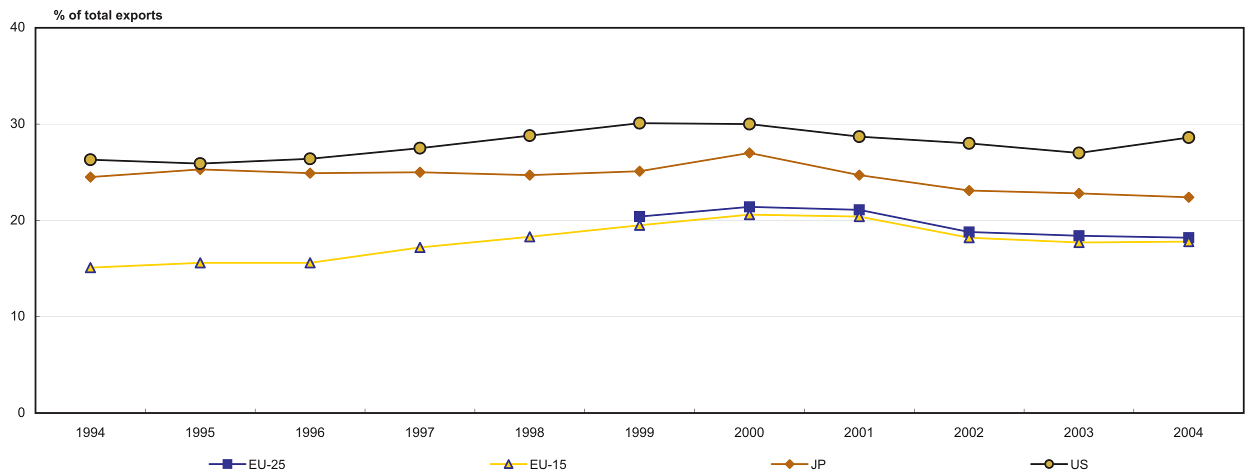
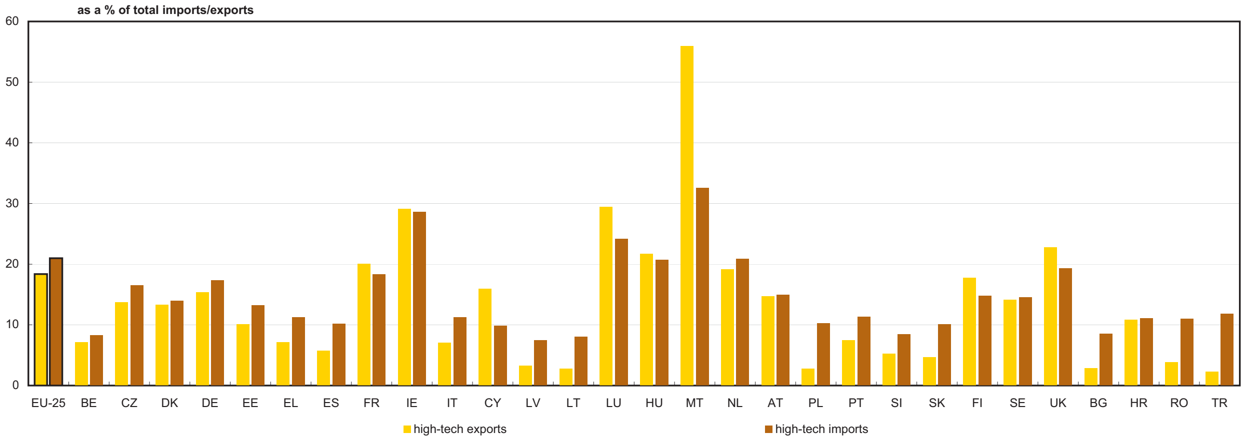
Figure 7.7 **High-tech exports as a percentage of total exports, EU-25, EU-15, Japan and the United States - 1994 to 2004**



EU-15 and EU-25 do not include intra-EU trade.

Figure 7.8

High-tech imports and exports as a percentage of total imports/exports, EU-25 and selected countries -2004



EU-25 does not include intra-EU trade.

Table 7.9

High-tech trade in 2004, in million euro and of which proportion of extra EU-25, and AAGR 1999-2004 of high-tech imports and exports, EU-25 and selected countries

	Imports			Balance	Exports		
	million euro	of which extra EU-25	AAGR 1999-2004	million euro	million euro	of which extra EU-25	AAGR 1999-2004
EU-25	**216 566**	**100**	**3.4**	**-38 508**	**178 058**	**100**	**4.9**
BE	18 890	34	5.0	-1 327	17 563	23	5.9
CZ	9 309	32	20.3	-1 732	7 577	18	31.1
DK	7 628	32	3.6	618	8 246	41	4.7
DE	99 899	54	6.1	12 420	112 318	41	9.2
EE	886	38	14.8	-406	480	13	16.0
EL	4 772	40	4.7	-3 896	876	33	9.1
ES	21 137	22	8.0	-12 763	8 374	35	7.5
FR	69 261	38	1.0	3 678	72 939	48	-0.1
IE	14 201	53	-2.2	10 294	24 496	40	-1.4
IT	32 068	34	3.8	-11 926	20 142	49	3.9
CY	437	30	7.4	-316	121	41	50.5
LV	425	22	12.0	-321	103	51	22.4
LT	798	25	21.1	-595	203	41	30.8
LU	3 886	75	13.0	-37	3 848	2	27.1
HU	10 095	55	19.1	-395	9 701	24	16.3
MT	959	40	-0.8	160	1 120	65	1.6
NL	53 645	71	3.6	1 232	54 877	22	4.1
AT	14 386	25	8.6	-360	14 026	33	13.8
PL	7 359	30	8.4	-5 712	1 648	30	23.2
PT	4 988	22	4.5	-2 832	2 156	58	16.4
SI	1 208	19	6.5	-524	684	59	17.8
SK	2 392	26	19.7	-1 369	1 023	14	25.0
FI	6 116	31	1.9	2 674	8 790	61	1.4
SE	11 704	31	1.4	2 307	14 010	58	-0.3
UK	72 870	53	0.9	-9 195	63 675	47	-1.8
BG	988	:	10.9	-759	229	:	24.3
HR	1 484	:	9.5	-786	699	:	13.7
RO	2 890	:	18.7	-2 171	720	:	24.2
TR	9 263	:	7.9	-8 116	1 147	:	5.3

EU-25 does not include intra-EU trade and therefore does not correspond to the sum of Member States.
Exception to the reference period: HR: 2002-2004.

7.5 Employment in high-tech industries and knowledge-intensive services

Performance at national level in Europe

Within EU-25, market services accounted for some two thirds (66.9%) of total employment, whereas manufacturing offered 18.7% of all jobs.

In 2004, high- and medium-high-tech manufacturing provided 6.8% of total employment in the EU market economy.

Approximately half of the employment in market services was in knowledge-intensive services (KIS). The other half was in the less knowledge-intensive services sector (LKIS).

The remaining jobs (14.3%) were in other sectors of the economy such as Agriculture, hunting and forestry; Mining and quarrying; Electricity, gas and water supply and construction.

Employment in services is however well above the EU average in four European countries, namely Luxembourg, Sweden, the United Kingdom and Norway, with ratios above 75%.

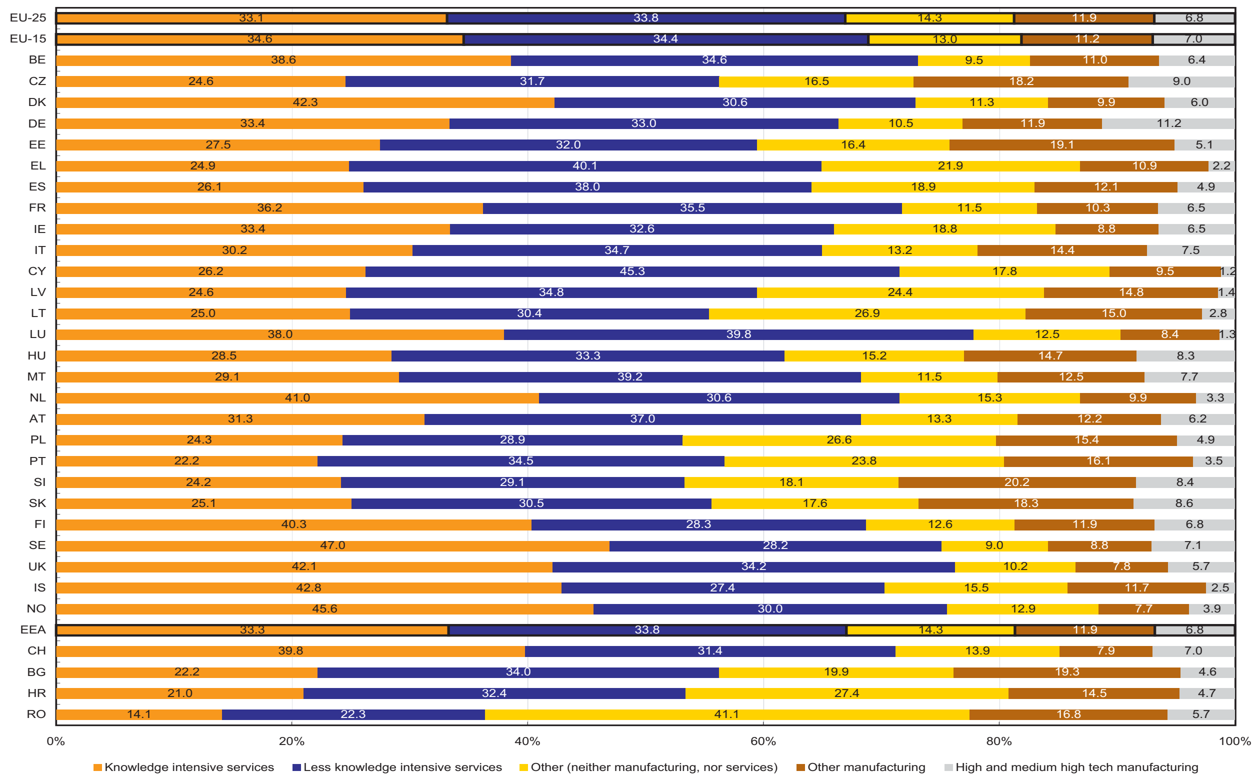
The knowledge-intensive services sector provided more than 40% of total employment in Sweden, Norway, Iceland, the United Kingdom, the Netherlands and Finland.

Manufacturing accounted for more than 20% of total employment in nine Member States (including seven new Member States) and two candidate countries: the Czech Republic, Germany, Estonia, Italy, Hungary, Malta, Poland, Slovenia, Slovakia and Bulgaria and Romania.

Employment in high- and medium-high-tech manufacturing exceeded 10% of total employment only in Germany (11.2%). The Czech Republic, Slovakia and Slovenia followed with ratios of 9.0%, 8.6% and 8.4% respectively.

Figure 7.10

Distribution of employment by sector as a percentage of total, EU-25 and selected countries - 2004



Eurostat estimates: EU-25, EU-15 and EEA.

Almost 20 million people employed in high-tech sectors within the EU in 2004

In 2004, almost 130 million people were employed in services in EU-25, whereas more than 36 million were employed in manufacturing.

Among the 36 million persons employed in manufacturing, 11 million were working in medium-high-tech manufacturing (5.7% of total employment) and more than 2.2 million in high-tech manufacturing (1.1% of the total).

Germany led in total manufacturing with 8.2 million people employed. Italy, France, the United Kingdom and Spain followed with 4.9, 4.1, 3.8 and 3.0 million employees respectively.

In medium-high-tech manufacturing too, most of the jobs were in Germany, with 3.3 million persons employed.

Of the 130 million jobs in services in EU-25, half were in knowledge-intensive services (KIS) and the other half in less knowledge-intensive services (LKIS).

Five countries were responsible for 68% of total EU-25 employment in services, namely: Germany, Spain, France, Italy and the United Kingdom.

In knowledge-intensive services, Germany and the United Kingdom led, both with approximately 12 million persons employed.

Around 5% of all services jobs in EU-25 were related to high-tech knowledge-intensive services such as post, telecommunication, computer or R&D services. Around 2.4 million of those jobs were located in the United Kingdom or in Germany.

In 2004, almost 20 million people were employed in all high-tech sectors (high- and medium-high-tech manufacturing plus high-tech KIS) in EU-25. Germany, with more than 5 million persons employed, was at the top of the country list. The United Kingdom, France, Italy and Spain also had more than one million persons employed in all high-tech sectors.

7

Table 7.11 **Total employment in thousand, in manufacturing and in services sectors, EU-25 and selected countries - 2004**

	Manufacturing			Total High Tech sectors (1)	Services			
	Total	High Tech	Medium high tech		Total	Knowledge intensive (KIS)	High Tech KIS	Less Knowledge intensive (LKIS)
EU-25	36 265 s	2 218 s	11 023 s	19 702 s	129 517 s	64 116 s	6 460 s	65 400 s
EU-15	29 845 s	1 914 s	9 550 s	17 216 s	113 408 s	56 862 s	5 752 s	56 546 s
BE	718	32	233	427	3 027	1 597	163	1 430
CZ	1 275	61	361	566	2 634	1 150	144	1 484
DK	434	27	137	276	1 998	1 160	112	838
DE	8 201	651	3 331	5 169	23 544	11 831	1 187	11 714
EE	144	11	20	45	354	164	14	190
EL	570	7	89	177	2 811	1 077	81	1 735
ES	3 035	92	776	1 321	11 448	4 659	453	6 790
FR	4 053	295	1 275	2 542	17 333	8 754	972	8 579
IE	280	50	69	185	1 212	614	66	598
IT	4 901	232	1 443	2 363	14 574	6 786	688	7 788
CY	36	:	3	11	241	88	7	152
LV	166	:	14	44	607	251	29	356
LT	255	12 u	28	68	796	359	28	437
LU	18	1 u	2	8	145	71	6	74
HU	895	101	222	439	2 406	1 109	116	1 298
MT	29	6	5	15	100	42	4	57
NL	1 055	54	208	599	5 743	3 290	337	2 453
AT	674	48	180	323	2 494	1 143	95	1 352
PL	2 772	69	600	961	7 274	3 324	292	3 949
PT	1 004	23	158	251	2 904	1 136	70	1 768
SI	270	10 u	69	103	504	228	24	276
SK	577	34	150	234	1 194	539	50	655
FI	445	46	116	271	1 637	962	109	676
SE	684	46	258	510	3 237	2 024	205	1 214
UK	3 774	310	1 276	2 794	21 299	11 761	1 208	9 537
IS	22	:	3	11	110	67	7	43
NO	263	12	77	177	1 718	1 037	89	682
EEA	36 549 s	2 231 s	11 103 s	19 891 s	131 345 s	65 220 s	6 556 s	66 125 s
CH	589	81	196	435	2 818	1 575	158	1 243
BG	709	13	124	218	1 670	659	81	1 011
HR	304	5 u	69	105	845	332	31	512
RO	2 089	38	490	668	3 376	1 306	139	2 070

(1) = High- and medium-high-tech manufacturing + High-tech KIS.

The manufacturing sectors

New Member States with highest share of female employment in manufacturing sectors

In EU-25 fewer than 30% of persons employed in manufacturing sectors were female. In every EU-25 Member State female employment in manufacturing was lower than 50%. This ratio was often higher in the new Member States than in the old ones. Only the EU candidate country Bulgaria had more female workers than male employed in manufacturing.

Countries where female employment in total manufacturing was highest were two of the Baltic countries: Lithuania (47.8%) and Estonia (47.5%).

By contrast, twelve EU-25 Member States had a female share of total manufacturing employment below 30%.

In medium-high-tech manufacturing, the share of female employment (at 23.7%) was even lower than in total manufacturing. Exceptions here are Ireland and Cyprus.

Cyprus led with a share of female employment in medium-high-tech manufacturing of above 50%.

The highest ratio of female employment was observed in high-tech manufacturing (35.6%). This was higher than for total manufacturing and for medium-high-tech manufacturing.

In high-tech manufacturing, significant female employment shares were again found in the new Member States (e.g. in Lithuania, Slovakia, the Czech Republic and Hungary) and in Luxembourg (70.7%).

Table 7.12 **Total employment in thousand and percentage of female employment, in the manufacturing sectors, EU-25 and selected countries - 2004**

	Total manufacturing		High tech manufacturing		Medium high tech manufacturing	
	Total	% of female	Total	% of female	Total	% of female
EU-25	**36 265 s**	**29.9 s**	**2 218 s**	**35.6 s**	**11 023 s**	**23.7 s**
EU-15	**29 845 s**	**28.2 s**	**1 914 s**	**33.3 s**	**9 550 s**	**22.5 s**
BE	718	24.1	32	30.1	233	23.6
CZ	1 275	38.7	61	51.9	361	33.6
DK	434	30.4	27	43.8	137	28.4
DE	8 201	28.2	651	34.3	3 331	21.7
EE	144	47.5	11	49.7	20	37.5
EL	570	27.7	7	:	89	18.4
ES	3 035	25.1	92	33.4	776	20.6
FR	4 053	30.5	295	35.3	1 275	25.8
IE	280	31.6	50	42.2	69	31.8
IT	4 901	29.5	232	34.3	1 443	22.8
CY	36	36.6	:	:	3	52.5
LV	166	42.5	:	:	14	34.9
LT	255	47.8	12 u	61.9 u	28	27.7
LU	18	18.8	1 u	70.7 u	2	:
HU	895	39.8	101	51.2	222	34.0
MT	29	23.0	6	43.5	5	:
NL	1 055	23.0	54	21.9	208	15.7
AT	674	27.1	48	39.9	180	22.2
PL	2 772	35.0	69	42.2	600	28.7
PT	1 004	42.2	23	47.7	158	31.3
SI	270	38.0	10 u	42.5 u	69	35.0
SK	577	39.9	34	54.6	150	31.4
FI	445	28.3	46	31.1	116	20.1
SE	684	25.3	46	29.8	258	22.7
UK	3 774	25.4	310	27.6	1 276	21.3
IS	22	35.4	:	:	3	:
NO	263	26.4	12	:	77	12.7
EEA	**36 549 s**	**29.9 s**	**2 231 s**	**35.5 s**	**11 103 s**	**23.6 s**
CH	589	28.1	81	34.0	196	22.5
BG	709	50.8	13	45.6	124	29.6
HR	304	36.8	5 u	: u	69	22.8
RO	2 089	47.9	38	44.9	490	32.8

High average employment growth rates in high- and medium-high-tech manufacturing in a number of new Member States

Figure 7.13 shows the proportion of employment in high- and medium-high-tech manufacturing and the annual average growth rate (AAGR) of this proportion between 1999 and 2004.

For EU-15, high- and medium-high-tech manufacturing provided 6.97% of total employment in 2004. This share decreased between 1999 and 2004 at an AAGR of -1.84%.

Four main groups of countries can be distinguished when combining employment share with AAGR. The first group can be seen as an 'average group'. In this group the shares of employment in high- and medium-high-tech manufacturing and the AAGR were quite close to EU-15 figures. This first group included such countries as Malta, Sweden, Switzerland, Finland, France, Ireland, Belgium, Austria, Denmark and Romania.

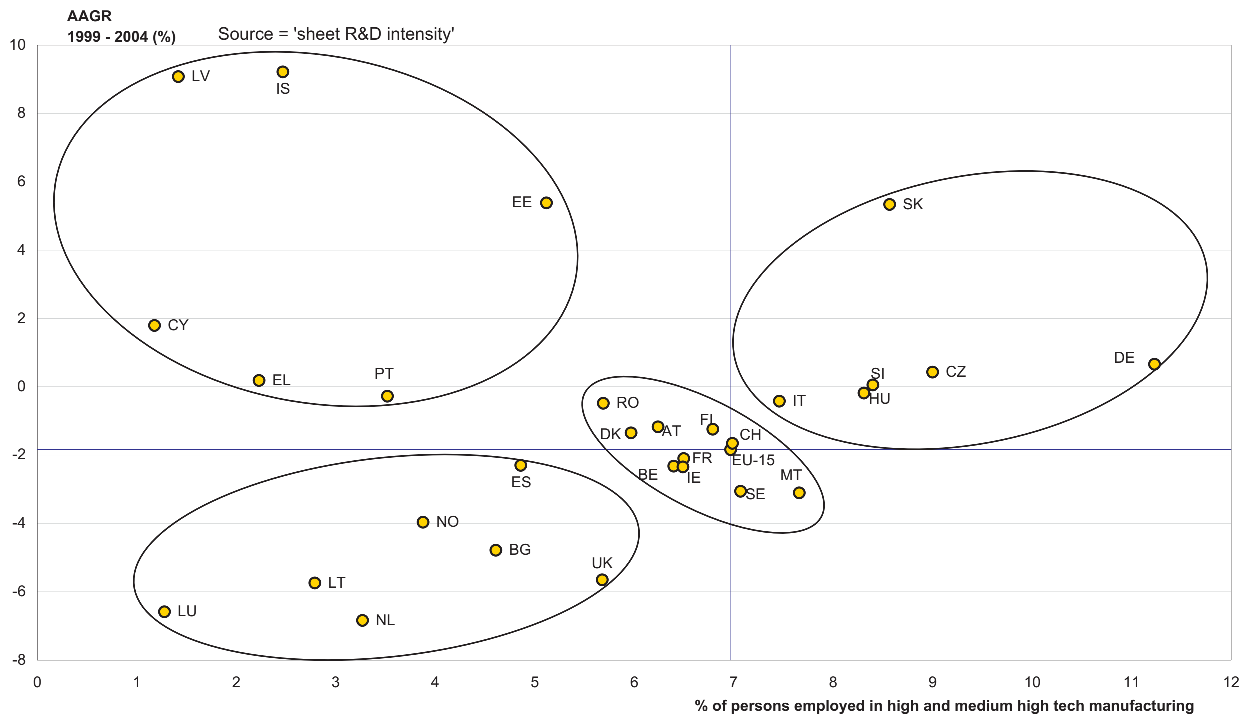
In the second group of countries, the share of employment in high- and medium-high-tech manufacturing was lower than the EU average, but the AAGR lay above the EU-AAGR. These countries were lagging behind, but they are closing the gap. They are: Estonia, Portugal, Greece, Iceland, Cyprus and Latvia.

The third group of countries can be considered as the leading group in terms of employment in high- and medium-high-tech manufacturing. The proportion of employment and the AAGR of these countries were both above the EU average. This group of countries comprised Germany, Czech Republic, Slovakia, Slovenia, Hungary and - marginally - Italy. Of these, Germany was the only Member State that had more than 10% of total employment in high- and medium-high-tech manufacturing.

The fourth and final group comprises countries where the proportion of employment in high- and medium-high-tech manufacturing and the AAGR were lower than the average. This was the case in the United Kingdom, Spain, Bulgaria, Norway, the Netherlands, Lithuania and Luxembourg.

Figure 7.13

Employment in high- and medium-high-tech manufacturing as a percentage of total employment in 2004, and annual average growth rate (AAGR) 1999-2004(1), EU-25 and selected countries



(1) Calculated on employment expressed as a percentage of total employment.
Exceptions to the reference period 1999-2004:
BG: 2000-2004,
MT: 2002-2004.
Eurostat estimates: EU-15.

Employment declining faster in high-tech manufacturing than in total manufacturing

Table 7.14 shows the trends in employment in high-and medium-high-tech manufacturing in absolute terms and the related annual average growth rates (AAGR) between 1999 and 2004.

Employment in total manufacturing between 1999 and 2004 decreased at an annual average growth rate (AAGR) of -1.2% in EU-15. However, it grew or remained stable during this period in Estonia, Greece, Spain, Italy and Slovakia. The AAGR even reached 3.5% in Estonia.

The EU Member State with the steepest employment decline in total manufacturing was the United Kingdom with an AAGR of -5.0% during the period 1999 - 2004.

For EU-15, employment in high-tech manufacturing also decreased between 1999 and 2004 at a rate of 2.0%.

Compared to total manufacturing, though, more Member States recorded an annual average growth of employment in high-tech manufacturing. These were Belgium, the Czech Republic, Germany, Estonia, Spain, Italy, Lithuania, Hungary, Malta, Portugal, Slovenia and Slovakia. The AAGR was even as high as 11.0% in Slovakia and 10.7% in Estonia.

By contrast, the Netherlands (-10.3%), Sweden (-8.3%) and the United Kingdom (-7.0%) were the Member States where employment in high-tech manufacturing fell most significantly between 1999 and 2004.

Medium-high-tech manufacturing is holding up best, with a loss of employment in the EU-15 countries of just 0.6% between 1999 and 2004. Several countries even managed to increase the number of jobs in these sectors, with Latvia returning an outstanding annual average growth rate of 11.3%.

Table 7.14 **Employment in high-tech and medium-high-tech manufacturing in thousand in 2004 and AAGR([1]) 1999-2004 of employment in manufacturing sectors, EU-25 and selected countries**

	Total employment in high and medium high tech manufacturing in thousands						AAGR 1999-2004 of total employment in manufacturing		
	1999	2000	2001	2002	2003	2004	Total	High Tech	Medium high tech
EU-25	:	:	:	:	:	13 242 s	:	:	:
EU-15	11 938 s	12 140 s	12 211 s	12 018 s	11 645 s	11 464 s	-1.2 s	-2.0 s	-0.6 s
BE	287 b	284	265	271	261	265	-0.6	1.7	-2.0
CZ	415	419	430	423	410	422	-0.5	1.8	0.1
DK	173	175	190	173	165	164	-3.3	-0.1	-1.3
DE	3 924	4 063	4 093	4 122	3 966	3 982	-0.9	0.8	0.2
EE	23	24	28	20	20	30	3.5	10.7	3.8
EL	87	87	87	87	87	96	0.0	-1.3	2.4
ES	792	825	874	869	871	867	1.9	0.8	2.0
FR	1 628	1 672	1 695	1 628	1 629	1 570	-0.9	-2.1	-0.4
IE	116	116	125	120	113	119	-0.8	-0.8	1.4
IT	1 570	1 596	1 586	1 603	1 637	1 675	0.1	1.7	1.2
CY	3	3	3	4	4	4	-0.4	:	5.6
LV	9	6	17 b	19	19	15	-1.0	:	11.3
LT	61	48	47 b	38	45	40	-1.9	3.6	-11.1
LU	3	4	2	2	3	2	-3.3	-1.1	-7.3
HU	318	307	337	328	324	324	-0.8	7.4	-2.1
MT	:	:	:	12	9	11	-3.9	3.6	-10.9
NL	355	350 b	346	332	324	262	-0.8	-10.3	-4.5
AT	243	249	240	246	230	228	-2.2	-6.4	0.4
PL	:	:	:	:	:	669	:	:	:
PT	173	181	181	169	162	181	-2.2	3.2	0.6
SI	74	78	80	85	80	79	-0.4	4.4	0.9
SK	141	143	143	173	173	184	1.1	11.0	4.5
FI	169	171	179	177	165	162	-1.1	-0.6	-0.9
SE	335	326	335 b	316	306	305	-1.9	-8.3	-0.4
UK	2 083	2 043	2 017	1 901	1 727	1 586	-5.0	-7.0	-4.9
IS	2	2	3	3	4	4	-1.0	:	6.7
NO	107	102	95	105	103	88	-3.0	-3.0	-3.9
EEA	:	:	:	:	:	13 335 s	:	:	:
CH	294	299	319	296	279	277	-1.1	-1.6	-1.0
BG	:	161	151 b	149	134	137	1.3	-5.8	-3.8
HR	:	:	:	:	65	74	0.3	-27.0	19.3
RO	642	543	531	537	499	529	-0.7	2.1	-4.2

([1]) Calculated on employment expressed in thousand.
Exceptions to the reference period: 2000-2004: BG, 2002-2004: MT, 2003-2004: HR.

Female employment up in medium-high-tech manufacturing

Table 7.15 shows the trend of female employment in high- and medium-high-tech manufacturing, together with the respective annual average growth rates (AAGR) between 1999 and 2004.

In total manufacturing, female employment decreased at the same annual rate as total employment (-1.2%). Only six EU Member States generated more female jobs in manufacturing: Belgium, Estonia, Spain, Cyprus, Latvia and Slovakia during the period 1999 - 2004.

For EU-15, female employment in high-tech manufacturing fell even more sharply between 1999 and 2004 (-1.5%). However, the rate of decline is lower than for total employment in high-tech manufacturing (-2.0%).

Some countries, though, managed to boost female jobs, the most successful ones being Slovakia (15.1%) and Spain (10.5%).

Within EU-25, medium-high-tech manufacturing was the only sector that experienced a growth of female employment during the observation period 1999 - 2004, with an annual rate of 0.7%. The most successful countries were here Cyprus and Latvia, with an AAGR of 10.7% in each case. Six other countries lost female employment in this sector, with the highest relative average loss in Lithuania (-14.8%).

Table 7.15 **Female employment in high-tech and medium-high-tech manufacturing in thousand in 2004 and AAGR(1) 1999-2004 of female employment in manufacturing sectors, EU-25 and selected countries**

	Female employment in high and medium high tech manufacturing in thousands						AAGR 1999-2004 of female employment in manufacturing		
	1999	2000	2001	2002	2003	2004	Total	High Tech	Medium high tech
EU-25	:	:	:	:	:	3 402 s	:	:	:
EU-15	2 764 s	2 846 s	2 935 s	2 903 s	2 728 s	2 787 s	-1.2 s	-1.5 s	0.7 s
BE	57 b	62	50	66	59	65	1.1	5.8	2.1
CZ	144	140	151	150	146	153	-1.0	3.3	0.7
DK	54	54	60	55	49	51	-4.5	3.0	-2.2
DE	925	949	973	977	933	947	-1.0	0.4	0.5
EE	9	8 u	11	12	10 u	13	4.3	5.2	8.7
EL	17	18	16	18	15	18	-2.0	:	2.5
ES	127	162	184	193	173	190	4.0	10.5	8.0
FR	432	450	448	451	418	433	-0.5	-2.8	1.0
IE	44	44	47	45	41	43	-0.6	-2.9	2.2
IT	350	358	387	364	388	408	-0.1	4.2	2.9
CY	1 u	1 u	1 u	2	2	2	0.1	:	10.7
LV	3 u	:	6 b	5 u	6	6	0.2	:	10.7
LT	23	20	19 b	12	18	15 u	-3.2	6.6	-14.8
LU	1 u	1 u	1 u	1 u	1 u	1 u	-0.3	:	:
HU	102	111	125	120	118	127	-1.1	10.7	1.4
MT	:	:	:	4	2 u	3	-15.9	-2.5	:
NL	64	62 b	56	57	56	45	-0.4	-11.1	-5.0
AT	57	59	60	57	56	59	-1.5	3.2	-0.1
PL	:	:	:	:	:	201	:	:	:
PT	62	60	70	63	46	60	-3.4	2.3	-1.1
SI	26	28	31	33	31	29	-1.0	6.0	1.4
SK	48	50	49	64	60	66	0.7	15.1	3.9
FI	40	40	47	44	41	38	-2.4	-3.2	0.5
SE	81	79	86 b	81	74	73	-2.1	-12.4	1.8
UK	455	446	451	428	378	357	-5.9	-8.2	-3.4
IS	:	:	:	:	:	1	-1.0	:	:
NO	18	18	17	19	18	12	-2.5	:	-6.2
EEA	:					3 415 s			
CH	77	81	83	73	69	72	0.0	-2.6	-0.6
BG	:	56	53 b	52	45	43	3.2	-4.9	-6.7
HR	:	:	:	:	17 u	18 u	-5.9	:	12.3
RO	199	169	167	176	164	178	0.8	11.2	-3.2

(1) Calculated on employment expressed in thousand.
Exceptions to the reference period:
2000-2004: BG,
2002-2004: MT,
2003-2004:HR.

The services sectors

Female employment share lower in knowledge-intensive services than in total services

In the EU-25 countries, 60.1% of persons employed in all services were female. This is about twice as high as the percentage of female jobs in total manufacturing.

Malta was the only EU Member State to employ fewer women than men in services, with a rate of 45.7%. On the other side of the coin, this share was at 71.7% - highest in Lithuania, followed by seven other new Member States.

In all Member States and also at EU-25 level, the share of female employment was, however, lower in knowledge-intensive services (KIS) and lower still in the high-tech KIS sector, with ratios of 53.4% and 33.8% respectively.

Women were quite well represented in the knowledge-intensive services workforce in Finland and Lithuania, with shares of 59.0% and 58.7% respectively in 2004.

These countries were followed by Estonia and Latvia, each recording 58.5%. Greece, Italy, Luxembourg, Malta and Sweden were, however, below the 50% female employment threshold.

Of the EU-25 countries, only Latvia employed more women (53.9%) than men in high-tech knowledge-intensive services. After Latvia, the Czech Republic and Slovakia had the highest ratio of 47.7% in each case. Only five other countries had a female share above 40%: Estonia, France, Lithuania, Hungary and Poland.

On the other hand, the Netherlands, Luxembourg, Belgium, the United Kingdom and Austria had relatively low female employment shares in high-tech KIS.

Table 7.16 **Total employment in thousand and percentage of female employment in the services sectors, EU-25 and selected countries - 2004**

	Total		Knowledge intensive (KIS)		High tech KIS	
	Total	% of female	Total	% of female	Total	% of female
EU-25	**129 517 s**	**60.1 s**	**64 116 s**	**53.4 s**	**6 460 s**	**33.8 s**
EU-15	**113 408 s**	**59.3 s**	**56 862 s**	**53.0 s**	**5 752 s**	**32.4 s**
BE	3 027	59.0	1 597	51.6	163	26.0
CZ	2 634	65.2	1 150	54.4	144	47.7
DK	1 998	63.5	1 160	54.8	112	37.2
DE	23 544	60.5	11 831	55.1	1 187	33.3
EE	354	65.5	164	58.5	14	45.6 u
EL	2 811	51.9	1 077	44.2	81	32.9
ES	11 448	56.1	4 659	50.9	453	36.8
FR	17 333	60.7	8 754	54.5	972	40.3
IE	1 212	60.9	614	54.3	66	29.6
IT	14 574	55.3	6 786	47.5	688	31.2
CY	241	58.2	88	52.2	7	34.7
LV	607	69.1	251	58.5	29	53.9
LT	796	71.7	359	58.7	28	43.1 u
LU	145	52.9	71	47.9	6	25.4
HU	2 406	64.8	1 109	55.1	116	41.9
MT	100	45.7	42	35.4	4	:
NL	5 743	58.2	3 290	52.2	337	23.9
AT	2 494	58.3	1 143	54.2	95	26.2
PL	7 274	66.2	3 324	55.8	292	45.7
PT	2 904	62.9	1 136	54.5	70	34.8
SI	504	64.2	228	55.4	24	37.3 u
SK	1 194	66.9	539	57.3	50	47.7
FI	1 637	66.1	962	59.0	109	39.4
SE	3 237	64.3	2 024	56.9	205	35.2
UK	21 299	59.8	11 761	54.5	1 208	26.2
IS	110	64.0	67	57.5	7	39.1
NO	1 718	62.6	1 037	56.5	89	31.0
EEA	**131 345 s**	**60.1 s**	**65 220 s**	**53.4 s**	**6 556 s**	**33.8 s**
CH	2 818	54.9	1 575	52.5	158	29.3
BG	1 670	64.3	659	52.6	81	50.4
HR	845	61.3	332	53.0	31	36.1 u
RO	3 376	64.2	1 306	52.0	139	50.4

7

Higher proportion of KIS employment in northern European countries, lower proportion in new Member States

Figure 7.17 reveals the proportion of employment in knowledge-intensive services and the annual average growth rate (AAGR) of this proportion between 1999 and 2004.

At EU-15 level, knowledge-intensive services accounted for 33.1% of total employment in 2004. This share increased between 1999 and 2004 at an AAGR of 1.55%.

Three main groups of countries can be distinguished when we take a combined look at the share of total employment and the AAGR in the observation period 1999-2004. These groups differ mainly according to the proportion of employment in KIS. The AAGR by contrast is less varied.

The first group can be seen as an 'average group'. The share of employment in KIS is fairly similar to the EU-15 figure, with ratios between 30% and 40%. AAGR can be as high as 3% (e.g. for Italy).

The second group of countries has a higher proportion of employment in knowledge-intensive services compared to the EU-15 average in 2004. Most of the countries even had ratios of above 40%.

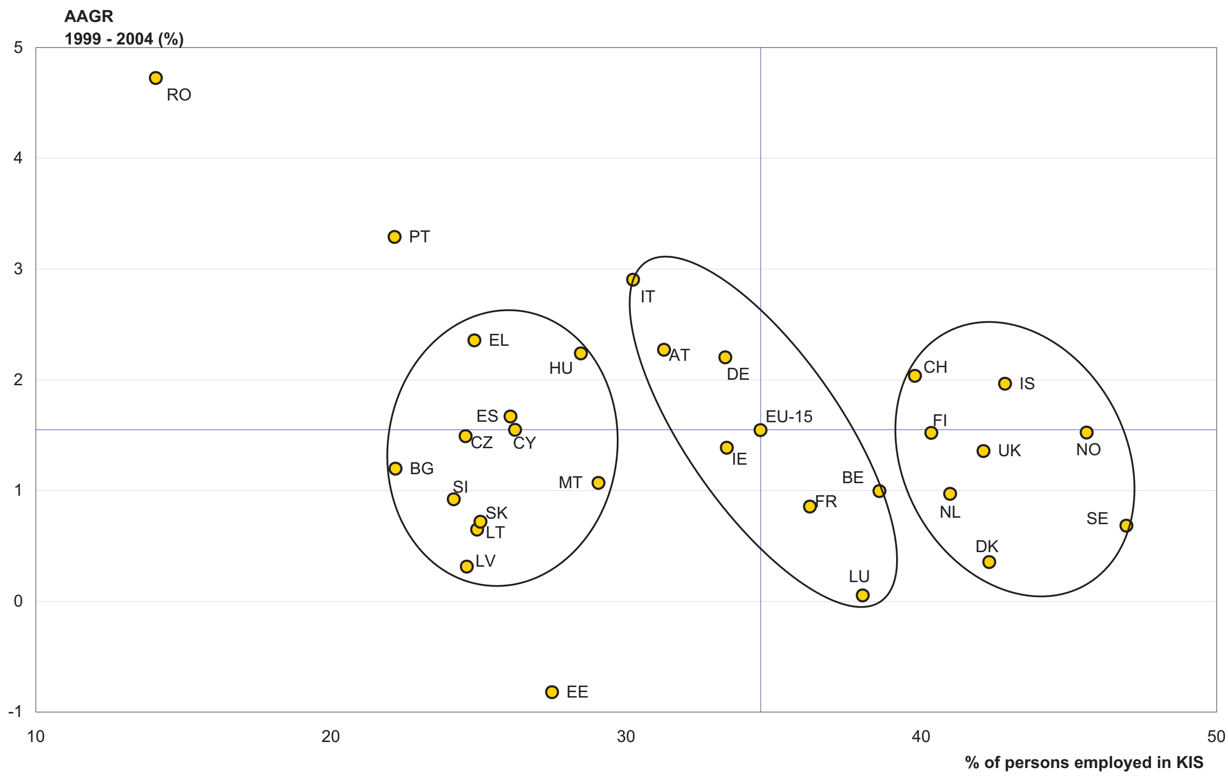
Countries in this group are the Scandinavian countries plus the Netherlands, the United Kingdom and Switzerland.

For the last group of countries the proportion of employment in KIS was lower than the EU-15 average and also below 30%.

Countries in this group are mainly new Member States plus Greece and Spain.

Romania and Portugal had the least developed knowledge-intensive services sector, albeit with high annual average growth rates of 4.7% and 3.3% respectively.

Figure 7.17 **Employment in KIS as a percentage of total employment in 2004, and annual average growth rate (AAGR) 1999-2004([1]), EU-25 and selected countries**



([1]) Calculated on employment expressed as a percentage of total employment.
Exceptions to the reference period 1999-2004:
2000-2004: BG,
2002-2004: MT observable.
Eurostat estimates: EU-15.

Employment rising faster in knowledge-intensive services than in total services, and even more so in high-tech knowledge-intensive services

For EU-15, employment in all services increased at an AAGR of 1.9% between 1999 and 2004. The knowledge-intensive services sector grew faster, with an annual average growth rate of 2.6%. High-tech knowledge-intensive services - a KIS subgroup - grew at an even faster 2.9%.

The number of jobs in all services increased most in Spain (5.0%), Ireland (4.0%) and Cyprus (4.7%). Only Lithuania recorded a decline (-1.1%) during the observation period.

Employment in knowledge-intensive services increased at an AAGR of 6.0% or more in Spain and Cyprus. These countries were followed by Italy and Portugal.

Looking at the EU-15 aggregate, the highest overall average employment growth rates in services were recorded in high-tech KIS. Nevertheless, a number of countries suffered employment declines in those activities between 1999 and 2004. These were the Czech Republic, Denmark, Estonia, Lithuania, Luxembourg, Malta, Austria and Slovakia.

Table 7.18 **Employment in KIS in thousand in 2004 and AAGR(1) 1999-2004 of employment in services sectors, EU-25 and selected countries**

	Total employment in knowledge intensive services (KIS) in thousands						AAGR 1999-2004 of total employment in services		
	1999	2000	2001	2002	2003	2004	Total	KIS	High tech KIS
EU-25	:	:	:	:	:	64 116 s	:	:	:
EU-15	49 938 s	51 397 s	53 104 s	54 257 s	54 883 s	56 862 s	1.9 s	2.6 s	2.9 s
BE	1 464 b	1 516	1 538	1 531	1 588	1 597	1.1	1.7	4.8
CZ	1 076	1 124	1 135	1 130	1 151	1 150	0.6	1.3	-0.2
DK	1 125	1 144	1 161	1 205	1 169	1 160	1.2	0.6	-1.7
DE	10 797	11 031	11 330	11 536	11 852	11 831	0.6	1.8	3.2
EE	166	153	161	179	186	164	0.4	-0.3	-1.2
EL	872	875	892	898	989	1 077	3.5	4.3	6.0
ES	3 483	3 756	3 952	4 148	4 386	4 659	5.0	6.0	7.8
FR	7 814	8 019	8 295	8 485	8 231	8 754	2.1	2.3	2.4
IE	497	529	548	584	598	614	4.0	4.3	0.7
IT	5 404	5 581	5 756	5 973	6 051	6 786	2.6	4.7	4.2
CY	66	70	77	83	88	88	4.7	6.1	12.7
LV	241	240	238 b	245	241	251	1.3	0.8	6.1
LT	390	400	397 b	351	357	359	-1.1	-1.7	-3.8
LU	67	64	66	72	72	71	1.7	1.2	-0.8
HU	965	1 009	1 006	1 023	1 097	1 109	1.6	2.8	2.1
MT	:	:	:	42	43	42	0.6	0.0	-8.7
NL	2 970	3 083 b	3 222	3 168	3 395	3 290	1.4	2.1	4.3
AT	1 028	1 036	1 082	1 124	1 118	1 143	1.2	2.1	-0.6
PL	:	:	:	:	:	3 324	:	:	:
PT	910	958	989	1 007	1 024	1 136	2.9	4.5	3.7
SI	205	203	210	211	217	228	2.1	2.2	4.3
SK	515	510	536	507	524	539	0.6	0.9	-3.2
FI	873	898	940	944	954	962	1.3	2.0	1.9
SE	1 840	1 886	2 002 b	2 045	2 055	2 024	2.1	1.9	1.2
UK	10 793	11 054	11 365	11 552	11 400	11 761	1.5	1.7	1.1
IS	59	61	65	66	68	67	1.4	2.7	3.2
NO	952	960	993	1 015	1 009	1 037	0.9	1.7	0.2
EEA	:	:	:	:	:	65 220 s	:	:	:
CH	1 389	1 401	1 484	1 464	1 544	1 575	1.5	2.5	1.6
BG	:	608	637 b	621	634	659	2.0	2.0	3.1
HR	:	:	:	:	318	332	4.0	4.5	-5.5
RO	1 231	1 181	1 188	1 254	1 219	1 306	1.2	1.2	-2.2

(1) Calculated on employment expressed in thousand.
Exceptions to the reference period:
2000-2004: BG,
2002-2004: MT,
2003-2004: HR.

Female employment increasing faster in knowledge-intensive services than in all services

Female employment in all services in the EU-15 increased at an annual average growth rate of 2.5% between 1999 and 2004. Growth was even more marked in knowledge-intensive services (3.0%), but the rate for high-tech KIS was more or less the same as for all services.

Moreover, female employment in all services rose at a faster rate than in total services employment (2.5% as against 1.9%). On the other side of the coin, total employment in high-tech KIS (2.9%) increased faster than the female employment in that sector (2.6%).

Two countries shed female services jobs between 1999 and 2004: Lithuania (-0.6%) and Malta (-0.9%).

On the other hand, Cyprus and Spain returned fairly high AAGR for employment in services between 1999 and 2004, with rates of 7.6% and 6.7% respectively.

Both were also the countries with the highest relative increase in female employment in KIS and in high-tech KIS.

For EU-15, female employment increased faster in KIS than in all services. Three countries, however, lost jobs in knowledge-intensive services: Lithuania, Malta and Estonia.

In the narrower high-tech KIS, female employment between 1999 and 2004 deteriorated in eight EU Member States: Lithuania, Slovakia, Estonia, Luxembourg, the Netherlands, Hungary, Austria and the Czech Republic. Norway and the EU candidate countries likewise had to cope with a similar development.

Table 7.19 **Female employment in KIS in thousand in 2004 and AAGR(1) 1999-2004 of female employment in services sectors, EU-25 and selected countries**

	Female employment in knowledge intensive services (KIS) in thousands						AAGR 1999-2004 of female employment in services		
	1999	2000	2001	2002	2003	2004	Total	KIS	High tech KIS
EU-25	:	:	:	:	:	38 522 s	:	:	:
EU-15	29 060 s	29 969 s	30 975 s	31 719 s	32 538 s	33 738 s	2.5 s	3.0 s	2.6 s
BE	842 b	884	877	874	922	941	1.4	2.3	1.2
CZ	711	742	734	735	750	750	0.3	1.1	-0.3
DK	702	707	737	754	731	736	1.2	1.0	2.5
DE	6 523	6 653	6 847	6 923	7 159	7 155	0.8	1.9	2.4
EE	110	108	111	117	115	107	0.4	-0.6	-3.6
EL	439	450	459	464	513	559	4.4	5.0	8.7
ES	1 816	1 989	2 141	2 278	2 434	2 613	6.7	7.6	12.3
FR	4 654	4 797	4 914	5 046	5 020	5 310	2.5	2.7	2.6
IE	289	309	327	351	361	374	4.6	5.3	0.0
IT	2 799	2 919	3 027	3 202	3 310	3 752	4.4	6.0	3.9
CY	36	40	43	47	51	51	7.6	7.5	20.4
LV	159	160	167 b	173	165	174	2.3	1.7	6.0
LT	278	286	292 b	254	259	257	-0.6	-1.6	-8.1
LU	34	34	35	39	39	37	2.1	2.0	-1.4
HU	637	657	653	667	711	718	1.7	2.4	-0.6
MT	:	:	:	20	20	19	-0.9	-0.6	:
NL	1 672	1 729 b	1 830	1 811	1 953	1 913	2.5	2.7	-1.3
AT	609	618	643	681	677	666	1.2	1.8	-0.5
PL	:	:	:	:	:	2 201	:	:	:
PT	571	597	617	654	663	714	3.4	4.6	4.3
SI	134	129	132	132	137	147	2.2	1.7	6.1
SK	356	347	374	344	355	361	0.4	0.2	-5.1
FI	579	591	619	620	629	636	1.4	1.9	2.5
SE	1 210	1 216	1 279 b	1 302	1 322	1 302	1.9	1.5	0.8
UK	6 321	6 496	6 644	6 731	6 805	7 029	1.8	2.1	0.1
IS	38	40	42	42	44	43	1.8	2.5	2.1
NO	612	610	619	640	635	648	0.9	1.2	-3.8
EEA	:	:	:	:	:	39 214 s	:	:	:
CH	752	778	814	817	850	865	1.6	2.8	-3.0
BG	:	419	424 b	411	416	424	1.5	0.3	-0.5
HR	:	:	:	:	204	204	5.3	-0.1	-19.6
RO	807	793	777	803	778	839	1.2	0.8	-4.5

(1) Calculated on employment expressed in thousand.
Exceptions to the reference period:
2000-2004: BG,
2002-2004: MT,
2003-2004: HR.

Performance at regional level in Europe

The manufacturing sectors

German regions top the high- and medium-high-tech manufacturing chart

Figure 7.20 shows the regional disparities in employment in high-tech and medium-high-tech manufacturing in the EU in 2004, presented in terms of share of employment taken by high-tech and medium-high-tech manufacturing in total regional employment. For each country, the national average, the region with the lowest share and the region with the highest share are displayed.

In 2004, the percentage of employment taken by high-tech and medium-high-tech manufacturing ranged from 0.8% in Canarias (ES) to 22.2% in Stuttgart (DE).

None of the countries shown had all its regions above the EU-25 average of 6.84%. However, the Czech Republic, Germany, Italy, Hungary, Malta, Slovenia, Slovakia, Finland and Sweden had their national average higher than the EU-25 average. This was also the case for Switzerland.

For a number of countries the proportion of employment in high- and medium-high-tech manufacturing of all regions was consistently below the EU-25 average. Those countries are Greece, Ireland, the Netherlands and Portugal, as well as Norway and Bulgaria.

Regional disparities in high- and medium-high-tech manufacturing were largest in Germany, France, Hungary, Italy and Spain. These countries also had the regions recording the highest percentage of employment in these sectors: Stuttgart (22.2%), Franche-Comté (16.0%), Közép-Dunántúl (14.4%), Piemonte (12.1%) and Comunidad Foral de Navarra (10.7%).

By contrast, in Ireland, Portugal and to a lesser extent in Greece, regional disparities in high- and medium-high-tech manufacturing were only minor.

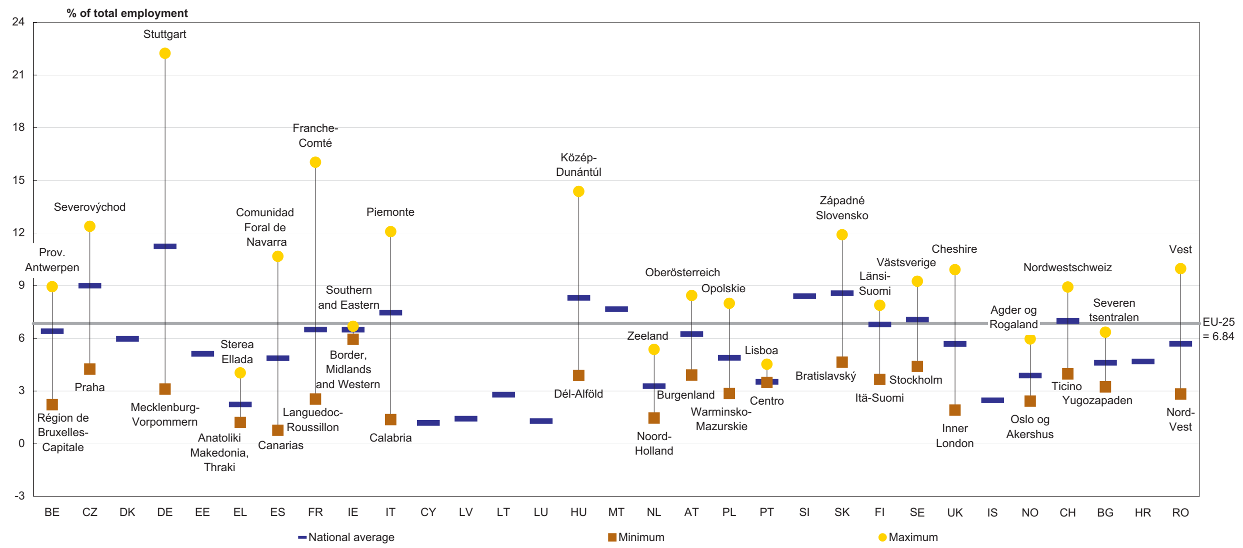
In 2004, the proportion of employment in high- and medium-high-tech manufacturing was under 3% in the lowest ranking regions of Belgium, Greece, Spain, France, Italy, the Netherlands, Poland, the United Kingdom, Norway and Romania.

Map 7.21 sets out the share of employment taken by high-tech and medium-high-tech manufacturing in 2004 across the EU-25 regions, candidate countries, Iceland, Norway and Switzerland at the NUTS 2 level.

Regions specialised in high-tech and medium-high-tech manufacturing sectors are highly concentrated in Germany.

Other regions from other EU-25 countries also showed a high proportion of employment in high- and medium-high-tech manufacturing: Franche-Comté (FR), Severovýchod (CZ), Piemonte (IT) and Západné Slovensko (SK).

Figure 7.20 Regional range of employment in high- and medium-high-tech manufacturing, as a percentage of total employment, EU-25 and selected countries - 2004



Map 7.21

Employment in high-tech and medium-high-tech manufacturing as a percentage of total employment, EU-25, Iceland and Norway - 2004

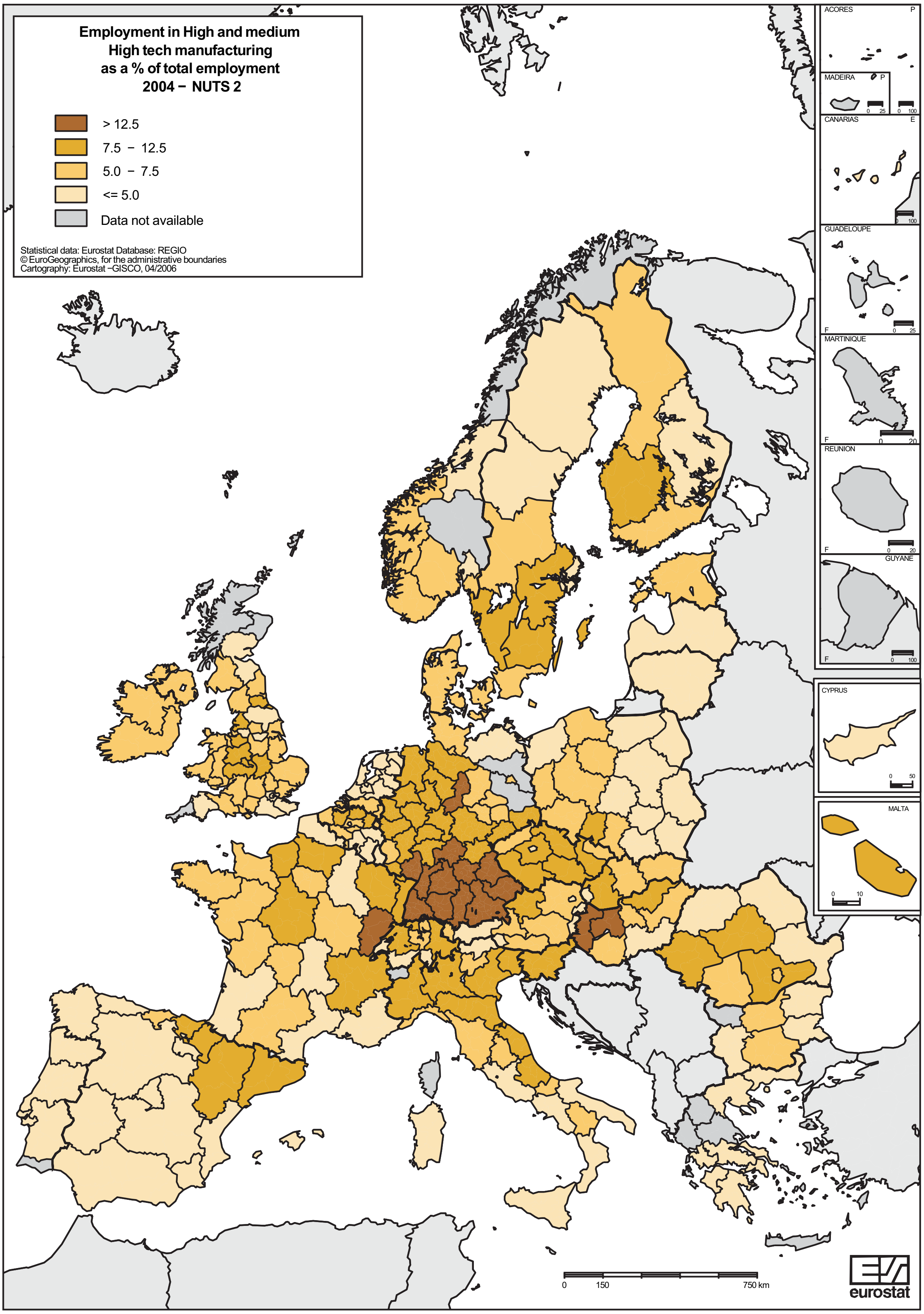


Figure 7.22 shows the leading regions in terms of employment in high- and medium-high-tech manufacturing in 2004, both in absolute (1000s) and in relative terms (as a percentage of the total employment).

In 2004, the leading region in terms of absolute employment was Lombardia (IT) with 444 000 persons employed in high- and medium-high-tech manufacturing. This Italian region was followed by two German regions: Stuttgart and Oberbayern, with 415 000 and 280 000 persons employed, respectively.

Among the fifteen leading regions in terms of absolute jobs held, seven were German, four Italian, two French and one was Spanish. Denmark (the entire country is classified at NUTS 2 level) was the 14th leading region in absolute terms.

Looking at Denmark in relative terms, the proportion in high- and medium-high-tech employment was only 6.0% of the total employment. The same occurred for the region Île de France (FR), which ranked as fourth region in absolute terms, but had a share of 5.4% of total employment in relative terms. Île de France was however also the first region in terms of employment in high-tech manufacturing, with 82 000 persons employed (see Figure 7.23).

Looking at relative employment in high- and medium-high-tech manufacturing, German regions dominated even more. Indeed, twelve of the fifteen leading regions in 2004 were located in Germany, two were in Hungary and one was in France.

Of the German regions, Stuttgart (DE) ranked first with 22.2% of total employment in high- and medium-high-tech manufacturing. Stuttgart was also the second region in absolute terms, with 415 000 persons employed in these activities.

Figure 7.23 shows the leading regions in high-tech manufacturing. In absolute terms, Île de France (FR) led with 82 000 employees. The ranking of regions according to employment (in absolute terms) in high-tech manufacturing is fairly similar to the ranking for to high- and medium-high-tech manufacturing.

On the other hand, the high-tech manufacturing ranking is quite different to the high- and medium-high-tech one when we look at employment in relative terms. In fact, two Hungarian regions displayed the highest proportion of employment in high-tech manufacturing, with 5.3% and 4.3% respectively. Only one German region was among the first five regions: Freiburg.

Table 7.24 sets out the ranking of the top 25 regions with the highest annual average growth rates (AAGR) between 1999 and 2004 in terms of employment for both high-tech manufacturing and medium-high-tech manufacturing. The AAGR of the two leading regions, Prov. Oost-Vlaanderen (BE) and Limousin (FR), were more than 17%.

In high-tech manufacturing, the regions with the highest employment growth rates were often not very small regions in absolute terms. By contrast, regions with the highest medium-high-tech manufacturing employment growth rates were often quite small in absolute terms of employment.

Figure 7.22 **Leading regions in employment in high-tech and medium-high-tech manufacturing, absolute and relative terms - 2004**

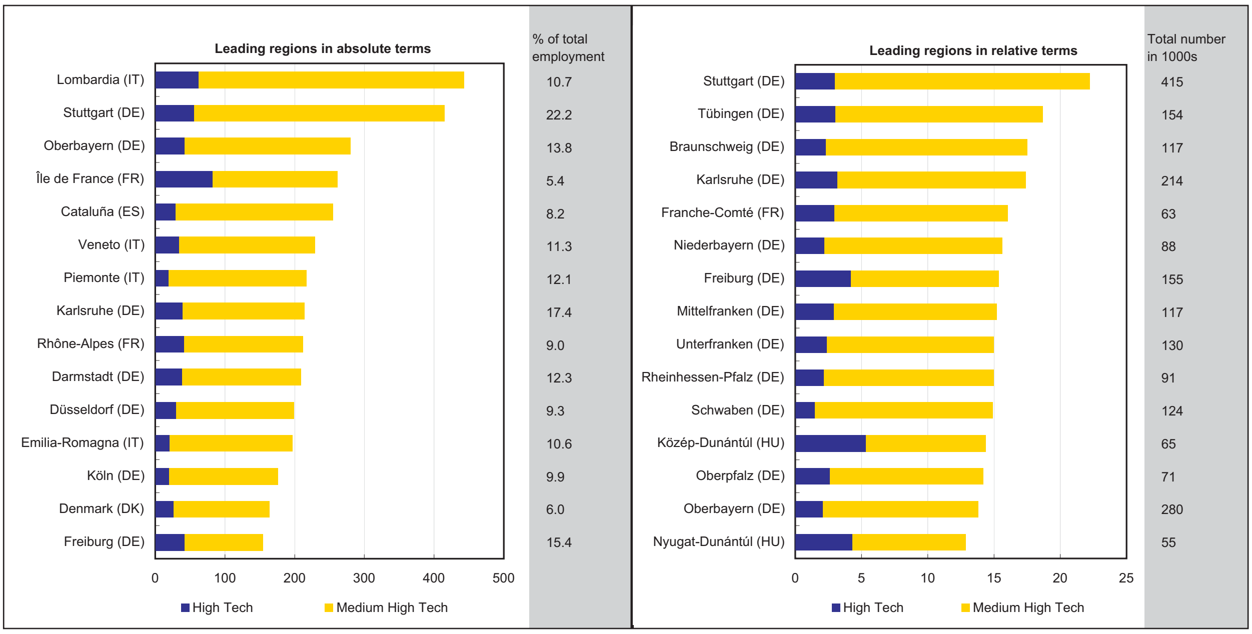


Figure 7.23

Leading regions in employment in high-tech manufacturing, absolute and relative terms - 2004

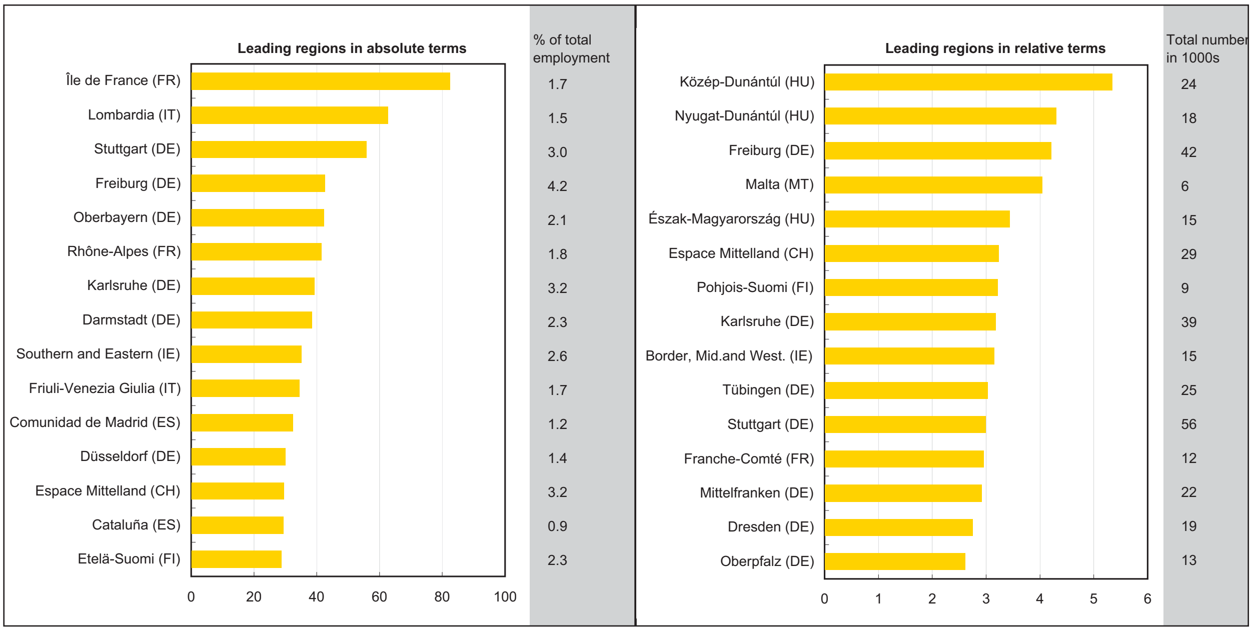


Table 7.24

Regions with the highest AAGR in employment in high and medium high-tech manufacturing, 1999 to 2004

Leading regions	High tech manufacturing 1000's	as a % of total emp.	AAGR 1999-2004	Medium High tech manufacturing AAGR 1999-2004	as a % of total emp.	1000's	Leading regions
Prov. Oost-Vlaanderen (BE)	6	1.0	**17.4**	**17.2**	5.7	20	Limousin (FR)
Poitou-Charentes (FR)	9	1.1	**13.0**	**14.4**	3.5	19	Región de Murcia (ES)
Hannover (DE)	16	1.7	**11.6**	**14.1**	4.0	8	Sterea Ellada (EL)
Estonia (EE)	11	1.8	**10.7**	**13.2**	1.5	7	Illes Balears (ES)
Toscana (IT)	15	1.0	**10.5**	**11.3**	1.3	14	Latvai (LV)
Friuli-Venezia Giulia (IT)	11	2.1	**10.2**	**11.0**	4.7	12	Salzburg (AT)
Unterfranken (DE)	15	2.4	**10.2**	**10.0**	7.0	33	Abruzzo (IT)
Mittelfranken (DE)	22	2.9	**10.1**	**8.3**	6.6	67	Thüringen (DE)
Oberpfalz (DE)	13	2.6	**10.0**	**7.9**	2.0	14	Castilla-la Mancha (ES)
Marche (IT)	7	1.1	**9.6**	**6.4**	6.5	42	Marche (IT)
Languedoc-Roussillon (FR)	7	0.9	**8.4**	**5.9**	8.5	61	Lüneburg (DE)
Sicilia (IT)	6	0.4	**7.9**	**5.7**	2.5	10	Principado de Asturias (ES)
Thüringen (DE)	21	2.1	**6.6**	**5.6**	1.0	3	Cyprus (CY)
Picardie (FR)	8	1.3	**6.6**	**5.5**	1.6	20	Inner London (UK)
Pais Vasco (ES)	5	0.6	**5.3**	**4.8**	9.7	62	Picardie (FR)
Slovenia (SI)	10	1.1	**4.4**	**4.7**	0.7	5	Canarias (ES)
Braunschweig (DE)	16	2.3	**4.0**	**4.7**	9.6	195	Veneto (IT)
Karlsruhe (DE)	39	3.2	**3.9**	**4.5**	10.0	49	Oberfranken (DE)
Lazio (IT)	24	1.1	**3.8**	**4.4**	3.7	77	Lazio (IT)
Lithuania (LT)	12	0.9	**3.6**	**4.4**	3.4	67	Comunidad Valenciana (ES)
Comunidad de Madrid (ES)	32	1.2	**3.5**	**4.3**	5.0	17	Umbria (IT)
Pays de la Loire (FR)	26	1.7	**3.5**	**4.2**	5.0	56	Midi-Pyrénées (FR)
Prov. Antwerpen (BE)	4	0.6	**3.3**	**4.1**	13.4	75	Niederbayern (DE)
Nord - Pas-de-Calais (FR)	11	0.7	**3.3**	**3.9**	9.9	42	Saarland (DE)
Prov. West-Vlaanderen (BE)	6	1.2	**2.7**	**3.8**	1.6	13	Languedoc-Roussillon(FR)

The services sectors

Capital regions strong in knowledge-intensive services

Figure 7.25 shows the regional disparities in the share of employment accounted for by knowledge-intensive services within the EU. For each Member State, this figure maps the national average, the region with the lowest percentage and the region with the highest percentage of KIS employment in total regional employment.

The proportion of employment accounted for by knowledge-intensive services in EU-25 ranged from 15.9% in Sterea Ellada (EL) to 59.8% in Inner London (UK).

With the exception of Greece and Poland, all EU-25 Member States for which regional data are available had at least one region above the EU average of 33.1%.

The Netherlands, Finland and Sweden, along with Norway and Switzerland, placed all theirs regions above the EU-25 average (33.1%). Moreover, Belgium, Germany, France, Luxembourg and the United Kingdom had their national average above the EU-25 average.

For most EU-25 Member States for which regional data are available the leading region in terms of relative employment in knowledge-intensive services was the capital region. In Ireland and also in Norway, the regional disparities were, however, small.

In 2004, the proportion of employment in KIS was less than 20% in the bottom regions of Greece, Spain, Poland, Portugal as well as of Bulgaria and Romania.

Of the EU-25 countries, none of the Greek and Polish regions reached the EU-25 average in terms of proportion of employment in KIS (33.1%). This was also the case for Bulgaria and Romania.

Map 7.21 provides an overview of the percentage of employment taken by knowledge-intensive services in 2004 across the regions of the EU-25, candidate countries, Iceland, Norway and Switzerland at the NUTS 2 level.

In addition to the capital regions, regions with a high proportion of employment in knowledge-intensive services were mainly located in the United Kingdom, Sweden and Norway.

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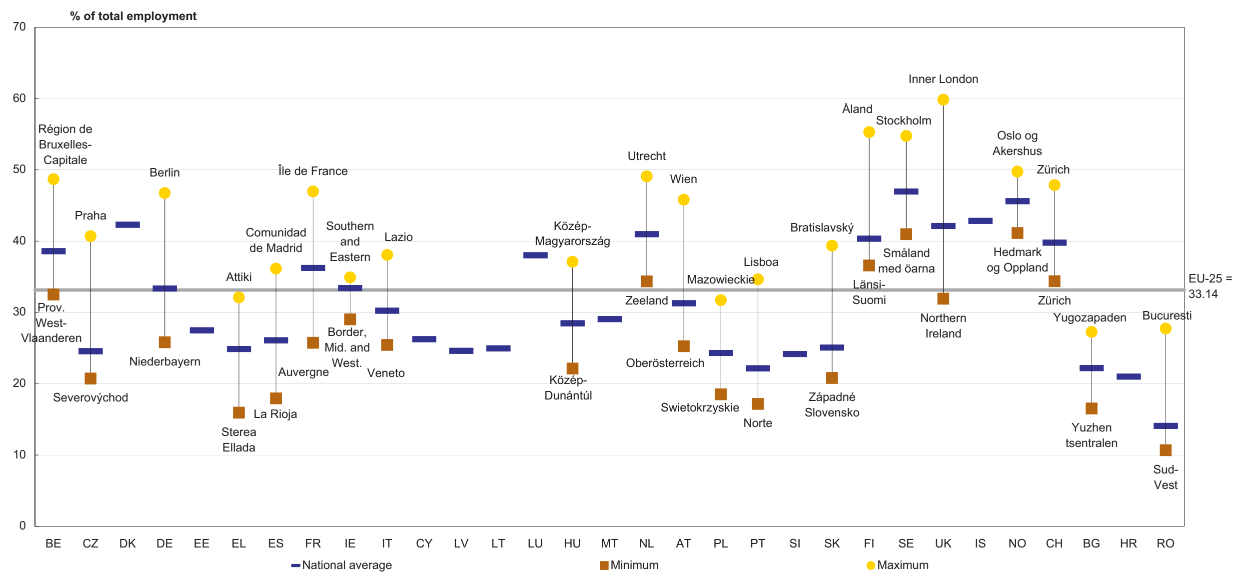
Figure 7.25 **Regional range of employment KIS, as a percentage of total employment, EU-25 and selected countries**



Map 7.26

Employment in KIS as a percentage of total employment, EU-25, Iceland and Norway - 2004

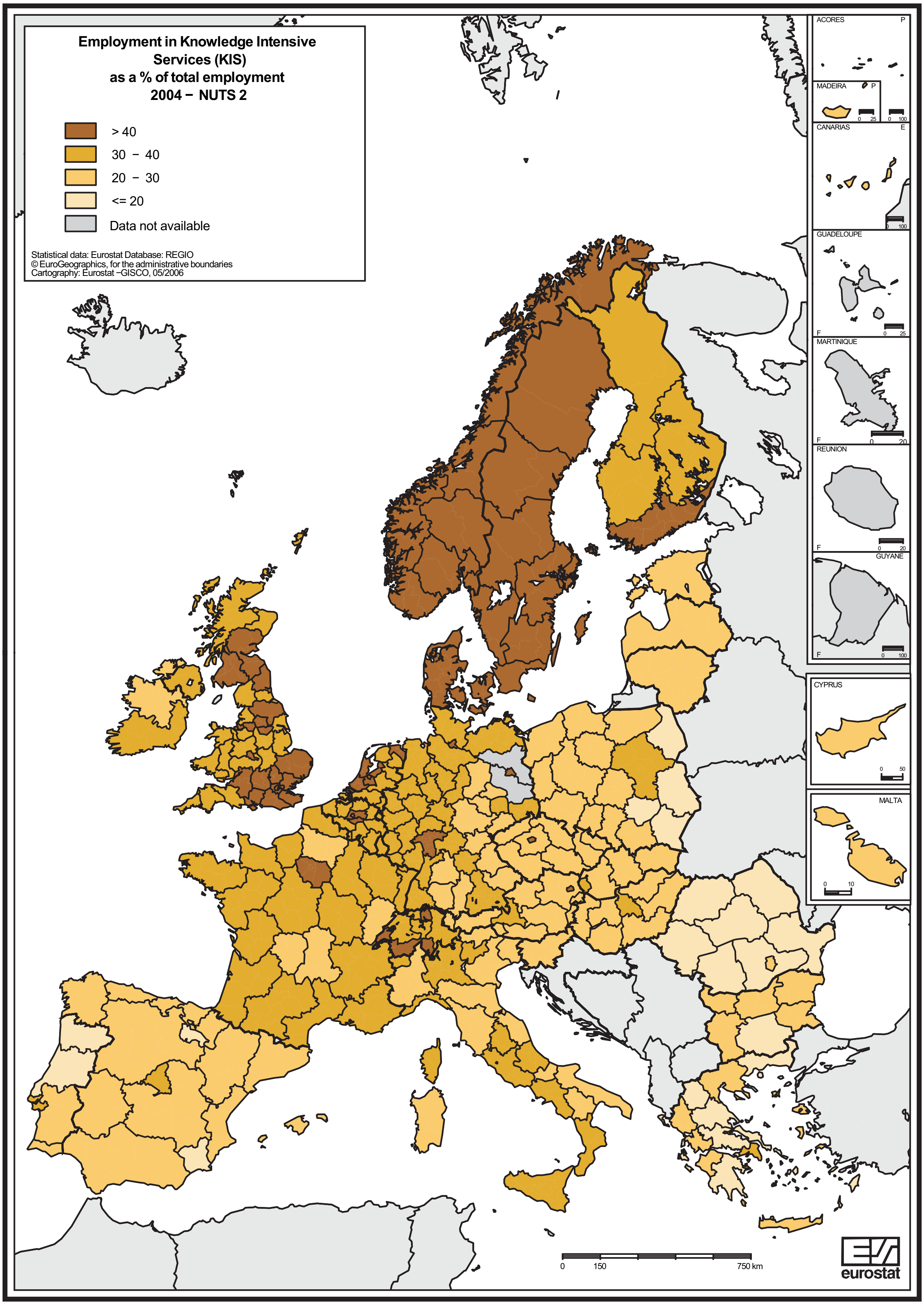


Figure 7.27 sets out the leading regions in terms of employment in knowledge-intensive services in 2004, both in absolute and in relative terms.

Along with Denmark, two of the first nine regions in absolute terms were French, two Italian, two Spanish and two were located in the United Kingdom. These nine regions were followed by four German regions, Zuid-Holland (NL) and Andalucia (ES).

Île de France (FR) was the leading region in terms of absolute KIS employment with 2.3 million jobs. With 364 000 persons employed, Île de France (FR) was also the leading region in high-tech KIS (a sub-set of knowledge-intensive services) (Figure 7.28).

Lombardia (IT) came second with 1.3 million persons employed in total KIS. However, in relative terms, it accounted for 31.6% of total employment in the region. This was less than the EU-25 average of 33.1%. The same was true of Cataluña (ES) and of Andalucia (ES), ranking sixth and fifteenth respectively, with 27.7% and 24.1% of total employment in knowledge-intensive services respectively.

Denmark, being a NUTS 2 region in its own right, was the third ranking region in absolute terms, with 1.2 million people employed in KIS. This corresponded to 42.3% of the total employment in the country.

Looking at the fifteen leading regions in absolute terms, five of them included capitals: Île de France (FR), Outer and Inner London (UK), Comunidad de Madrid (ES) and Lazio (IT).

In relative terms (as a percentage of total employment), four of the 15 leading regions were located in the United Kingdom, three in Sweden and three more in Norway.

Seven of the fifteen leading regions in relative terms were capital regions: Inner and Outer London (UK), Stockholm (SE), Oslo og Akershus (NO), Région Bruxelles-Capitale (BE), Île de France (FR) and Berlin (DE).

The first region was Inner London with almost 60% of total employment in knowledge-intensive services, followed by Stockholm (54.7%), Oslo og Akershus (49.8%) and Outer London (49.2%).

Three regions featured in the rankings both in absolute terms and in relative terms: Île de France (FR), Inner London and Outer London (UK).

Taking into account only high-tech KIS (Figure 7.28), the region Berkshire, Buckinghamshire and Oxfordshire (UK) led with more than 9% of total employment. It was followed by Stockholm (SE) with 8.0%, Praha (CZ) and Île de France (FR), both with 7.6% shares.

Looking at the fifteen leading regions in high-tech KIS in absolute terms (Figure 7.28), only two regions were not among the leading regions for knowledge-intensive services (Figure 7.27): Berkshire, Buckinghamshire and Oxfordshire (UK) and Mazowieckie (PL).

Table 7.29 shows the top 25 regions with the highest annual average growth rate (AAGR) between 1999 and 2004 in terms of employment for both knowledge-intensive services (KIS) and high-tech KIS. The AAGR of the leading region was less than 10% for KIS, while the average growth ratio was more than 20% for high-tech KIS.

With the exception of Communidad de Madrid (ES), the best performing regions in terms of employment growth in KIS and high-tech KIS were quite small in absolute terms.

7

Figure 7.27

Leading regions in employment in KIS, absolute and relative terms - 2004

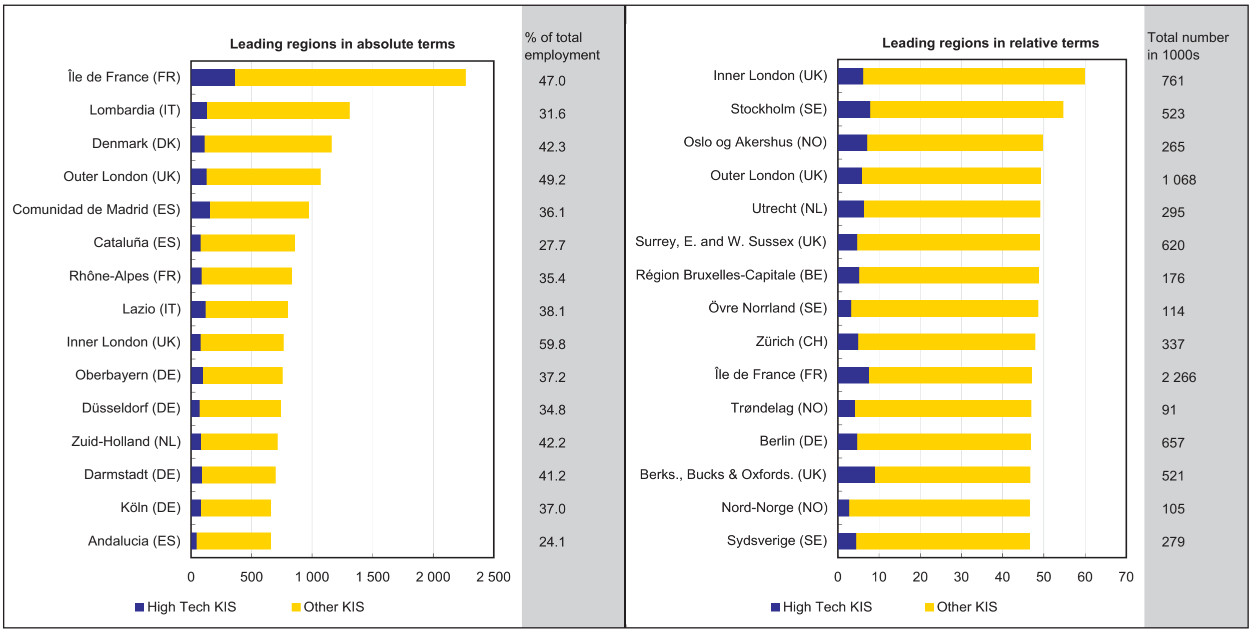


Figure 7.28 Leading regions in employment in high-tech KIS, absolute and relative terms - 2004

Table 7.29 Regions with the highest AAGR in employment in KIS, 1999 to 2004

	Knowledge intensive services			High tech KIS			
Leading regions	1000's	as a % of total emp.	**AAGR 1999-2004**	**AAGR 1999-2004**	as a % of total emp.	1000's	**Leading regions**
Ionia Nisia (EL)	15	17.9	**9.2**	**21.1**	5.0	36	Shropshire and Staffordshire (UK)
Kriti (EL)	57	22.4	**9.1**	**20.8**	3.2	11	Prov. Limburg (BE)
Sterea Ellada (EL)	33	15.9	**8.7**	**17.9**	1.6	9	Región de Murcia (ES)
Ipeiros (EL)	30	23.6	**8.7**	**16.1**	2.4	9	Principado de Asturias (ES)
Border, Midlands and Western (IE)	136	29.0	**8.3**	**15.8**	2.3	12	Aragón (ES)
Cantabria (ES)	48	21.3	**8.1**	**15.8**	2.4	25	Thüringen (DE)
Canarias (ES)	197	24.7	**8.1**	**15.5**	3.4	28	Alsace (FR)
Peloponnisos (EL)	47	19.8	**8.1**	**15.4**	1.7	13	Canarias (ES)
Highlands and Islands (UK)	97	37.0	**7.9**	**12.7**	2.1	7	Cyprus (CY)
Illes Balears (ES)	105	23.0	**7.7**	**11.7**	4.3	29	Prov. Antwerpen (BE)
Abruzzo (IT)	144	30.6	**7.5**	**11.4**	3.4	4	Burgenland (AT)
Umbria (IT)	114	32.8	**7.4**	**11.4**	4.9	8	Prov. Namur (BE)
Comunidad de Madrid (ES)	976	36.1	**7.1**	**10.8**	3.6	21	Northumb., Tyne and Wear (UK)
Lincolnshire (UK)	118	35.8	**7.0**	**10.7**	3.8	25	Lancashire (UK)
Limousin (FR)	102	29.7	**6.8**	**10.2**	1.7	6	Extremadura (ES)
Región de Murcia (ES)	105	19.5	**6.7**	**10.0**	2.6	52	Veneto (IT)
Região Autónoma da Madeira (PT)	25	21.5	**6.6**	**9.2**	2.4	15	Saarland (DE)
Castilla-la Mancha (ES)	145	20.4	**6.5**	**9.0**	3.8	19	East Wales (UK)
Basilicata (IT)	50	25.6	**6.4**	**9.0**	1.7	47	Andalucia (ES)
Dytiki Makedonia (EL)	20	19.2	**6.4**	**8.6**	3.0	22	Lüneburg (DE)
Voreio Aigaio (EL)	16	24.0	**6.3**	**8.6**	2.8	25	Pais Vasco (ES)
Cyprus (CY)	88	26.2	**6.1**	**8.5**	3.2	11	Umbria (IT)
Principado de Asturias (ES)	94	24.0	**6.1**	**8.5**	2.8	49	Campania (IT)
Calabria (IT)	206	34.0	**6.0**	**8.4**	3.6	23	Picardie (FR)
Galicia (ES)	246	22.9	**6.0**	**8.4**	5.8	157	Comunidad de Madrid (ES)

7.6 R&D in high technology

Germany and the United Kingdom showed the highest business enterprise R&D expenditure in high- and medium-high-tech manufacturing

Figure 7.30 shows absolute and relative business enterprise R&D expenditure in the manufacturing sectors in million euro for 2003.

The share of R&D expenditure in high-tech manufacturing was above 40% in Greece and in the Netherlands. However, in absolute terms spending in the Netherlands was EUR 1 530 million, but in Greece only EUR 86 million. The proportion of R&D expenditure in high-tech manufacturing was also significant in Austria and in Ireland.

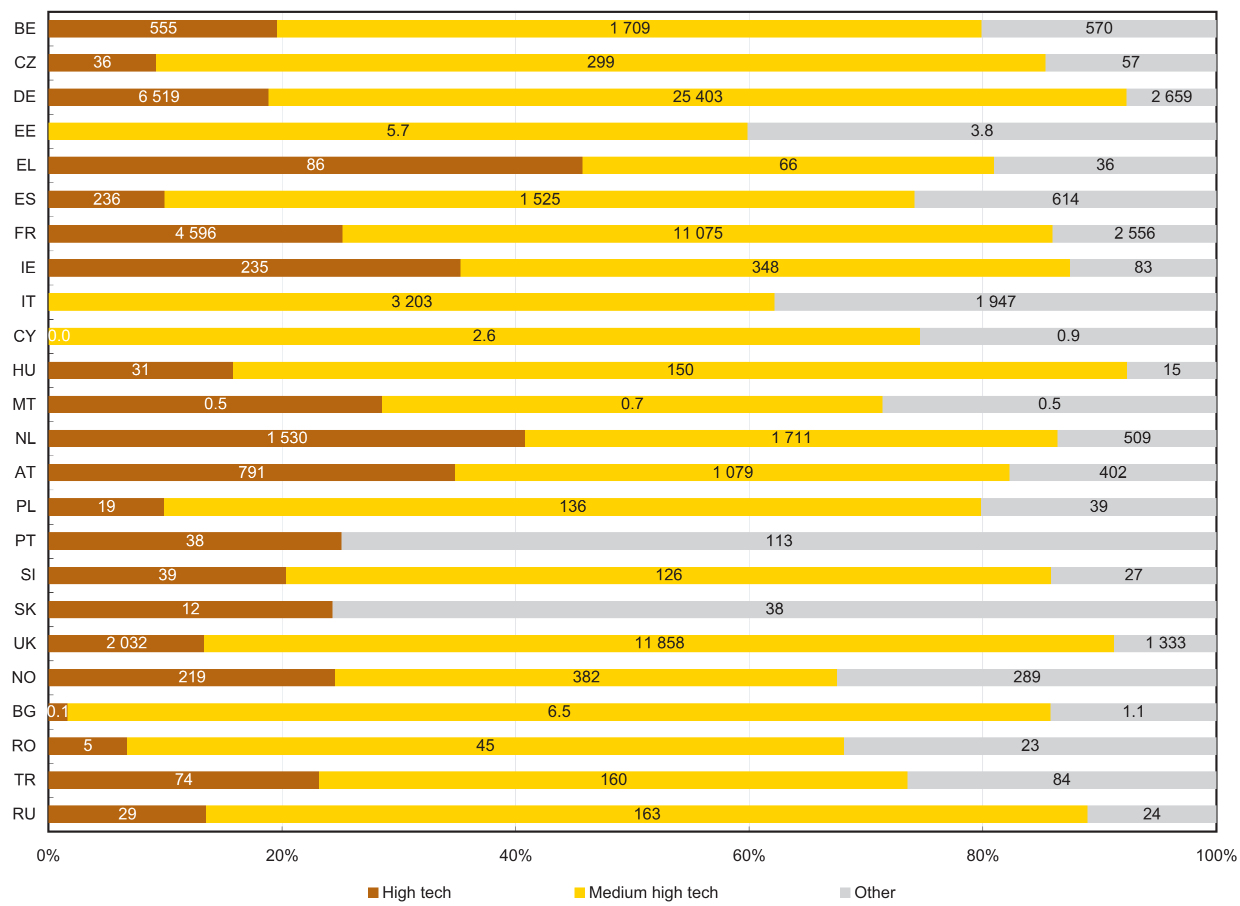
In Germany, the United Kingdom, Italy and Cyprus a larger share of national R&D expenditure was invested in enterprises engaged in medium-high-tech manufacturing.

In absolute terms, Germany and the United Kingdom were the leading countries in terms of business enterprise R&D expenditure in medium-high-tech manufacturing, at EUR 25 billion and 12 billion respectively. They were followed by France with EUR 11 billion.

For the EU-25 Member States for which data are available, more than 90% of total business R&D expenditure was spent in high and medium-high-tech manufacturing in Germany, Hungary and in the United Kingdom.

The 80% mark was also surpassed by the Czech Republic, Greece, France, Ireland, the Netherlands, Austria and Slovenia. This was also the case for Bulgaria and for the Russian Federation.

Figure 7.30 **Business enterprises R&D expenditure in the manufacturing sectors in million euro, EU-25 and selected countries - 2003**



Exceptions to the reference year: FR, MT, AT, SK, BG, RO TR and RU.

Highest proportion of researchers in high-tech manufacturing

In 2003 R&D personnel in EU-25 manufacturing enterprises numbered more than 800 000 in Full-Time Equivalent (FTE), not much more than the corresponding EU-15 figure of 774 000.

R&D personnel were mainly working in three countries: Germany, France and the United Kingdom, with 267 000, 135 000 and 119 000 respectively counted in FTE.

In high-tech manufacturing Germany again had most R&D staff (57 000) followed by France, United Kingdom, Italy and the Netherlands with 36 000, 18 000, 12 000 and 11 000 persons FTE respectively.

In medium-high-tech manufacturing, the same countries, namely Germany, the United Kingdom and France, were ranked top in absolute terms with 184 000, 85 000 and 78 000 persons FTE respectively.

Reflecting in part the economic structure of the country, in Cyprus, Hungary, Poland and the United Kingdom, around 70% of R&D personnel were employed in medium-high-tech manufacturing.

In 2003, more than half (51.5%) of all EU-25 R&D personnel working in manufacturing were researchers. This share varied considerably from country to country, with a figure of above 60% in Estonia, Ireland, Malta and the United Kingdom, but below 40% in Greece, Italy and Slovenia.

With the exception of Malta, the Netherlands, Slovenia and Slovakia, the proportion of researchers among R&D personnel was higher in high-tech manufacturing than in total manufacturing. Hungary had the highest proportion, with 85.8% of researchers in high-tech manufacturing.

Table 7.31

Business enterprises R&D personnel in FTE and percentage of researchers in the manufacturing sectors, EU-25 and selected - 2003

	Manufacturing									
	Total		High tech		Medium high tech		Medium low tech		Low tech	
	R&D personel	% of researchers	R&D personel	% of researchers	R&D personel	% of researchers	R&D personel	% of researchers	R&D personel	% of researchers
EU-25	801 361 s	51.5 s	:	:	:	:	:	:	:	:
EU-15	773 639 s	51.6 s	:	:	:	:	:	:	:	:
BE	22 659	46.9	4 563	51.8	12 440	46.8	3 549	41.8	2 107	46.2
CZ	7 756	44.4	1 008	45.7	5 214	46.6	1 059	39.9	475	26.7
DK	16 071	52.1	:	:	:	:	:	:	:	:
DE	267 404	53.3	57 820	65.8	184 138	50.7	17 540	44.2	7 907	42.9
EE	298	64.8	86	70.9	:	:	:	:	:	:
EL	5 543	30.5	:	:	2 273	44.6	407	30.9	:	:
ES	34 357	38.4	3 997	49.3	19 912	38.5	4 901	34.1	5 547	:
FR	135 378	47.5	36 280	66.8	77 524	41.7	12 651	35.0	8 924	36.3
IE	5 057	62.0	2 065	76.8	2 070	59.7	369	31.4	553	35.6
IT	50 174	34.0	12 380	41.1	30 561	34.9	4 040	19.6	3 194	16.2
CY	89	59.7	0	:	64	63.8	3	36.0	22	50.4
LV	299	49.8	:	:	:	:	:	:	:	:
LT	459	65.1	:	:	:	:	:	:	:	:
LU	1 511	50.0	:	:	:	:	:	:	:	:
HU	4 922	59.6	772	85.8	3 441	58.3	274	49.3	435	29.7
MT	46	65.2	12	58.3	26	73.1	2	0.0	6	66.7
NL	32 080	40.5	10 843	34.7	15 404	44.8	2 281	41.6	3 553	38.7
AT	19 137	56.1	6 408	70.5	8 996	47.6	:	:	:	:
PL	8 191	57.6	833	66.9	5 764	56.8	947	58.5	647	51.2
PT	2 673	52.9	709	79.9	:	:	:	:	:	:
SI	3 762	32.2	966	25.3	2 120	32.6	377	44.6	299	35.8
SK	1 900	47.9	395	34.4	:	:	:	:	:	:
FI	24 312	:	:	:	:	:	:	:	:	:
SE	38 748	55.7	:	:	:	:	:	:	:	:
UK	118 535	62.1	18 044	76.5	85 427	60.5	6 363	57.9	8 701	50.7
NO	7 071	68.2	1 762	80.3	3 285	70.9	721	62.6	1 303	48.3
BG	940	52.9	:	:	623	50.1	:	:	67	:
RO	10 844	62.8	588	76.7	7 509	64.5	1 832	61.4	914	42.3
TR	4 588	59.2	845	84.1	2 422	57.9	:	:	:	:

Exceptions to the reference year: 2002: FR, MT, AT, SI, SK, TR.

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PART3

Chapter 8
2005 EU industrial R&D investments scoreboard

8.1 Introduction

The source of the data for the 2005 EU Industrial R&D Investment Scoreboard[1] is not Eurostat, but the Commission's industrial research investment monitoring activity run jointly by the Directorate-General for Research (DG-RTD) and the Joint Research Centre (JRC).

Unlike the R&D data collected officially by Eurostat on all institutional sectors, the data in the 2005 EU Industrial R&D Investment Scoreboard cover only the business enterprise sector (BES).

The data are based on the group accounts of the largest enterprise groups performing R&D in the EU and beyond - including stock-exchange listed and private companies (provided their audited financial accounts are available)[2]. The groups are assigned the nationality of the country where the registered office of the ultimate parent company is located.

The Financial Times Stock Exchange (FTSE) Global Classification System is used. It is a three-level classification system that divides the whole of industry into ten economic groups, 36 sectors and 104 sub-sectors. Several stock exchanges, index-providers and financial media apply the FTSE Global Classification System for classifying companies.

However, for sectoral allocation of R&D statistics Eurostat uses the Statistical Classification of Economic Activities in the European Community (NACE). This very detailed four-digit classification is subdivided into 17 sections, 31 sub-sections, 62 divisions, 224 groups and 514 classes.

The 2005 EU Industrial R&D Investment Scoreboard is the first to contain two tables (one for the top 700 EU companies and another for the top 700 non-EU companies, broken down by country) where the companies are classified in accordance with the FTSE Global Classification System and also with the NACE. The industrial sectors mentioned in this chapter are, however, based on the FTSE Global Classification System.

The enterprise group data cover all R&D investment, no matter where. The ultimate goal is to provide recent information on industrial R&D investment by European and non-European companies so that new policy measures can be tailored more closely to achieving the Barcelona targets - i.e. that by 2010 overall EU R&D investment should approach 3% of GDP, at least two thirds of which should be from private sources.

After the data collected from the enterprise groups had been validated, information from individual countries was fed into a standard mapping database. This database facilitates updates or searches for general information at EU level, regardless of the search method or criteria used (by country, R&D variable or indicator, or information source).

The R&D investment included in the Scoreboard is the cash investment funded by the companies themselves. It excludes R&D undertaken under contract for customers, such as governments or other companies. It also excludes the companies' share of R&D investment by any associated company or joint venture. Where part or all of R&D costs have been capitalised, the additions to the relevant intangible assets are included to calculate the cash investment and any amortisation avoided.

By contrast, Eurostat R&D statistics are based on Commission Regulation (EC) No 753/2004 of 22 April 2004 implementing Decision No 1608/2003/EC of the European Parliament and of the Council. The requirements for the R&D statistics are also consistent with those of the OECD and are based on the Frascati Manual.

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(1) European Commission (JRC-IPTS and DG RTD-M) - *The 2005 EU Industrial R&D Investment Scoreboard* - EUR 21851 EN, December 2005.

(2) The Scoreboard includes a considerable number of unlisted "private" companies. Their names are in italics in Vol. II, e.g. in Table II.1.1. (for example, *Robert Bosch*) - see also Methodological Notes in Vol. II.2 under 'Sources'.

8.2 Overview of industrial R&D investment

Levels of R&D investment

The Scoreboard covers the 700 largest EU enterprise groups and the 700 largest non-EU enterprise groups in terms of R&D investment.

In 2004 the top 700 EU companies invested EUR 102.2 billion in R&D, while the top 700 non-EU companies invested EUR 212.8 billion. The combined total - EUR 315 billion - accounts for just over half of the estimated world business enterprise R&D expenditure.

Company dynamics (new entries and exits from the Scoreboard)

DaimlerChrysler has taken over as the world's number one on the Scoreboard for R&D investment in 2004.

Within the EU group, pharmaceuticals and biotechnology were the most dynamic sectors, with eight new entries and six exits compared with the previous year's top 500.

In the non-EU group, the largest numbers of new entries were in the pharmaceuticals and biotechnology, IT hardware and chemicals sectors. Exits were spread across sectors, with more companies in general retail and health leaving the top 500.

Mergers and acquisitions have led to some significant changes in both the EU and the non-EU rankings, particularly in the pharmaceuticals and biotechnology sector.

Table 8.1 Top 20 enterprise groups in terms of total R&D investment (million euro) in 2004

	EU		Non-EU	
1	DaimlerChrysler (DE)	5658.0	Pfizer (US)	5653.2
2	Siemens (DE)	5063.0	Ford Motor (US)	5444.3
3	Volkswagen (DE)	4164.0	Toyota Motor (JP)	5421.8
4	GlaxoSmithKline (UK)	4010.1	General Motor (US)	4782.2
5	Sanofi-Aventis (FR)	3961.0	Microsoft (US)	4549.7
6	Nokia (FI)	3834.0	Matsushita Electric (JP)	4419.4
7	Robert Bosch (DE)	2898.0	IBM (US)	4167.1
8	BMW (DE)	2818.0	Johnson & Johnson (US)	3827.9
9	AstraZeneca (UK)	2797.9	Sony (JP)	3604.3
10	Philips Electronics (NL)	2534.0	Intel (US)	3515.3
11	Ericsson (SE)	2435.9	Samsung Electronics (KR)	3484.3
12	Bayer (DE)	2404.0	Honda Motor (JP)	3358.4
13	EADS (NL)	2295.0	Roche (CH)	3295.1
14	Peugeot-PSA (FR)	2118.0	Novartis (CH)	3095.2
15	Renault (FR)	1961.0	Merck (US)	2950.4
16	Istituto Finanziario Industriale (IT)	1827.0	Hitachi (JP)	2790.3
17	BAE Systems (UK)	1 567.9	Hewlett-Packard (US)	2579.4
18	Alcatel (FR)	1557.0	Nissan Motor (JP)	2544.0
19	Finmeccanica (IT)	1 454.0	Toshiba (JP)	2417.6
20	Boehringer Ingelheim (DE)	1232.0	Cisco Systems (US)	2348.4

Source: Eurostat based on "The 2005 EU Industrial R&D Investment Scoreboard.

Trends

Over the past year, R&D investment - in euros - has risen by 0.7% for the 700 EU companies and by 6.9% for the 700 non-EU companies.

Over the past three years R&D investment - in euros - has grown, on average, by 0.1% per annum (p.a.) for the 700 EU companies and by about 4% p.a. for the 700 non-EU companies.

Net sales and operating profits increased at significant rates in 2004, in both the EU and non-EU regions.

R&D investment by the world's top Scoreboard companies - in euros - rose by around 5% in 2004, while the R&D/sales ratio declined slightly as net sales grew even faster than R&D investment.

Table 8.2 Overall performance in 2004 by the enterprise groups on the scoreboard

Factor	Non-EU 700	EU 700
R&D investment (EUR billion)	**212.8**	**102.2**
R&D investment per company (EUR billion)	0.3	0.15
Change in R&D investment over previous year	**6.90%**	**0.70%**
R&D investment/employee (EUR)	11 326	7 469
Net sales (EUR billion)	5 122.20	3 579.50
Change in net sales over previous year	**10.90%**	**7.20%**
Net sales/employee (EUR thousand)	271.2	261.5
Change in number of employees over previous year	1.30%	-0.30%
R&D investment/net sales ratio	**4.20%**	**2.90%**
- Difference compared to previous year	**-0.2%**	**-0.2%**
Change in operating profit over previous year	30.5%	49.1%

Source: Eurostat based on "The 2005 EU Industrial R&D Investment Scoreboard.

Top R&D investors

Unlike the previous year when America's Ford Motor group was the world's largest R&D investor, in 2004 the leader was an EU company, Daimler-Chrysler (DE), with investment of almost EUR 5.7 billion. Pfizer (US) was very close behind in second place (also EUR 5.7 billion but behind by about EUR 5 million).

R&D investment by the top 50 EU companies has developed unfavourably over the last three years. Over this period on average 22 of the top 50 EU companies increased R&D investment by more than 5% per year compared with 33 of the non-EU companies, while 16 of the top 50 companies in the EU cut their R&D investment compared with 12 in non-EU countries. Together, the top 50 EU companies increased their R&D investment by 1% and 0.9% in nominal euro terms in the previous year and over the last three years, respectively. By contrast, the top 50 non-EU companies increased their R&D investment by 6.5% and 4.6% in the previous year and over the last three years, respectively.

The EU has one more company than the US in the world top 50 (18 versus 17), although the combined R&D investment by all the EU Scoreboard companies is significantly lower than that by US companies.

By country, South Korea recorded the highest jump up the world rankings, with Samsung climbing from 33rd to 17th. Entries to and exits from the EU and non-EU top 50 are influenced, to a large extent, by mergers and acquisitions.

For both the EU and non-EU enterprise groups, R&D investment is highly concentrated in a small number of companies and sectors: the top five companies in three of the five largest sectors (automobiles and parts, IT hardware and pharmaceuticals and biotechnology) account for more than 50% of the total R&D investment by all Scoreboard companies in each of these sectors. The degree of concentration is higher in the EU than elsewhere.

R&D by companies on the world scoreboard by sector

The breakdown by sector is based on the FTSE Global Classification System. Table 8.3 shows the five largest sectors in terms of R&D investment and growth rates.

Industrial R&D investment worldwide remains highly concentrated in just three sectors: automobiles and parts, IT hardware and pharmaceuticals and biotechnology. Together, they accounted for more than half of global R&D investment in 2004 by the top 942 Scoreboard companies. The top five sectors accounted for more than 73% of global R&D investment recorded on the Scoreboard in 2004.

The same five sectors accounted for large amounts of the total R&D investment on the Scoreboard (automobiles and parts: EUR 58.5 billion; IT hardware: EUR 57.4 billion; pharmaceuticals and biotechnology: EUR 56.0 billion; electronic and electrical equipment: EUR 34.7 billion; and software and computer services: EUR 19.6 billion).

The automobiles and parts sector accounted for by far the highest R&D investment per company in 2004 on EUR 900.3 million.

The highest average growth rates in annual R&D investment over the last four years were recorded by pharmaceuticals and biotechnology (12.6%) and by software and computer services (8.0%), whereas for IT hardware the growth rates were very low, if not negative, over the last four years.

Pharmaceuticals and biotechnology companies also achieved very high annual growth rates in 2004 (9.7%).

Table 8.3 Top five sectors in terms of R&D investment in 2004 by the top companies on the world scoreboard

Rank	Sectors	Total R&D investment (EUR million)	Sector R&D investment as a percentage of all sectors (%)	R&D Investment/ company	Number of companies	R&D growth rate in 2004 (%)	R&D annual average growth rate 2001-2004 (%)
1	Automobiles & Parts	58 516	19	900.3	65	7.2	4.9
2	IT Hardware	57 351	18.6	339.4	169	0.6	-5.0
3	Pharmaceuticals & Biotechnology	56 028	18.2	463.0	121	9.7	12.6
4	Electronic & Electrical Equipment	34 652	11.2	444.3	78	7.2	3.7
5	Software & Computer Services	19 625	6.4	245.3	80	1.3	8.0

Source: Eurostat based on "The 2005 EU Industrial R&D Investment Scoreboard.

Performance of EU Scoreboard companies versus non-EU companies

All the main regions in the world showed an increase in R&D investment in 2004 compared with 2003.

As with the 2004 Scoreboard, EU companies performed worse than non-EU companies in terms of R&D investment growth, although 2004 brought a turnaround for EU companies from a decrease of 2.0% (top 500) to an increase of 0.7% (top 700). For US companies the growth rate increased from 4.7% on the previous year's Scoreboard (top 288) to 6.7% on this year's (top 398).

Almost 45% of the 700 EU companies increased their R&D investment by more than 5% in 2004, compared with 58% of the 700 non-EU companies and with 38% and 47% respectively on the 2003 Scoreboard (top 500). The percentages of the top 700 EU and non-EU companies which cut their R&D were 40% and less than 28% respectively, compared with 46% (EU) and 37% (non-EU) in 2003.

R&D/sales ratios have decreased as sales have grown faster than R&D investment in every region of the world, except Japan.

The main explanation for the higher R&D/sales ratios of US companies compared with EU or Japanese companies is the higher proportion of US Scoreboard companies operating in sectors with intrinsically high R&D intensity, such as pharmaceuticals, biotechnology, software, internet, computer services, semiconductors and health.

The top 50 EU and top 50 US Scoreboard companies invested practically the same total in R&D in 2004, well above the amount spent by Japanese companies. However, the US companies in the bottom-ranked groups invest more in R&D and have much higher R&D/sales ratios than their EU and Japanese counterparts.

R&D investment in EU countries

Together just three countries (Germany, France and UK) account for around three quarters of both total R&D investment and sales and about 60% of the total number of EU Scoreboard companies.

French, Danish and Italian companies increased their shares of total R&D investment, while Swedish groups decreased theirs, both the previous year and on average over the period from 2001 to 2004.

There were no significant changes in the average R&D/sales ratios for Scoreboard companies in major EU countries over the period from 2001 to 2004.

Almost all countries show at least one marked area of specialisation in terms of industrial R&D investment compared to the average for groups on the EU Scoreboard.

Seven enterprise groups from four new Member States - Czech Republic (1), Slovenia (2), Poland (2) and Hungary (2) - are included on the 2005 Scoreboard. The average R&D/sales ratio is much lower for the companies from the new Member States, at 1.3%. However, the R&D investment growth rate was higher in the last three years for the enterprise groups on the Scoreboard from the new Member States than in EU-15.

Table 8.4 Proportions of R&D and sales in total by EU-25 Member States and number of companies, in 2004

EU Member State	Proportion of R&D in total (%)	Proportion of Sales in total (%)	Number of companies in *Scoreboard* 2005
Germany	37.03	29.31	135
France	18.94	21.04	81
UK	16.72	21.87	211
Subtotal DE + FR + UK	*72.69*	*75.22*	*427*
Netherlands	7	3.69	33
Sweden	5.97	3.98	60
Finland	4.75	3.33	43
Italy	4.3	5.82	25
Denmark	1.77	1.3	31
Belgium	1.42	1.44	26
Spain	0.93	2.57	13
Austria	0.37	0.97	21
Luxembourg	0.35	0.97	4
Ireland	0.28	0.22	7
Hungary	0.06	0.03	2
Slovenia	0.04	0.04	2
Greece	0.03	0.03	2
Poland	0.02	0.13	2
Czech Republic	0.01	0.09	1
Portugal	0.01	0.17	1
TOTAL EU	100	100	700

Source: The 2005 EU Industrial R&D Investment Scoreboard.

Financial indicators for Scoreboard companies

The profitability gap between EU and non-EU Scoreboard groups shrank in 2004, although on average EU companies still show a lower operating profit/sales ratio. Since 2002 all the Scoreboard companies have enjoyed a strong recovery in profitability.

The average market capitalisation/sales ratio for EU Scoreboard companies rose markedly, by 20%, in 2004.

Capital expenditure by non-EU Scoreboard companies increased at the same rate as their net sales in 2004.

For EU companies capital expenditure grew at a slightly lower rate than net sales.

The financial performance of US companies is, on average, better than that of EU or Japanese companies.

Most sectors with high market capitalisation have a high average R&D/sales ratio. Examples include pharmaceuticals and biotechnology, software and computer services, health and IT hardware companies.

8

8.3 Key findings

The 2005 EU Industrial R&D Investment Scoreboard reports on the worldwide research and development (R&D) activities of 1 400 companies: the top 700 R&D investors with registered offices in the EU and the top 700 registered elsewhere. Together they invested EUR 315 billion in R&D or just over half of total R&D investment by the private sector worldwide.

The 2005 EU Industrial R&D Investment Scoreboard is the only corporate scoreboard to present information in such depth on R&D investment by companies in the EU and beyond. It also provides an extensive comparison of the performance of EU companies with that of their competitors worldwide.

The snapshot provided by the 2005 edition of the Scoreboard shows a reversal of the decline in R&D investment reported in 2004. It shows a slight increase in R&D investment by EU companies (0.7%). However, that good news is tempered by the fact that competitors outside the EU are still growing faster (6.9%) - with the result that the R&D gap between the EU and non-EU companies is continuing to widen.

The 2005 Scoreboard also highlights a number of other interesting findings about EU and non-EU enterprise groups:

Sector by sector, the average R&D intensity of EU companies is comparable with that of their counterparts worldwide. However, there are relatively few EU companies in highly R&D-intensive sectors, reflecting, amongst other things, the structure of the economy in the EU. EU companies are much more active in medium-R&D-intensive sectors, where they are investing heavily in R&D. This is often converted into products which command a premium for quality and reputation.

The sectors with the highest rates of growth in R&D investment worldwide are services plus pharmaceuticals and biotechnology. EU companies are holding their own in several of these fast-growing sectors, notably in pharmaceuticals and biotechnology, leisure and hotels, and support services. However, EU companies are losing ground to the rest of the world in sectors with significant R&D investment and growth, such as software and computer services, health services, and media and entertainment.

Individually, EU companies are performing at least as well in R&D investment as their counterparts outside the EU. An EU company, DaimlerChrysler, tops this year's world ranking of R&D investors. Beyond that, there are few sectors where there is not at least one EU company in a leading position - even in highly R&D-intensive sectors. Also, the EU is the region with the largest number of companies in the world's top 50. However, the EU appears to be less successful in enabling medium-sized R&D investors to grow into large R&D investors.

The key findings of the 2005 EU Industrial R&D Investment Scoreboard are:

1. R&D investment by EU companies increased in 2004, but the gap between them and their non-EU counterparts is still widening because growth rates for R&D investment by non-EU companies were much higher.

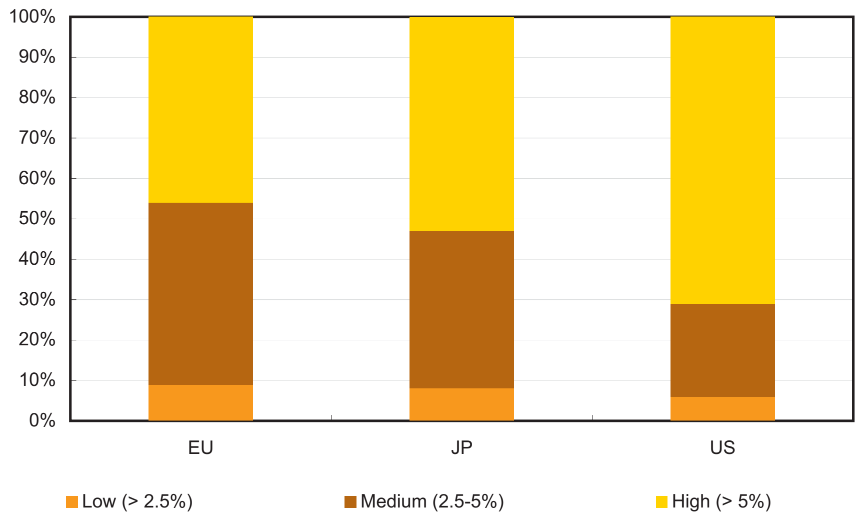
2. The very top EU companies are world leaders in R&D investment. 18 out of the top 50 R&D investors worldwide were EU companies.

3. EU companies have a weaker presence in R&D-intensive sectors. Only about 40% of EU companies have a high level of R&D intensity. In Japan more than 50% of companies have a high level of R&D intensity and in the United States more than 70%.

One important point which must be taken into account when analysing the results is that the definition of "R&D intensity" used in the 2005 EU Industrial R&D Investment Scoreboard is different to the one used by Eurostat and in other official statistics. In the Scoreboard "R&D/sales ratio" means the ratio between a company's R&D investment and its net sales, as a proxy for "R&D intensity".

By contrast, the official definition of "R&D intensity" is the ratio between R&D investment and GDP.

Figure 8.5 **Share of R&D investment by level of R&D intensity, EU-25, Japan and the United States**



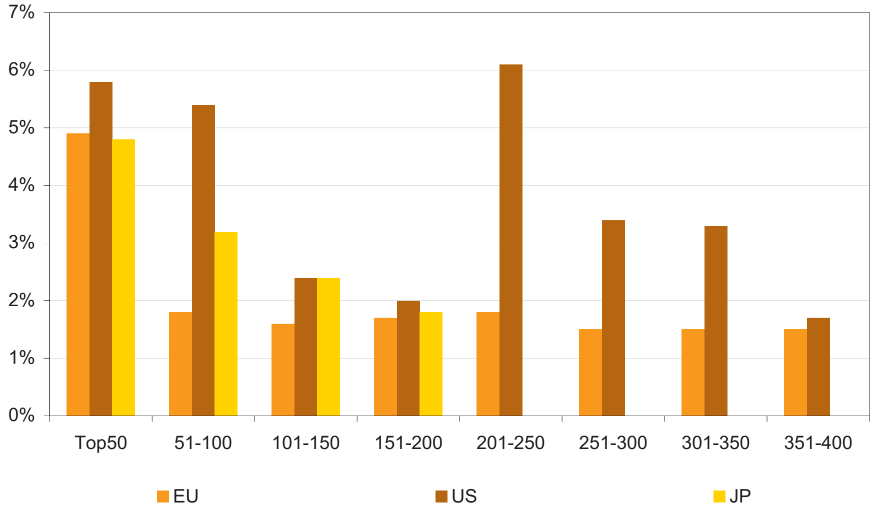
Source: The 2005 EU Industrial R&D Investment Scoreboard.

4. Much weight on a few shoulders: In the R&D-intensive sectors a very small number of EU companies do most of the R&D. Taking IT hardware and electronics and electrical equipment as examples, in these two sectors the top five EU-companies account for 86% and 88% of the R&D investment respectively. For the top five non-EU companies these percentages are much lower with 29% for the IT hardware sector and 58% for electronics and electrical equipment.

5. The largest R&D investors amongst EU, US and Japanese Scoreboard companies have similarly high R&D intensities. As the volume of company R&D declines, in line with the Scoreboard ranking, the R&D intensity also falls for both Japanese and EU companies, but more steeply in the EU. This is not the case with US companies.

Figure 8.6

Share of R&D investment by level of R&D intensity, breakdown of 400 US, 400 European and 200 Japanese companies by groups of 50 companies



Source: The 2005 EU Industrial R&D Investment Scoreboard.

Note: There are 400 US and 200 Japanese Scoreboard companies that can be compared with the EU companies.

6. A cluster of medium-sized US companies are also very R&D-intensive. The US companies ranked 201st to 250th have the highest share of R&D investment.

7. Each region of the world has a different specialisation. The EU, the United States and the rest of the world group (especially Switzerland) specialise in pharmaceuticals and biotechnology. Companies from the EU and Japan also specialise in automobiles and parts. R&D data for companies from the US and the rest of the world (particularly Taiwan and South Korea) show specialisation in IT hardware. Asian companies (Japan, South Korea and Taiwan) are strong in electronics and electrical equipment. In the case of software and computer services, US companies account for more than 85% of global R&D spending by the top Scoreboard companies.

8. The world's fastest growth in R&D investment is in service sectors and in pharmaceuticals and biotechnology. In the pharmaceuticals and biotechnology sector the EU has high growth rates in R&D investment, comparable with the world level. The EU's share of R&D investment is relatively small in most of the service sectors. Leisure and hotels is the only sector where the EU accounts for 40% of R&D investment.

Scoreboard webpage

The electronic version of the 2005 EU Industrial R&D Investment Scoreboard (both Analysis - Volume I and Company Data - Volume II) is available on and can be downloaded from the Scoreboard webpage at:

http://eu-iriScoreboard.jrc.es/index.htm.

PART3

Chapter 9
Background data

The data presented in this chapter are compiled from Eurostat's reference database as at 31 August 2005. These are the data that have been used for calculating derived indicators (per million inhabitants, as a percentage of GDP, 1995 constant PPS, etc).

9.1 Population

Table 9.1

Population in thousand

EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
EU-25	445 337	449 975	451 080	452 050	:	:	:
EU-15	370 134	375 017	376 204	377 654	:	:	:
BE	10 101	10 214	10 239	10 263	10 310	10 356	10 396
CZ	10 334	10 290	10 278	10 267	10 206	10 203	10 211
DK	5 197	5 314	5 330	5 349	5 368	5 384	5 398
DE	81 338	82 037	82 163	82 260	82 440	82 537	82 532
EE	1 477	1 379	1 372 p	1 367 p	1 361	1 356	1 351 p
EL	10 511	10 861	10 904	10 931	10 969	11 006	:
ES	39 219	39 724	39 961	40 376	40 851	41 551	42 198 p
FR	57 565	58 497	58 749	59 043	59 343	59 635 e	59 901 e
IE	3 583	3 732	3 778	3 833	3 900	3 964	4 028 e
IT	56 843	56 914	56 929	56 968	56 994	57 321	57 888 e
CY	633	683	690	698	706	715	730
LV	2 541	2 399	2 382	2 364	2 346	2 331	2 319
LT	3 671	3 536	3 512	3 487	3 476	3 463	3 446
LU	400	427	434	439	444	448	452
HU	10 350	10 253	10 222	10 200	10 175	10 142	10 117
MT	366	379	380	391 e	395 e	397	400
NL	15 342	15 760	15 864	15 987	16 105	16 193	16 258
AT	7 929	7 982	8 002	8 021	8 065 p	8 102 p	8 140 p
PL	38 505	38 667	38 654	38 254	38 242	38 219 b	38 191
PT	9 991	10 149	10 195	10 257	10 329	10 407	10 475
SI	1 989	1 978	1 988	1 990	1 994	1 995	1 996
SK	5 336	5 393	5 399	5 379	5 379	5 379	5 380
FI	5 078	5 160	5 171	5 181	5 195	5 206	5 220
SE	8 745	8 854	8 861	8 883	8 909	8 941	8 976
UK	58 293	59 391	59 623	59 863 e	59 322	:	59 673
IS	265	276	279	283	287	288	291
LI	30	32	32	33 e	34	34	34
NO	4 325	4 445	4 478	4 503	4 524	4 552	4 577
CH	6 969	7 124	7 164	7 204	7 256	7 314	7 364
BG	8 460	8 230	8 191	7 929	7 892	7 846	7 801
HR	4 778	:	4 568	4 437	:	4 442 e	:
RO	22 748	22 489	22 455	22 430	21 833 b	21 773	21 711
TR	:	:	:	:	:	70 171 e	71 254 e
CA	29 077	:	:	:	:	:	:
JP	125 034	126 451	:	:	:	:	:
US	259 159	271 626	:	:	:	:	:

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9.2 Labour force

Table 9.2

Labour force in thousand (employment and unemployment)
EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
EU-25	:	:	207 221	208 219	210 117	211 839	213 318
EU-15	:	171 854	173 239	174 090	176 201	178 101	179 603
BE	4 148	4 365	4 410	4 305	4 353	4 392	4 473
CZ	:	5 153	5 124	5 088	5 090	5 087	5 101
DK	2 759	2 855	2 843	2 835	2 863	2 858	2 893
DE	39 267	39 595	39 447	39 606	39 637	39 821	39 724
EE	:	656	654	658	642	660	661
EL	4 154	4 583	4 617	4 581	4 652	4 729	4 824
ES	16 078	17 304	17 909	17 932	18 690	19 432	20 093
FR	24 689	25 571	25 754	25 909	26 161	26 409	26 745
IE	1 413	1 687	1 746	1 788	1 842	1 877	1 922
IT	22 693	23 347	23 475	23 641	23 963	24 203	24 361
CY	:	:	309	323	326	341	351
LV	:	1 127	1 098	1 107	1 138	1 123	1 133
LT	:	1 718	1 688	1 651	1 633	1 691	1 621
LU	171	180	185	188	193	195	195
HU	:	4 067	4 074	4 091	4 098	4 165	4 135
MT	:	:	153	158	160	161	157
NL	7 223	7 891	8 080	8 240	8 390	8 428	8 496
AT	:	3 859	3 865	3 851	3 856	3 876	3 857
PL	:	17 033	17 348	17 460	17 252	16 938	16 907
PT	4 759	5 142	5 202	5 304	5 401	5 451	5 472
SI	:	959	960	969	980	958	1 006
SK	:	2 532	2 574	2 625	2 597	2 615	2 640
FI	:	2 642	2 664	2 679	2 686	2 682	2 659
SE	:	4 388	4 364	4 554	4 575	4 608	4 620
UK	28 420	28 445	28 677	28 677	28 937	29 140	29 270
IS	:	154	160	161	161	164	163
NO	:	2 329	2 352	2 364	2 389	2 365	2 374
CH	:	3 987	3 985	4 038	4 084	4 133	4 137
BG	:	:	3 428	3 442	3 419	3 334	3 376
HR	:	:	:	:	1 790	1 787	1 834
RO	:	11 755	11 714	11 565	10 630	10 068	10 059

9.3 Total employment

Table 9.3

Total employment in thousand
EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
EU-25	:	:	188 073	190 549	191 597	192 615	193 573
EU-15	:	155 648	158 730	161 359	162 690	163 726	164 683
BE	3 748	3 987	4 120	4 039	4 052	4 055	4 144
CZ		4 716	4 675	4 681	4 733	4 703	4 682
DK	2 537	2 708	2 716	2 717	2 741	2 704	2 742
DE	35 840	36 089	36 324	36 528	36 275	35 927	35 463
EE	:	580	568	576	581	589	595
EL	3 786	4 040	4 098	4 103	4 190	4 287	4 331
ES	12 186	14 626	15 440	16 076	16 597	17 241	17 866
FR	21 580	22 507	23 123	23 678	23 885	24 041	24 175
IE	1 207	1 589	1 671	1 722	1 764	1 793	1 836
IT	20 176	20 618	20 930	21 373	21 757	22 057	22 438
CY	:	279	294	310	315	327	336
LV	:	972	942	962	987	1 004	1 021
LT	:	1 488	1 419	1 373	1 421	1 473	1 437
LU	165	176	181	185	188	188	186
HU	:	3 785	3 807	3 859	3 868	3 924	3 894
MT	:	:	143	147	149	149	146
NL	6 706	7 605	7 860	8 065	8 176	8 125	8 101
AT	:	3 678	3 684	3 697	3 669	3 693	3 654
PL	:	14 940	14 518	14 252	13 820	13 657	13 682
PT	4 440	4 906	5 003	5 101	5 158	5 118	5 125
SI	:	889	894	914	922	896	946
SK	:	2 128	2 083	2 116	2 111	2 167	2 149
FI	:	2 333	2 367	2 403	2 406	2 401	2 384
SE	:	4 054	4 125	4 339	4 348	4 352	4 311
UK	25 677	26 732	27 088	27 334	27 483	27 744	27 929
IS	:	151	157	158	156	157	156
NO	:	2 253	2 271	2 276	2 293	2 265	2 273
CH	:	3 862	3 879	3 938	3 965	3 963	3 959
BG	:	:	2 872	2 756	2 800	2 876	2 970
HR	:	:	:	:	1 521	1 538	1 583
RO	:	11 022	10 898	10 807	9 768	9 368	9 283

9.4 GDP

Table 9.4

Gross Domestic Product (GDP) in million euro
EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
EU-25	:	8 382 007	8 977 260	9 327 047	9 672 005	9 811 805	10 266 471
EU-15	6 348 170	8 053 361	8 602 444	8 904 721	9 225 446	9 370 233	9 790 446
BE	198 401	235 683	247 924	254 153	261 124	269 546	283 752
CZ	:	55 345	60 397	67 960	78 388	80 254	86 239
DK	128 024	162 430	171 584	177 527	181 790	187 134	194 421
DE	1 809 747	2 012 000	2 062 500	2 113 160	2 145 020	2 163 400	2 215 650
EE	2 037	5 226	5 940	6 676	7 472	8 138	9 043
EL	84 353	117 850	123 173	131 317	141 669	153 472	165 281
ES	425 089	565 419	630 263	679 848	729 004	780 557	837 557
FR	1 151 431	1 366 466	1 441 372	1 497 184	1 548 555	1 585 172	1 648 369
IE	46 148	90 612	104 379	117 114	130 515	139 097	148 557
IT	863 368	1 107 994	1 166 548	1 218 535	1 260 598	1 300 929	1 351 328
CY	6 273	9 008	9 895	10 599	11 073	11 651	12 402
LV	3 407	6 752	8 379	9 227	9 792	9 868	11 064
LT	3 572	10 169	12 320	13 505	14 928	16 271	17 926
LU	12 951	18 739	21 279	22 020	22 806	23 956	25 664
HU	34 910	45 075	50 655	57 874	68 902	72 584	80 816
MT	:	3 661 b	4 122	4 191	4 255	4 209	4 316
NL	293 571	374 070	402 291	447 731	465 214	476 349	488 642
AT	171 697	200 025	210 392	215 878	220 688	226 968	237 039
PL	:	154 354	180 601	207 128	202 497	185 227	195 206
PT	76 303	112 695	120 302	122 550	128 458	130 511	135 035
SI	12 130	19 924	20 581	21 845	23 518	24 576	25 895
SK	13 003	19 131	21 926	23 322	25 733	28 952	33 119
FI	84 411	120 965	130 859	136 472	140 853	143 807	149 725
SE	179 611	235 768	259 907	245 178	256 840	267 251	279 008
UK	876 967	1 374 500	1 564 573	1 602 840	1 667 312	1 598 172	1 715 791
IS	5 145	7 884	9 107	8 472	8 891	9 204	9 857
NO	104 298	148 373	181 079	189 632	202 319	195 159	201 387
CH	226 815	248 637	266 724	279 699	293 840	284 884	287 878
BG	8 162	12 164	13 704	15 250	16 589	17 725	19 459
HR	:	18 677	19 955	22 138	24 199	25 508	27 623
RO	:	33 388	40 346	44 904	48 442	50 688	58 947
TR	108 862	173 097	216 736	161 836	192 803	212 268	239 895 f
JP	4 038 888	4 183 119	5 144 868	4 657 390	4 219 959	3 800 854	3 757 705
RU	:	181 880	280 790	341 998	364 192	380 765	468 430
US	5 945 431	8 696 191	10 629 060	11 308 620	11 071 912	9 698 727	9 433 475

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9.5 GDP deflator

Table 9.5

GDP deflator (index 1995 = 100)
EU-25 and selected countries - 1994 to 2004

	1994	1995	1999	2000	2001	2002	2003	2004
EU-25	:	100	110.7	114.3	116.7	119.6	120.1	122.8
EU-15	98.6	100	110.3	113.6	115.6	118.4	119.2	121.8
BE	98.8	100	105.8	107.1	109.0	111.0	113.2	115.8
CZ	:	100	134.5	136.4	143.1	147.1	150.8	155.4
DK	98.3	100	107.7	110.9	113.3	115.1	117.6	119.5
DE	98.2	100	101.7	101.0	102.2	103.7	104.8	105.6
EE	76.1	100	156.3	164.7	173.9	181.5	185.2	190.9
EL	91.1	100	124.3	128.5	133.0	138.3	143.1	148.0
ES	95.3	100	111.4	119.0	124.0	129.4	134.7	140.2
FR	99.0	100	103.2	104.6	106.5	108.8	110.5	112.3
IE	97.1	100	119.6	126.2	133.3	140.0	142.9	146.0
IT	95.2	100	112.5	114.9	118.0	121.6	125.1	128.4
CY	97.1	100	109.7	113.8	117.5	120.1	125.8	128.6
LV	86.9	100	134.7	139.8	142.7	147.6	152.6	163.7
LT	68.3	100	143.6	145.1	144.9	144.9	143.7	148.4
LU	97.7	100	109.9	114.5	116.7	117.9	120.4	123.4
HU	78.9	100	175.4	192.7	209.2	227.9	243.5	258.1
MT	:	:	116.0	116.5	118.6	120.9	127.0	129.5
NL	98.0	100	106.6	110.8	121.6	126.2	129.3	130.5
AT	98.1	100	101.9	103.7	105.5	106.9	108.4	110.5
PL	:	100	160.3	171.1	178.0	180.3	181.1	186.4
PT	96.7	100	114.5	117.8	123.4	128.8	132.4	135.7
SI	81.3	100	137.6	145.3	158.5	171.2	180.6	186.0
SK	91.0	100	124.7	135.2	140.9	146.5	153.3	160.4
FI	95.4	100	105.2	108.4	111.9	113.0	112.6	113.2
SE	96.7	100	104.3	105.7	108.1	109.9	112.3	113.2
UK	97.4	100	111.8	113.2	115.8	119.4	122.8	125.3
IS	97.2	100	113.7	116.9	127.7	134.9	134.7	138.0
NO	97.2	100	113.3	131.3	132.8	130.7	133.9	140.4
CH	99.2	100	100.2	101.0	101.6	103.3	104.3	105.2
BG	61.4	100	2 964.4	3 163.0	3 374.9	3 501.6	3 581.6	3 732.8
HR	:	100	125.2	131.1	136.3	140.3	144.8	149.8 f
RO	:	:	823.4	1 187.2	1 631.0	2 015.9	2 415.9	2 798.7 f
TR	53.4	100	882.3	1 322.6	2 047.5	2 951.1	3 615.4	3 978.5 f
JP	100.6	100	98.1	96.6	95.4	94.2	92.8	91.7
US	98.0	100	106.3	108.6	111.2	113.1	115.4	118.4

9.6 Exchange rates

Table 9.6

Exchange rate: national currency per euro
EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
BE	0.98	1	1	1	1	1	1
CZ	34.15	36.88	35.60	34.07	30.80	31.85	31.89
DK	7.54	7.44	7.45	7.45	7.43	7.43	7.44
DE	0.98	1	1	1	1	1	1
EE	15.39	15.65	15.65	15.65	15.65	15.65	15.65
EL	0.85	0.96	0.99	1	1	1	1
ES	0.96	1	1	1	1	1	1
FR	1.00	1	1	1	1	1	1
IE	1.01	1	1	1	1	1	1
IT	0.99	1	1	1	1	1	1
CY	0.58	0.58	0.57	0.58	0.58	0.58	0.58
LV	0.66	0.63	0.56	0.56	0.58	0.64	0.67
LT	4.73	4.26	3.70	3.58	3.46	3.45	3.45
LU	0.98	1	1	1	1	1	1
HU	125.03	252.77	260.04	256.59	242.96	253.62	251.66
MT	0.45	0.43	0.40	0.40	0.41	0.43	0.43
NL	0.98	1	1	1	1	1	1
AT	0.98	1	1	1	1	1	1
PL	2.70	4.23	4.01	3.67	3.86	4.40	4.53
PT	0.98	1	1	1	1	1	1
SI	152.77	194.47	206.61	217.98	225.98	233.85	239.09
SK	38.12	44.12	42.60	43.30	42.69	41.49	40.02
FI	1.04	1	1	1	1	1	1
SE	9.16	8.81	8.45	9.26	9.16	9.12	9.12
UK	0.78	0.66	0.61	0.62	0.63	0.69	0.68
IS	83.11	77.18	72.58	87.42	86.18	86.65	87.14
NO	8.37	8.31	8.11	8.05	7.51	8.00	8.37
CH	1.62	1.60	1.56	1.51	1.47	1.52	1.54
BG	64.39	1.96	1.95	1.95	1.95	1.95	1.95
HR	:	7.58	7.64	7.48	7.41	7.57	7.50
RO	1 972	16 345	19 922	26 004	31 270	37 551	40 510
TR	0.04	0.45	0.57	1.10	1.44	1.69	1.78
CN	:	:	:	7.41	7.83	9.36	10.30
JP	121.32	121.32	99.47	108.68	118.06	130.97	134.44
RU	:	26.52	26.02	26.15	29.70	34.67	35.82
US	1.19	1.07	0.92	0.90	0.95	1.13	1.24

Table 9.7

Exchange rate: national currency per PPS (Purchasing Power Parities)
EU-25 and selected countries - 1994 to 2004

	1994	1999	2000	2001	2002	2003	2004
BE	1.04	1.07	1.05	1.03	1.02	1.03	1.03
CZ	11.26	16.31	16.34	16.74	16.53	17.02	17.15
DK	9.66	9.62	9.56	9.57	9.76	9.89	9.81
DE	1.15	1.15	1.12	1.12	1.11	1.12	1.09
EE	3.88	7.77	7.87	8.33	8.70	8.96	9.17
EL	0.60	0.78	0.78	0.80	0.79	0.80	0.82
ES	0.77	0.84	0.84	0.86	0.86	0.87	0.89
FR	1.08	1.06	1.04	1.03	1.04	1.07	1.07
IE	0.91	1.05	1.08	1.13	1.16	1.19	1.16
IT	0.85	0.93	0.92	0.94	0.96	0.99	0.99
CY	0.44	0.48	0.48	0.48	0.51	0.54	0.53
LV	0.18	0.28	0.28	0.29	0.29	0.31	0.33
LT	0.97	1.76	1.71	1.67	1.66	1.66	1.68
LU	1.12	1.12	1.12	1.14	1.14	1.16	1.13
HU	53.40	114.34	122.10	126.20	132.87	141.78	147.16
MT	:	0.28	0.28	0.29	0.28	0.29	0.29
NL	1.01	1.06	1.05	1.05	1.07	1.08	1.07
AT	1.06	1.06	1.04	1.05	1.06	1.07	1.06
PL	:	2.00	2.07	2.12	2.11	2.17	2.21
PT	0.68	0.74	0.74	0.75	0.76	0.78	0.79
SI	87.35	142.59	147.71	156.29	167.10	175.46	177.33
SK	11.97	17.90	18.27	18.67	18.77	19.97	21.07
FI	1.07	1.12	1.11	1.12	1.12	1.13	1.12
SE	10.43	10.69	10.45	10.71	10.85	11.06	10.87
UK	0.70	0.74	0.72	0.71	0.71	0.73	0.73
IS	83.10	92.78	94.66	101.81	106.77	110.56	113.00
NO	10.03	10.53	10.25	10.45	10.59	10.86	10.70
CH	2.27	2.21	2.16	2.17	2.09	2.11	2.06
BG	0.01	0.59	0.61	0.64	0.67	0.69	0.73
HR	:	4.18 e	4.24 e	4.32 e	4.34 e	4.47 e	4.52
RO	:	5 107.57	7 155.87	9 539.35	11 455.70	13 775.70	15 521.90
TR	12 927.00	0.22	0.31	0.49	0.71	0.86	0.92
JP	203.18	185.34	176.14	170.12	164.19	159.86	152.24
US	1.13	1.14	1.13	1.14	1.13	1.15	1.15

9

Methodological Notes

This part presents, in some detail, the methodology used for the data set out in this publication. After some general information, specific details are given for the following domains:

- Government budget appropriations or outlays on R&D - GBAORD,
- R&D expenditure and personnel,
- Human Resources in Science and Technology - HRST,
- Innovation,
- Patents,
- High-tech industries and knowledge based services and
- The 2005 EU industrial R&D investment scoreboard.

1. General information

1.1 Currency

Series in current euro have been calculated by using the euro-national currency exchange rate.

Data measured in 1995 constant PPS - Purchasing Power Standard - are first corrected for inflation using the GDP deflator (a Paasche index with 1995 = 100 as base year) of the country in question before applying the PPS-national currency exchange rate.

1.2 GDP

Gross domestic product (GDP) at market prices is the final result of the production activity of resident producer units (ESA 95, 8.89). It can be defined in three ways:

- Output approach:
GDP is the sum of gross value added of the various institutional sectors or the various industries plus taxes and less subsidies on products (which are not allocated to sectors and industries). It is also the balancing item in the total economy production account.

- Expenditure approach

GDP is the sum of final uses of goods and services by resident institutional units (final consumption expenditure and gross capital formation), plus exports and minus imports of goods and services.

- Income approach
GDP is the sum of uses in the total economy generation of income account: compensation of employees, taxes on production and imports less subsidies, gross operating surplus and mixed income of the total economy.

1.3 Population

The population on 1st January is the number of inhabitants of a given area on 1st January of the year in question (or, in some cases, on 31st December of the previous year). The population figures are based on data from the most recent census adjusted by the components of population change produced since the last census, or based on population registers.

For HRST indicators, population totals are calculated from the LFS data, thus using the same source for numerators and denominators. Population totals derived from LFS may differ from the population totals from demographic statistics used in other chapters mainly because of a different reference date and the non-inclusion of some institutionalised persons

1.4 Employment

Employed persons are persons aged 15 and over who during the reference week performed work, even for just one hour per week, for pay, profit or family gain or were not at work but had a job or business from which they were temporarily absent because of, e.g., illness, holidays, industrial dispute and education or training.

1.5 Labour force

The labour force is the active population; this is the sum of employed and unemployed persons as defined by the EU Labour Force Survey. Persons in employment are those who during the reference week did any work for pay or profit, or were not working but had jobs from which they were temporarily absent, including family workers. Unemployed persons comprise persons aged 15 to 74 who were:

- without work during the reference week, i.e. neither had a job nor were at work (for one hour or more) in paid employment or self-employment;

- currently available for work, i.e. were available for paid employment or self-employment before the end of the two weeks following the reference week;

- actively seeking work, i.e. had taken specific steps in the four-week period ending with the reference week to seek paid employment or self-employment or who found a job to start later, i.e. within a period of at most three months.

1.6 Annual average growth rate

Annual average growth rates (AAGR) in this publication are calculated according to the following formula:

$$AAGR_{T,\ T\text{-}n} = [(X_T/X_{T\text{-}n})^{1/n} - 1] \times 100$$

Where X = value,
T = final year,
n = period in years for which the annual growth rate is calculated.

1.7 Institutional classification by sectors

The business enterprise sector - BES

With regard to R&D, the business enterprise sector includes: all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price and the private non-profit institutions mainly serving them - *Frascati Manual, § 163*.

The government sector - GOV

In the field of R&D, the government sector includes: all departments, offices and other bodies which furnish but normally do not sell to the community those common services, other than higher education, which cannot otherwise be conveniently and economically provided, and administer the state and the economic and social policy of the community (public enterprises are included in the business enterprise sector) as well as PNPs controlled and mainly financed by government - *Frascati Manual, § 184*.

The higher education sector - HES

This sector comprises: all universities, colleges of technology and other institutes of post-secondary education, whatever their source of finance or legal status. It also includes all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education establishments - *Frascati Manual, § 206*.

The private non-profit sector - PNP

This sector covers: non-market, private non-profit institutions serving households (i.e. the general public) and private individuals or households - *Frascati Manual, § 194*.

(1) NACE is derived from the French "**N**omenclature statistique des **A**ctivités économiques dans la **C**ommunauté **E**uropéenne" (Statistical classification of economic activities in the European Community).

1.8 Nomenclature - NACE Rev 1.1

NACE ([1]) is the statistical classification of economic activities; it is designed to categorise data relating to "statistical units", in this case a unit of activity, for example an individual plant or group of plants constituting an economic entity such as an enterprise.

Section/sub-section	Description	NACE Rev 1.1 codes
A	Agriculture, hunting, forestry	01 to 02
B	Fishing	5
C	Mining and quarrying	10 to 14
CA	Mining and quarrying of energy producing materials	10 to 12
CB	Mining and quarrying, except of energy producing materials	13 to 14
D	Manufacturing	15 to 37
DA	Manufacture of food products, beverages and tobacco	15 to 16
DB	Manufacture of textiles and textile products	17 to 18
DC	Manufacture of leather and leather products	19
DD	Manufacture of wood and wood products	20
DE	Manufacture of pulp, paper and paper products; publishing and printing	21 to 22
DF	Manufacture of coke, refined petroleum products and nuclear fuel	23
DG	Manufacture of chemicals, chemical products and man-made fibres	24
DH	Manufacture of rubber and plastic products	25
DI	Manufacture of other non-metallic mineral products	26
DJ	Manufacture of basic metals and fabricated metal products	27 to 28
DK	Manufacture of electrical and optical equipment	29
DL	Manufacture of electrical and optical equipment	30 to 33
DM	Manufacture of transport equipment	34 to 35
DN	Manufacturing n.e.c.	36 to 37
E	Electricity, gas and water supply	40 to 41
F	Construction	45
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	50 to 52
H	Hotels and restaurants	55
I	Transport, storage and communication	60 to 64
J	Financial intermediation	65 to 67
K	Real estate, renting and business activities	70 to 74
L	Public administration and defence; compulsory social security	75
M	Education	80
N	Health and social work	85
O	Other community, social and personal service activities	90 to 93
P	Activities of households	95 to 97
Q	Extra-territorial organizations and bodies	99

([1]) NACE is derived from the French "**N**omenclature statistique des **A**ctivités économiques dans la **C**ommunauté **E**uropéenne" (Statistical classification of economic activities in the European Community)

Aggregations of manufacturing based on NACE Rev 1.1

Eurostat uses the following aggregation of the manufacturing industry according to technological intensity and based on NACE rev. 1.1 at 3-digit level for compiling aggregates related to high-technology, medium high-technology, medium low-technology and low-technology.

Manufacturing industries	NACE Rev 1.1 codes
High-technology	**24.4** Manufacture of pharmaceuticals, medicinal chemicals and botanical products; **30** Manufacture of office machinery and computers; **32** Manufacture of radio, television and communication equipment and apparatus; **33** Manufacture of medical, precision and optical instruments, watches and clocks; **35.3** Manufacture of aircraft and spacecraft
Medium-high-technology	**24** Manufacture of chemicals and chemical product, **excluding 24.4** Manufacture of pharmaceuticals, medicinal chemicals and botanical products; **29** Manufacture of machinery and equipment n.e.c.; **31** Manufacture of electrical machinery and apparatus n.e.c.; **34** Manufacture of motor vehicles, trailers and semi-trailers; **35** Manufacture of other transport equipment, **excluding 35.1** Building and repairing of ships and boats **and excluding 35.3** Manufacture of aircraft and spacecraft.
Medium-low-technology	**23** Manufacture of coke, refined petroleum products and nuclear fuel; **25 to 28** Manufacture of rubber and plastic products; basic metals and fabricated metal products; other non-metallic mineral products; **35.1** Building and repairing of ships and boats.
Low-technology	**15 to 22** Manufacture of food products, beverages and tobacco; textiles and textile products; leather and leather products; wood and wood products; pulp, paper and paper products, publishing and printing; **36 to 37** Manufacturing n.e.c.

Please note that in a few cases (R&D, Employment in high tech and HRST), due to restrictions of the data sources used, the aggregations are only made on a NACE 2-digit level. This means that High-technology includes the NACE codes 30, 32 and 33, Medium-high-technology 24, 29, 31, 34 and 35, Medium-low-technology 23 and 25 to 28 and Low-technology 15 to 22 and 36 to 37.

Aggregations of services based on NACE Rev 1.1

Following a similar approach as for manufacturing, Eurostat defines the following sector as knowledge intensive services (KIS) or as less knowledge-intensive services (LKIS):

Knowledge based services	NACE Rev 1.1 codes
Knowledge intensive services (KIS)	**61** Water transport; **62** Air transport; **64** Post and telecommunications; **65 to 67** Financial intermediation; **70 to 74** Real estate, renting and business activities; **80** Education; **85** Health and social work; **92** Recreational, cultural and sporting activities
High tech KIS	**64** Post and telecommunications; **72** Computer and related activities; **73** Research and development.
Market KIS (excl. financial intermediation and high-tech services)	**61** Water transport; **62** Air transport; **70** Real estate activities; **71** Renting of machinery and equipment without operator and of personal and household goods; **74** Other business activities.
Less Knowledge-Intensive Services (LKIS)	**50 to 52** Motor trade; **55** Hotels and restaurants; **60** Land transport; transport via pipelines; **63** Supporting and auxiliary transport activities; activities of travel agencies; **75** Public administration and defence; compulsory social security; **90** Sewage and refuse disposal, sanitation and similar activities; **91** Activities of membership organization n.e.c.; **93** Other service activities; **95** Activities of households as employers of domestic staff; **99** Extra-territorial organizations and bodies
Market services less KIS	**50 to 52** Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; **55** Hotels and restaurants; **60** Land transport; transport via pipelines; **63** Supporting and auxiliary transport activities; activities of travel agencies.

1.9 Nomenclature of territorial units for statistics - NUTS

The regional data presented in this publication are broken down according to the Nomenclature of Territorial Units for Statistics - NUTS - classification, 2003 version. The NUTS was established by the Statistical Office of the European Communities (Eurostat), in co-operation with the Commission's other departments, to provide a single, uniform breakdown of territorial units for the production of regional statistics for the European Union.

The NUTS is a five-level hierarchical classification comprising three regional and two local levels. In this way, NUTS subdivides each Member State into a whole number of NUTS 1 regions, each of which is in turn subdivided into a whole number of NUTS 2 regions, and so on. In the present publication most data are presented at NUTS 2 level on the basis of the NUTS 2003 version. The exceptions have been indicated in the tables or figures.

For eight countries (Denmark, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta and Slovenia) the national level coincides with the NUTS 2 level, which explains their potential presence amongst the regional rankings in this publication.

Iceland and Norway are not included in the NUTS classification but do have similar statistical regions. Iceland is also classified at the statistical region level 2.

Some data are presented at NUTS 1 level. For twelve countries (Czech Republic, Denmark, Estonia, Ireland, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Slovenia, Slovakia and Sweden) the national level coincides with the NUTS 1 level, which explains their potential presence amongst the regional rankings in this publication.

2. Methodological notes by domain

2.1 Government Budget Appropriations or Outlays on R&D - GBAORD

Definition

Government budget appropriations or outlays on R&D (GBAORD) are all appropriations allocated to R&D in central government or federal budgets and therefore refer to budget provisions, not to actual expenditure. Provincial or state government should be included where the contribution is significant. Unless otherwise stated, data include both current and capital expenditure and cover not only government-financed R&D performed in government establishments, but also government-financed R&D in the business enterprise, private non-profit and higher education sectors, as well as abroad (*Frascati Manual, § 496*). Data on actual R&D expenditure, which are not available in their final form until some time after the end of the budget year concerned, may well differ from the original budget provisions. This and further methodological information can be found in the *Frascati Manual*, OECD, 2002.

GBAORD data are assembled by national authorities using data for public budgets. These measure government support to R&D activities, or, in other words, how much priority Governments place on the public funding of R&D.

Eurostat collects aggregated data which are checked and processed, and compared with other data sources such as OECD. Then, all the necessary aggregates are calculated (or estimated).

Sources

The basic data are forwarded to Eurostat by the national administrations of Member States and other countries. Data for Japan and the United States come from the OECD.

Statistical data compilation

Until 2003, data on GBAORD were collected under a gentlemen's agreement. From the reference year 2004 on, data collection is based on the Commission Regulation on statistics on science and technology, No 753/2004 (OJ L 118, page 23 of 23 April 2004).

Breakdown by socio-economic objective

Government R&D appropriations or outlays on R&D are broken down by socio-economic objectives on the basis of NABS - *Nomenclature for the analysis and comparison of scientific programmes and budgets*, Eurostat 1994. The 1993 version of NABS applies from the 1993 final and the 1994 provisional budgets onwards.

The NABS socio-economic objectives are:

- 01: Exploration and exploitation of the earth
- 02: Infrastructure and general planning of land-use
- 03: Control and care of the environment
- 04: Protection and improvement of human health
- 05: Production, distribution and rational utilization of energy
- 06: Agricultural production and technology
- 07: Industrial production and technology
- 08: Social structures and relationships
- 09: Exploration and exploitation of space
- 10: Research financed from GUF
- 11: Non-oriented research
- 12: Other civil research
- 13: Defence
- **Total civil GBAORD** (sum of socio-economic objectives 01 to 12)
- **Total GBAORD** (sum of socio-economic objectives 01 to 13)

Not all countries collect the data directly by NABS. Some follow other compatible classifications (OECD, Nordforsk), which are then converted to the data compiled according to the NABS classification (see Table 8.2 of the *Frascati Manual*).

Exceptions

No GBAORD data exist for Luxembourg before 2000, and therefore EU aggregates exclude Luxembourg before that year.
No GBAORD data exist for Cyprus before 2004, and therefore EU-25 and EEA exclude Cyprus before that year.
No GBAORD data exist for Hungary, and therefore EU-25 and EEA exclude Hungary.

Time series

The analysis in the present Panorama covers the period 1994 to 2004, with 2004 being provisional.

2.2 R&D expenditure and personnel

Concepts and definitions

The basic concepts, guidelines for collecting data and the classifications used in compiling statistics on research and experimental development are given in the *Frascati Manual* - OECD, 2002. R&D expenditure and personnel are specially detailed in chapters 5 and 6 respectively. Regional data are collected according to the standards defined by the Regional Manual - Eurostat 1996.

Research and experimental development (R&D) activities comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications. There are two basic statistical variables in this domain, namely R&D expenditure and R&D personnel.

Sources

The basic data are forwarded to Eurostat by the national administrations of Member States and other countries. Data for China, Japan and the United States come from the OECD.

Statistical data compilation

Until 2003, data on R&D were collected under a gentlemen's agreement. From the reference year 2003 on, data collection is based on the Commission Regulation on statistics on science and technology, No 753/2004 (OJ L 118, page 23 of 23 April 2004).

R&D expenditure

Intramural expenditures are all expenditures for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds (*Frascati Manual, § 358*).

R&D intensity

R&D intensity is R&D expenditure expressed as a percentage of GDP.
For the computation of R&D intensity at the national level (EEA countries), GDP from national accounts is used as reference data. At the regional level, GDP data are taken from the regional accounts. Both data series were extracted from NewCronos - Eurostat as at 31 August 2005.

R&D personnel

Total personnel

All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators and clerical staff. Those providing indirect services, such as canteen and security staff, should be excluded (*Frascati Manual, § 294-296*).

Full-time equivalent - FTE

Full-time equivalent corresponds to one year's work by one person. Thus, someone who normally devotes 40% of his/her time to R&D and the rest to other activities (e.g. teaching, university administration or counselling) should be counted as only 0.4 FTE.

Personnel in head count - HC

Head count corresponds to the number of individuals who are employed mainly or partly on R&D. For purposes of comparison between different regions and periods, this indicator is often used in conjunction with employment or population variables.

Classifications

Institutional classification

Internal expenditure and R&D personnel are broken down by institutional sector, i.e. the sector in which the R&D is performed. There are four main sectors:

- The business enterprise sector - BES;
- The government sector - GOV;
- The higher education sector - HES;
- The private non-profit sector - PNP.

For definition of institutional sectors, please refer to general information.

Source of funds

R&D expenditure is subdivided into five sources of funds: Business Enterprise, Government, Higher Education, PNP and Abroad - *Frascati Manual, § 389 ff*. Since the amounts from the Higher Education and PNP sectors are small, they have been combined as "other national sources".

M

Field of sciences

Data on R&D expenditure and personnel may be broken down by six fields of science. The classification of field of science is based on the nomenclature suggested by UNESCO: Recommendation concerning the *International Standardisation of Statistics on Science and Technology*. These fields are: natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences and humanities.

Sector of activity

Data on R&D expenditure and personnel in the BES may be broken down by sector of activity on the basis of the NACE Rev 1.1 (see general methodologies).

Size class of enterprise

Data on R&D personnel in the BES may be broken down by size class of enterprises. The main size classes of enterprises are:

- small enterprises: 0 to 49 employees,
- medium enterprises: 50 to 499 employees,
- large enterprises: more than 500 employees.

Type of cost

R&D expenditures include both current and capital expenditures.

- Current costs are composed of labour costs and other current costs. The current costs comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, holiday pay, contributions to pension funds and other social security payments, payroll taxes, etc.
The other current costs comprise non-capital purchases of materials, supplies and equipment to support R&D performed by the statistical unit in a given year.

- Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units. They should be reported in full for the period when they took place and should not be registered as an element of depreciation.

Occupation

- Researchers: They are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned (*Frascati Manual, § 301*).
- Technicians and equivalent staff: they are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences or social sciences and humanities.
- Other supporting: This includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

Qualification

ISCED provides the basis for classifying R&D personnel by formal qualification. Six classes are recommended for the purposes of R&D statistics but only four are usually collected:

- ISCED level 6: holders of university degrees at Doctorate level
- ISCED level 5A: holders of basic university degrees below the Doctorate level
- ISCED level 5B: holders of other tertiary level diplomas
- Others: this includes holders of other post-secondary non-tertiary diplomas (ISCED level 4), holders of diplomas of secondary education (ISCED level 3) and all those with secondary diplomas at less than ISCED level 3 or with incomplete secondary qualifications or education not falling under any of the other classes.

Geographical coverage

These data are available for EU-25 Member States, candidate countries, Iceland, Norway, Switzerland, China, Japan and the United States at the national level and for European countries at the regional level NUTS level 2 (see general methodologies).

Aggregates

For both R&D expenditure and personnel, EU totals are calculated as the sum of the national data by sector. Where data are missing, estimates are first made for the country in question, reference period, institutional sector or relevant R&D variable, as appropriate. This method is not applied identically to the calculation of R&D personnel in head count (HC). The estimates for R&D personnel in full-time equivalents (FTE) serve as a basis for the HC calculation. An FTE/HC ratio based on available FTE and HC personnel data at the national level is estimated for the EU aggregates, by institutional sector and by year. This ratio is then applied to the FTE data to calculate the EU totals in HC.

- EU-15, EU-25 and EEA data are estimated values.
- EEA: Liechtenstein is not included.

Time series

Data are presented for the period 1994-2004. However, data series in NewCronos are available from 1981 onwards with differences in terms of availability according to variables and institutional sectors. Not all years are complete, and therefore the latest year available for each country is presented in the analysis.

Additional information on the methodology used may be found at Eurostat's reference database (http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL) under Science and Technology / Research and Development / Statistics on Research and Development.

2.3 Human resources in science and technology

Statistics on Human Resources in Science and Technology - HRST - can improve our understanding of both the demand for, and supply of highly qualified personnel. The data presented in this publication focus on two main aspects: stocks and flows. The former serves to show the needs and the current situation of the labour force, and the latter indicates to what degree this demand is likely to be met in the future by looking at the current participation and graduation output of educational systems.

The general recommendations for the collection of HRST data are laid down in the Canberra Manual (1), where HRST is defined as a person fulfilling one of the following conditions:

- successfully completed education at the third level in an S&T field of study (ISCED '97 version levels 5a, 5b or 6) or;
- not formally qualified as above but employed in an S&T occupation where the above qualifications are normally required (ISCO '88 COM codes 2 or 3).

The conditions of the above educational or occupational requirements are considered according to internationally harmonised standards:

- the *International Standard Classification of Education* - ISCED - giving the level of formal education achievement;
- the *International Standard Classification of Occupation* - ISCO - detailing the type of occupation.

Stocks

Stocks provide information on the number of HRST at a particular point in time. In this publication, stock data relate to the employment status as well as the occupational and educational profiles of individuals in quarter 2 of any given year. HRST stock data and their derived indicators are extracted and built up using data from the EU Labour Force Survey. The EU Labour Force Survey is based on a sample of this population. All results conform to Eurostat guidelines on sample-size limitations and are therefore not published if the degree of sampling error is likely to be high and flagged as unreliable if the degree of reliability is too small.

The basic categories of HRST are as follows:

Category	People that have/are
HRST: Human Resources in Science and Technology	• successfully completed education at the third level in a S&T field of study (ISCED '97 version levels 5a, 5b or 6); **or** • not formally qualified as above but are employed in a S&T occupation where the above qualifications are normally required (ISCO '88 COM codes 2 or 3).

Sub-categories of HRST	People belonging to HRST that have/are
HRSTO: Human Resources in Science and Technology — Occupation	• employed in a S&T occupation (ISCO '88 COM codes 2 or 3).
HRSTE: Human Resources in Science and Technology — Education	• successfully completed education at the third level in a S&T field of study (ISCED '97 version levels 5a, 5b or 6).
HRSTC: Human Resources in Science and Technology — Core	• successfully completed education at the third level in a S&T field of study (ISCED '97 version levels 5a, 5b or 6) **and** • are employed in a S&T occupation (ISCO '88 COM codes 2 or 3).
S&E: Scientists and Engineers	• employed in "Physical, mathematical and engineering" occupations or "life science and health" occupations (ISCO '88 COM codes 21 and 22).
HRSTU: Human Resources in Science and Technology — Unemployed	• successfully completed education at the third level in a S&T field of study (ISCED '97 version levels 5a, 5b or 6) **and** are unemployed.
NHRSTU: Unemployed non-HRST	• no education at the third level in a S&T field of study **and** are unemployed.

(1) Manual on the Measurement of Human Resources devoted to S&T - *Canberra Manual*, OECD, Paris, 1994.

M

Inflows

HRST inflows are the number of people who do not fulfil any of the conditions for inclusion in HRST at the beginning of a time period but gain at least one of them during the period.

The number of graduates from a country's higher education system represents the main inflow into the national stock of HRST.

HRST education inflow data are extracted from the Eurostat Education database building on the UNESCO/OECD/Eurostat questionnaire on education, which is based on the International Standard Classification of Education - ISCED.

The International Standard Classification of Education - ISCED 97

Levels of tertiary education	
ISCED level 5A	• programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skill requirements.
ISCED level 5B	• programmes that are generally more practical/ technical/occupationally specific than ISCED 5A programmes.
ISCED level 6	• this level is reserved for tertiary programmes that lead to the award of an advanced research qualification. The programmes are devoted to advanced study and original research.

This publication includes the following totals and sub-totals (for ISCED 1997 version):

Title	Short name	Description	ISCED '97 subject codes
Total	Total	Sum of fields of study	
Science and Engineering	S&E	Life sciences, Physical sciences, Mathematics and statistics, Computing, Engineering and engineering trades, Manufacturing and processing, Architecture and building.	42, 44, 46, 48, 52, 54, 58.

The International Standard Classification of Occupations - ISCO (S&T occupations)

Title	ISCO subject codes	Description
Professionals	ISCO 2	• occupations whose main tasks require a high level of professional knowledge and experience in the fields of physical and life sciences, or social sciences and humanities.
Technicians and Associate professionals	ISCO 3	• occupations whose main tasks require technical knowledge and experience in one or more fields of physical and life sciences, or social sciences and humanities.

The user should note that definition of S&T occupations constitutes a certain deviation from the recommendations laid down in the Canberra Manual. In addition to ISCO major groups 2 and 3 the Canberra Manual proposes also considering as HRST: production and operations managers, other specialist managers, managers of small enterprises (ISCO 122, 123 and 131) who may work in the field of S&T. However, they are not included in the term HRST as used here (but they are included in HRST(E) if they have successfully completed third level education).

The limitation applied here is justified as a pilot survey conducted in 1995 tested the validity of the original definitions for HRST, and the results indicated that, for the EU, including these particular managerial occupations distorted the results significantly, due to variations between countries in the treatment and classification of managers.

Doctorate students

The term Doctorate defines in general tertiary education programmes which lead to the award of an advanced research degree (ISCED level 6), e.g. a doctorate in economics.

For the definition of this level, the following criteria are relevant:

- Main criterion: It typically requires the submission of a thesis or dissertation of publishable quality which is the product of original research and represents a significant contribution to knowledge.
- Subsidiary criterion: It prepares graduates for faculty posts in institutions offering ISCED 5A programmes, as well as research posts in government, industry, etc.

The programmes are therefore devoted to advanced study and original research and are not based on course-work only. They usually require 3-5 years of research and course work, generally after a Master's degree. Indicators of the number of Doctorate students therefore provide an idea of the degree to which countries will have researchers at the highest level of education.

Foreign students

A foreign student is defined as someone not having the citizenship of the country in which he/she is educated. Overestimation of non-national students may occur in some countries where permanently resident second generation migrants with foreign nationalities constitute an important group of students.

Mobility

Data on job-to-job mobility can be defined as the movement of employed HRST from one job to another, during the past 12-month period. They do not include inflows into the labour market from unemployment or inactivity.

Employed HRST are those who have:

- successfully completed tertiary level education in a S&T field of study and are employed in any type of occupation
Or
- are not formally qualified as above but are employed in a S&T occupation.

Breakdown by sector of activity

HRST data by sector of activity are collected according to the Statistical classification of economic activities in the European Community - NACE Rev. 1.1. For further information on the sector groups please refer to General Information part.

Time series

Data are available in many countries from 1994 onwards, but differences exist and certain years are missing. Users should note that the existence of data in this NewCronos domain also depends on their reliability. The guidelines on the sample size reliability of the data established by the EU LFS are applied to the HRST database. Therefore, breakdowns for which quality levels are considered insufficient are either flagged as not available or unreliable.

Sources

Additional information on the methodology used may be found at Eurostat's reference database under Science and Technology Human Resources in Science & Technology:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL) .

2.4 Innovation

The Third Community Innovation Survey and the Community Innovation Survey 2002/2003

The CIS is designed to obtain information on innovation activities within enterprises, as well as various aspects of the process such as the effects of innovation, sources of information used, costs etc.

The CIS is based on the Oslo Manual (second edition from 1997 and third edition from 2005), which gives methodological guidelines and defines the innovation concept.

More information can be found in the metadata available in Eurostat's reference database NewCronos under Science and Technology / Survey on innovation in EU enterprises:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL) .

Data and metadata for the Fourth Community Innovation Survey will be available in autumn/winter 2006.

European Innovation Scoreboard 2005

Various documents on the European Innovation Scoreboard 2005 and the scoreboard itself can be found at this address http://www.trendchart.org/scoreboards/scoreboard2005/scoreboard_papers.cfm

The Methodology Report in particular gives a detailed description of the indicators used in the European Innovation Scoreboard 2005.

2.5 Patents

Patents reflect part of a country's inventive activity. Patents also show the country's capacity to exploit knowledge and translate it into potential economic gains. In this context, indicators based on patent statistics are widely used to assess the inventive performance of the country or regions.

The grounds for the assumption that a patent represents a codification of inventive activity rely on the novelty, utility and inventiveness that an invention requires to be patented. On the basis of this assumption, Eurostat collects patent statistics to build up indicators of R&D output.

Eurostat's patents database contains data on patent applications to the European Patent Office (EPO) and patents granted by the United States Patent and Trademark Office (USPTO). In addition Chapter 6 of this publication looks at data on triadic patent families. Due to methodological differences in the manner of processing the data, no cross sectional comparisons are advisable between the EPO, USPTO and patent family data. Methodological issues specific to each type of data are explained below.

Regional data are given according to the Nomenclature of Territorial Units for Statistics. NUTS classification, 2003 version (See general information). For regionalisation purposes, concordance tables were used. These tables link postcodes and/or city names to NUTS regions.

Patent applications to the EPO by priority year

Data in Eurostat's EPO database refer to patent applications to the EPO by priority year, which include both applications filed directly under the European Patent Convention (EPC) and applications filed under the Patent Co-operation Treaty (PCT) and designating the EPO (Euro-PCT) for protection. The regional (national) distribution of patent applications is according to the inventor's place of residence. If an application has more than one inventor, the application is divided equally among all of them and subsequently among their regions, thus avoiding double counting. EPO data are shown from 1992 to 2002; longer time series are available, but more recent data are not comparable as they are incomplete due to the patenting procedure.

For further information on definitions and explanatory notes concerning EPO patent data see Eurostat's reference database NewCronos under Science and Technology / Patent statistics / Patent applications to EPO by priority year:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL) .

Patents granted by the USPTO by priority year

Data on patents granted by the USPTO refer to patents granted, and not to applications as is the case for data coming from the EPO. Data in these two collections are therefore not comparable.
USPTO data are available from 1989 to 1999; longer time series are available, but more recent data are not comparable as they are incomplete due to the patenting procedure.

For further information on definitions and explanatory notes concerning USPTO patent data see Eurostat's reference database NewCronos under Science and Technology / Patent statistics / Patents granted by the USPTO by priority year:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL)

Triadic patent families by priority year

A patent family is defined as a set of patents taken in various countries for protecting the same invention, i.e. related patents are regrouped into a single record to derive a unique patent family. A patent is a member of a triadic patent family if and only if it has been applied for and filed at the European Patent Office (EPO) and the Japanese Patent Office (JPO) and if it has been granted by the US Patent and Trademark Office (USPTO). Patent families, as opposed to patents, are intended to improve international comparability (the home advantage is suppressed; the values of the patents are more homogeneous).

Data on triadic patent families are presented by priority year, i.e. the year of the first international filing of a patent. This exacerbates the disadvantage of traditional patent counts with respect to timeliness, and therefore latest available data refer to 1999 only.

For further methodological notes please refer to: OECD triadic patent families, OECD, 2004.
Metadata are available in Eurostat's reference database NewCronos under Science and Technology Patent statistics / Triadic patent families by earliest priority year:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL)

Patent Cooperation Treaty

The Patent Cooperation Treaty (PCT) provides the possibility to seek patent rights in a large number of countries by filing a single international application with a single patent office, and is increasingly being used for patent applications. The PCT procedure consists of two main phases: (a) an "international phase"; and (b) a PCT "national/regional phase". In order to measure inventive activity, Eurostat has included these both phases of PCT applications.

European Patent Convention

The European Patent Convention (EPC) is the convention on the granting of European patents. The first version of the convention entered into force on 5 October 1973. The latest version, from April 2006, is the 12th.

One of the problems of patent applications to the EPO are the costs, which are mainly translations costs. The official languages of the EPO are governed by Article 14 “Languages of the European Patent Office” (see http://www.european-patent-office.org/legal/epc/e/ar14.html#A14) and the translations by Article 65 of the EPC “Translation of the specification of the European patent” (see http://www.european-patent-office.org/legal/epc/e/ar65.html#A65).

Foreign ownership

Data on foreign ownership measure the number of patents invented within (or applied for by) a given country that involve at least one foreign applicant (or a foreign inventor).

To make this definition clearer let us take as example a patent with three inventors (one French, one German and one American) and two applicants (one German and one American). Combining the nationalities of inventors and applicants there are six partnerships, of which four are foreign, because they involve two different nationalities, and two are national.

International Patent Classification

Patent data follow the International Patent Classification (IPC), which assigns an invention to one or more IPC-classes according to its function or intrinsic nature or its field of application. If a patent is assigned to more than one IPC code, only the first listed is taken into account. Only the first four digits of the IPC are used for breakdowns and aggregations.

SECTION A - HUMAN NECESSITIES

AGRICULTURE
A 01 AGRICULTURE; FORESTRY; ANIMAL HUSBANDRY; HUNTING; TRAPPING; FISHING
FOODSTUFFS; TOBACCO
A 21 BAKING; EDIBLE DOUGHS
A 22 BUTCHERING; MEAT TREATMENT; PROCESSING POULTRY OR FISH
A 23 FOODS OR FOODSTUFFS; THEIR TREATMENT, NOT COVERED BY OTHER CLASSES
A 24 TOBACCO; CIGARS; CIGARETTES; SMOKERS' REQUISITES
PERSONAL OR DOMESTIC ARTICLES
A 41 WEARING APPAREL
A 42 HEADWEAR
A 43 FOOTWEAR
A 44 HABERDASHERY; JEWELLERY
A 45 HAND OR TRAVELLING ARTICLES
A 46 BRUSHWARE
A 47 FURNITURE; DOMESTIC ARTICLES OR APPLIANCES; COFFEE MILLS; SPICE MILLS; SUCTION CLEANERS IN GENERAL
HEALTH; AMUSEMENT
A 61 MEDICAL OR VETERINARY SCIENCE; HYGIENE
A 62 LIFE-SAVING; FIRE-FIGHTING
A 63 SPORTS; GAMES; AMUSEMENTS

SECTION B - PERFORMING OPERATIONS; TRANSPORTING

SEPARATING; MIXING
B 01 PHYSICAL OR CHEMICAL PROCESSES OR APPARATUS IN GENERAL
B 02 CRUSHING, PULVERISING, OR DISINTEGRATING; PREPARATORY TREATMENT OF GRAIN FOR MILLING
B 03 SEPARATION OF SOLID MATERIALS USING LIQUIDS OR USING PNEUMATIC TABLES OR JIGS; MAGNETIC OR ELECTROSTATIC SEPARATION OF SOLID MATERIALS FROM SOLID MATERIALS OR FLUIDS; SEPARATION BY HIGH-VOLTAGE ELECTRIC FIELDS
B 04 CENTRIFUGAL APPARATUS OR MACHINES FOR CARRYING-OUT PHYSICAL OR CHEMICAL PROCESSES
B 05 SPRAYING OR ATOMISING IN GENERAL; APPLYING LIQUIDS OR OTHER FLUENT MATERIALS TO SURFACES, IN GENERAL
B 06 GENERATING OR TRANSMITTING MECHANICAL VIBRATIONS IN GENERAL
B 07 SEPARATING SOLIDS FROM SOLIDS; SORTING
B 08 CLEANING
B 09 DISPOSAL OF SOLID WASTE; RECLAMATION OF CONTAMINATED SOIL
SHAPING
B 21 MECHANICAL METAL-WORKING WITHOUT ESSENTIALLY REMOVING MATERIAL; PUNCHING
B22 CASTING; POWDER METALLURGY
B 23 MACHINE TOOLS; METAL-WORKING NOT OTHERWISE PROVIDED FOR
B 24 GRINDING; POLISHING
B 25 HAND TOOLS; PORTABLE POWER-DRIVEN TOOLS; HANDLES FOR HAND IMPLEMENTS; WORKSHOP EQUIPMENT; MANIPULATORS
B 26 HAND CUTTING TOOLS; CUTTING; SEVERING
B 27 WORKING OR PRESERVING WOOD OR SIMILAR MATERIAL; NAILING OR STAPLING MACHINES IN GENERAL
B 28 WORKING CEMENT, CLAY, OR STONE
B 29 WORKING OF PLASTICS; WORKING OF SUBSTANCES IN A PLASTIC STATE IN GENERAL
B 30 PRESSES
B 31 MAKING PAPER ARTICLES; WORKING
B 32 LAYERED PRODUCTS
PRINTING
B 41 PRINTING; LINING MACHINES; TYPEWRITERS; STAMPS
B 42 BOOKBINDING; ALBUMS; FILES; SPECIAL PRINTED MATTER
B 43 WRITING OR DRAWING IMPLEMENTS; BUREAU ACCESSORIES
B 44 DECORATIVE ARTS
TRANSPORTING
B 60 VEHICLES IN GENERAL
B 61 RAILWAYS
B 62 LAND VEHICLES FOR TRAVELLING OTHERWISE THAN ON RAILS
B 63 SHIPS OR OTHER WATERBORNE VESSELS; RELATED EQUIPMENT
B 64 AIRCRAFT; AVIATION; COSMONAUTICS
B 65 CONVEYING; PACKING; STORING; HANDLING THIN OR FILAMENTARY MATERIAL
B 66 HOISTING; LIFTING; HAULING
B 67 OPENING OR CLOSING BOTTLES, JARS OR SIMILAR CONTAINERS; LIQUID HANDLING
B 68 SADDLERY; UPHOLSTERY

MICRO-STRUCTURAL TECHNOLOGY; NANO-TECHNOLOGY
B 81 MICRO-STRUCTURAL TECHNOLOGY
B 82 NANO-TECHNOLOGY

SECTION C - CHEMISTRY; METALLURGY

CHEMISTRY
C 01 INORGANIC CHEMISTRY
C 02 TREATMENT OF WATER, WASTE WATER, SEWAGE, OR SLUDGE
C 03 GLASS; MINERAL OR SLAG WOOL
C 04 CEMENTS; CONCRETE; ARTIFICIAL STONE; CERAMICS; REFRACTORIES
C 05 FERTILISERS; MANUFACTURE THEREOF
C 06 EXPLOSIVES; MATCHES
C 07 ORGANIC CHEMISTRY
C 08 ORGANIC MACROMOLECULAR COMPOUNDS; THEIR PREPARATION OR CHEMICAL WORKING-UP; COMPOSITIONS BASED THEREON
C 09 DYES; PAINTS; POLISHES; NATURAL RESINS; ADHESIVES; MISCELLANEOUS COMPOSITIONS; MISCELLANEOUS APPLICATIONS OF MATERIALS
C 10 PETROLEUM, GAS OR COKE INDUSTRIES; TECHNICAL GASES CONTAINING CARBON MONOXIDE; FUELS; LUBRICANTS; PEAT
C 11 ANIMAL OR VEGETABLE OILS, FATS, FATTY SUBSTANCES OR WAXES; FATTY ACIDS THEREFROM; DETERGENTS; CANDLES
C 12 BIOCHEMISTRY; BEER; SPIRITS; WINE; VINEGAR; MICROBIOLOGY; ENZYMOLOGY; MUTATION OR GENETIC ENGINEERING
C 13 SUGAR INDUSTRY
C 14 SKINS; HIDES; PELTS; LEATHER
METALLURGY
C 21 METALLURGY OF IRON
C 22 METALLURGY; FERROUS OR NON-FERROUS ALLOYS; TREATMENT OF ALLOYS OR NON-FERROUS METALS
C 23 COATING METALLIC MATERIAL; COATING MATERIAL WITH METALLIC MATERIAL ; CHEMICAL SURFACE TREATMENT; DIFFUSION TREATMENT OF METALLIC MATERIAL; COATING BY VACUUM EVAPORATION, BY SPUTTERING, BY ION IMPLANTATION OR BY CHEMICAL VAPOUR DEPOSITION, IN GENERAL ; INHIBITING CORROSION OF METALLIC MATERIAL OR INCRUSTATION IN GENERAL
C 25 ELECTROLYTIC OR ELECTROPHORETIC PROCESSES; APPARATUS THEREFOR
C 30 CRYSTAL GROWTH

SECTION D - TEXTILES; PAPER

TEXTILES OR FLEXIBLE MATERIALS NOT OTHERWISE PROVIDED FOR
D 01 NATURAL OR ARTIFICIAL THREADS OR FIBRES; SPINNING
D 02 YARNS; MECHANICAL FINISHING OF YARNS OR ROPES; WARPING OR BEAMING
D 03 WEAVING
D 04 BRAIDING; LACE-MAKING; KNITTING; TRIMMINGS; NON-WOVEN FABRICS
D 05 SEWING; EMBROIDERING; TUFTING
D 06 TREATMENT OF TEXTILES OR THE LIKE; LAUNDERING; FLEXIBLE MATERIALS NOT OTHERWISE PROVIDED FOR
D 07 ROPES; CABLES OTHER THAN ELECTRIC
PAPER
D 21 PAPER-MAKING; PRODUCTION OF CELLULOSE

SECTION E - FIXED CONSTRUCTIONS

BUILDING
E 01 CONSTRUCTION OF ROADS, RAILWAYS, OR BRIDGES
E 02 HYDRAULIC ENGINEERING; FOUNDATIONS; SOIL-SHIFTING
E 03 WATER SUPPLY; SEWERAGE
E 04 BUILDING
E 05 LOCKS; KEYS; WINDOW OR DOOR FITTINGS; SAFES
E 06 DOORS, WINDOWS, SHUTTERS, OR ROLLER BLINDS, IN GENERAL; LADDERS
EARTH OR ROCK DRILLING; MINING
E 21 EARTH OR ROCK DRILLING; MINING

SECTION F - MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

ENGINES OR PUMPS
F 01 MACHINES OR ENGINES IN GENERAL; ENGINE PLANTS IN GENERAL; STEAM ENGINES
F 02 COMBUSTION ENGINES; HOT-GAS OR COMBUSTION-PRODUCT ENGINE PLANTS
F 03 MACHINES OR ENGINES FOR LIQUIDS; WIND, SPRING, WEIGHT, OR MISCELLANEOUS MOTORS; PRODUCING MECHANICAL POWER OR A REACTIVE PROPULSIVE THRUST, NOT OTHERWISE PROVIDED FOR
F 04 POSITIVE-DISPLACEMENT MACHINES FOR LIQUIDS; PUMPS FOR LIQUIDS OR ELASTIC FLUIDS
ENGINEERING IN GENERAL
F 15 FLUID-PRESSURE ACTUATORS; HYDRAULICS OR PNEUMATICS IN GENERAL
F 16 ENGINEERING ELEMENTS OR UNITS; GENERAL MEASURES FOR PRODUCING AND MAINTAINING EFFECTIVE FUNCTIONING OF MACHINES OR INSTALLATIONS; THERMAL INSULATION IN GENERAL
F 17 STORING OR DISTRIBUTING GASES OR LIQUIDS

LIGHTING; HEATING
F 21 LIGHTING
F 22 STEAM GENERATION
F 23 COMBUSTION APPARATUS; COMBUSTION PROCESSES
F 24 HEATING; RANGES; VENTILATING
F 25 REFRIGERATION OR COOLING; COMBINED HEATING AND REFRIGERATION SYSTEMS; HEAT PUMP SYSTEMS; MANUFACTURE OR STORAGE OF ICE; LIQUEFACTION OR SOLIDIFICATION OF GASES
F 26 DRYING
F 27 FURNACES; KILNS; OVENS; RETORTS
F 28 HEAT EXCHANGE IN GENERAL
WEAPONS; BLASTING
F 41 WEAPONS
F 42 AMMUNITION; BLASTING

SECTION G - PHYSICS

INSTRUMENTS
G 01 MEASURING; TESTING
G 02 OPTICS
G 03 PHOTOGRAPHY; CINEMATOGRAPHY; ANALOGOUS TECHNIQUES USING WAVES OTHER THAN OPTICAL WAVES; ELECTROGRAPHY; HOLOGRAPHY
G 04 HOROLOGY
G 05 CONTROLLING; REGULATING
G 06 COMPUTING; CALCULATING; COUNTING
G 07 CHECKING-DEVICES
G 08 SIGNALLING
G 09 EDUCATING; CRYPTOGRAPHY; DISPLAY; ADVERTISING; SEALS
G 10 MUSICAL INSTRUMENTS; ACOUSTICS
G 11 INFORMATION STORAGE
G 12 INSTRUMENT DETAILS
NUCLEONICS
G 21 NUCLEAR PHYSICS; NUCLEAR ENGINEERING

SECTION H - ELECTRICITY

H 01 BASIC ELECTRIC ELEMENTS
H 02 GENERATION, CONVERSION, OR DISTRIBUTION OF ELECTRIC POWER
H 03 BASIC ELECTRONIC CIRCUITRY
H 04 ELECTRIC COMMUNICATION TECHNIQUES
H 05 ELECTRIC TECHNIQUES NOT OTHERWISE PROVIDED FOR

IPC-NACE correspondence

The breakdown by NACE sector codes is based on the IPC-NACE concordance tables created by the Fraunhofer Institute for Systems and Innovation Research in Karlsruhe (Germany).

For further information on the methodology used see Eurostat's reference database NewCronos under Science and Technology / Patent statistics:
(http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL)

The easiest way to explain the link between the two classifications is to give an example. Let us take two patents from the IPC sector A - Human necessities. The first patent has the code IPC A24B (Manufacture or preparation of tobacco for smoking, chewing; tobacco; snuff). With the help of the concordance tables this patent is converted to NACE code DA (Manufacture of food products, beverages and tobacco). The second patent has the code A24C (Machines for making cigars or cigarettes). The NACE code for the second patent is, after conversion, DK (Manufacture of machinery and equipment n.e.c.).

NACE-ISIC correspondence

Table 6.12 in Chapter 6 of the publication shows in brackets behind the title of the NACE division the International Standard Industrial Classification (ISIC) code. ISIC codes are currently used at the world-wide level whereas the NACE codes are used at the EU level.

Nace Rev. 1.1		ISIC Rev.3.1	
DA	Manufacture of food products, beverages and tobacco	D 15	Manufacture of food products and beverages
		D 16	Manufacture of tobacco products
DB	Manufacture of textiles and textile products	D 17	Manufacture of textiles
		D 18	Manufacture of wearing apparel; dressing and dyeing of fur
DC	Manufacture of leather and leather products	D 19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
DD	Manufacture of wood and wood products	D 20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
DE	Manufacture of pulp, paper and paper products; publishing and printing	D 21	Manufacture of paper and paper products
		D 22	Publishing, printing and reproduction of recorded media
DF	Manufacture of coke, refined petroleum products and nuclear fuel	D 23	Manufacture of coke, refined petroleum products and nuclear fuel
DG	Manufacture of chemicals, chemical products and man-made fibres	D 24	Manufacture of chemicals and chemical products
DH	Manufacture of rubber and plastic products	D 25	Manufacture of rubber and plastics products
DI	Manufacture of other non-metallic mineral products	D 26	Manufacture of other non-metallic mineral products
DJ	Manufacture of basic metals and fabricated metal products	D 27	Manufacture of basic metals
		D 28	Manufacture of fabricated metal products, except machinery and equipment
DK	Manufacture of electrical and optical equipment	D 29	Manufacture of machinery and equipment n.e.c.
DL	Manufacture of electrical and optical equipment	D 30	Manufacture of office, accounting and computing machinery
		D 31	Manufacture of electrical machinery and apparatus n.e.c.
		D 32	Manufacture of radio, television and communication equipment and apparatus
DM	Manufacture of transport equipment	D 34	Manufacture of motor vehicles, trailers and semi-trailers
		D 35	Manufacture of other transport equipment
DN	Manufacturing n.e.c.	D 36	Manufacture of furniture; manufacturing n.e.c.
		D 37	Recycling

Technological fields

1. Biotechnology: The OECD definition is the application of Science & Technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services. An indicative list of technologies is DNA, Proteins and molecules (the functional blocks), cell and tissue culture and engineering, process biotechnologies, sub-cellular organisms (gene therapy, viral vectors).

Patent applications/patents granted with the IPC codes (7th edition, 2000) listed below are aggregated to calculate the indicator "biotechnology patent applications/patents granted".

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).

2. High tech: Based on the data on patent applications/patents granted by IPC codes (7th edition, 2000), Eurostat has calculated data on patent applications/patents granted in high-technology fields.

The aggregation "high-tech patents" is made up as follows in the IPC. For each of the six high-tech groups the patents with the IPC codes in brackets are used.

1. Aviation - AVI [B64B, B64C, B64D, B64F, B64G];
2. Computer and automated business equipment - CAB [B41J, G06C, G06D, G06E, G06F, G06G, G06J, G06K, G06M, G06N, G06T, G11C];
3. Communication technology - CTE [H04B, H04H, H04J, H04K, H04L, H04M, H04N, H04Q, H04R, H04S];
4. Lasers - LSR [H01S];
5. Micro-organism and genetic engineering - MGE [C12M, C12N, C12P, C12Q];
6. Semi-conductors - SMC [H01L].

3. Information and Communication Technologies (ICT): The IPC codes (7th edition, 2000) listed behind each ICT sub-category are added up for the aggregation of each ICT-sub-category:

1. 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];
2. Consumer electronics [G11B, H03F, H03G, H03J, H04H, H04N, H04R, H04S];
3. Computers, office machinery [B07C, B41J, B41K, G02F, G03G, G05F, G06, G07, G09G, G10L, G11C, H03K, H03L];
4. 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].

2.6 High-tech industries and knowledge based service

Enterprises in high-tech industries and knowledge-intensive services

Indicators on enterprises in high-tech industries and knowledge-intensive services are extracted and aggregated on the basis of the NACE (see general information) using data from the Structural Business Statistics - SBS.

These data are available for EU-25 Member States, candidate countries, Norway and Switzerland at the national level. The data are aggregated using the definition of high tech industries and knowledge-intensive services based on NACE rev. 1.1 at 3-digit level (see general information).

M

Definition of indicators

Value added at factor cost is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. It can be calculated from turnover, plus capitalised production, plus other operating income, plus or minus the changes in stocks, minus the purchases of goods and services, minus other taxes on products which are linked to turnover but not deductible, minus the duties and taxes linked to production. Value added at factor cost is calculated "gross", as value adjustments (such as depreciation) are not subtracted.

Labour productivity to the value added at factor cost per person employed.

Production value measures the amount actually produced by the unit, based on sales, including changes in stocks and the resale of goods and services. The production value is defined as turnover, plus or minus the changes in stocks of finished products, work in progress and goods and services purchased for resale, minus the purchase of goods and services for resale, plus capitalised production, plus other operating income (excluding subsidies). Income and expenditure classified as financial or extra-ordinary in company accounts is excluded from production value. Included in purchases of goods and services for resale are services purchased in order to be rendered to third parties in the same condition.

Gross investment in tangible goods is defined as investment during the reference period in all tangible goods. Included are new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. Capitalised production of tangible capital goods), having a useful life of more than one year including non-produced tangible goods such as land. Investment in intangible and financial assets is excluded.

Gross investment in machinery and equipment covers machinery (office machines etc.), special vehicles used on the premises, other machinery and equipment, all vehicles and boats used off the premises, i.e. motor cars, commercial vehicles and lorries as well as special vehicles of all types, boats, railway wagons, etc. acquired new or second hand during the reference period. Machinery and equipment acquired through restructuring (such as mergers, take-overs, break-ups, split-offs) are excluded. Also included are all additions, alterations, improvements and renovations which prolong the service life or increase the productive capacity of these capital goods. Current maintenance costs are excluded.

Venture capital investment

Venture Capital Investment (VCI) is defined as private equity raised for investment in companies. Management buyouts, management buy-ins, and venture purchase of quoted shares are excluded.

Data are broken down into two investment stages:
- Early stage (seed + start-up) and
- Expansion and replacement (expansion and replacement capital).

Venture capital is expressed as a percentage of GDP (Gross domestic product at market prices), which is defined in conformity with the European System of national and regional Accounts in the Community (ESA 95).

The data cover EU-15, EU-25 Member States (except for Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta), Norway and Switzerland.

The basic data are provided by the European Private Equity and Venture Capital Association (EVCA). For more information on venture capital, please refer to: http://www.evca.com.

Definition of indicators

Seed is defined as financing provided to research, assess and develop an initial concept before a business has reached the start-up phase.

Start-up is defined as financing provided for product development and initial marketing, manufacturing, and sales. Companies may be in the process of being set up or may have been in business for a short time, but have not sold their product commercially.

Expansion is defined as financing provided for the growth and expansion of a company which is breaking even or trading profitably. Capital may be used to finance increased production capacity, market or product development, and/or provide additional working capital. It includes bridge financing for the transition from private to public quoted company, and rescue/turnaround financing.

Replacement capital is defined as purchase of existing shares in a company from another private equity investment organisation or from another shareholder or shareholders. It includes refinancing of bank debt.

High-tech trade

Indicators on high-tech trade are extracted and aggregated on the basis of the Standard International Trade Classification (SITC Rev3) using data from COMEXT and from COMTRADE databases.

These data are available for EU-25 Member States, candidate countries, Iceland, Norway, Switzerland, Japan and the United States. There are no data for Luxembourg and Belgium separately before 1999. Hence, both countries are treated together previous to that year. EU aggregates exclude intra-EU trade.

High technology groups of products are defined according to the R&D intensity of products. Nine SITC Rev3 groups of products are considered as high-tech. These are:
- Aerospace,
- Computers-Office machinery,
- Electronics-Telecommunications,
- Pharmacy,

- Scientific instruments,
- Electrical machinery,
- Chemistry,
- Non-electrical machinery and
- Armament.

Employment in high-tech industries and knowledge-intensive services

Data on employment in high-tech industries and knowledge-intensive services are extracted and aggregated on the basis of the NACE (see general information) using data from the Community Labour Force Survey - CLFS.

These data are available for EU-25 Member States, candidate countries, Iceland, Norway and Switzerland both at national level and at regional NUTS level 2 (see general information). These are aggregated using the definition of high tech industries and knowledge-intensive services based on NACE rev. 1.1 at 2-digit level (see general information).

2.7 The 2005 EU industrial R&D investment scoreboard

The 2005 EU industrial R&D investment scoreboard has been jointly prepared by the Directorate-General for Research (DG-RTD) and the Joint Research Centre (JRC). It reports on the worldwide research and development of 1 400 top companies.

Definitions of indicators

1. **"R&D investment"** - research & development (R&D) investment included in the Scoreboard is the cash spend, as described in "Scope of the EU Industrial R&D Investment Scoreboard" above. Being that disclosed in the annual report and accounts, it is subject to the accounting definitions of R&D. For example, a definition is set out in International Accounting Standard (IAS) 38 "Intangible assets" is based on the OECD "Frascati" manual.

2. **"(Net) Sales"** - the usual accounting definition of sales, excluding sales taxes and shares of sales of joint ventures & associates. For banks, sales are defined as the "total (operating) income" plus any insurance income. For insurance companies, sales are defined as "Gross premiums written" plus any banking income.

3. **"Operating profit (or loss)"** - this is calculated as net profit (or loss) before taxation, plus net interest cost (or minus net interest income), less gains (or plus losses) arising from the sale/disposal of businesses or fixed assets.

4. **"Annual growth (Change Year/Previous Year)"** - simple growth over the previous year, expressed as a percentage = 100*((C/B)-1); where C = current year amount, and B = previous year amount. Annual growth is calculated only if data exist for both the current and previous year. At the aggregate level, annual growth is calculated only by aggregating those companies for which data exist for both the current and previous year.

5. **"CAGR 3yrs (growth)"** - compound annual growth over the previous 3 years, expressed as a percentage = 100*(((C/B)^(1/t))-1); where C = current year amount, B = base year amount (where base year = current year - 3), and t = number of time periods (= 3). CAGR 3yrs growth is calculated only if data exist for the current and base years. At the aggregate level, CAGR 3yrs growth is calculated only by aggregating those companies for which data exist for the current and base years.

6. **"Capex"** - capital expenditure, disclosed in accounts as additions to tangible fixed assets.

7. **"Employees"** - the total consolidated average employees, or year-end employees if average not stated.

8. **"R&D/sales ratio"** - the ratio between R&D investment and net sales of a given company or group of companies. At the aggregate level, R&D/ sales ratio is calculated only by aggregating those companies for which data exist for both R&D and sales in the specified year.

9. **"R&D per employee"** - the simple ratio of R&D spend over Employees. At the aggregate level, R&D per employee and the other non-growth statistics are calculated only by aggregating those companies for which data exist for both the numerator and the denominator.

10. **"Market capitalisation"** - share price multiplied by the number of shares issued at a given date. Figures for each company in the Scoreboard are taken as at 15 August 2005. The gross market capitalisation amount is used to take account of those companies for which not all the equity is available on the market. Companies not listed on a recognised stock exchange have been distinguished separately by the use of italics.

11. **"Number of companies for calculation"** - indicates the number of companies available for calculations of aggregate data (based on groups of companies).

More information is available at http://eu-iriScoreboard.jrc.es/index.htm.

Abbreviations & Symbols

Statistical symbols and abbreviations

©........Copyright sign
®........Registered sign
% ....percentage
- ....not applicable or real zero or zero by default
: ....not available
0 ....less than half of the unit used
1000s ....thousands
1990-92 ....period of several calendar years (e.g. from 1.1.1999 to 31.12.2004)
b ....break in series
:c........ confidential value
e ....estimated value
f ....forecast
i ....more information in explanatory notes
p ....provisional value
r ....revised value
s ....Eurostat estimate
u ....unreliable
:u .... extremely unreliable data

Abbreviations

A

AAGR ....Annual Average Growth Rate
AGR ....Annual Growth Rate
AVI ....Aviation (High-tech group, based on International Patent Classification)

B

BERD ....Expenditure on R&D in the Business enterprise sector
BES ....Business enterprise sector

C

CAB ....Computer and automated business equipment (High-tech group, based on International Patent Classification)
CBSTII ....Common Basis for Science, Technology and Innovation Indicators
CD-ROM ....Compact Disc Read-Only Memory
CEC ....Commission of the European Communities
CIS ....Community Innovation Survey
CTE ....Communication technology (High-tech group, based on International Patent Classification)
CV ....Curriculum Vitae

D

DG ....Directorate-General
DG-RTD ....Research Directorate-General
DNA/RNA ....Deoxyribonucleic acid/Ribonucleic acid

E

EC ....European Community/Communities
ECU/EUR ....Ecu up to 31.12.1998/Euro from 1.1.1999
EEA ....European Economic Area
EFTA ....European Free Trade Association
EIS ....European Innovation Scoreboard
EP ....European Parliament
EPC ....European Patent Convention
EPO ....European Patent Office
EU LFS ....European Union Labour Force Survey
EU-15 ....European Union (15 countries)
EU/EU-25 ....European Union (25 countries)
EUR ....Euro
Eurostat ....Statistical Office of the European Communities
EVCA ....European Venture Capital Association

F

FAPESP ....Fundacão de Amparo à Pesquisa do Estado de São Paulo - State of São Paulo Research Foundation
FOS ....Field of science
FP ....Framework programme
FP6 ....EU Sixth Research Framework Programme 2002-2006
FP7 ....EU Seventh Research Framework Programme 2007-2013
FTE ....Full-time equivalent
FTSE ....Financial Times Stock Exchange

G

GBAORD ....Government budget appropriations or outlays on R&D
GDP ....Gross Domestic Product
GERD ....Gross Domestic Expenditure on R&D
GISCO ....Geographic Information System for the Commission - Eurostat
GOV ....Government sector
GUF ....General University Funds

H

HC ....Head Count
HES ....Higher education sector
HRST ....Human resources in science and technology
HRSTC ....Human resources in science and technology - Core

HRSTE .... Human resources in science and technology - Education
HRSTO .... Human resources in science and technology - Occupation
HRSTU .... Human resources in science and technology - Unemployed

I

ICT .... Information and Communication Technology
ILO .... International Labour Organisation
IPC .... International Patent Classification
ISBN .... International Standard Book Number
ISCED .... International standard classification for education
ISCO .... International standard classification of occupation
ISIC .... International Standard Industrial Classification of all Economic Activities
IT .... Information technology

J

JPO .... Japanese Patent Office
JRC .... Joint Research Centre

K

KIS .... Knowledge-intensive services

L

LFS .... Labour Force Survey
LKIS .... Less knowledge-intensive services
LSR .... Lasers (High-tech group, based on International Patent Classification)

M

MGE .... Micro-organism and genetic engineering (High-tech group, based on International Patent Classification)
Mio .... million
Mio EUR .... millions of euro
MSTI .... Main Science and Technological Indicators - OECD

N

NABS .... Nomenclature for the analysis and comparison of science budgets and programmes
NAC .... National currency
NACE .... General industrial classification of economic activities within the European Communities
NewCronos .... Eurostat's statistical reference database
NHRSTU .... Unemployed non-HRST
NUTS .... Nomenclature of territorial units for statistics

O

OECD .... Organisation for Economic Cooperation and Development
OHIM .... Office of Harmonisation for the Internal Market

P

p.a. .... per year *(per annum)*

PATSTAT .... Patent statistics database (provided by the EPO)

PNP .... Private non-profit sector

PPS .... Purchasing power standard

PSL .... Personnel

R

R&D .... Research and Development

S

SII .... Summary Innovation Index

SMC .... Semi-conductors (High-tech group, based on International Patent Classification)

SME .... Small and medium enterprises

S&E .... Science and Engineering

SE .... Scientists and Engineers

S&T .... Science and Technology

U

UN .... United Nations

UNESCO .... United Nations Educational, Scientific and Cultural Organisation

UOE .... Unesco/OECD/Eurostat

USPTO .... United States Patent and Trademark Office

V

VCI .... Venture Capital Investments

W

WIPO .... World Intellectual Property Organisation

Countries

EU-25

BE .... Belgium

CZ .... Czech Republic

DK .... Denmark

DE .... Germany

EE .... Estonia

EL .... Greece

ES .... Spain

FR .... France

IE .... Ireland

IT ....Italy
CY ....Cyprus
LV ....Latvia
LT ....Lithuania
LU ....Luxembourg
HU ....Hungary
MT ....Malta
NL ....the Netherlands
AT ....Austria
PL ....Poland
PT ....Portugal
SI ....Slovenia
SK ....Slovakia
FI ....Finland
SE ....Sweden
UK ....the United Kingdom

Candidate countries

BG ....Bulgaria
FYROM ....Former Yugoslav Republic of Macedonia
HR....................Croatia
RO ....Romania
TR ....Turkey

Other countries

CA ....Canada
CH ....Switzerland
CN ....China
IS ....Iceland
JP ....Japan
LI ....Liechtenstein
NO ....Norway
RU ....Russia
US ....United States