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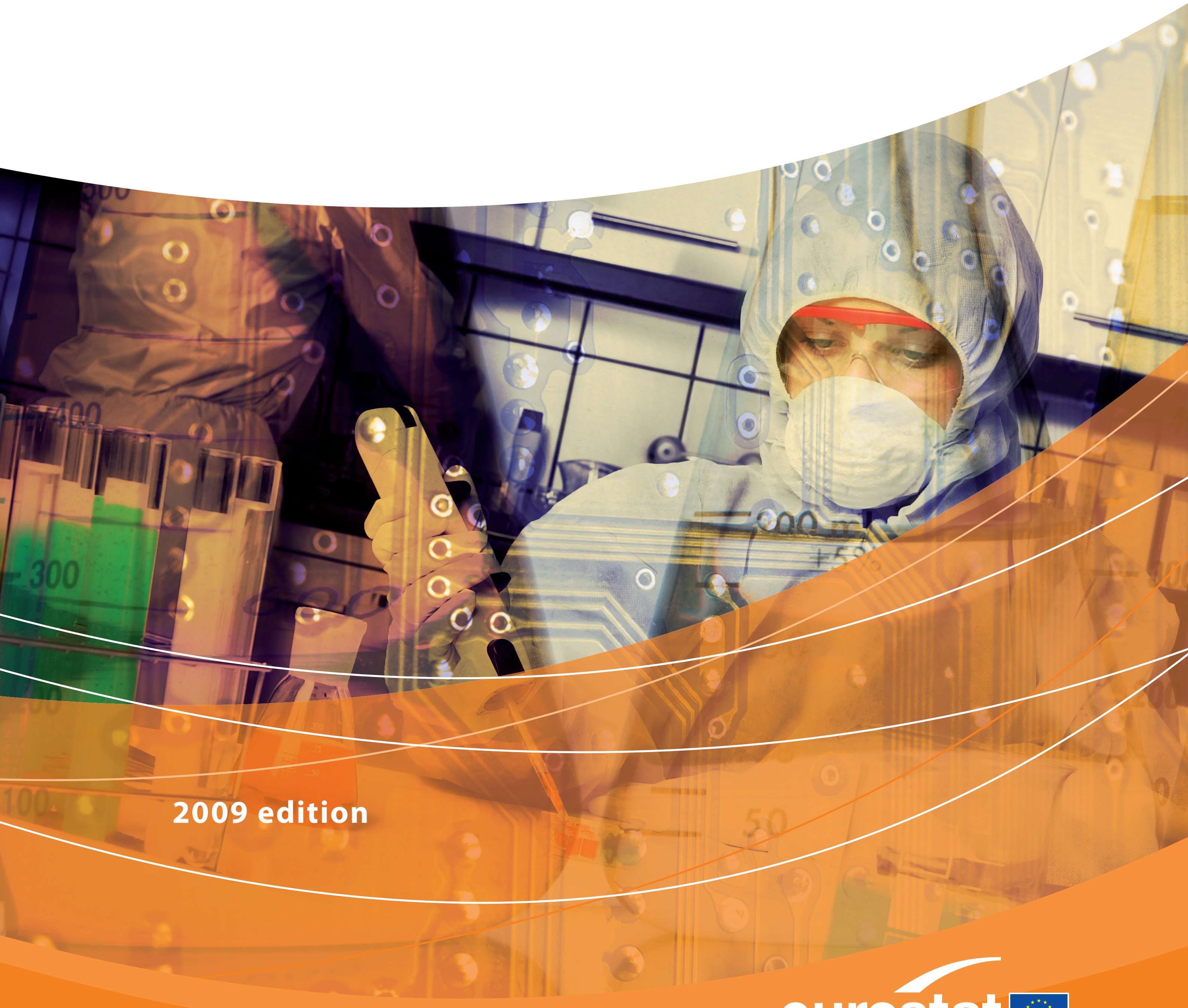
Science, technology and innovation in Europe



2009 edition

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Preface

The statistics and indicators presented in this 2009 edition of 'Science, Technology and Innovation in Europe' are line with the strategic goals set by the European Council in Lisbon in 2000 — the 'Lisbon strategy' — and Barcelona in 2002 aiming respectively to turn the European Union, by 2010, into most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion.

The Lisbon and Barcelona European Councils both signaled the important role of R&D and innovation in the European Union. Against this background, the 2005 initiative on 'Working together for growth and jobs' has re-launched the Lisbon strategy. Knowledge and innovation for growth became one of the three main areas for action in the new Lisbon partnership for growth and jobs, which places science, technology and innovation at the heart of European Union policies.

A knowledge-based society is one where research, education, training and innovation are fully mobilised to fulfil the economic, social and environmental ambitions of the European Union and the expectations of its citizens. Five new European Research Area initiatives launched in 2008 address researchers' careers and mobility, research infrastructures, knowledge sharing, joint programming and international science and technology cooperation. They aim at establishing durable partnerships with Member States and stakeholders — including businesses, universities and research organisations — to develop the European Research Area jointly in their specific areas of focus.

In this context, relevant and meaningful indicators on science, technology and innovation are paramount for informing where Europe stands on the path towards more knowledge and growth. Although several challenges remain, in particular concerning the measurement of the internationalisation of research, this publication presents, with the aid of the relevant statistics, the progress made in recent years on research, development and innovation activities in Europe and in comparison with the selected other economies.

Michel GLAUDE

Director for Social Statistics and Information Society

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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, technology and innovation in Europe* looking at the main statistical indicators in this field. It is intended for both generalists and specialists and is divided into three main parts:

- Part 1: Investing in R&D
- Part 2: Monitoring the knowledge workers
- Part 3: Productivity and competitiveness

It also contains comprehensive methodological notes and lists of abbreviations and symbols.

The statistics and indicators in this publication focus primarily on the 27 EU Member States and EFTA countries. Candidate countries are also considered whenever data are available. No data are currently available for the former Yugoslav Republic of Macedonia (FYROM). To allow comparisons with the rest of the world, data for China, Japan and the United States are presented where possible. This publication also provides a regional analysis of the situation within the EU Member States. The data presented reflect the information available at Eurostat as of 1 January 2008. (Revisions after this date have been included where necessary.)

Given the numerous data sources used in this publication, the coverage of the time series differs from one indicator to another. However, the first year taken into consideration for most indicators is 1995 (except for patents). As far as possible, this publication sets out to provide detailed and coherent time series.

This publication endeavours to maintain consistency with previous publications and further information has been added in response to users' requirements. All the data presented in this Statistical Book are available in Eurostat's NewCronos reference database.

1. Government budget appropriations or outlays on R&D — GBAORD

Chapter 1 provides an analysis of government budget appropriations or outlays on R&D in 2006.

In 2006, GBAORD levels in the EU-27, Japan and the United States stood at 0.76 %, 0.70 % and 1.03 % of GDP respectively. Between 1995 and 1999, GBAORD declined in relative terms (as a percentage of GDP) in the United States and in the EU-15, but increased in Japan. Between 1999 and 2006, the trends were distinctly different. GBAORD expressed as a percentage of GDP was stable in the EU-15, but increased slightly in Japan and noticeably in the United States.

Within the EU-27, in 2006 France recorded the highest GBAORD levels as a share of GDP (1.01 %). At the other end of the scale, GBAORD rates in Bulgaria, Latvia, Slovakia and Malta were no higher than 0.3 % of GDP.

Considering the distribution of GBAORD by socio-economic objective, 'research financed from general university funds (GUF)' took the lion's share of GBAORD at EU-27 level, with 30.3 % of the total. In Japan too the main socio-economic objective was 'research financed from GUF', with an even higher share (32.4 %). In the United States, however, over half of all government budget appropriations or outlays on R&D in 2005 were allocated to 'defence' (57.9 %). Variations were also observed between the EU Member States in terms of their socio-economic objectives: in 2006 'research financed from GUF' accounted for largest share of total GBAORD in 10 EU-27 Member States for which data are available. 'Defence' was the leading socio-economic objective in the United Kingdom only (28.3 %). 'Non-oriented research' was the top objective in eight Member States: the Czech Republic (26.8 %), Estonia (44.7 %), France (26.6 %), Cyprus (31.0 %), Latvia (41.1 %), Poland (76.9 %), Slovenia (49.6 %) and Slovakia (32.6 %). 'Industrial production and technology' was the most important socio-economic objective in Belgium, Spain, Luxembourg, Hungary, Romania and Finland, while 'social structures and relationships' ranked firstin Lithuania .

2. R&D expenditure

Chapter 2 presents the latest trends in R&D expenditure. In 2006 R&D expenditure as a share of GDP (R&D intensity) in the EU-27 remained stable at 1.84 %. Only Sweden (3.73 %) and Finland (3.45 %) exceeded the 3 % target set by the Lisbon strategy. However, the figures for these two countries were slightly down in relation to 2005.

Considering the estimates by sector, most R&D expenditure is financed by the business enterprise sector (BES), which accounted for almost two thirds (1.17 %) of R&D intensity in 2006, while the public sector (higher education and government) accounted for 0.65 % and the remaining 0.02 % was financed by the private non-profit sector (PNP).

In 2006 the leading EU-27 Member States in terms of R&D intensity were Sweden and Finland, with 3.73 % and 3.58 % respectively. R&D intensity also exceeded 2 % in Germany (2.53 %), Denmark (2.43 %), Austria (2.49 %) and France (2.09 %).

The EU-27 spent a total of EUR 213 billion on R&D in 2006, with an average annual growth rate (AAGR) of 3.6 % in relation to 2001. Germany, France and the United Kingdom accounted for two thirds of total R&D expenditure in the EU. Between 2001 and 2006, Estonia (25.3 %), Latvia (24.4 %) and Malta (23.5 %) accounted for the highest average annual growth rates in R&D expenditure .

In most Member States R&D expenditure in the BES was commensurate with the size of the enterprise. Medium-sized enterprises (50 to 249 employees) invested less in R&D than small enterprises (10 to 49 employees) in only four EU countries.

In the EU-27, seven of the top 15 regions in terms of R&D intensity were located in Germany. In 2005, the German region of Braunschweig came first with an R&D intensity of 5.78 %, which is more than three times the EU-27 average. Västsverige (SE) and Stuttgart (DE) followed with 5.33 % and 5.25 % respectively.

In terms of absolute R&D expenditure, Île-de-France was well ahead, accounting for 7.2 % of total R&D expenditure in the EU-27. However, with a share of 3.20 %, Île-de-France was not among the top 15 regions in terms of R&D intensity.

3. R&D personnel

In 2005, R&D personnel accounted for 1.45 % of total employment in the EU-27, with a headcount (HC) of more than 3 million persons working in R&D. Measured in full-time equivalents (FTE), R&D personnel numbered slightly more than 2 million in the EU-27.

At national level, Iceland was in the lead, with 3.58 % of all persons employed working in R&D, ahead of Finland (3.22 %), Sweden (2.71 %), Luxembourg (2.59 %) and Denmark (2.44 %).

In 2006, Germany, France and the United Kingdom employed 53.8 % of all R&D personnel in the EU-27, measured in full-time equivalents. These three countries were ahead in every sector, often followed by Spain and Italy.

In 2006, 1.3 million researchers (in FTE) were employed in the EU-27, which represents an increase of 77 700 over 2004. In the same period the number of researchers increased in most EU-27 Member States. In 2006, Germany employed the most researchers in FTE (282 000), followed by Spain (116 000).

Women are still under-represented in R&D in the EU-27, especially in the business enterprise sector: in 2005, women represented 30 % of all researchers in the EU and only 19 % of researchers employed in the BES. The share of female researchers was generally higher in the new Member States (2004 and 2007 enlargements) and candidate countries.

In 2004, the EU-27 employed 628 000 researchers (in FTE) in the BES. In most EU countries the largest group of BES researchers was employed in 'manufacturing', while most researchers in the higher education and government sectors were employed in 'natural sciences'.
In 2005, Île-de-France (FR) employed the most R&D personnel (in FTE) in absolute terms, with 3.39 % of the EU-27 total.
The leading region in terms of R&D personnel as a share of total employment was Wien (AT), with 4.52 %.

4. Human resources in science and technology — HRST

In 2005, every sixth student in the European Union was in tertiary education, giving an estimated 18.5 million students in higher education. Significant disparities were however observed at national level, as six countries — Germany, France, the United Kingdom, Italy, Spain and Poland — accounted for almost 70 % of students in tertiary education.

In 2005, more than 4 million tertiary students in the EU-27 were specialising in either 'science, mathematics and computing' or 'engineering, manufacturing and construction'. Although science degrees attracted more than 1.7 million students in 2005, this subject was less popular than engineering studies.

Within the EU, Denmark and Bulgaria ranked highest in terms of female participation in engineering studies, with 33.1 % and 32.0 % respectively. Conversely, Cyprus reported the lowest share of female engineering students, with 12.9 %.

In 2005, close to 3.8 million students graduated from tertiary education in the EU-27. Just under half of them were studying in one of only three countries: the United Kingdom, France and Poland. Germany came fourth, accounting for 9.1 % of graduates in the EU.

In 2005, more than 100 000 of the 3.8 million new graduates in the EU were awarded a doctorate. This is almost twice as many as in the United States and over six times more than in Japan. Among the EU Member States, Germany and the United Kingdom turned out the most doctoral graduates in 2005, accounting together for 42 % of the EU total. Between 2000 and 2005, the average annual increase in the number of new doctorate-holders in the EU-27 ranged from 2 % in science to 4 % in engineering.

At EU level, HRSTC (human resources in science and technology — core) stocks made up 17 % of the total labour force in 2006. Although HRSTC stocks grew on average by 2.9 % per year between 2001 and 2006, large differences persist between Member States.

Between 2001 and 2006, the highest AAGR in HRSTC was recorded in Slovenia (9.8 %), where HRSTC also accounted for a high share of the labour force (18.2 %). By comparison, Germany, which had a similar share of HRSTC among the labour force (17.8 %), reported one of the lowest average HRSTC growth rates in the EU, with only 1.4 %. Iceland was the only country to show a decline in HRSTC stocks between 2001 and 2006, with an annual average change of close to -1.9 %.

The EU-27 unemployment rate for the tertiary-educated population stood at 3 % in 2006, compared with 8 % for their non-tertiary-educated counterparts. The lowest unemployment rates for the non-tertiary-educated population were reported in Denmark and Norway (3 % each). By contrast, this rate reached 14 % in Poland. Slovakia and Germany also recorded high unemployment rates for human resources without tertiary education (13 % and 12 % respectively).

5. Innovation

Chapter 5 presents the results from the European Innovation Scoreboard (EIS) at European and national level, together with a look at the Community Innovation Surveys (CIS) for 2006 and 2008.

Based on their innovation performance, the countries included in the 2007 EIS were divided into the following groups:

- The *innovation leaders:* Denmark, Finland, Germany, Israel, Japan, Sweden, Switzerland, the United Kingdom and the United States.
- The *innovation followers:* Austria, Belgium, Canada, France, Iceland, Ireland, Luxembourg and the Netherlands.
- The *moderate innovators:* Australia, Cyprus, the Czech Republic, Estonia, Italy, Norway, Slovenia and Spain.
- The *catching-up countries:* Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania and Slovakia. Turkey's innovation performance is currently well below that of other countries included in the EIS.

The Community Innovation Survey (CIS) is a survey of innovation activity in enterprises covering EU Member States, candidate countries, Iceland and Norway.

The 2006 CIS was launched at national level in 2007. The deadline for transmitting the data listed in the annex to the Commission Regulation on innovation statistics was 30 June 2008.

6. Patents

Patents statistics are widely used to generate indicators that help measure a country's technological output. Chapter 6 takes a closer look at data on triadic patent families, patent applications to the European Patent Office (EPO) and, to a lesser extent, patents granted by the United States Patent and Trademark Office (USPTO). The last part of the chapter focuses on regional patent applications to the EPO.

The data for 2001 show that the triadic patent families were highly concentrated, with 36 % originating from the United States, 31 % from Japan and 26 % from the EU-27.

As regards patent applications to the EPO, in 2004 a total of 54 011 applications were filed by inventors residing in the EU, 33 122 by US-based inventors and 21 989 by inventors in Japan. In 2001, 95 375 patents granted by the USPTO went to inventors residing in the United States, 35 170 to Japanese residents and 24 594 to EU residents. These figures clearly reveal a home-country advantage. Data on patent families are generally less biased, as the home advantage disappears to a certain extent.

Germany was the leading European country in terms of patent applications in 2004, not only in absolute numbers, but also as share of GDP and per million inhabitants.

Patent statistics include breakdowns by IPC section, economic activity (NACE) and institutional sector. Indicators on Patent Cooperation Treaty (PCT) applications and foreign ownership are also available.

In 2004, 10 398 high-tech patents were filed at the EPO by inventors residing in the EU-27, 9 981 patents were submitted by inventors in the US and 6 898 by inventors in Japan.

Germany was again well ahead in terms of the number of patent applications filed at the EPO, but in relation to population size Finland, the Netherlands and Sweden were the best performers in high-tech patenting.

Regarding ICT (information and communication technology) patent applications to the EPO, EU-27 inventors were in the lead in 2004 with 14 929 applications, compared with 12 344 patent applications from US inventors and 9 998 from Japan-based inventors.

In terms of biotechnology patent applications, the United States was in the lead, with 2 586, followed by the EU-27 (2 314) and Japan (840).

In 2004, the five leading EU-27 regions in terms of number of patent applications to the EPO were Île-de-France (FR), Stuttgart (DE), Oberbayern (DE), Noord-Brabant (NL) and Darmstadt (DE). Chapter 6 also provides an overview of regional performance in fields such as high technology, ICT and biotechnology.

7. High-tech industries and knowledge-based services

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

Enterprises in high-tech industries and knowledge-intensive services

In 2004, the EU-27 counted almost 140 000 enterprises in high-tech manufacturing and four times as many in high-tech knowledge-intensive services (600 000), with a total turnover of EUR 658 000 million.

Venture capital investment — VCI

In 2006 the United Kingdom was the leading country in terms of early-stage VCI, investing EUR 4.2 billion in 591 companies, with a total of 823 investments.

High-tech trade

Considering the four leading economies in terms of high-tech trade (EU-27, China, Japan and the United States), in 2006 the EU-27 was no longer the top importer and exporter of high-tech products. China and the US took the lead in high-tech exports in 2006, accounting for 17.1 % and 17.0 % of global exports respectively; the US was marginally ahead of the EU-27 in terms of high-tech imports.

At EU level, high-tech exports grew on average by 0.5 % per year between 2001 and 2006, while high-tech imports declined by 0.1 % per year. At country level, Cyprus recorded the highest average annual growth rate in high-tech exports (63.5 %), followed by Latvia (32.7 %), Slovakia (32.0 %) and Bulgaria (31.2 %). Over the same period Slovakia recorded the highest AAGR in terms of high-tech imports (26.7 %).

Employment in high-tech industries and knowledge-intensive services

In 2006, 39 million people were employed in manufacturing in the EU-27, accounting for 18.2 % of total employment in the EU. Germany was the largest employer in manufacturing, with more than 8 million persons employed, followed by Italy and the United Kingdom.

Almost 12 million of these 39 million workers were employed in medium-high-tech manufacturing, against only 2.3 million in high-tech manufacturing.

In 2006, the services sector accounted for two thirds of EU employment, generating more than 140 million jobs, almost half of which were in knowledge-intensive services (KIS). In the EU-27, more than half (53.7 %) of all employees in services were women. In KIS, the share of female employment was even higher (60.5 %).

Between 2001 and 2006, employment in the services sector increased not only at EU level, but also in all the individual Member States.

In 2006, on average, 47.9 % of employees in high-tech sectors were technicians and professionals. Technicians and professionals made up more than half of the workforce in high-tech sectors in five Member States plus Norway.

Looking at regional statistics, in 2006, the leading region in terms of high-tech employment was Berkshire, Buckinghamshire and Oxfordshire (UK), where high-tech sectors provided 11.5 % of total employment. It was followed by Île-de-France (FR), with 8.9 %, and Oberbayern (DE), with 8.5 %.

8. EU Industrial R&D Investment Scoreboard

Chapter 8 presents the main results from the 2007 EU Industrial R&D Investment Scoreboard (produced by the European Commission's Directorate-General for Research). The Scoreboard provides information on the top 1 000 EU and non-EU companies investing in R&D. It includes R&D data along with other relevant economic and financial data from the last four financial years.

In 2006, the 1 000 EU companies on the Scoreboard increased their R&D investment by 7.4 %, compared with 5.3 % in the previous year. R&D investment growth in the 1 000 non-EU companies stood at 11.1 %, against 7.7 % in the previous year.

At company level, German firms accounted for more than one third of total R&D investment in the EU. Adding France and the United Kingdom, these three countries generated three quarters of total R&D investment in the EU. These figures were similar to those for the previous year (34 % for Germany and 19 % for both the United Kingdom and France).

In the EU, 'automobiles and parts' remained the first beneficiary sector of R&D investment, accounting for more than one fifth (22.4 %) of total investment in R&D, followed by 'pharmaceuticals and biotechnology' (16.5 %) and 'technology hardware and equipment' (10.8 %). These three sectors accounted for close to half of all R&D investment by EU companies.

In the case of non-EU enterprises, 'technology hardware and equipment' and 'pharmaceuticals and biotechnology' were the largest investors in R&D in 2006, accounting together for more than 40 % of total non-EU R&D investment. 'Automobiles and parts' came third with 13.5 %, down by one place in relation to the previous year.

Statistical symbols and abbreviations

© .... Copyright
® .... Registered
% .... Per cent
- .... Not applicable or real zero or zero by default
: .... Not available
0 .... Less than half of the unit used
1000s .... Thousands
200x-200x .... Period of several calendar years (e.g. from 1.1.2000 to 31.12.2005)
b .... Break in series
:c .... Confidential
e .... Estimate
f .... Forecast
i .... Further information in explanatory notes
p .... Provisional
r .... Revised
s .... Eurostat estimate
u .... Unreliable
:u .... Extremely unreliable

Acronyms and abbreviations

A

AAGR .... Average annual growth rate
AGR .... Annual growth rate
AVI .... Aviation (high-tech group, based on the International Patent Classification)

B

BERD .... Expenditure on R&D in the business enterprise sector
BES .... Business enterprise sector
bn .... billion

C

CAB .... Computer and automated business equipment (high-tech group, based on the International Patent Classification)
CBSTII .... Common basis for science, technology and innovation indicators
CC .... Candidate countries
CDH .... Careers of doctorate-holders
CD-ROM .... Compact disc read-only memory
CEC .... Commission of the European Communities
CeSTII .... Centre for Science, Technology and Innovation Indicators
CIP .... Competitiveness and Innovation Framework Programme
CIS .... Community Innovation Survey
COMEXT .... Eurostat reference database containing external trade statistics

CTE .... Communication technology (high-tech group, based on the International Patent Classification)
CV .... Curriculum vitae

D

DETE .... Department of Enterprise, trade and employment (Ireland)
DG .... Directorate-General
DG-RTD .... Directorate-General for Research
DVD .... Digital video disc

E

EC .... European Community/Communities
ECU/EUR .... Ecu up to 31.12.1998/euro since 1.1.1999
EEA30 .... European Economic Area (EU-27 plus IS, LI and NO)
EFTA .... European Free Trade Association
EIS .... European Innovation Scoreboard
EIT .... European Institute of Technology
EP .... European Parliament
EPC .... European Patent Convention
EPO .... European Patent Office
ERA .... European Research Area
ERA-MORE .... Network of Mobility Centers
ERDF .... European Regional Development Fund
ESF .... European Social Fund
EU LFS .... European Union Labour Force Survey
EU-15 .... European Union (15 countries)
EU-25 .... European Union (25 countries)
EU/EU-27 .... European Union (27 countries)
EU-CC .... Candidate 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 .... Sixth EU Research Framework Programme 2002-2006
FP7 .... Seventh EU Research Framework Programme 2007-2013
FSI .... Frank Stronach Institute
FTE .... Full-time equivalent
FTSE .... Financial Times Stock Exchange

G

G7 .... Group of Seven (Canada, France, Germany, Italy, Japan, United Kingdom and United States)
G8 .... Group of Eight (Canada, France, Germany, Italy, Japan, Russia, United Kingdom and United States)

GBAORD .... Government budget appropriations or outlays on R&D
GBER .... General Block Exemption Regulation
GDP .... Gross domestic product
GERD .... Gross domestic expenditure on R&D
GISCO .... Geographical information system for the Commission — Eurostat
GOV .... Government sector
GoveRD .... Expenditure on R&D performed in the Government sector
GPS .... Global positioning system
GUF .... General university funds

H

HC .... Head count
HEFCE .... Higher Education Funding Council for England
HERD .... Expenditure on R&D performed in the higher education sector
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

IAS .... International Accounting Standard
IBCS .... Integrated Business Characteristics Strategy
IBGE .... Brazilian Institute of Geography and Statistics
ICB .... Industrial classification benchmark
ICT .... Information and communication technology
ILO .... International Labour Organisation
IPC .... International Patent Classification
IPR .... Intellectual property rights
IRI .... Commission's Industrial Research and Innovation Programme
ISBN .... International standard book number
ISCED .... International Standard Classification of Education
ISCO .... International Standard Classification of Occupations
ISIC .... International Standard Industrial Classification of all Economic Activities
IT .... Information technology

J

JPO .... Japan Patent Office
JRC .... Joint Research Centre

K

KIC .... Knowledge and innovation community
KIS .... Knowledge-intensive services

L

LFS .... Labour Force Survey
LKIS .... Less knowledge-intensive services
LSR .... Lasers (high-tech group, based on the International Patent Classification)

M

m .... Million
MER .... Ministry of Education and Research
MGE .... Micro-organisms and genetic engineering (high-tech group, based on the International Patent Classification)
MSTI .... Main Science and Technology 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 in the European Community
NewCronos .... Eurostat's statistical reference database
NHRSTU .... Unemployed non-HRST
NIS .... National Innovation System
NUTS .... Nomenclature of Territorial Units for Statistics

O

OECD .... Organisation for Economic Cooperation and Development
OHIM .... Office for Harmonisation in the Internal Market

P

p.a. .... Per year (per annum)
PATSTAT .... Patent statistics database (provided by the EPO)
PCT .... Patent Cooperation Treaty
PhD .... Philosophiæ Doctor
PNP .... Private non-profit sector
PPS .... Purchasing power standard
PSL .... Personnel

R

Rev. .... Revision
R&D .... Research and development
RFID .... Radio frequency identification
RTDI .... Research, Technology Development and Innovation
RVCF .... Regional Venture Capital funds

S

SBS .... Structural Business Statistics
SE .... Scientists and engineers
SET .... Strategic Energy Technology
S&E .... Science and engineering
SFs .... EU Structural Funds
SII .... Summary Innovation Index

SITC .... Standard International Trade Classification
SMC .... Semi-conductors (high-tech group, based on the International Patent Classification)
SME .... Small and medium-sized enterprise
S&T .... Science and technology
STI .... Science, technology and innovation

T

TUG .... Graz University of Technology

U

UIS .... UNESCO Institute for Statistics
UN .... United Nations
UNESCO .... United Nations Educational, Scientific and Cultural Organisation
UOE .... UNESCO/OECD/Eurostat
USPTO .... United States Patent and Trademark Office

V

v. .... Versus
VCI .... Venture capital investment

W

WIPO .... World Intellectual Property Organisation

Countries

EU-27

BE	Belgium
BG	Bulgaria
CZ	Czech Republic
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
EL	Greece
ES	Spain
FR	France
IT	Italy
CY	Cyprus
LV	Latvia
LT	Lithuania
LU	Luxembourg
HU	Hungary
MT	Malta
NL	Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden
UK	United Kingdom

Candidate countries

MK[1]	Former Yugoslav Republic of Macedonia
HR	Croatia
TR	Turkey

Other countries

ASIOTH	Other Asian countries
AU	Australia
BR	Brazil
CA	Canada
CH	Switzerland
CN	China
HK	Hong Kong
ID	Indonesia
IL	Israel
IN	India
IS	Iceland
JP	Japan
KR	Republic of South Korea
LI	Liechtenstein
MX	Mexico
MY	Malaysia
NO	Norway
PH	Philippines
RU	Russia
SG	Singapour
TH	Thailand
TW	Taiwan
US	United States

(1) 'Provisional code which does not prejudge in any way the definitive nomenclature for this country, which will be agreed following the conclusion of negotiations currently taking place on this subject at the United Nations'.

Part 1

Investing in R&D

Government budget appropriations or outlays on R&D — GBAORD

1

1.1 Introduction

Data on government budget appropriations or outlays on research and development (GBAORD) refer to budget provisions, not to actual expenditure. This means that GBAORD measures government support for R&D using data collected from budgets. GBAORD is a way of measuring how much governments spend on R&D.

The advantage of GBAORD data is their timeliness, but there are some drawbacks, such as data sources and harmonisation, which should be taken into account when using these data.

GBAORD includes all appropriations allocated to R&D in central government or federal budgets; provincial or state government data should be included when their input is significant. Unless stated otherwise, data include both current and capital expenditure. They cover government-financed R&D carried out in government establishments and in the business enterprise, higher education and private non-profit sectors. However, some countries do not survey the private non-profit sector, as shown in the box below.

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 'Proposed standard practice for surveys on research and experimental development' (*Frascati Manual*, OECD, 2002).

The data are assembled by national authorities using figures from public budgets. As data are not obtained through surveys, they are more difficult to compile because, in most countries, national budget data have their own terminology and methodology, and therefore often do not match the OECD/Eurostat methodology set out in the *Frascati Manual*.

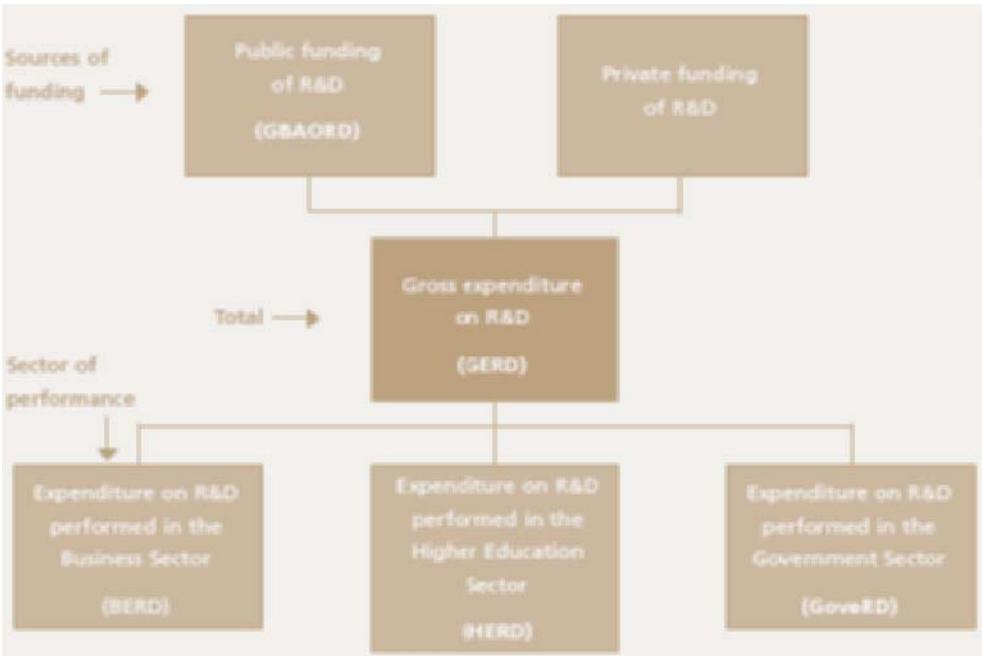
Government R&D appropriations or outlays on R&D are broken down into 13 main socio-economic objectives according to the purpose of the R&D programme or project on the basis of NABS — the Nomenclature for the analysis and comparison of scientific programmes and budgets, Eurostat 1994.

The analysis of GBAORD data in the present publication covers the period 1996-2006 (provisional). This chapter is divided into two main parts:

- Total GBAORD,
- GBAORD by socio-economic objective.

Please note that the data presented in this publication reflect data availability in Eurostat's reference database as of July 2008.

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



Source: State Expenditure on Science & Technology and Research & Development, Forfás Ireland, 2006

1.2 Total GBAORD

The United States leads the way in terms of GBAORD

Between 1996 and 2006, the United States allocated a greater share of GDP to government budget appropriations or outlays on research and development (GBAORD) than the European Union and Japan.

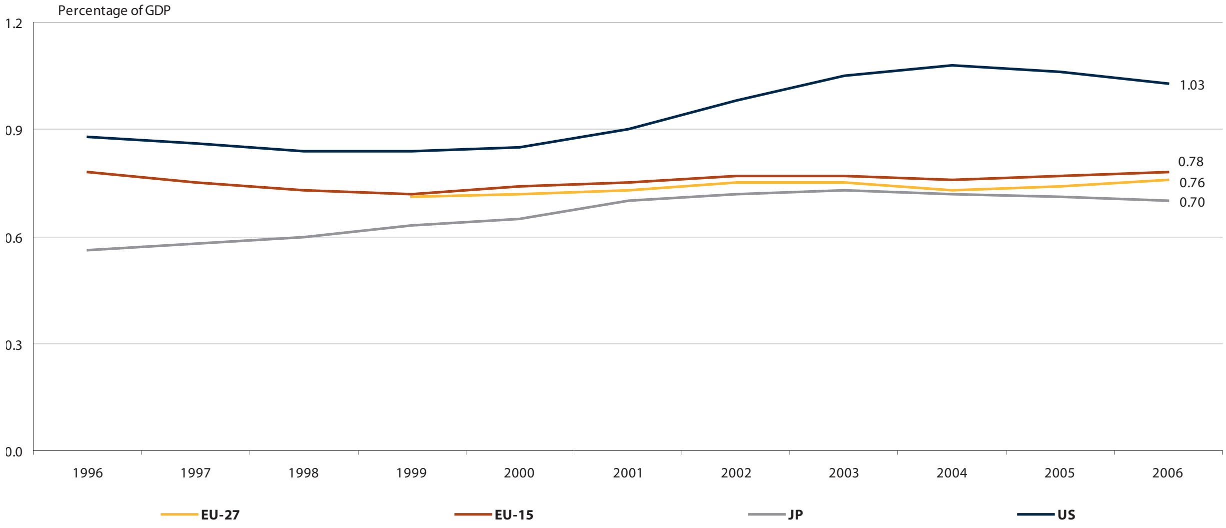
In 2006 the United States devoted more than 1 % of GDP to GBAORD, while the European Union and Japan allocated 0.76 % and 0.70 % respectively.

Between 1996 and 1999, a decline in GBAORD as a share of GDP was recorded in the United States and the EU-15, which followed similar trends. In Japan, by contrast, GBAORD increased over the same period.

Trends differed considerably from 1999 to 2004, with GBAORD as a share of GDP remaining relatively stable in the European Union, while it increased slightly in Japan and quite significantly in the US.

Since 2004, however, the United States and Japan have registered a moderate downturn in GBAORD as a share of GDP, whereas trends in the EU-27 have been fairly positive.

Figure 1.1: Total GBAORD as a percentage of GDP, EU-15, EU-27, Japan and the United States, 1996–2006



Eurostat estimations: EU-27 and EU-15.
US: 2000: break in series; 2007: provisional data.
JP and US: federal or central government only.
US: total excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF).

Sources of budgetary data for GBAORD

Although details of the budgetary procedure vary from country to country, seven broad stages can be identified:

1. Forecasts (estimates of funding before beginning of budget discussion).

2. Budget forecasts (preliminary figures as requested by ministries, especially for inter-ministerial discussions).

3. Budget proposal (figures presented to the parliament for the coming year).

4. Initial budget appropriations (figures as voted by the parliament for the coming year, including changes introduced in the parliamentary debate).

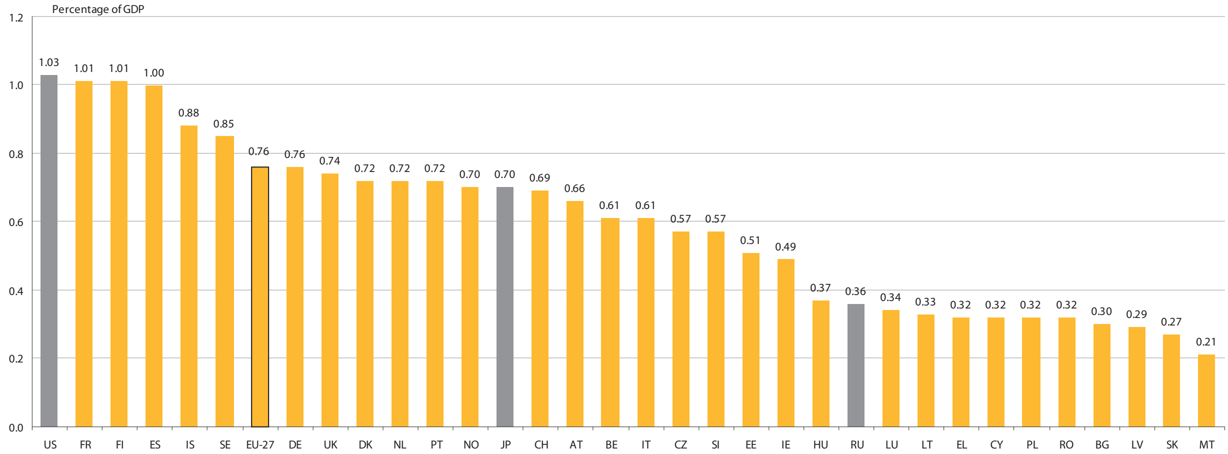
5. Final budget appropriations (figures as voted by the parliament for the coming year, including additional votes during the year).

6. Obligations (money actually committed during the year).

7. Actual outlays (money paid out during the year).

Source: based on the *Frascati Manual,* 2002

Figure 1.2: Total GBAORD as a percentage of GDP, EU-27 and selected countries, 2006



Eurostat estimations: EU-27.
Provisional data: FR, PT and UK.
National estimation: EE.
Exceptions to the reference year: 2005: HU and RU.
AT, JP and US: federal or central government only.
US: total excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF).

Figure 1.2 shows GBAORD expressed as a share of GDP by country. The main advantage of this indicator is that it adjusts for differences in economic size and facilitates comparisons across countries. In 2006, GBAORD accounted for 0.76 % of GDP in the EU-27 and 0.78 % of GDP in the EU-15. However, there were significant differences across countries: in 2006 GBAORD ranged from 1.01 % of GDP in France and Finland to 0.21 % of GDP in Malta. The United States, Iceland and four EU Member States (France, Finland, Spain and Sweden) recorded GBAORD levels higher than the EU-27 average. GBAORD levels ranged between the EU-27 average and 0.5 % of GDP in 11 Member States. This was also the case in Norway, Switzerland and Japan.

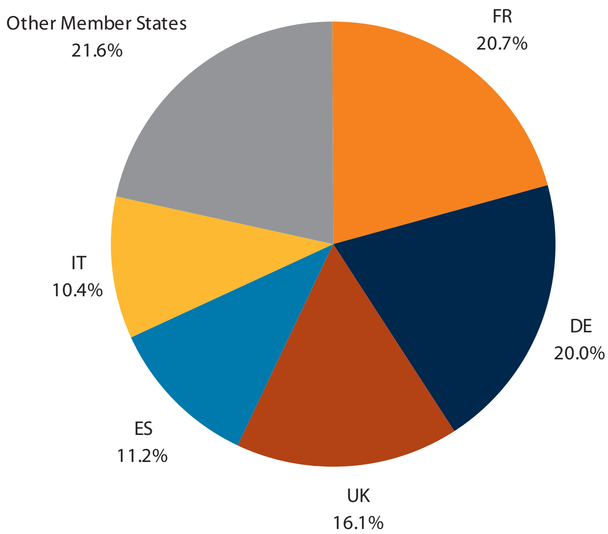
At the bottom of the scale, GBAORD levels were below 0.3 % of GDP in Latvia, Slovakia and Malta.

Figure 1.3 shows the shares of EU-27 total GBAORD for the top five EU countries. In 2006, total GBAORD in the EU-27 amounted to almost EUR 88 billion at current prices.

France recorded the highest GBAORD levels, with EUR 18.2 billion, followed closely by Germany with EUR 17.6 billion. The United Kingdom, Spain and Italy allocated respectively EUR 14.1, 9.8 and 9.1 billion to GBAORD. These five Member States accounted for approximately 80 % of total GBAORD in the EU-27.

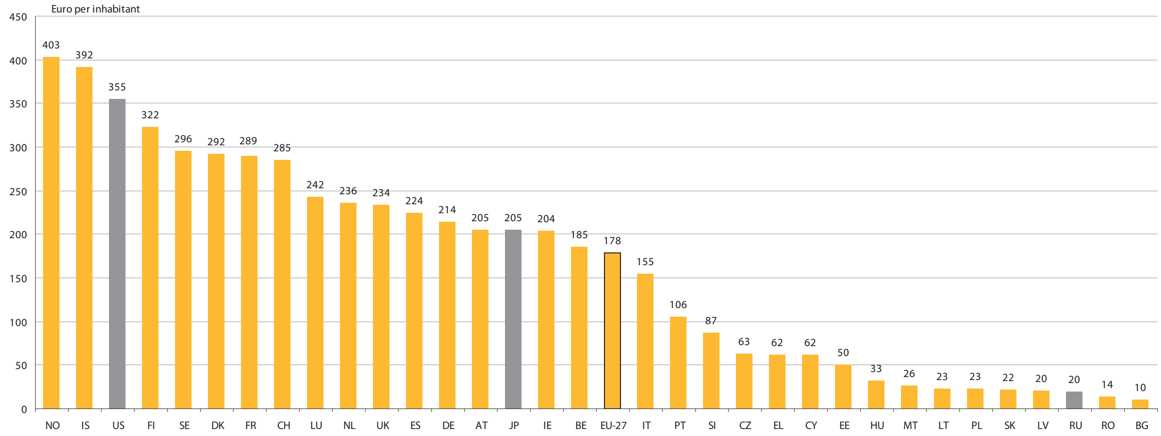
Taken together, GBAORD in the remaining 22 Member States amounted to EUR 19 billion. Belgium, Denmark, the Netherlands, Austria, Portugal, Finland and Sweden each devoted more than EUR 1 billion to GBAORD. This was also the case in Norway, Switzerland and Russia. At the other end of the scale, six Member States each allocated less than EUR 100 million to GBAORD: Bulgaria, Estonia, Cyprus, Latvia, Lithuania and Malta (see Table 1.6).

Figure 1.3: GBAORD in the top EU countries as a percentage of total GBAORD in the EU-27, 2006



Eurostat estimation: EU-27.
Provisional data: FR and UK.

Figure 1.4: Total GBAORD in EUR per inhabitant, EU-27 and selected countries, 2006



Eurostat estimation: EU-27.
Provisional data: FR, PT and UK.
National estimation: EE.
Exceptions to the reference year: 2005: HU, US and JP.
AT, JP and US: federal and central government only.
US: total excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF).

It would also be interesting to consider GBAORD in terms of EUR per inhabitant, as shown in Figure 1.4. This ratio allows national values to be compared independently of the population size of each country. This ranking reveals substantially different results compared with the figures as a share of GDP (see Figure 1.2).

Norway ranked first in terms of GBAORD per inhabitant, with EUR 403, followed by Iceland (EUR 392) and the United States (EUR 355). Finland, which ranked fourth, was the only other country where GBAORD per inhabitant was more than EUR 300. Twelve countries registered GBAORD levels per inhabitant between EUR 200 and EUR 300. These also included smaller countries such as Luxembourg.

At the lower end of the scale, GBAORD levels per inhabitant were below EUR 50 in Hungary, Malta, Lithuania, Poland, Slovakia, Latvia, Russia, Romania and Bulgaria.

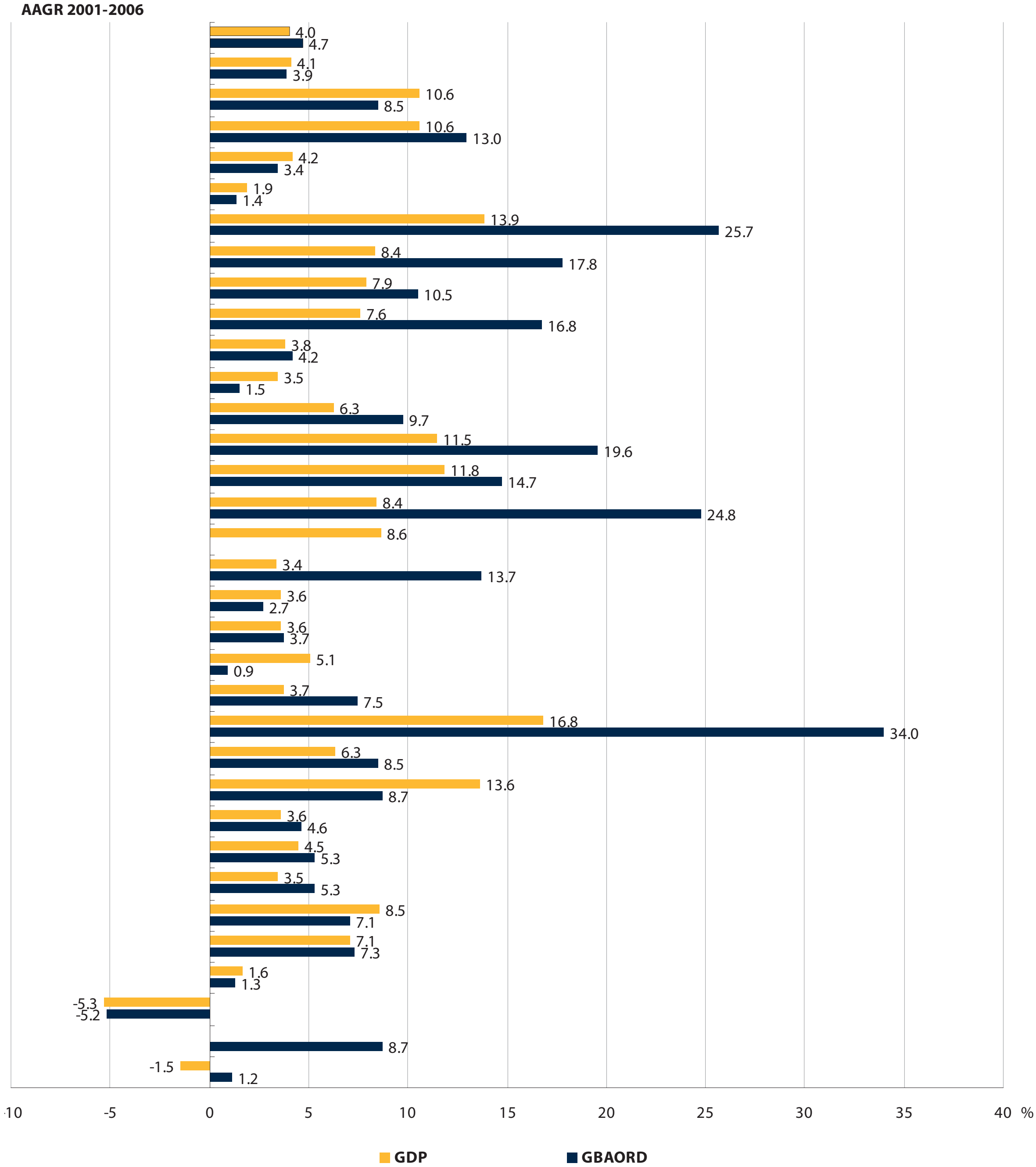
State aid: a new framework for research, development and innovation

The European Commission has adopted a new General block exemption Regulation giving automatic approval for a range of aid measures and so allowing Member States to grant such aid without first notifying the Commission. The Regulation authorises aid for SMEs, research, innovation, regional development, training, employment and risk capital. It also authorises support for environmental protection, measures to promote entrepreneurship, such as aid for young innovative businesses, aid for newly created small businesses in assisted regions, and measures to tackle problems faced by female entrepreneurs, such as difficulties in access to finance. As well as encouraging Member States to focus their state resources on aid that will genuinely benefit job creation and Europe's competitiveness, the Regulation reduces the administrative burden for public authorities, beneficiaries and the Commission. It also consolidates into one text and harmonises the rules previously set out in five separate Regulations, and expands the categories of state aid covered by the exemption.

The new Regulation also constitutes an important and immediately effective contribution to the Small Business Act adopted by the Commission in June 2008 (see IP/08/1003). It will allow Member States to support small and medium-sized enterprises (SMEs) at different stages of their development.

Source: European Commission, http://ec.europa.eu/comm/competition/state_aid/reform/reform.cfm

Figure 1.5: Average annual growth rate (AAGR)[1] of GBAORD and of GDP, EU-27 and selected countries, 2001–2006



Eurostat estimations: EU-27.
Provisional data: FR, PT and UK.
National estimation: EE.
Exceptions to the reference period: 2002-2006: CZ and CH
2004-2006: CY and MT.
AT, JP and US: federal and central government only.

(1) AAGR is calculated in current EUR

Figure 1.5 provides a breakdown by country of the nominal average annual growth rate (AAGR) of GBAORD and GDP between 2001 and 2006.

Over the period under review, the average annual growth rate of GBAORD and GDP in the EU-27 stood at 4.7 % and 4.0 % respectively, meaning that government budgets allocated to R&D grew faster than GDP. In general, GBAORD increased in all the European countries, but this was not the case in Japan, which recorded a decrease.

However, a number of differences were noted between EU countries. Eighteen Member States, together with Norway, registered stronger growth in GBAORD than in GDP during the period under review. Average annual growth rates for GBAORD reached 34.0 % in Romania and 25.7 % in Estonia.

On the other hand, this trend was reversed in countries such as Belgium, Bulgaria, Denmark, Germany, Italy, the Netherlands, Poland, Slovakia, Iceland and Switzerland, with higher growth rates recorded in GDP than GBAORD.

GBAORD growth rates were below the EU-27 average (4.7 %) in Belgium, Denmark, Germany, France, Italy, the Netherlands, Austria and Finland. Poland's growth was also below the EU average.

From a global perspective, GBAORD growth rates in Switzerland (1.3 %) and the United States (1.2 %) were also below the EU-27 average.

1.3 GBAORD by socio-economic objective

Table 1.6 shows, by country, total GBAORD in EUR million and its distribution by NABS socio-economic objective (NABS: Nomenclature for the analysis and comparison of scientific programmes and budgets).

The three leading Member States in terms of GBAORD — Germany, France and the United Kingdom — accounted for more than half of total GBAORD in the EU-27.

In 2006, the main socio-economic objective in the EU-27 was 'research financed from general university funds (GUF)', accounting for 30.3 % of total GBAORD, followed by 'non-oriented research' (17.1 %) and 'defence' (13.2 %). In contrast, 'exploration and exploitation of the earth' (1.6 %), 'infrastructure and general planning of land use' (1.8 %) and 'other civil research' (1.8 %) received least support in the EU-27.

At country level, 'research financed from general university funds (GUF)' also accounted for the largest share of total GBAORD in the ten Member States for which data by NABS socio-economic objective are available. It was also the most significant objective in Iceland, Norway, Switzerland and Japan. This covers R&D in various fields of science, such as natural sciences, engineering, medical sciences or social sciences.

'Non-oriented research' was the second most important socio-economic objective within the EU-27 overall. It was also the leading objective for eight Member States: Czech Republic (26.8 %), Estonia (44.7 %), France (26.6 %), Cyprus (31 %), Latvia (41.1 %), Poland (76.9 %), Slovenia (49.6 %) and Slovakia (32.6 %).

In Belgium, Spain, Luxembourg, Hungary, Romania and Finland, 'industry production and technology' was the most important socio-economic objective, while in Lithuania 'social structures and relationships' ranked first.

'Defence', ranking in third place at EU level, was the leading socio-economic objective only in the United Kingdom, with 28.3 % of total GBAORD, and in the United States (57.9 %).

However, this objective also accounted for large shares in France, Sweden and Spain, with 22.4 % 16.8 % and 16.2 %, respectively. Hence, the substantial share of 'defence' in total European GBAORD (13.2 %) is mainly due to these three countries and the United Kingdom.

'Protection and improvement of human health' also received a significant share of government funding for R&D in the EU-27, amounting to more than 7 %. Spain (10.5 %), Italy (10.3 %), Hungary (13.1 %) and the United Kingdom (14.1 %) each allocated more than 10 % of GBAORD to this objective.

'Social structures and relationships' and 'agricultural protection and technology' accounted for slightly more than 3 % of total GBAORD in the EU-27, followed by 'production, distribution and rational utilisation of energy' (2.6 %) and 'control and care of the environment' (2.5 %).

Defence R&D

Defence includes all R&D programmes undertaken primarily for defence reasons, regardless of their content or whether they have secondary civil applications. Thus, the criterion is not the nature of the product or subject (or who funds the programme) but the objective. The object of defence R&D is the creation or enhancement of techniques or equipment for use by the armed forces. For example, defence R&D includes nuclear and space R&D undertaken for defence purposes. It does not, however, include civil R&D financed by ministries of defence, for instance in meteorology or telecommunications. It also includes enterprise-financed R&D where the main applications are in the defence area.

At first sight, the definition of R&D as defence according to objective appears relatively straightforward. However, exactly the same R&D programme could have either a civil or a defence objective. An example is the Canadian research on cold-weather clothing intended for military use; because of its potential for civil applications, this programme could have been, or could become, civil.

Where there is pressure to 'spin off' defence R&D to civil uses, or vice versa, the blurring of the objective may become significant. In such cases, only the entity funding the R&D may be able to define its objective, and thus its classification as either defence or civil R&D.

The financing of defence R&D is increasingly becoming internationalised and privatised, and all sources of funds should be included. For countries with major defence R&D efforts, a breakdown by source of funds can be informative.

Source: Frascati Manual, 2002

Table 1.6: Total GBAORD in EUR million and by socio-economic objectives as a percentage of total GBAORD, EU-27 and selected countries, 2006

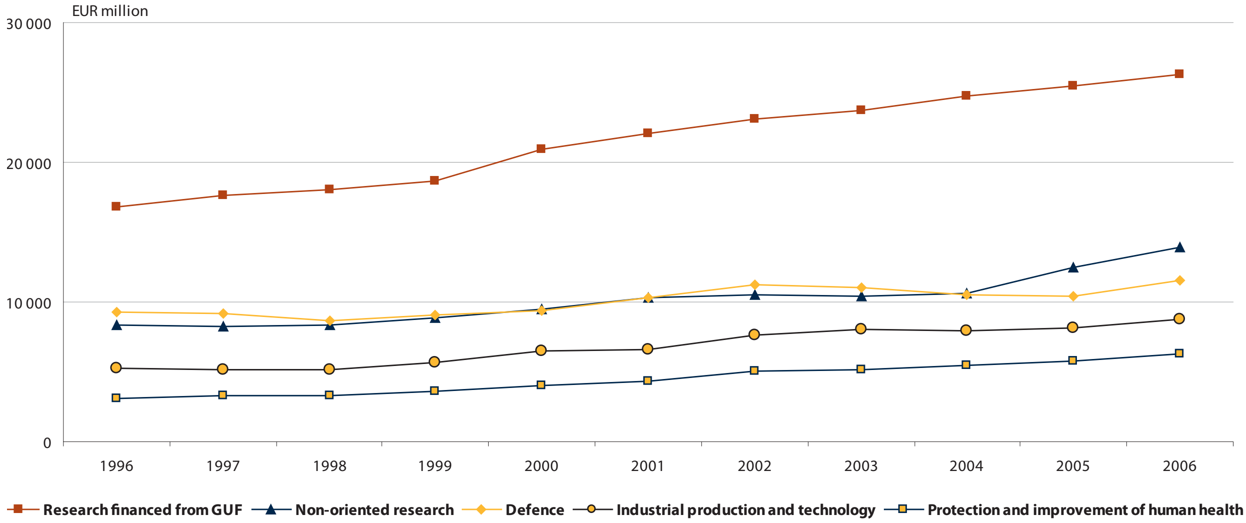
	Exploration and exploitation of the earth	Infrastructure and general planning of land-use	Control and care of the environment	Protection and improvement of human health	Production, distribution and rational utilization of energy	Agricultural production and technology	Industrial production and technology	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-27	1.6 s	1.8 s	2.5 s	7.4 s	2.6 s	3.3 s	10.4 s	3.5 s	4.6 s	30.3 s	17.1 s	1.8 s	13.2 s	86.8 s	87 840 s
BE	0.6	0.8	2.2	1.9	1.9	1.3	33.3	4.1	10.1	17.1	23.9	2.6	0.3	99.7	1 946
BG	:	:	:	:	:	:	:	:	:	:	:	:	:		75
CZ	2.1	3.8	2.6	6.8	2.4	4.9	11.8	2.5	0.7	26.4	26.8	6.0	3.1	96.9	646
DK	0.7	0.7	1.7	8.5	2.1	5.9	6.4	6.5	1.9	44.3	19.2	1.5	0.7	99.3	1 587
DE	1.8 i	1.8 i	3.1 i	4.5 i	2.9 i	2.3 i	12.6 i	3.5 i	4.9 i	39.2 i	16.9 i	0.6 i	6.5 i	93.5 i	17 608
EE	1.5 e	7.0 e	5.8 e	9.3 e	3.1 e	10.3 e	5.2 e	7.6 e	0.0 e	0.0 e	44.7 e	4.4 e	1.0 e	99.0 e	67 e
IE	2.6	0.5	0.8	5.5	0.0	9.8	9.3	11.1	0.0	57.4	2.9	0.0	0.0	100	858
EL	3.4	2.0	3.1	7.1	2.1	6.0	10.3	4.7	2.0	47.9	9.3	1.7	0.5	99.5	685
ES	1.2	4.3	3.7	10.5	2.7	6.2	19.5	3.1	2.9	18.4	7.3	4.0	16.2	83.8	9 799
FR	0.7 p	0.7 p	2.2 p	4.8 p	3.6 p	1.2 p	5.9 p	0.5 p	7.1 p	21.7 p	26.6 p	2.6 p	22.4 p	77.6 p	18 225 p
IT	2.3	1.0	2.6	10.3	4.0	4.0	11.7	5.2	9.5	41.8	6.2	0.0	1.4	98.6	9 099
CY	1.6	1.3	1.1	6.1	0.4	21.0	2.7	7.9	0.0	27.0	31.0	0.0	0.0	100	47
LV	0.6	1.6	2.8	6.9	3.4	18.7	16.2	8.1	0.3	:	41.1	:	0.3	99.7	46
LT	2.6	4.2	9.3	9.9	3.2	8.4	12.2	32.3	:	:	:	17.0	0.9	99.1	78
LU	0.4	3.2	4.0	8.4	0.6	2.6	22.1	15.8	0.4	18.8	20.4	3.1	0.0	100.0	114
HU	2.9	2.1	9.7	13.1	10.4	16.4	19.6	9.1	2.3	9.1	5.0	0.3	0.1	99.9	329
MT	0.0	0.8	0.0	0.0	0.0	6.3	0.0	4.2	0.0	86.1	1.3	1.3	0.0	100	10.5
NL	0.3	3.8	1.9	4.5	2.1	5.3	10.9	1.8	3.1	47.1	10.0	7.1	2.1	97.9	3 858
AT	2.0 i	1.4 i	1.6 i	3.8 i	0.7 i	1.9 i	12.6 i	1.9 i	0.2 i	60.7 i	13.2 i	0.0 i	0.0 i	100 i	1 692 i
PL	0.9	0.7	1.3	1.5	0.7	0.7	10.8	0.5	0.1	4.8	76.9	0.2	0.9	99.1	858
PT	1.2 p	6.6 p	3.8 p	7.0 p	0.9 p	8.1 p	16.9 p	3.7 p	0.3 p	38.5 p	9.2 p	3.2 p	0.6 p	99.4 p	1 116 p
RO	2.3	3.0	5.1	5.7	2.3	9.4	22.1	11.9	1.4	:	13.8	19.8	3.2	96.8	309
SI	0.0	1.6	1.6	3.7	0.9	2.3	22.8	2.3	0.0	4.5	49.6	9.2	1.6	98.4	173
SK	1.0	7.3	0.0	5.0	0.1	8.1	8.9	2.5	:	26.0	32.6 i	1.7	6.6 i	93.4 i	120
FI	1.2	2.0	1.6	6.2	4.4	5.8	27.2	5.5	1.7	25.6	16.2	:	2.8	97.2	1 694
SE	0.7 p	4.0 p	1.8 p	1.2 p	3.6 p	2.2 p	5.7 p	4.5 p	0.9 p	45.1 p	13.6 p	:	16.8	83.2	2 675
UK	2.7 p	0.8 p	1.8 p	14.1 p	0.2 p	3.1 p	1.1 p	5.3 p	2.2 p	21.6 p	18.6 p	0.4 p	28.3 p	71.7 p	14 124 p
IS	:	4.7	0.4	10.9	1.5	21.1	0.9	7.6	:	40.4	12.5	0.0	0.0	100	117
NO	2.5	2.4	1.9	11.3	3.3	8.5	7.9	6.3	2.1	34.9	12.9	:	5.9	94.1	1 869
CH	0.1 i	0.3 i	0.1 i	1.3 i	1.0 i	2.2 i	1.0 i	2.2 i	4.5 i	59.6 p	9.1 i	17.7 i	0.6 i	99.4 i	2 123
JP	1.8 i	4.1 i	0.8 i	3.9 i	15.2 i	3.4 i	7.3 i	0.7 i	6.8 i	34.2 i	16.7 i	:	5.1 i	94.9 i	24 478 i
RU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	2 854
US	0.8 i	1.3 i	0.5 i	21.8 i	0.9 i	2.0 i	0.3 i	1.3 i	7.6 i	:	5.5 i	0.0	57.9 i	42.1 i	108 330 i

Exception to the reference year: 2005: HU

Flag 'i'

DE: unrevised breakdown not adding up to the revised total.
AT, CH, JP and US : federal or central government only.
SK: includes other classes.
JP: defense is underestimated or based on underestimated data.
US: total excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF).

Figure 1.7: Main NABS socio-economic objectives in EUR million, EU-15, 1996–2006



Eurostat estimation: EU-15.

Figure 1.7 shows the trends in the five main European socio-economic objectives expressed in EUR million between 1996 and 2006 for the EU-15.

The same trends as those highlighted in total GBAORD as a share of GDP (Figure 1.1) can be observed for the main socio-economic objectives. From 1996 to 1999 the main socio-economic objectives were either stable or in decline (as for 'defence'). Between 1999 and 2006, however, all main socio-economic objectives recorded an increase (although this trend was more unstable in defence).

Research financed from GUF — the main European socio-economic objective — also registered the greatest increase in absolute terms, growing from EUR 16 billion in 1995 to EUR 26 billion in 2006.

Defence was the second leading socio-economic objective in the EU-15 until 2003, before being overtaken by 'non-oriented research'.

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 considering changes over time according to funding objectives, since the relative ups and downs of different objectives can be taken as indicators of changes in government priorities with respect to different research objectives.

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

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

Table 1.8 shows that the main increases in GBAORD between 2001 and 2006 at EU-15 level were in 'other civil research' (15.2 %), 'protection and improvement of human health' (8.1%) and 'exploration and exploitation of the earth' (6.9 %).

Government budget allocations to 'research financed from GUF' — the leading socio-economic objective in the European Union — grew in all countries between 2001 and 2006, reaching an AAGR of 48.1 % in Ireland.

'Defence', the third main objective at European level, saw considerable variation across individual Member States, both in terms of trend and volume. Indeed, it increased sharply in some countries, such as Lithuania (81.3 %), Slovenia (59.4 %) and Romania (58.0 %), whereas it decreased slightly in Germany and Spain (both -1.2 %), and sharply in Italy (-18.3 %), Poland (-19.9 %) and Portugal (-17.1 %).

Overall, the 'defence' objective grew on average by 2.2 % at EU-15 level, although this increase was lower than growth in total GBAORD (4.6 %). In other words, the relative importance of 'defence' in total GBAORD at EU level decreased between 2001 and 2006.

Trends in the government R&D budget devoted to 'other civil research', which registered an overall increase at EU-15 level, also varied significantly from one country to another.

'Infrastructure and general planning of land use', 'agricultural production and technology' and 'non-oriented research' recorded increases of more than 6 %.

Large variations in AAGR in individual countries can be partly explained by relatively low GBAORD levels in absolute terms, as is the case in Poland for 'agricultural production and technology'.

Table 1.8: Average annual growth rate (AAGR)[2] of GBAORD by socio-economic objectives EU-27, EU-15 and selected countries, 2001–2006

	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-27	:	:	:	:	:	:	:	:	:	:	:	:	:	:	5 s
EU-15	6.9 s	6.6 s	3.3 s	8.1 s	3.4 s	6.3 s	5.8 s	4.1 s	2.4 s	3.6 s	6.3 s	15.2 s	2.2 s	5.0 s	5 s
BE	-0.3	-9.0	-0.5	7.5	-2.5	-4.5	7.3	0.8	2.6	2.6	4.5	-0.3	0.5	3.9	4
BG	:	:	:	:	:	:	:	:	:	:	:	:	:	:	9
CZ	3.6	12.3	1.2	8.2	20.7	15.9	18.9	26.2	7.7	11.8	14.2	12.9	11.1	13.0	13
DK	-7.0	-15.2	-3.4	7.6	4.7	-4.5	-2.1	-3.8	-1.0	7.0	4.7	17.9	11.2	3.4	3
DE	3.6 i	1.5 i	1.4 i	3.2 i	0.1 i	3.1 i	2.7 i	-4.0 i	1.2 i	1.8 i	1.1 i	0.5 i	-1.2 i	1.6 i	1
EE	80.7 e	27.0 e	26.4 e	57.0 e	16.7 e	18.4 e	12.9 e	76.2 e	-37.0 e	:	13.4	:	:	22 e	22 e
IE	14.9	-14.0	3.4	25.9	:	-0.9	6.7	44.4	:	48.1	-25.2	:	:	17.8	18
EL	5.8	1.8	4.5	12.2	16.6	6.3	14.2	8.2	68.3	11.7	3.7	63.9	0.3	10.5	10
ES	3.6	40.1	17.0	60.1	39.6	34.6	20.4	32.5	21.3	9.1	49.7	166.9	-1.2	23.8	17
FR	3.0 p	5.2 p	-0.7 p	0.6 p	3.0 p	-6.5 p	3.4 p	-3.3 p	-2.1 p	2.8 p	11.1 p	7.2 p	3.8 p	4.3 p	4 p
IT	6.0	21.9	3.9	9.6	3.2	18.3	4.3	5.3	7.1	0.6	-13.0	:	-18.3	2	1
CY	4.0	-11.1	-28.2	1.7	:	-4.0	:	-7.0	:	5.7	39.9	:	:	9.7	10
LV	12.3	53.9	22.9	10.5	30.4	26.6	19.4	26.5	-5.1	:	34.4	:	2.4	19.9	20
LT	26.5	10.1	29.0	13.8	49.7	25.1	9.2	49.0	:	:	:	-6.4	81.3	14.5	15
LU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	25
HU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
MT	:	:	:	-94.3	:	109.5	:	-38.2	:	24.1	-8.5	:	:	13.7	14
NL	-0.8	-3.7	-7.5	17.5	-10.0	9.3	0.5	-6.4	6.5	3.0	1.3	12.5	4.9	3	3
AT	1.1 i	-1.2 i	7.3 i	7.1 i	3.4 i	-2.3 i	7.2 i	3.5 i	7.5 i	3.5 i	2.9 i	-38.3 i	5.3 i	3.7 i	4 i
PL	111.5	188.9	356.9	47.0	69.9	46.3	82.5	6.2	81.0	8.6	10.0	48.8	-19.9	16.5	16
PT	-3.0 p	12.6 p	8.0 p	4.6 p	0.1 p	-2.4 p	15.7 p	5.4 p	-1.3 p	9.2 p	4.6 p	16.7 p	-17.1 p	7.8 p	7 p
RO	26.7	4.6	42.9	43.6	24.8	26.1	24.8	98.2	23.9	:	20.4	98.7	58.0	33.5	34
SI	-39.2	16.3	-1.2	32.4	12.5	-3.6	29.6	8.7	:	7.4	0.4	:	59.4	8.2	8
SK	:	53.4	-67.9	12.9	-40.4	-1.6	6.3	-19.1	:	17.0	10.7 i	-20.2	:	:	9
FI	3.9	3.0	-1.5	3.9	5.1	5.4	3.2	4.3	2.0	4.4	7.4	:	17.6	4.3	5
SE	18.3 p	5.8 p	19.2 p	15.0 p	8.4 p	3.3 p	22.2 p	-7.7 p	-15.2 p	5.1 p	4.3 p	:	8.3	4.7	5
UK	17.2 p	-7.2 p	3.8 p	4.0 p	-11.3 p	0.2 p	-17.2 p	11.5 p	6.3 p	5.2 p	12.2 p	13.7 p	3.8 p	6 p	5 p
IS	:	-3.4	-0.9	14.1	4.7	7.1	4.9	1.0	:	11.6	1.0	:	:	7.1	7
NO	11.1	8.7	0.3	17.9	18.9	7.1	-3.3	5.3	6.2	6.4	15.5	:	2.6	7.7	7
CH	-17.4 i	-11.2 i	-17.4 i	-4.3 i	-1.7 i	-3.3 i	-24.4 i	18.9 i	0.9 i	0.7 p	13.7 i	2.4 i	5.6 i	1.3 i	1
JP	-6.8 i	-6.3 i	-6.1 i	-4.9 i	-7.7 i	-6.0 i	-5.8 i	-8.6 i	-5.1 i	-5.5 i	-1.5 i	:	-1.7 i	-5.3 i	-5 i
RU	:	:	:	:	:	:	:	:	:	:	:	:	:	:	9
US	-3.6 i	-5.7 i	-5.0 i	-0.5 i	-7.6 i	-4.9 i	-6.9 i	10.2 i	-3.7 i	:	-3.3 i	:	4.0 i	-2.0 i	1 i

Exceptions to the reference period:

2000-2006: LV
2002-2006: CZ, EE and CH
2004-2006: CY, MT and PL.

Flag 'i'

DE: unrevised breakdown not adding up to the revised total.
AT, CH, JP and US : federal or central government only.
SK: includes other classes.
JP: defense is underestimated or based on underestimated data.
US: total excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF).

[2] AAGR is calculated in current EUR

EU nations urged to pool public research budgets

The European Commission wants Member States to pool together their money and brains to conduct joint research on major social challenges such as ageing and energy security, arguing that individual efforts on such vast topics waste resources.

In his Communication of 15 July 2008 on joint programming, Research Commissioner Janez Potočnik listed fighting climate change, securing energy supply, preventing major disease pandemics, preserving marine ecosystems and biodiversity, ensuring food quality and securing food supply as 'the most shared challenges of our societies'.

These are challenges that 'can be addressed through research and technological development' and require a response at European — if not global — level, he added.

The aim of the Commission's communication is to allow cross-border research on these strategic areas by setting common research agendas, he explained.

'Obviously, national programming of research has a place when it addresses national needs and priorities, but for major societal challenges, national-level action is a waste of time, money and resources', the Commissioner argued.

He explained that joint programming is about public cooperation in strategic research areas where Member States voluntarily decide to pool financial and human resources. It will also be up to these stakeholders to identify common objectives and develop and implement the research agenda.

Joint programming 'does not require all Member States to be involved. It can be à la carte, but such partnerships will be open to any Member State or associated country to join whenever they want', Mr Potočnik added.

According to the optimistic Commissioner, joint programming 'has the potential to become a mechanism at least as important as the Framework Programmes in the European research landscape and change the very way in which Europeans think about research'.

Background

According to the Commission, some 85 % of public sector research in Europe is programmed, financed, monitored and evaluated at national level. Only 15 % of European publicly financed civil R&D is funded in a cross-border collaborative manner (10 % by intergovernmental organisations and schemes and 5 % by the EU Framework Programme).

The Commission has repeatedly voiced concern over this situation, saying fragmentation and duplication of research efforts are a major obstacle to the EU's chances of delivering on the Lisbon Strategy for growth and jobs.

In its review of the European Research Area (ERA) in spring 2007, the Commission called for the optimisation of research programmes. This, it suggested, should be done by making national and regional research more coherent through joint priority setting.

Under the European Union's Strategic Energy Technology (SET) plan, the Commission has already proposed more coordinated national research on low-carbon technologies.

Source: http://www.euractiv.com/en/science/eu-nations-urged-pool-public-research-budgets/article-174305, 17 July 2008

2

R&D expenditure

2.1 Introduction

R&D is often considered to be a key element in the European Union's bid to be the most dynamic and competitive economy in the world. It is defined as 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 European target for R&D, as set out in the relaunched Lisbon Strategy, is to achieve an R&D intensity of at least 3 % of GDP for the EU by 2010, two thirds of which are to be financed by the business sector.

R&D expenditure refers here to 'intramural' expenditure, comprising all expenditure on R&D within a statistical unit or sector of the economy during a specific period, regardless of the source of funds. It 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(1);
- the Regional Manual(2).

They provide a model for obtaining comparable statistics between countries.

This chapter presents the key indicators for R&D expenditure and outlines the main trends over the past five years. It is divided into two sections:

- Firstly, main trends at national level are highlighted by analysing the performance of the EU-27 Member States, Iceland, Norway and Candidate Countries. This part also considers the international level by taking a look at data for China, Japan and the United States.
- Secondly, R&D expenditure at the regional level is analysed, focusing on the EU-27 Member States, Iceland and Norway.

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

- R&D intensity (measured as R&D expenditure as a percentage of GDP);
- R&D expenditure in volume (in euros).

The indicators are then broken down by sectors of performance:

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

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

- source of funds;
- sector of activity;
- size class;
- field of science.

The regional analysis has been carried out at NUTS 2 level. Footnotes specify when other levels of NUTS are used. Readers should also note that under the NUTS classification, the entire national territories of Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta and Iceland are considered to be NUTS 0, 1 or 2 regions, which means that these countries may appear in rankings at NUTS 2 level.

The analysis refers to the period 2001-2006, but the length of time series is not identical across all countries. As a rule, if data for 2006 are not available for a particular country, the latest available year is presented.

The complete time series for R&D expenditure are available in NewCronos, Eurostat's reference database. Data for China, Japan and the United States are based on the OECD's 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 statistics and of innovation — *Regional Manual*, Eurostat, 1996.

2.2 R&D at national level

R&D intensity

Table 2.1 presents R&D expenditure expressed as a percentage of GDP, or R&D intensity, by country and by sector of performance. An advantage of this indicator is that it is not affected by the size of countries or regions and thus allows comparisons between them.

In 2006, R&D intensity in the EU-27 amounted to 1.84 % of GDP, the same as in 2005, still below the 3 % target set for 2010 by the Lisbon Strategy.

In 2006, only two Member States exceeded the 3 % objective: Sweden (3.73 %) and Finland (3.45 %), although these figures were slightly down on 2005.

Four other Member States achieved R&D intensities above 2 %: Germany (2.53 %), Denmark (2.43 %), Austria (2.49 %) and France (2.09 %), although only Germany and Austria registered a notable increase compared to 2005. All other Member States were below this threshold, and R&D intensity was below 1 % in ten Member States.

At global level, the EU share of GDP devoted to R&D in 2005 was significantly lower than that of Japan (3.32 %), Switzerland (2.90 %) and the United States (2.61 %).

The breakdown of R&D intensity within the EU-27 was as follows: almost two thirds (1.17 %) came from the business enterprise sector, while the public sector (higher education and government) accounted for the remaining third (0.65 %). The rest, 0.02 %, was contributed by the private non-profit sector (PNP).

The business enterprise sector generally accounted for the highest share of R&D intensity in most Member States and other selected countries. Exceptions were Bulgaria and Poland, where the government was the main sector, and Cyprus, Greece and Lithuania, where the higher education sector (HES) accounted for the largest share.

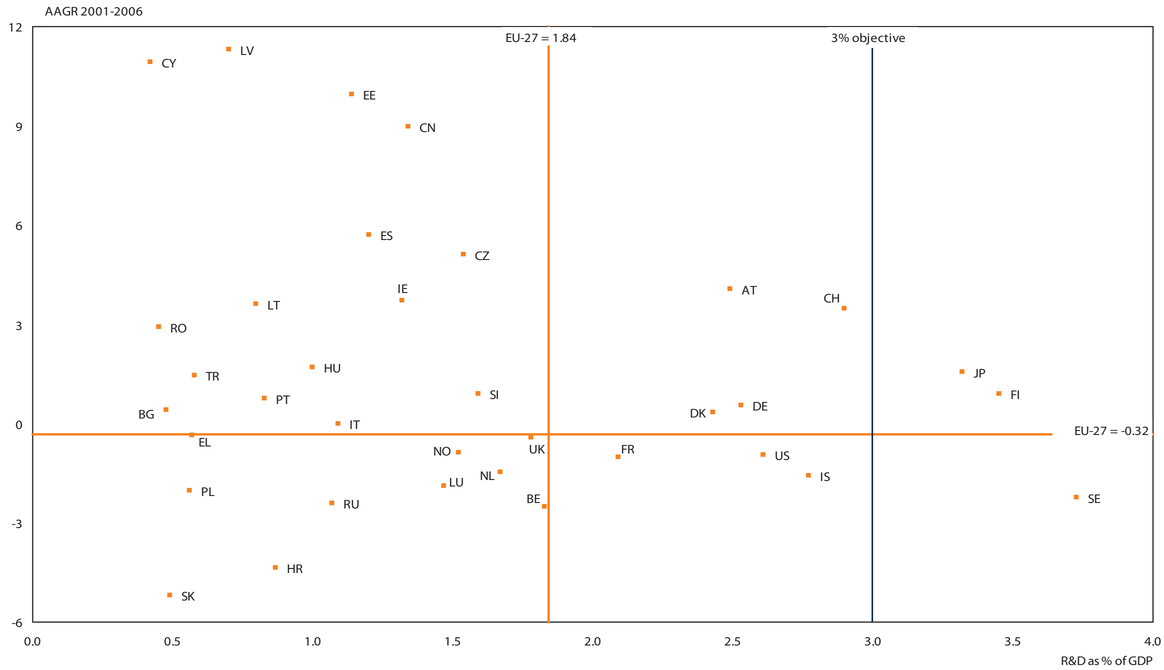
Table 2.1: R&D expenditure as a percentage of GDP, by sector of performance, EU-27 and selected countries, 2004–2006

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	2004	2005	2006	2004	2005	2006	2004	2005	2006	2004	2005	2006
EU-27	1.83 s	1.84 s	1.84 s	1.17 s	1.16 s	1.17 s	0.24 s	0.25 s	0.25 s	0.40 s	0.40 s	0.40 s
BE	1.87	1.84	1.83 p	1.29	1.25	1.24 p	0.14	0.15	0.16 p	0.41	0.41	0.41 p
BG	0.50	0.49	0.48	0.12	0.10	0.12	0.33	0.32	0.31	0.05	0.05	0.05
CZ	1.25	1.41	1.54	0.79	0.91	1.02	0.26	0.26	0.27	0.18	0.23	0.25
DK	2.48	2.45	2.43 p	1.69	1.67	1.62 p	0.17	0.16	0.16 p	0.61	0.60	0.63 p
DE	2.49	2.48	2.53 p	1.73	1.72	1.77	0.34 i	0.35 i	0.35 p	0.41	0.41	0.41 p
EE	0.86	0.93	1.14 p	0.34	0.42	0.51 p	0.11	0.10	0.15	0.39	0.38	0.46
IE	1.24	1.26	1.32 p	0.81	0.82	0.89 p	0.09	0.09	0.09	0.33	0.34	0.34
EL	0.55 e	0.58	0.57 e	0.17 e	0.18	0.17 e	0.11 e	0.12	0.12 e	0.27 e	0.28	0.27 e
ES	1.06	1.12	1.20	0.58	0.60	0.67	0.17	0.19	0.20	0.31	0.33	0.33
FR	2.15 b	2.12	2.09 p	1.36 b	1.32	1.32 p	0.37	0.37	0.36 p	0.40 b	0.40	0.38 p
IT	1.10	1.09	:	0.52	0.55	0.54 p	0.20	0.19	0.19 p	0.36	0.33 b	:
CY	0.37	0.40	0.42 p	0.08	0.09	0.09 p	0.13	0.13	0.12 p	0.13	0.16	0.18 p
LV	0.42	0.56	0.70	0.19	0.23	0.35	0.08	0.10	0.11	0.15	0.23	0.24
LT	0.76	0.76	0.80	0.16	0.15	0.22	0.19	0.19	0.18	0.41	0.41	0.40
LU	1.63	1.57	1.47 pe	1.43	1.36	1.25 e	0.18	0.19	0.19 p	0.02	0.02	0.04 p
HU	0.88 b	0.94	1.00	0.36 i	0.41 i	0.48 i	0.26 bi	0.26 i	0.25 i	0.22 i	0.24 i	0.24 i
MT	0.54 b	0.54 p	0.54 p	0.35 b	0.35 p	0.34 p	0.01	0.03	0.03	0.17	0.16	0.18
NL	1.78 pe	1.74 pe	1.67 pe	1.03 p	1.02 p	0.96 p	0.26 i	0.24 i	0.24 i	:	:	:
AT	2.22	2.43 e	2.49 e	1.51	1.64 e	1.66 e	0.11	0.12 e	0.13 e	0.59	0.64 e	0.65 e
PL	0.56	0.57	0.56	0.16	0.18	0.18	0.22	0.21	0.21	0.18	0.18	0.17
PT	0.77 e	0.81	0.83 e	0.28 e	0.31	0.35 e	0.12 e	0.12	:	0.28 e	0.29	:
RO	0.39	0.41	0.45	0.21	0.20	0.22	0.13	0.14	0.15	0.04	0.06	0.08
SI	1.42	1.46	1.59	0.95	0.86	0.96	0.28	0.35	0.39	0.18	0.24	0.24
SK	0.51	0.51	0.49	0.25	0.25	0.21	0.16 i	0.15 i	0.16 i	0.10	0.10	0.12
FI	3.45	3.48	3.45	2.42	2.46	2.46	0.33	0.33	0.32	0.68	0.66	0.65
SE	3.62 i	3.80 b	3.73	2.67 i	2.81 b	2.79	0.11 i	0.18 b	0.17	0.83	0.79 b	0.76
UK	1.71	1.76	1.78	1.07	1.08	1.10	0.18	0.19	0.18	0.42	0.45	0.46
IS	:	2.77	:	:	1.43	:	:	0.65	:	:	0.61	:
NO	1.59	1.52	1.52	0.87	0.82	0.82	0.25	0.24	0.24	0.47	0.47	0.46
CH	2.90	:	:	2.14	:	:	0.03 i	:	0.02 i	0.66	:	:
HR	1.13	1.00	0.87	0.47	0.41	0.32	0.24	0.24	0.23	0.42	0.35	0.32
TR	0.52	0.59	0.58	0.13	0.20	0.21	0.04	0.07	0.07	0.35	0.32	0.30
CN	1.23	1.34	:	0.82	0.91	:	0.28	0.29	:	0.13	0.13	:
JP	3.17	3.32	:	2.38	2.54	:	0.30	0.28	:	0.43	0.45	:
RU	1.15	1.07	:	0.80	0.73	:	0.29	0.28	:	0.06	0.06	:
US	2.58 i	2.61 pi	2.61 pi	1.78 i	1.82 pi	1.83 pi	0.31 i	0.31 pi	0.29 pi	0.37 i	0.37 pi	0.37 pi

CN, JP, RU and US: source OECD-MSTI.

Flag 'i' DE: includes other classes.
HU: incomplete breadown of R&D expenditure by sector of performance.
SK: defence excluded (all or mostly).
SE: underestimated or based on underestimated data.
SE, CH and US: federal or central government only.
US: excludes most or all capital expenditure.

Figure 2.2: R&D expenditure as a percebtage of GDP in 2006 and average annual growth rate (AAGR) 2001–2006(1), all sectors, EU-27 and selected countries



(1) Calculated on R&D expenditure expressed as a percentage of GDP.
MT does not appear because the 2002-2006 AAGR amounts to 20 %. MT's R&D intensity amounted to 0.54 % of GDP in 2006.
Eurostat estimation: EU-27 – Provisional data: BE, DE, DK, EE, IE, FR, CY and US – National estimations: EL, AT and PT – National estimations and provisional data: NL and LU.
US: excludes most or all capital expenditure.
CN, JP, RU and US: source OECD-MSTI.

Exceptions to the reference year:	2005: IT, IS, CN, JP and RU
	2004: CH.
Exceptions to the reference period:	2000-2004: CH
	2000-2006: LU.
	2001-2005: IT, IS, CN, JP and RU
	2002-2006: MT and HR.

Looking at Figure 2.2, three main groups of countries can be distinguished in terms of R&D intensity and average annual growth rate (AAGR), compared to the EU-27 averages.

In 2006, the EU-27 registered an average R&D intensity of 1.84 %, with an AAGR of -0.32 % between 2001 and 2006.

In the leading group, the R&D intensities in 2006 and AAGR for 2001-2006 were above the EU-27 average. This group includes four Member States — Finland, Germany, Denmark, and Austria — plus Japan and Switzerland.

In fact, with the exception of Sweden and France, all Member States with an R&D intensity higher than the EU-27 average also registered an above-average AAGR.

Finland and Sweden were the only Member States where the 3 %-target set by the Lisbon Strategy was already achieved. Considering the trends for other countries in this group, this target appears quite realistic.

In the second group of countries, the R&D intensity was below the EU-27 average, but the AAGR was above that of the EU as a whole. This group comprises thirteen Member States, including Spain, Italy, Cyprus and Romania, plus China and Turkey. While still lagging behind, this group is gradually closing the gap with the EU-27 average. However, it seems that reaching the 3 % target will require considerable efforts.

The third group comprises countries where both R&D intensity and AAGR were below the EU-27 average. This group includes Belgium, Luxembourg, the Netherlands, Slovakia, the United Kingdom, Greece and Poland, along with Norway, Croatia and Russia. With an R&D intensity below the 3 %-target and an AAGR below the EU-27 average, the gap between this third group and the others can be expected to widen. If no major changes are forthcoming in these countries, the 3 %-target will not be attained in the near future.

R&D expenditure in volume

In 2006, R&D spending amounted to more than EUR 213 billion in the EU-27. Between 2001 and 2006, R&D expenditure increased at an average annual rate of 3.6 %, as shown in Table 2.3.

Germany, France and the United Kingdom accounted for two thirds of total R&D expenditure. However, average annual growth rates for these three countries were between 2.5 % and 3 %, below the EU-27 average.

In many new Member States, such as Estonia, Latvia, Malta and Romania, expenditure on R&D increased on average by more than 20 %, a remarkable rate suggesting that these countries are making considerable efforts to reach the Lisbon Strategy target.

For the EU-27, Norway, Iceland and Switzerland, the highest levels of R&D investment were reported in the business enterprise sector (BES).

On the whole, higher education was the second most important sector investing in R&D after business enterprises, except in some countries such as the Czech Republic, Hungary, Poland, Romania, Slovenia, Slovakia, Iceland, China and Russia, where government sector spending was higher, probably as a result of the government's interventionist tradition in these countries. This trend was also noted in Luxembourg, where R&D spending in higher education surged by an average 54 % between 2001 and 2006.

Between 2001 and 2006, the AAGR for research and development in Japan and the United States was negative in all sectors except for higher education in the United States, whereas China and Russia registered substantial increases over the same period.

Croatia's average annual growth rate in R&D expenditure was low (2.4 %).

Table 2.3: R&D expenditure in EUR million and average annual growth rate (AAGR), by sector of performance, EU-27 and selected countries, 2001–2006

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	2001	2006	AAGR 2001-2006	2001	2006	AAGR 2001-2006	2001	2006	AAGR 2001-2006	2001	2006	AAGR 2001-2006
EU-27	178 549 s	213 127 s	3.6 s	115 689 s	135 716 s	3.2 s	23 570 s	28 777 s	4.1 s	37 914 s	46666 s	4.2 s
BE	5 373	5 798 p	1.5 p	3 921	3 934 p	0.1 p	331	500 p	8.6 p	1 059	1 291 p	4.0 p
BG	71	121	11.3	15	31	16.2	48	78	10.2	9	12	5.9
CZ	832	1 761	16.2	501	1 165	18.4	197	309	9.4	130	279	16.5
DK	4 278	5 349 p	4.6 p	2 934	3 560 p	3.9 p	503	360 p	-6.5 p	809	1 396 p	11.5 p
DE	52 002	58 848 p	2.5 p	36 332	41 148	2.5	7 146 i	8 100 p	2.5 p	8 524	9 600 p	2.4 p
EE	49	151 p	25.3 p	16	67 p	32.5 p	7	20	23.6	25	61	20.0
IE	1 284	2 311 p	12.5 p	900	1 560 p	11.6 p	104	150	7.6	280	601	16.5
EL	852	1 223 e	7.5 e	278	367 e	5.7 e	188	254 e	6.3 e	383	585 e	8.9 e
ES	6 227	11 815	13.7	3 261	6 558	15.0	989	1 971	14.8	1 925 e	3 266	11.1
FR	32 887	37 844 p	2.8 p	20 782 b	23 942 p	2.9 p	5 432	6 546 p	3.8 p	6 217	6 875 p	2.0 p
IT	13 572	15 599	3.5	6 661	7 856	4.2	2 493	2 701	2.0	4 418	4 712 b	1.6 b
CY	27	62 p	17.6 p	5	14 p	21.0 p	12	18 p	7.0 p	7	26 p	29.1 p
LV	38	112	24.4	14	57	32.7	8	17	15.9	16	39	19.5
LT	91	191	15.9	27	53	14.9	36	44	3.8	29	94	26.8
LU	364	497 pe	5.3 pe	337	422 e	3.8 e	26	63 p	15.8 p	1	12 p	54.0 p
HU	548 i	900	10.4	220 i	435 i	14.6 i	142 i	228 i	10.0 i	141 i	219 i	9.2 i
MT	12	28 p	23.5 p	3	17 p	55.2 p	2	1	-9.3	7	9	7.2
NL	8 075	8 910 pe	2.0 pe	4 712	5 134 p	1.7 p	1 114	1 260 i	2.5 i	2 184	:	:
AT	4 684	6 423 e	8.2 e	3 131	4 284 e	8.2 e	266	325 e	5.1 e	1 266	1 689 e	7.5 e
PL	1 323	1 513	2.7	474	477	0.1	414	560	6.2	433	469	1.6
PT	1 038	1 201	3.7	330	462	8.8	216	176	-5.0	381	425	2.8
RO	177	444	20.2	109	215	14.6	48	144	24.6	20	79	31.5
SI	341	484	7.2	197	291	8.1	83	119	7.4	55	73	5.7
SK	149	217	7.7	101	93	-1.5	35 i	71 i	14.9 i	13	52	31.2
FI	4 619	5 761	4.5	3 284	4 108	4.6	471	539	2.7	834	1 079	5.3
SE	10 511 i	11 691	2.2	8 118 i	8 754	1.5	297 i	525	12.1	2 085	2 387	2.7
UK	29 403	34 037	3.0	19 260 b	20 985	1.7	2 949 b	3 401	2.9	6 671	8 892	5.9
IS	261	364	8.7	153	187	5.1	52	86	13.1	49	80	13.0
NO	3 037	4 071	6.0	1 814	2 204	4.0	444	637	7.5	780	1 229	9.5
CH	6 852	8 486	5.5	5 065	6 257	5.4	90 bi	91 i	0.2 i	1 566	1 943	5.5
HR	271	297	2.4	115	109	-1.4	60	79	7.0	95	109	3.5
TR	1 172	2 432	15.7	395	901	17.9	86	284	26.9	690	1 248	12.6
CN	14 063	30 002	16.4	8 499	21 325	20.2	4 183	5 912	7.2	1 381	2 765	14.9
JP	143 015	121 831	-3.9	105 364	93 137	-3.0	13 637	10 100	-7.2	20 687	16 330	-5.7
RU	4 025	8 466	16.0	2 829	5 643	14.8	978	2 285	18.5	210	517	19.8
US	310 205 i	273 772 pi	-2.5 pi	225 566 i	192 584 pi	-3.1 pi	35 013 i	30 462 pi	-2.7 pi	37 642 i	39 098 pi	0.8 pi

Exceptions to the reference year 2001: 2000: LU and CH - 2002: MT, AT and HR.
Exceptions to the reference period 2001-2006: 2000-2004: CH - 2000-2006: LU - 2001-2005: IT, PT, IS and JP - 2002-2006: MT, AT and HR.
Exceptions to the reference year 2006: 2004: CH - 2005: IT, PT, IS and JP.

Flag 'i' DE and NL: includes other classes.
HU: incomplete breadown of R&D expenditure by sector of performance.
SK: defence excluded (all or mostly).
SE: underestimated or based on underestimated data.
SE, CH and US: federal or central government only.
US: excludes most or all capital expenditure.

'Think Small First'

Managing the transition towards a knowledge-based economy is the key challenge for the EU today. Success will ensure a competitive and dynamic economy with more and better jobs and a higher level of social cohesion.

Dynamic entrepreneurs are particularly well-placed to reap opportunities from globalisation and from the acceleration of technological change. Our capacity to build on the growth and innovation potential of small and medium-sized enterprises (SMEs) will therefore be decisive for the future prosperity of the EU. In a globally changing landscape characterised by continuous structural changes and enhanced competitive pressures, the role of SMEs in our society has become even more important as providers of employment opportunities and key players for the wellbeing of local and regional communities. Vibrant SMEs will make Europe more robust to stand against the uncertainty thrown up in the globalised world of today.

The EU has thus firmly placed the needs of SMEs at the heart of the Lisbon Growth and Jobs Strategy, notably since 2005 with the use of the partnership approach, which has achieved tangible results. Now it is time once and for all to cement the needs of SMEs in the forefront of the EU's policy and to translate the vision of the EU Heads of State and Government of 2000 into reality — making the EU a world-class environment for SMEs.

The national and local environments in which SMEs operate are very different and so is the nature of SMEs themselves (including crafts, micro-enterprises, family-owned or social economy enterprises). Policies addressing the needs of SMEs therefore need to fully recognise this diversity and fully respect the principle of subsidiarity.

Source: 'Small Business Act'- European Commission- 2008

Figure 2.4 (all sectors) shows that in 2006, the business enterprise sector remained the primary source of R&D financing, accounting for 55 % of total R&D expenditure in the EU-27. However, more business investment will be required in order to reach the 'two thirds' target set by the relaunched Lisbon strategy.

Germany (68 %), Luxembourg (80 %), Finland (67 %) and Sweden (66 %) have already achieved this target. This was also the case in China (69 %). Belgium and Denmark registered shares of 60 %, followed by Ireland and Slovenia, with shares of 59 %.

A closer look at country level reveals some remarkable differences in the sources of R&D financing.

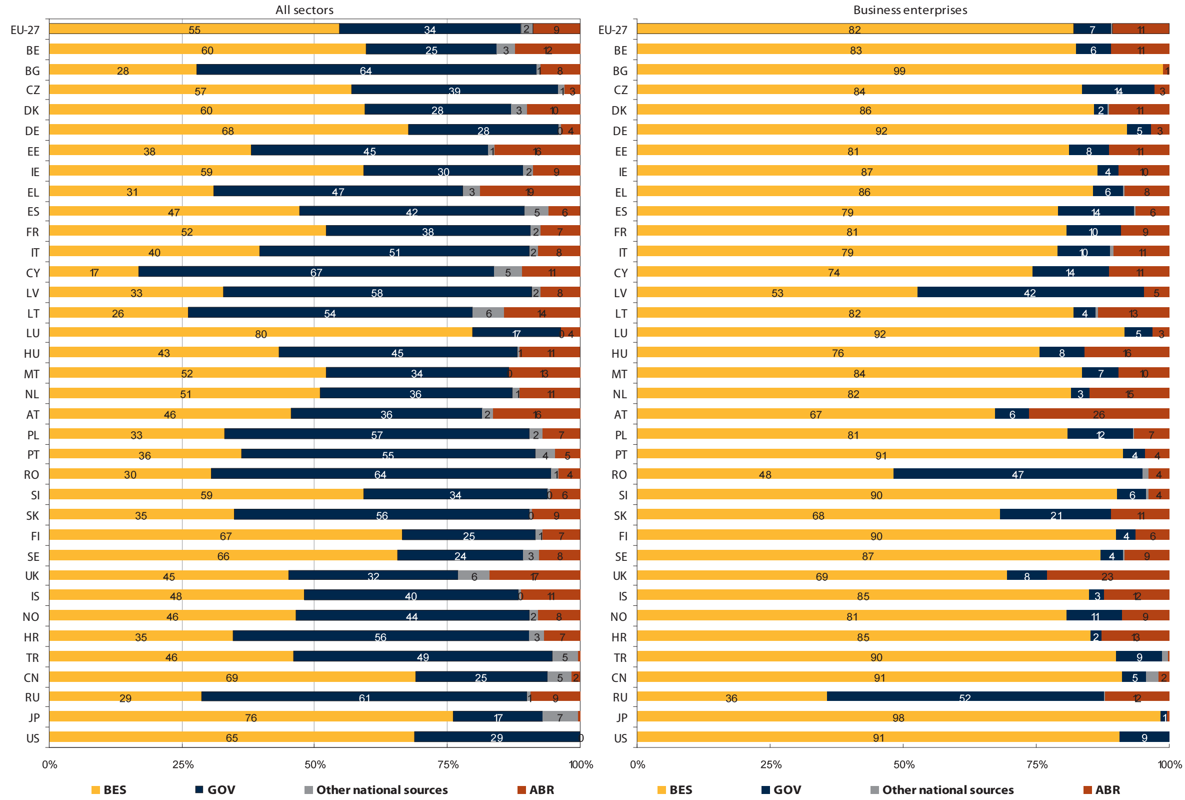
With the exceptions of the Czech Republic, Malta and Slovenia, the share of the government sector in the new Member States and Greece was far greater than that of the business enterprise sector. In the case of the new Member States this may be explained by the fact that the government sector was traditionally very strong in these countries and the business sector still needs time to develop further in order to be able to invest more in R&D.

Taken together, the business enterprise sector and the government sector accounted for more than 75 % of R&D expenditure across all countries under scrutiny. The remaining sources, 'abroad' and 'other national sources', were of minor importance for the majority of countries. R&D funding from 'abroad' was only significant in Estonia (16 %), Greece (19 %), Austria (16 %) and the UK (17 %).

The distribution of business R&D expenditure by source of funds clearly shows that the business enterprise sector played the major role in R&D financing. Indeed, close to 82 % of business R&D expenditure in the EU-27 was self-financed. With the exception of Russia, this sector was the main source of R&D funding for all Member States and most of the selected countries.

The business enterprise sector in Latvia (42 %) and Romania (47 %) registered high shares of government financing, while R&D funding from 'abroad' was comparatively high in the Netherlands (15 %), Hungary (16 %), Austria (26 %) and the United Kingdom (23 %).

Figure 2.4: Total and business enterprise R&D expenditure by source of funds as a percentage of total, EU-27 and selected countries, 2006



EU-27: Eurostat Estimation – IE, EE, MT and US: Provisional data – AT: national estimation – SE: break in series

Exceptions to the reference year: 2003: NL
2004: AT (BES)
2005: EU-27, BE (all sectors), BG, DK, DE (all sectors), EL, FR, IT (all sectors), CY, LU, PT, SE, IS, NO (all sectors) and JP.

flag 'i' HU: incomplete breadown of R&D expenditure by source of funds.
SK: underestimated or based on underestimated data.
US: excludes most or all capital expenditure.

Table 2.5 provides an overview of the breakdown of business R&D expenditure by sector of activity based on NACE Rev. 1.1 (See methodological notes). In 2005, the EU-27's business enterprise sector invested around EUR 128 billion in R&D.

In absolute terms, the business enterprise sector in Germany invested most in R&D, with close to EUR 38.6bn, followed by France, with EUR 22.8bn, and the United Kingdom with EUR 19.4bn.

In most EU countries, the largest shares of R&D expenditure in the business enterprise sector were devoted to manufacturing. However, in Bulgaria, Estonia, Cyprus, Latvia, Luxembourg and Slovakia, together with Iceland, Croatia and Norway, the services sector was the most important R&D performer.

The business enterprise sector in Germany, Slovenia, Finland and Switzerland invested more than 80 % of total R&D expenditure in the manufacturing sector. Six other Member States, including Italy and Sweden, registered shares in excess of 70 %.

Enterprises in Bulgaria and Cyprus devoted more than 60 % of R&D investment to the services sector, while R&D investment in the services sector was also significant in Luxembourg (56 %), Slovakia (55 %) and Estonia (54 %).

The remaining sectors accounted for only marginal shares, with R&D expenditure in the agricultural sector accounting for 15 % in Romania and 8 % in Latvia, while Portuguese R&D investment in construction accounted for 9 % of total R&D investment by businesses.

Table 2.5: Business enterprise R&D expenditure in EUR million, by sector of activity (NACE Rev 1.1), EU-27 and selected countries, 2005

	Total	Agriculture, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Services
EU-27	128 068 s	:	:	:	:	:	:
BE	3 776	39	4	3 045	10	39	639
BG	23	: c	: c	7	0	0	16
CZ	914	3	4	576	7	11	313
DK	3 477	19	: c	: c	: c	8	: c
DE	38 651	81	28	34 522	95	26	3 899
EE	47	0	: c	19	1	: c	25
IE	1 330	1	1	881	0	0	447
EL	357	2 p	6 p	188 p	1	1 p	161 p
ES	5 485	54	9	2 986	30	115	2 290
FR	22 802	:	:	:	:	:	:
IT	7 856	:	27	5 612	36	14	2 166
CY	12	0	0	4	0	0	8
LV	30	2	:	12	:	1	14
LT	32	:	0	17	0	0	14
LU	408	:	:	181	:	:	227
HU	362	5	0	286	2	1	68
MT	17 p	:	0 p	9 p	0 p	0 p	8 p
NL	5 169 p	63	99	3 988	23	70	901
AT	3 556	3	3	2 550	8	17	975
PL	440	2	0	221	6	0	212
PT	462	1	1	213	1	43	203
RO	163	24	5	98	13	4	18
SI	243	0	4	196	0	0	42
SK	97	2	0	42	: c	: c	53
FI	3 877	0	4	3 113	12	25	723
SE	8 290 b	25	28	6 104	10	64	2 059
UK	19 464	: c	63	15 168	21	: c	3 992
IS	187	3	0	70	2	0	112
NO	1 987	27	112	832	7	19	988
CH	6 257	:	:	5 033	:	:	1 224
HR	114	4	:	10	0	3	97
TR	774	2	4	569	1	4	194
RU	4 458	27 i	26 i	724 i	11 i	3 i	3 506 i

Exceptions to the reference year: 2004: AT and CH
2003: HR.

Flag 'i' RU: excludes most or all capital expenditure.

Table 2.6 shows the level of business R&D expenditure by size of enterprise in 2005. In most Member States, R&D expenditure in the business enterprise sector was related to enterprise size.

Only in 4 EU countries did enterprises with 50 to 249 employees invest less in R&D than enterprises with 10 to 49 employees.

Germany (84.8 %), France (74.7 %), Sweden (73.9 %), Italy (72.2 %) and the United Kingdom (72.2 %) reported the highest share of business R&D expenditure in enterprises with more than 500 employees. Nine other Member States registered shares of over 50 %.

Small countries registered higher levels of business R&D expenditure in smaller companies. For instance, enterprises with 10 to 49 employees were responsible for 51.6 % of total R&D expenditure in Malta, while companies with 1 to 9 employees accounted for 31.2 % of total R&D spending in Cyprus and 20.2 % in Latvia.

Table 2.6: Business R&D expenditure in EUR million, by size class, EU-27 and selected countries, 2005

	Total	0 employees	1 to 9 employees	10 to 49 employees	50 to 249 employees	250 to 499 employees	500 and more employees
EU-27	128 068 s	:	:	:	:	:	:
BE	3 776	3	89	537	889	330	1 928
BG	23	0	1	3	5	2	12
CZ	914	3	13	74	213	126	485
DK	3 477	:	96	426	488	304	2 164
DE	38 651	:	137	777	2 890	2 087	32 760
EE	47	:	5	13	10	3	:
IE	1 330	0	38	229	360	235	468
EL	357	:	16	105	93	21	123
ES	5 485	:	168	900	1 412	769	2 236
FR	22 523 b	:	259 bi	1 174 bi	2 207 bi	1 746 bi	16 824 bi
IT	6 979	:	70	285	832	715	5 077
CY	12	0	4	1	2	0	5
LV	30	:	6	4	13	0	6
LT	32	:	2	9	8	2	11
LU	408	:	:	42	73	44	249
HU	362	3	11	25	31	52	239
MT	17 p	:	:	9 p	2 p	3 p	2 p
NL	4 804	:	:	388	898	:	:
AT	3 556	:	90 i	251	622	372	2 222
PL	440	0	2	19	110	93	216
PT	462	:	14	45	103	68	231
RO	163	2	5	13	60	17	:
SI	243	1	9	15	50	18	150
SK	97	0	2	6	42	12	35
FI	3 877	:	78 i	272	438	326	2 764
SE	8 290 b	:	:	685	962	517	6 125
UK	19 464	:	333 i	813	2 502	1 903	14 060
IS	187	:	:	:	:	:	:
NO	1 987	:	:	427	601	173	:
CH	6 257	:	77	426	777	709	4 269
HR	129	:	:	:	:	:	:
TR	774	:	:	:	:	:	:
RU	4 458	:	:	:	:	:	:

Exceptions to the reference year: 2004: FR, AT and CH
2003: NL and IT

Footnote 'i' FR: Unrevised breakdown not adding to the revised total
AT, FI and UK: Includes other classes

Table 2.7 presents R&D expenditure by type of cost in all sectors and, more specifically, in the business enterprise sector. Current expenditure is composed of labour costs and other costs of consumable goods that last for only a limited period of time. Capital expenditure refers to expenditure on fixed assets used in R&D.

Most of the R&D expenditure in all sectors in 2005 comprised current expenditure. In nine Member States, current expenditure accounted for more than 90 % of total expenditure. With the exception of Latvia and Poland, all countries in the EU registered current expenditure shares above 80 %.

A similar pattern was observed in the business enterprise sector, where the share of current expenditure ranged from 60.1 % in Latvia to 94.2 % in Sweden and Finland.

Capital expenditure shares in the business enterprise sector were remarkably high in Latvia (39.9 %), Bulgaria (31.1 %) and Portugal (29.1 %).

Table 2.7: R&D expenditure in EUR million, by type of cost, all sectors and business enterprise sector, EU-27 and selected countries, 2005

	All sectors			Business enterprise		
	Total	Current expenditure	Capital expenditure	Total	Current expenditure	Capital expenditure
EU-27	202 018 s	182 887 s	19 131 si	128 068 s	117 314 s	10 755 si
BE	5 552	5 063	488	3 776	3 439	336
BG	106	95	12	23	16	7
CZ	1 417	1 255	162	914	812	101
DK	5 094	4 809	285	3 477	3 244	233
DE	55 739	50 630 i	5 059 i	38 651	35 503	3 148
EE	104	88	16	47	35	12
IE	2 030	1 761	269	1 330	1 141	189
EL	1 154	1 018	136	357	300	57
ES	10 197	8 404	1 793	5 485	4 570	915
FR	36 526	33 482	3 045	22 802	21 253	1 549
IT	15 599	13 852	1 747	7 856	7 121	735
CY	55	50	5	12	11	1
LV	73	49	24	30	18	12
LT	157	134	23	32	24	8
LU	472	410	62	408	350	58
HU	838	677	130	362 i	280	81
MT	26 p	:	:	17 p	15 p	1 p
NL	8 842 pe	7 932 pe	885 pe	5 169 p	4 629	515
AT	5 250	4 812	438	3 556	3 262	294
PL	1 386	1 096	289	440	355	85
PT	1 201	1 001	200	462	328	134
RO	327	287	40	163	145	18
SI	413	374	39	243	219	24
SK	194	174	21	97	87	10
FI	5 474	5 203 i	270 i	3 877	3 652 i	225 i
SE	11 184 b	10 591	593	8 290 b	7 808	482
UK	31 707	:	:	19 464	18 005	1 459
IS	364	336	28	187	167	21
NO	3 699	3 441	259	1 987	1 865	122
CH	8 486	7 809	677	6 257	5 691	567
HR	345	296	49	144	119	24
TR	2 287	1 918	369	774	617	157
RU	6 559	6 284	275	4 458	4 298	161

Exceptions to the reference year: 2004: AT, CH and HR.

Flag 'i' DE: no breakdown is available for the additional funds from Germany Research Association.
HU: incomplete breakdown of R&D expenditure by type of cost.
FI (current exp.): includes other classes.
EU-27 and FI (capital exp.): includes elsewhere.

Tables 2.8 and 2.9 provide a breakdown of R&D expenditure in the government and higher education sectors by fields of science.

In 2005, 'natural sciences' accounted for the largest share of R&D expenditure in the government sector in most Member States for which data are available. The government sector in Germany gave the highest priority to natural sciences, with investment totalling EUR 3.6bn, followed by Italy with EUR 1.2bn.

'Engineering and technology' was the leading field of science in Belgium, Luxembourg, Romania and Finland, while 'medical sciences' received the most government R&D funding in Denmark, Spain and Austria. In Ireland, Cyprus, Portugal and Iceland, government sector expenditure on R&D was highest in 'agriculture'.

The largest shares of government expenditure in 'social sciences' were registered in Malta and Norway. 'Social sciences' also accounted for a substantial share of government R&D spending in Luxembourg (17.4 %) and Croatia (17.0 %).

Estonia (32.4 %) devoted the most government R&D expenditure to 'humanities'. Austria also allocated a substantial share of government expenditure to this field (21.8 %), while, in contrast, Ireland, Malta and Iceland did not even manage 1 %.

The government sector in Russia, like some EU countries, devoted the highest shares of R&D expenditure to 'engineering and technology', with 44.3 %, followed by 'natural sciences' with 37.7 %.

Table 2.8: R&D expenditure in EUR million by field of science, government sector, EU-27 and selected countries, 2005

	Total	Agriculture	Engineering and technology	Medical sciences	Natural sciences	Social sciences	Humanities
EU-27	27 516 s	:	:	:	:	:	:
BE	464	48	329	6	43	11	27
BG	71	18	11	2	32	2	6
CZ	265	29	36	18	143	17	22
DK	329	73	55	80	66	37	18
DE	7 867 i	428	2 320	483	3 636	369	631
EE	12	2	1	2	3	0	4
IE	150	70	1	30	30	19	0
EL	234	:	:	:	:	:	:
ES	1 738	406	349	591	248	89	55
FR	6 437	:	:	:	:	:	:
IT	2 701	177	414	449	1 260	355	45
CY	18	10	0	1	4	1	2
LV	14	4	1	0	7	2	0
LT	39	5	8	0	16	5	5
LU	57	4	21	9	13	10	1
HU	235 i	40	27	23	83	27	35
MT	1	0	0	0	0	1	0
NL	1 216	:	:	:	:	:	:
AT	270	29	14	104	27	38	59
PL	504	68	132	58	204	19	22
PT	176	54	45	27	26	17	6
RO	112	3	43	19	35	9	3
SI	100	4	9	3	61	10	13
SK	58 i	7 i	11 i	7 i	22 i	7	3
FI	523	95 i	221 i	82 i	84 i	63 i	9 i
SE	528 b	:	:	:	:	:	:
UK	3 348	:	:	:	:	:	:
IS	86	30	8	9	14	11	1
NO	577	130	95	65	129	136	22
CH	91 i	:	:	:	:	:	:
HR	72	6	7	7	32	12	8
TR	264	:	:	:	:	:	:
RU	1 710	89	758	112	644	57	49

Exceptions to the reference year: 2004: AT and HR.
Flag 'i' DE, FI and NL: include other classes.
SK: defence excluded (all or mostly).
CH: federal or central government only.

In absolute terms, the higher education sector in Germany spent the most on R&D, with EUR 9.2 billion, followed by the United Kingdom with EUR 8.1 billion.

As for the government sector (see Table 2.8), R&D expenditure by the higher education sector was in most countries mainly devoted to 'natural sciences'. Latvia (51.8 %), Slovakia (44.9 %) and Cyprus (43.0 %) allocated the largest shares to this field of science.

In Bulgaria, the Czech Republic, Spain, Lithuania, Poland, Romania and Slovenia, 'engineering and technology' was the main field of science in the higher education sector, while in Belgium, Denmark, Sweden and Norway 'medical sciences' registered a clear preference.

'Social sciences' was the leading field of science for higher education R&D investment in Malta and Iceland, and the second most important in Spain and Cyprus.

Although no country allocated the largest share of R&D expenditure in higher education to 'agriculture' or 'humanities', 'agriculture' did receive a substantial share of R&D expenditure in Romania (22.9 %) and Slovenia (18.1 %), and R&D investment in 'humanities' was significant in Spain (16.2 %) and Denmark (15.9 %).

Higher education institutions in Russia devoted more than half of R&D investment to 'engineering and technology', followed by 'natural sciences'.

Table 2.9: R&D expenditure in EUR million by field of science, higher education sector, EU-27 and selected countries, 2005

	Total	Agriculture	Engineering and technology	Medical sciences	Natural sciences	Social sciences	Humanities
EU-27	44 535 s	:	:	:	:	:	:
BE	1 239	128	206	339	260	210	95
BG	11	0	5	1	2	2	1
CZ	232	14	84	49	50	22	13
DK	1 254	69	157	355	299	175	200
DE	9 221	328	1 856	2 307	2 700	852	1 127
EE	43	3	10	4	17	6	3
IE	550	14	99	100	198	99	40
EL	548	:	:	:	:	:	:
ES	2 960	60	692	461	613	655	478
FR	6 821	:	:	:	:	:	:
IT	4 712 b	193 p	685 p	736 p	1 489 p	875 p	717 p
CY	22	0	3	0	9	6	3
LV	29	3	5	2	15	2	2
LT	86	4	23	18	16	16	9
LU	7	0	2	0	3	2	1
HU	211	20	49	35	50	26	30
MT	8	0	1	2	1	3	1
NL	:	:	:	:	:	:	:
AT	1 402	63	194	375	449	181	140
PL	438	38	155	43	120	63	20
PT	425	31	106	35	124	78	51
RO	45	10	12	8	6	8	0
SI	69	13	26	11	6	9	4
SK	40	4	10	2	18	4	2
FI	1 042	27	205	247	266	213	84
SE	2 333 b	119	532	742	448	306	148
UK	8 160	:	:	:	:	:	:
IS	80	5	2	11	1	15	6
NO	1 136	55	126	375	233	232	115
CH	1 943	45	181	304	447	:	:
HR	129	13	37	15	10	35	19
TR	1 249	70	178	551	99	225	126
RU	379	6	198	11	112	42	11

Exceptions to the reference year: 2004: AT, CH and HR.

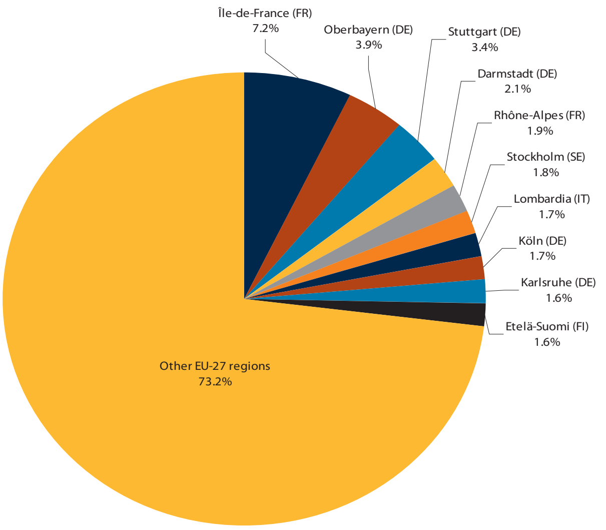
2.3 R&D at regional level

Figure 2.10 presents the top ten regions in terms of relative R&D expenditure (expressed as a percentage of the EU-27 total), and Table 2.11 shows the leading 15 regions in terms of R&D intensity.

In 2005, Île-de-France (FR) ranked first, accounting for 7.2 % of total R&D expenditure in the EU-27. This was followed by nine other regions, together accounting for close to 30 % of total R&D expenditure in the EU-27.

In absolute terms, five German regions (Oberbayern, Stuttgart, Darmstadt, Köln and Karlsruhe) featured among the top ten in R&D expenditure, together with the French Rhône-Alpes, the Stockholm region in Sweden, Lombardia in Italy and Etelä-Suomi in Finland.

Figure 2.10: R&D expenditure in the top 10 EU regions as a percentage of EU-27, all sectors, 2005



Exceptions to the reference year: 2004: Île-de-France (FR) and Rhône-Alpes (FR).

With an R&D intensity of 5.78 % of GDP, Braunschweig (DE) led the way in terms of R&D expenditure as a share of GDP. This was followed by Västsverige (SE) with 5.33 % and Stuttgart with 5.25 %. All other EU regions were below 5 %. However, the 15 leading regions were above the 3 % target set by the Lisbon strategy. Oberbayern (DE) reported the highest share of R&D expenditure in the EU-27.

Five regions in the top 15 were comparatively small in terms of volume of R&D expenditure (accounting for less than 1 % of the EU-27 total): Pohjois-Suomi (FI) ranked fourth, Sydsverige (SE) sixth, Östra Mellansverige (SE) ninth, Länsi-Suomi (FI) thirteenth and Dresden (DE) fourteenth.

Table 2.11: Top 15 EU regions in terms of R&D expenditure as a percentage of GDP, all sectors, 2005

Regions	% of GDP	EUR million	% of EU-27
EU-27	**1.84 s**	202 018 s	100
Braunschweig (DE)	**5.78**	2 467	1.2
Västsverige (SE)	**5.33**	3 020	1.5
Stuttgart (DE)	**5.25**	6 896	3.4
Pohjois-Suomi (FI)	**4.79**	782	0.4
Oberbayern (DE)	**4.75**	7 854	3.9
Sydsverige (SE)	**4.41**	1 680	0.8
Stockholm (SE)	**4.24**	3 621	1.8
Midi-Pyrénées (FR)	**4.15**	2 680	1.3
Östra Mellansverige (SE)	**3.95**	1 667	0.8
Tübingen (DE)	**3.94**	2 041	1.0
Karlsruhe (DE)	**3.89**	3 303	1.6
Berlin (DE)	**3.82**	3 018	1.5
Länsi-Suomi (FI)	**3.60**	1 273	0.6
Dresden (DE)	**3.59**	1 231	0.6
Etelä-Suomi (FI)	**3.53**	3 164	1.6

Exceptions to the reference year: 2004: Midi-Pyrénées (FR).

Map 2.12 shows that twenty EU regions registered R&D intensities above the 3 % Lisbon Strategy target: eight were German, four Swedish, three Finnish, two Austrian, two French and one Dutch. East of England (UK), which is classified as NUTS 1, also recorded an R&D intensity higher than 3 %.

As shown on Map 2.12, not many countries counted one or more regions with an R&D expenditure higher than 2 % of GDP. In addition to Germany, Sweden, France and the United Kingdom, mentioned above, Austria, the Czech Republic, Denmark and the Netherlands, along with Iceland, also recorded R&D intensities of over 2 %.

Map 2.12: R&D expenditure as a percentage of GDP, all sectors, 2005 - NUTS 2

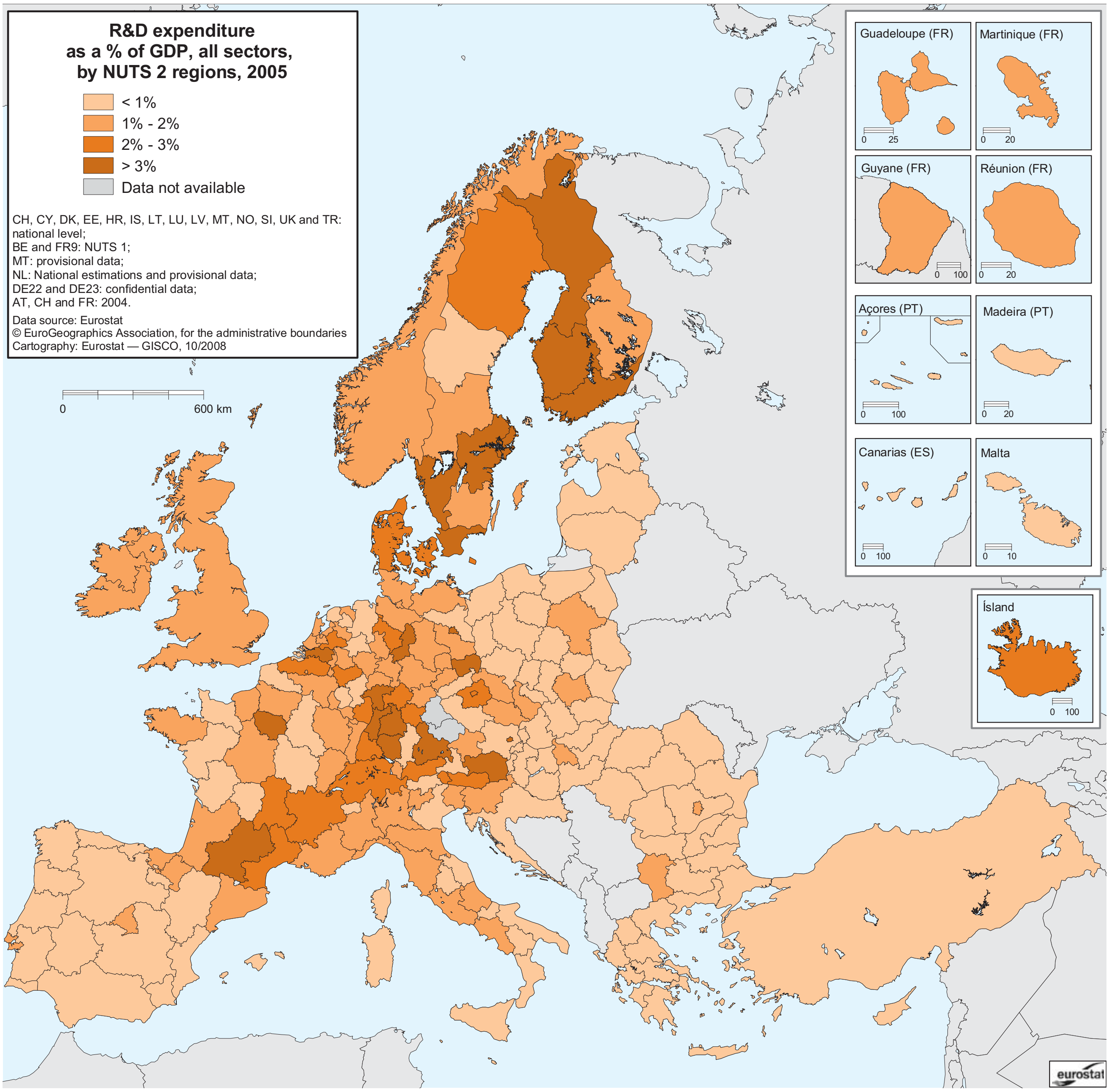
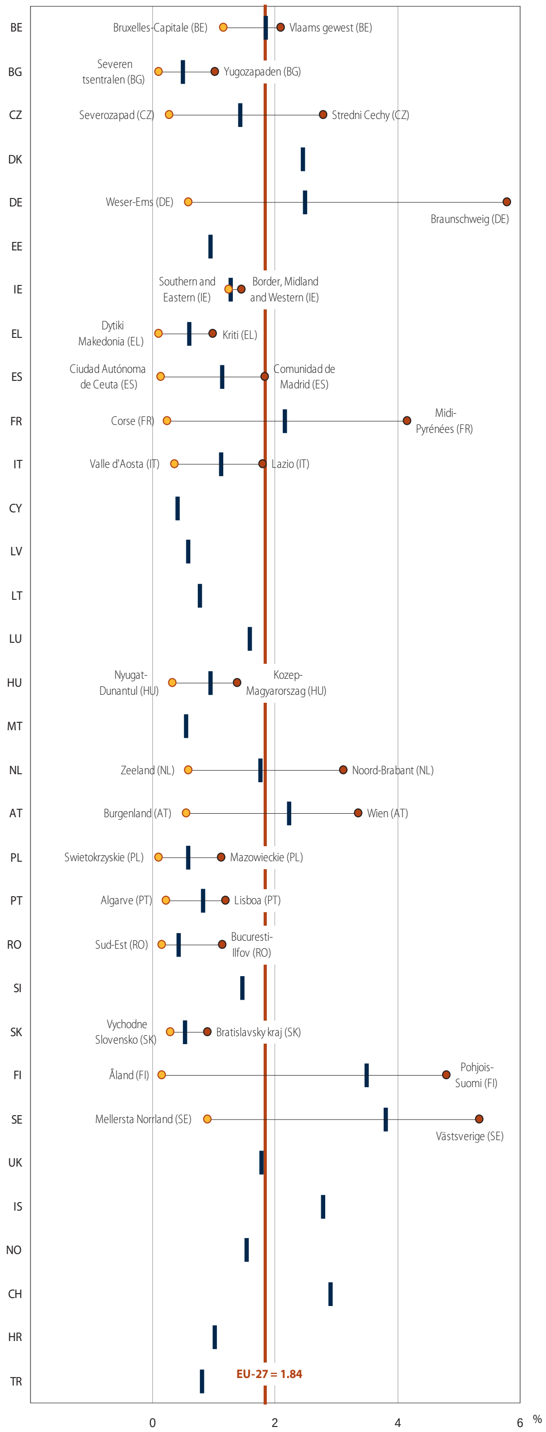


Figure 2.13: Regional disparities (at NUTS 2 level) in R&D expenditure as a percentage of GDP, all sectors, EU-27 and selected countries, 2005



BE: NUTS level 1.
EU-27: Eurostat estimation.
MT: provisional data.
NL: national estimates and provisional data.
FR and SE: break in series.
Exceptions to the reference year: AT, FR and CH: 2004.

Figure 2.13 shows the regional disparities in R&D expenditure as a share of GDP for the EU-27 and selected countries. At national level, the R&D intensity of the leading regions varied significantly from one country to another.

For all the sectors considered, three main groups of countries emerge from the ranking. At the top, Germany, France, Finland and also Sweden (national average only) stand out, with R&D intensities in their leading region higher than 4 %.

The second group includes countries with R&D intensities in the leading region between the EU-27 average (1.84 %) and 4 %. This group includes Belgium, the Czech Republic, Denmark, the Netherlands and Austria.

The final group comprises countries where R&D intensity in the foremost region is below the EU-27 average. These countries include Bulgaria, Estonia, Greece, Spain, Italy, Ireland, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Hungary, Poland, Portugal, Slovakia, Slovenia and Romania.

Disparities exist not only between countries but also within regions of the same country. The largest discrepancy between the leading region and the bottom region was registered in Germany, reaching 5.2 percentage points; conversely, the smallest gap was registered in Ireland, at 0.21 percentage points. With the exception of Bruxelles-Capitale in Belgium and Southern and Eastern region in Ireland, with R&D expenditure amounting to 1.14 % and 1.22 % of GDP, respectively, the R&D intensity in all the other lowest-ranked regions in the Czech Republic, Germany, Greece, Spain, France, Italy, Hungary, the Netherlands, Austria, Portugal, Slovakia and Finland was less than 1 %.

Braunschweig

Research is right at home in Braunschweig: names like Gauß or Agnes Pockels are witness to the long tradition of science in this city. According to a recent EU study, Braunschweig is the most research-intensive region in Europe, boasting the highest density of scientists. Over 16 000 students study at the Technical University, the University of Applied Sciences (Fachhochschule) and the University of Art (Kunsthochschule, HBK) — with 14 400 studying in technical fields. Braunschweig's 'brains' teach, carry out research and work at 27 research institutions and 250 companies in the high-tech sector.

The Braunschweig region has by far the highest R&D intensity in the whole of the European Economic Area, standing at 7.1 % of the region's gross domestic product (GDP).

Source: based on http://www.braunschweig.de/english/business_science_education/region_of_science.html

Map 2.14: R&D expenditure as a percentage of GDP, business enterprise sector, 2005 - NUTS 2

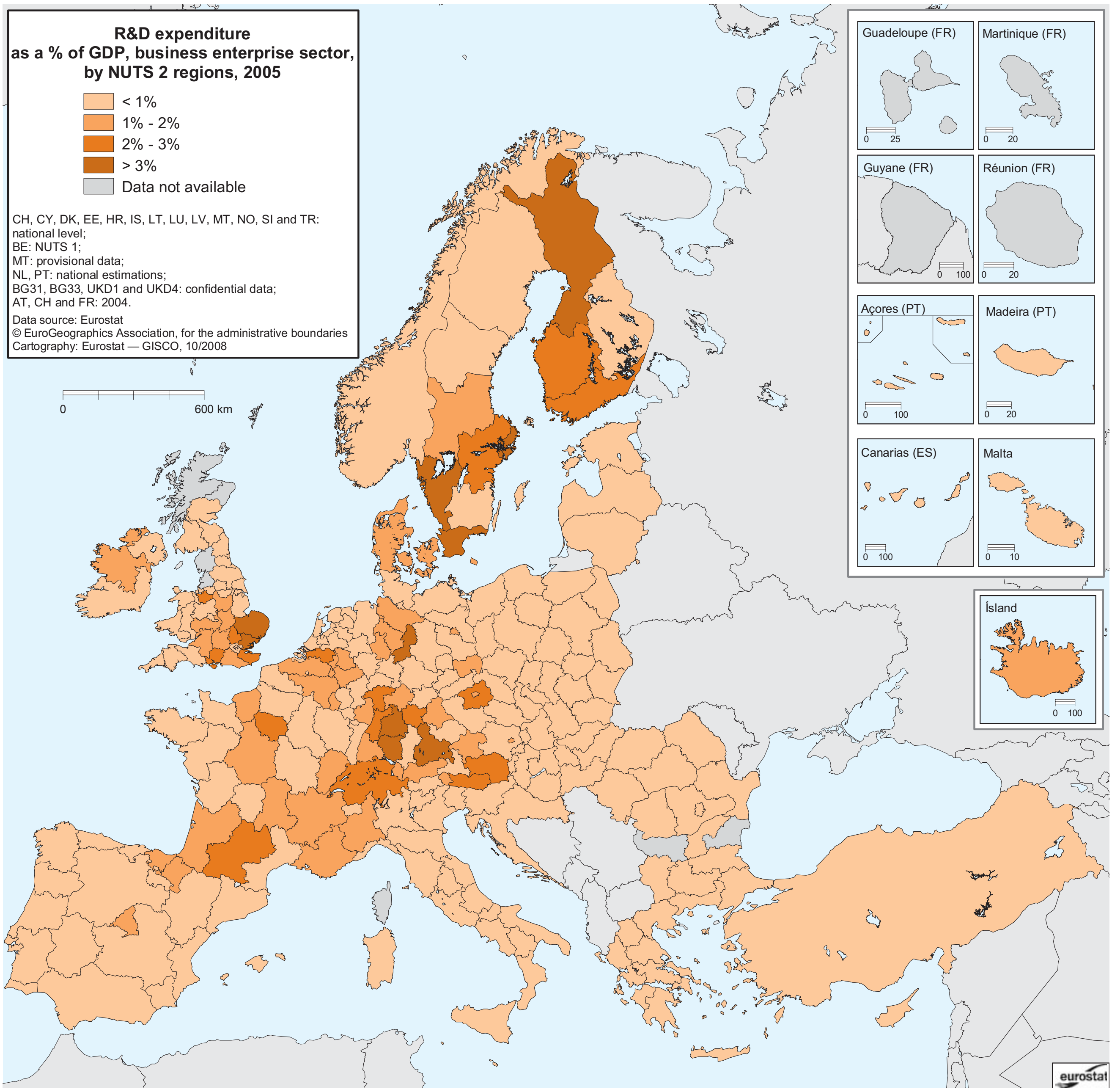
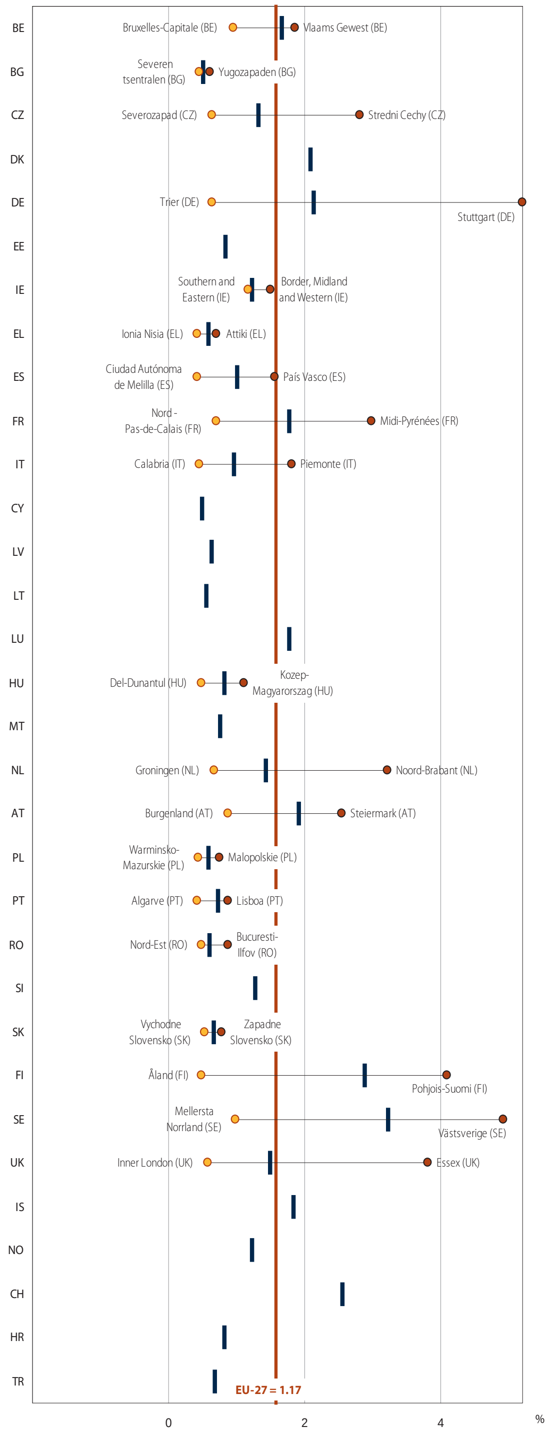


Figure 2.15: Regional disparities (at NUTS 2 level) in R&D expenditure as a percentage of GDP, business enterprise sector, EU-27 and selected countries, 2005



BE: NUTS level 1.
EU-27: Eurostat estimation.
MT: provisional data.
NL and PT: national estimates.
FR and SE: break in series.
Exceptions to the reference year: AT, FR and CH: 2004.

Regional disparities also exist in terms of sector of performance. The situation in the business enterprise sector is similar to that described for all sectors, with the top region in ten countries remaining unchanged.

Stuttgart in Germany was at the top of the ranking, where R&D expenditure in the BES accounted for 4.79 % of GDP. The leading Swedish region of Västsverige followed with an R&D intensity higher than 4.51 %.

Germany registered the most pronounced regional disparities, followed by Sweden, Finland and the United Kingdom. By contrast, regional disparities were lowest in Bulgaria, Poland, Greece and Slovakia.

Stuttgart Region

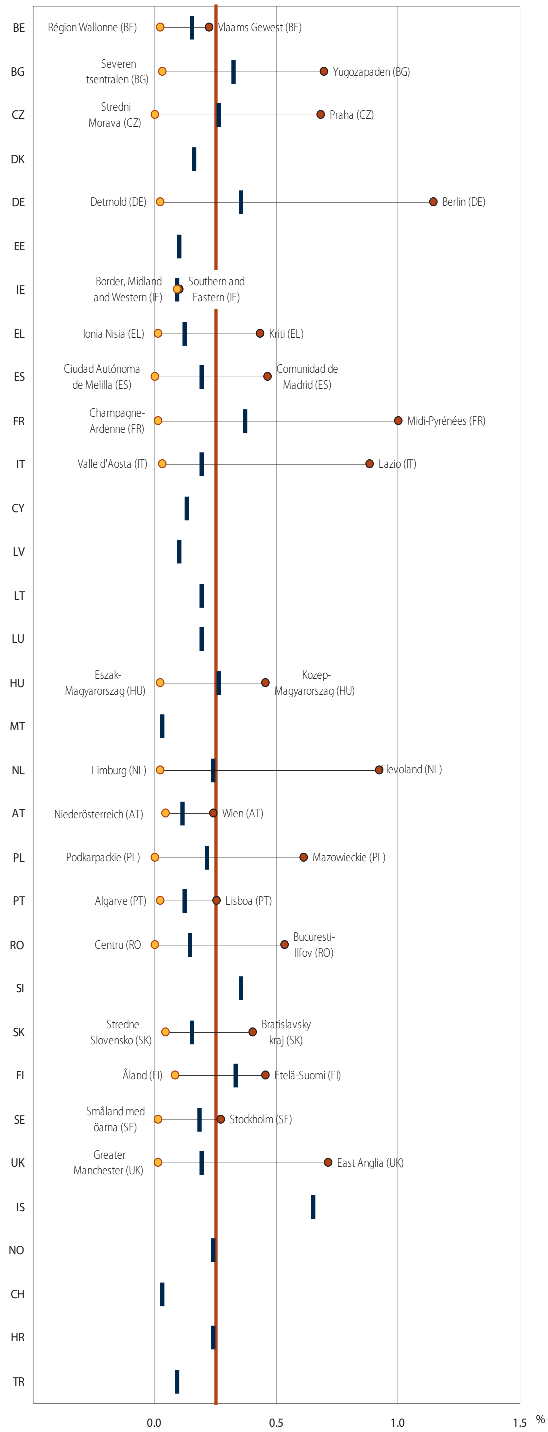
The Stuttgart Region comprises the City of Stuttgart (capital of the state of Baden-Württemberg) and the surrounding five districts, with a total of 179 local authorities covering an area of 3 650 square kilometres. It is the hub of economic, scientific, and political life in south-west Germany and the centre of a flourishing economy with its own elected assembly and administrative structure (Verband Region Stuttgart). The main economic activities are services (43.3 %), commerce (13.2 %), industry (37.7 %), construction (5.2 %) and agriculture (0.6 %).

The Stuttgart Region is home to many major global companies, including: DaimlerChrysler, Porsche, Robert Bosch, IBM, HP and many highly successful medium-sized companies ('hidden champions'), e.g. Kärcher, Dürr, Schuler, Eberspächer and Beru. In 2003 the regional economy generated a GDP of EUR 88bn.

R&D expenditure by high-tech companies has encouraged the establishment of numerous research institutes. Start-ups and young technology-led businesses are to be found in close proximity at a number of technology parks and business incubation centres.

Source: based on http://www.ricarda-project.org/regions/

Figure 2.16: Regional disparities (at NUTS 2 level) in R&D expenditure as a percentage of GDP, government sector, EU-27 and selected countries, 2005



BE: NUTS level 1.
EU-27: Eurostat estimation.
SE: break in series.
Exceptions to the reference year: AT, FR and CH: 2004.

In the government sector, discrepancies in R&D intensity were less significant between countries, with the exception of Berlin (DE), which ranked ahead of a group of leading regions including Midi-Pyrénées (FR), Flevoland (NL) and Lazio (IT).

In contrast with total and BES R&D expenditure, in the government sector few countries registered R&D intensities below the European average (0.25 %) across all regions.

Berlin

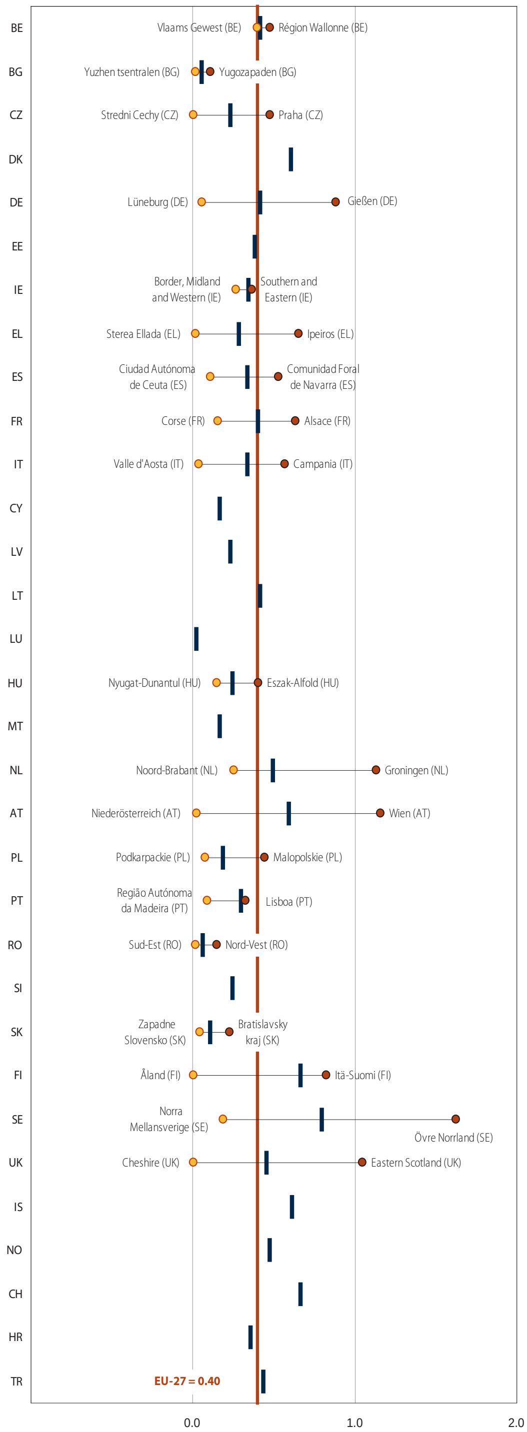
Berlin is the German Land with the lowest rate of economic growth, although there are positive signs as well. The share of the eastern districts in GDP has been growing in recent years and the investment transfers of the past are triggering sustainable growth.

The services sector, which employs about 50 % of the workforce, is seeing dynamic growth in consulting, financial services, software development, marketing, advertising and engineering services. The building sector has received an enormous boost from the decision to move the German government and parliament to the capital. Major international companies have decided to open large branches in Berlin, and some have moved their headquarters to the capital.

The goal of Berlin's economic policies is to promote the city as an international centre for services with a strong industrial core. Key sectors will be transport technology, environmental and energy technologies, research in medical and biological technology and new media. The 250 R&D institutions that exist today provide an excellent infrastructure for future developments. Recently, centres for innovation and new small and medium-sized enterprises have been established in the districts of Wedding and Köpenick, which aim to facilitate the transfer of knowledge and the establishment of new companies in the high-tech sector.

Source: based on http://www.innovating-regions.org

Figure 2.17: Regional disparities (at NUTS 2 level) in R&D expenditure as a percentage of GDP, higher education sector, EU-27 and selected countries, 2005



NBE: NUTS level 1.
EU-27: Eurostat estimation.
IT and SE: break in series.
Exceptions to the reference year: AT, FR and CH: 2004
NL: 2003.

Considering the higher education sector, Övre Norrland (SE) stands out with an R&D intensity of 1.62 %. Three other EU regions registered shares above 1 %: Wien (AT), Groningen (NL), and Eastern Scotland (UK). The regions of Gießen (DE) and Itä-Suomi (FI) followed with R&D intensities of 0.88 % and 0.82 % respectively.

Regional disparities in higher education R&D intensities were lowest in Belgium, Bulgaria, Ireland and Romania, while Sweden presented the largest disparities.

Övre Norrland

The region of Övre Norrland consists of two of the northernmost counties of Sweden — Norrbotten and Västerbotten. The region is sparsely populated. Nevertheless, there are important driving forces that have created a vibrant region, such as excellent communications, dynamic growth in key sectors and highly acclaimed research and educational facilities.

It is however important to note that technological development has made its mark as well: IT is among the largest and fastest-growing primary industries in Övre Norrland.

Key sectors in this field include telecommunications, medical technology, energy, environmental research and space technology.

Source: based on STIMENT http://www.stiment.net Stimulating New Ways of Entrepreneurship, Interreg III project

Part 2

Monitoring the knowledge workers

3

R&D personnel

3.1 Introduction

As seen in Chapter 2, 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.

R&D personnel is one of the two basic R&D input indicators, the other being R&D expenditure.

As it is a key element of knowledge, S&T dissemination and development, the R&D personnel indicator has become increasingly appreciated by policy makers. R&D personnel data measure the human resources going directly into R&D activities. R&D personnel includes all persons employed directly in 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:

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

This chapter presents the key R&D personnel indicators as well as the main trends during the period 2001-2006. It is divided into two sections:

- First, the main trends are highlighted at national level, by examining the performance of the EU-27 Member States, Iceland, Norway and the candidate countries. This part also looks at the global level by making comparisons with China, Japan and Russia.
- Second, R&D personnel is analysed at regional level, by focusing on the regions of the EU-27 Member States, Iceland and Norway.

Two populations are measured in every section of this chapter:

- Total R&D personnel, and its sub-population
- Researchers.

'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 (Frascati Manual, paragraph 301), and are possibly the most important population in terms of R&D activities.

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

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

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

Data concerning R&D personnel are broken down by the following institutional sectors:

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

In addition to sectors of performance, other breakdowns can be used, such as:

- sector of economic activity,
- field of science.

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, the entire national territory of Denmark, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Slovenia and Iceland is considered as a NUTS 0, 1 or 2 region, which means that those countries as a whole may appear in rankings at the NUTS 2 level.

The analysis refers to the period 2001-2006 (or 2005). The same length of time series does not cover all countries. In general, therefore, when data for the reference year 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 NewCronos reference database. Data for China and Japan are taken from OECD — Main Science and Technology Indicators (MSTI).

Headcount (HC) data are the most appropriate measure for collecting additional information about R&D personnel.

However, depending on the type of work, R&D may be either the principal activity of a worker or a subsidiary task. R&D may also be a significant part-time activity. Counting only persons whose primary function is R&D would underestimate the actual amount of labour devoted to R&D. Conversely, including every person who invests at least some time in R&D activities would lead to an overestimation of results. The number of persons engaged in R&D must therefore also be expressed in full-time equivalents (FTE).

For more information see:

http://www.uis.unesco.org/TEMPLATE/pdf/S&T/Workshops/CAsia/Almaty_7.pdf

Source: UNESCO Institute for Statistics (UIS), 2006

3.2 R&D personnel at national level

R&D personnel as a percentage of total employment

R&D personnel expressed as a share of total employment — or R&D personnel intensity — enables comparisons between countries and regions (Figure 3.1).

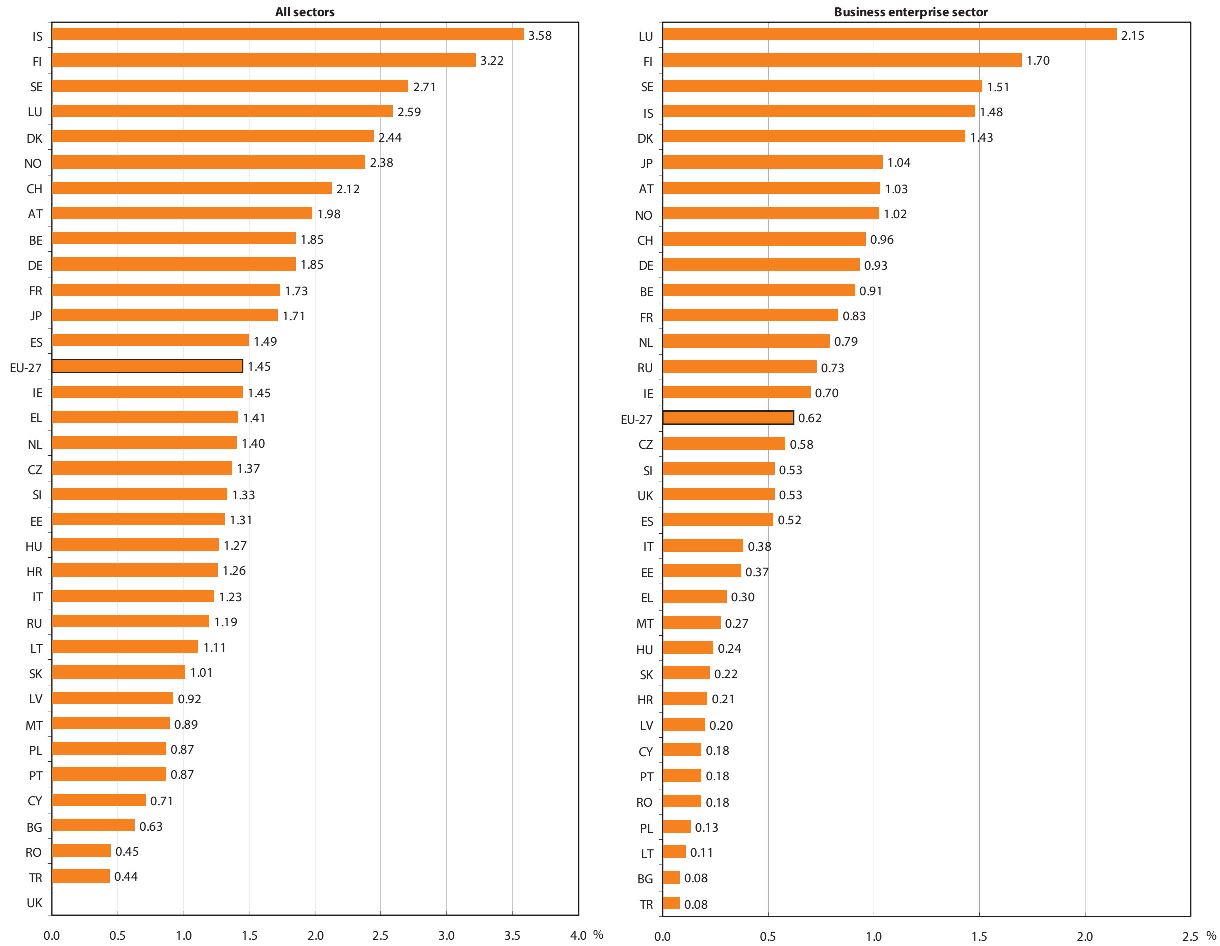
In 2005, 1.45 % of total EU-27 employment was related to R&D activities and the business enterprise sector (BES) accounted for 0.62 % of R&D employment.

R&D personnel intensity varied significantly across EU countries, ranging from 3.22 % in Finland to 0.45 % in Romania. At 3.58 %, Iceland registered the highest share of persons employed in R&D, followed by Finland, the only EU Member State with a share above 3 %. R&D personnel comprised more than 2 % of total employment in three other Member States: Sweden (2.71 %), Luxembourg (2.59 %) and Denmark (2.44 %). This was also the case in Norway (2.38 %) and Switzerland (2.12 %).

The highest R&D personnel intensity in the business enterprise sector was found in Luxembourg (2.15 %), followed by Northern European countries such as Finland (1.70 %), Sweden (1.51 %), Iceland (1.48 %) and Denmark (1.41 %).

The relatively low R&D personnel intensity observed in the new Member States (2004 and 2007 enlargements) may be explained by the fact that the government sector (GOV) in these countries has traditionally had a strong influence in terms of R&D and that the business sector still needs time to develop.

Figure 3.1: R&D personnel (HC) as a percentage of total employment, all sectors and business enterprise sector, EU-27 and selected countries, 2005



EU-27: Eurostat estimation.
MT: provisional data.
NL (all sectors): national estimations and provisional data.
UK (BES): national estimations.
FR (all sectors): defence excluded (all or mostly).
RU: underestimated or based on understimated data.

Exceptions to the reference year: 2004: AT, CH and HR.

In 2005 the BES and HES both recorded an R&D personnel intensity of 0.62 % (see Table 3.2).

In the government sector, R&D personnel represented only 0.19 % of total employment.

However, a different pattern emerges when looking at national data. The share of persons employed in R&D varies significantly according to the sector of performance from one country to another. For example, in Luxembourg the BES was far ahead of the other sectors, with a share of 2.15 %. At the opposite end of the scale, R&D personnel intensity stood at only 0.08 % and 0.11 % in Bulgaria and Lithuania respectively.

R&D personnel intensity in the BES remained stable in Germany, Spain, France and Romania, compared to previous years. On the other hand, significant increases were reported in Estonia, Latvia and Slovenia.

In 2005, the HES R&D personnel intensity in Finland (1.07 %), Sweden (1.06 %) and Norway (1.06 %) was well above the EU-27 average (0.62 %). The lowest HES R&D personnel intensity was registered in Luxembourg (0.11 %), followed by Romania (0.15 %) and Bulgaria (0.17 %). In the case of Luxembourg a substantial increase in this indicator has been observed since 2003, most probably as a result of the creation of the new university.

As a rule, the government sector registered the lowest R&D personnel intensities across all countries considered, with the exception of Bulgaria (0.37 %), Hungary (0.30 %), Lithuania (0.22 %), Cyprus (0.21 %) and Poland (0.16 %), where the share of R&D personnel in this sector was higher than in the BES.

Table 3.2: R&D personnel (HC), as a percentage of total employment, by sector of performance, EU-27 and selected countries, 2003–2005

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
EU-27	1.41 s	1.43 s	1.45 s	0.60 s	0.62 s	0.62 s	0.19 s	0.19 s	0.19 s	0.60 s	0.61 s	0.62 s
BE	1.81	1.84	1.85	0.93	0.90	0.91	0.10	0.09	0.10	0.77	0.84	0.84
BG	0.61	0.62	0.63	0.08	0.09	0.08	0.39	0.38	0.37	0.14	0.15	0.17
CZ	1.18	1.28	1.37	0.51	0.57	0.58	0.28	0.28	0.28	0.38	0.42	0.50
DK	2.24	2.41	2.44	1.32	1.47	1.43	0.19	0.18	0.18	0.72	0.74	0.81
DE	1.85	:	1.85	0.93	:	0.93	0.24	0.24	0.24	0.69	0.68	0.68
EE	1.28	1.32	1.31	0.26	0.29	0.37	0.19	0.18	0.16	0.81	0.82	0.76
IE	1.39	1.43	1.45	0.66	0.69	0.70	0.09	0.09	0.06	0.64	0.65	0.69
EL	1.33	:	1.41	0.29	:	0.30	0.21	:	0.18	0.82	:	0.93
ES	1.45	1.49	1.49	0.48	0.52	0.52	0.20	0.22	0.23	0.76	0.75	0.74
FR	1.68 i	1.70 i	1.73 i	0.82	0.83	0.83	0.21 i	0.21 i	0.23 i	0.62	0.63	0.64
IT	1.13	1.14	1.23	0.37	0.37	0.38	0.19	0.20	0.20	0.55	0.55	0.61 b
CY	0.64	0.66	0.71	0.17	0.17	0.18	0.22	0.21	0.21	0.18	0.22	0.25
LV	0.79	0.81	0.92	0.12	0.11	0.20	0.15	0.14	0.19	0.53	0.56	0.53
LT	1.01	1.15	1.11	0.05	0.09	0.11	0.23	0.23	0.22	0.73	0.82	0.78
LU	2.21	:	2.59	1.89	:	2.15	0.29	:	0.33	0.03 e	:	0.11
HU	1.24 i	1.27 b	1.27	0.24	0.23	0.24	0.29 i	0.29 b	0.30	0.71	0.75	0.74
MT	0.66	0.90 b	0.89 p	0.07	0.29 b	0.27 p	0.03	0.04	0.03	0.57	0.57	0.59
NL	1.32	1.46 ep	1.40 ep	0.71	0.84	0.79	0.20 bi	0.19 i	0.17 i	0.41	:	:
AT	:	1.98	:	:	1.03	:	:	0.15	:	:	0.78	:
PL	0.93	0.92	0.87	0.11	0.12	0.13	0.19	0.17	0.16	0.63	0.63	0.59
PT	0.86	0.87 e	0.87	0.19	0.19 e	0.18	0.14	0.14 e	0.14	0.42	0.43 e	0.44
RO	0.44	0.45	0.45	0.19	0.18	0.18	0.11	0.11	0.11	0.14	0.15	0.15
SI	1.06	1.08	1.33	0.48	0.49	0.53	0.21	0.21	0.30	0.36	0.37	0.49
SK	0.97	1.02	1.01	0.21	0.21	0.22	0.21 i	0.19 i	0.19 i	0.55	0.62	0.60
FI	3.16	3.24	3.22	1.70	1.72	1.70	0.42	0.42	0.41	1.02	1.07	1.07
SE	2.51	:	2.71	1.21	:	1.51	0.13	:	0.13	1.16	:	1.06
UK	:	:	:	:	:	0.53 e	0.08	0.08	0.08	:	:	:
IS	3.53	:	3.58	1.41	:	1.48	1.12	:	1.07	0.85	:	0.92
NO	2.27	:	2.38	1.00	1.05	1.02	0.29	:	0.30	0.97	:	1.06
CH	:	2.12	:	:	0.96	:	:	0.04 i	:	:	1.13 e	:
HR	1.12	1.26	:	0.15	0.21	:	0.36	0.41	:	0.62	0.65	:
TR	0.39 i	0.40 i	0.44	0.05	0.06	0.08	0.04	0.04	0.05	0.30 i	0.30 i	0.31
JP	1.66	1.68	1.71	1.00	1.01	1.04	0.11	0.11	0.11	0.52	0.53	0.53
RU	1.30 i	1.25 i	1.19 i	0.85 i	0.80 i	0.73 i	0.39 i	0.38 i	0.40 i	0.07 i	0.06 i	0.06 i

Flag 'i' FR, HU and SK: defence excluded (all or mostly).
CH: federal or central government only.
NL: includes other classes.
TR and RU: underestimated or based on understimated data.

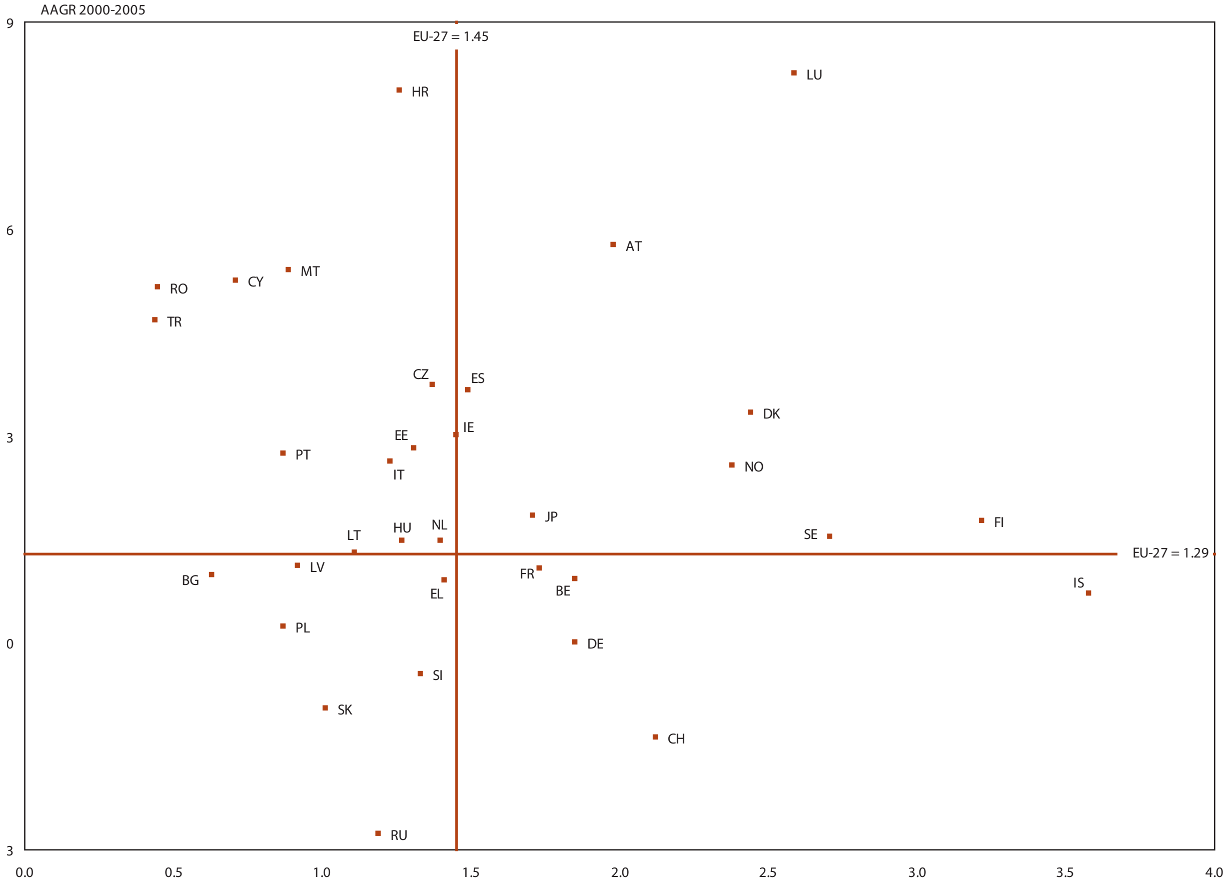
In the EU-27, R&D personnel intensity increased between 2000 and 2005 at an average annual growth rate (AAGR) of 1.29 % (see Figure 3.3).

Four groups of countries can be identified in this graph. A first group includes countries where R&D personnel intensity and AAGR are higher than the EU-27 average. This group includes the Nordic countries (except for Iceland, which was below average in terms of R&D personnel intensity), together with Luxembourg, Austria, Spain and Japan.

The second group comprises countries where AAGR was below the EU-27 average, but where R&D personnel intensity was high. This group includes France, Belgium, Germany and Switzerland. A third group includes countries where R&D personnel intensity was below the EU-27 average, but where R&D personnel AAGR was higher than the average. This group comprises 10 Member States, namely Malta, Cyprus, Romania, the Czech Republic, Estonia, Italy, Portugal, the Netherlands, Hungary and Lithuania, plus Croatia and Turkey.

The fourth group comprises countries where R&D personnel intensity and AAGR were below the EU-27 average, namely Bulgaria, Latvia, Greece, Poland, Slovenia, Slovakia and Russia.

Figure 3.3: R&D personnel (HC) as a percentage of total employment in 2005 and average annual growth rate (AAGR) 2000–2005 (1), EU-27 and selected countries



(1) Calcultated on R&D personnel expressed as a percentage of total employment.

Exceptions to the reference year: 2004: AT, CH and HR.

Exceptions to the reference period: 2000-2004: CH
2001-2005: EL, ES, SE, NO and JP
2002-2004: AT and HR
2002-2005: BE, MT and NL
2003-2005: DE, LU and IS.

EU-27: Eurostat estimation.
MT: provisional data.
FR: defence excluded (all or mostly).
NL: national estimations and provisional data.
RU: underestimated or based on understimated data.

R&D personnel in full-time equivalent — FTE

In 2006, more than 2 million persons (expressed in full-time equivalent — FTE) were engaged in R&D activities in the EU-27. Of these, 54 % were employed in Germany, France and the United Kingdom.

In the EU-27, the business enterprise sector employed around 1.15 million persons in FTE, representing 53 % of the total R&D personnel. The higher education sector (HES) counted 655 000 persons employed (in FTE) in R&D, and the government sector (GOV) employed 330 000 persons (in FTE) in R&D. The remaining 21 000 were employed in the private non-profit sector.

In absolute terms, Germany and France registered the most R&D personnel (in FTE) in all sectors. In relative terms, Luxembourg accounted for the highest share of R&D personnel employed full-time in the business enterprise sector (81.7 %). Bulgaria led the way in terms of R&D personnel in the government sector (62.8 %), and Lithuania registered the highest share of R&D personnel working in the higher education sector (63.2 %).

Overall, the AAGR of R&D personnel employed full-time was positive in all sectors, although at country level some countries such as Belgium (0.3 %), Lithuania (-0.9 %), Poland (-1.0 %) and Romania (-1.2 %) registered a decrease.

On average, women accounted for only 32.9 % of R&D personnel in 2006. This share tended to be higher in the higher education (44.9 %) and government sectors (43.3 %) than in the business enterprise sector (22.8 %). More than half of all R&D personnel employed in the goverment sector in Bulgaria, Estonia, Latvia, Lithuania, Portugal, Romania and Slovakia were women.

Table 3.4: R&D personnel in FTE and percentage of women in 2006 by sector of performance and average annual growth rate (AAGR) 2001-2006 (1), by sector of performance, EU-27 and selected countries

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	R&D PSL in FTE	% of women	AAGR 2001-2006	R&D PSL in FTE	% of women	AAGR 2001-2006	R&D PSL in FTE	% of women	AAGR 2001-2006	R&D PSL in FTE	% of women	AAGR 2001-2006
EU-27	2 167 381 s	32.9 s	1.8 s	1 155 669 s	22.8 s	1.5 s	330 452 s	43.3 s	1.3 s	654 955 s	44.9 s	2.3 s
BE	55 161 p	:	-0.3 p	32 206 p	24.5 p	-1.9 p	3 861 p	:	1.0 p	18 540 p	:	2.7 p
BG	16 321	:	1.8	2 463	:	5.5	10 255	:	-0.3	3 464	:	6.2
CZ	47 729	31.5	12.8	24 101	21.4	14.9	10 698	45.8	6.6	12 776	38.6	16.1
DK	45 182 p	:	2.5 p	29 268 p	:	2.5 p	3 305 p	:	-9.6 p	12 322 p	:	8.3 p
DE	489 145 p	:	0.4 p	312 145	:	0.3	77 000 p	:	1.4 p	100 000 p	:	-0.3 p
EE	4 740 p	42.5 e	4.8 p	1 630 p	30.2 e	21.1 p	714	62.6	-1.0	2 290	44.2	-0.3
IE	17 647 p	:	5.8 p	10 800 p	:	3.4 p	1 248	38.3	-0.8	5 599	42.1	14.1
EL	35 140 e	:	3.1 e	11 402 e	:	0.4 e	4 578 e	:	-0.6 e	18 952 e	:	5.9 e
ES	188 978	38.2	8.5	82 870	29.2	12.3	34 588	49.3	8.1	70 950	43.2	5.4
FR	353 554 i	:	1.5 i	198 864	:	1.8	49 645 i	:	0.1 i	98 743	:	1.8
IT	175 248	34.8	3.3	70 725	19.7	2.0	32 684	42.7	2.4	66 976 b	45.5 b	3.3 b
CY	1 220 p	:	12.1 p	310 p	:	16.6 p	355 p	:	0.1 p	465 p	:	26.4 p
LV	6 520	49.1	3.6	1 873	38.3	6.7	1 164	63.4	1.3	3 482	50.2	2.8
LT	11 443	:	-0.9	1 276	:	14.6	2 930	:	-9.0	7 237	:	1.8
LU	4 586 ep	:	4.6 ep	3 746 e	:	2.3 e	592 p	:	7.5 p	248 p	:	93.9 p
HU	25 971	41.6	2.5	9 279	32.7	6.5	8 169	47.3	1.0	8 523	45.7	0.3
MT	752 p	19.9 p	12.2 p	402 p	18.7 p	52.2 p	43	18.6	-24.9	307	22.1	3.7
NL	94 689 ep	:	1.2 ep	52 796 p	:	1.8 p	12 765	:	-0.1	:	:	:
AT	50 322 e	:	6.7 e	34 192 e	:	6.4 e	2 388 e	:	3.8 e	13 494 e	:	8.1 e
PL	73 554	:	-1.0	14 166	:	-3.9	17 668	:	0.2	41 535	:	-0.4
PT	25 728	45.3	2.9	6 133	28.2	12.2	4 533	58.0	-6.7	11 680	49.1	3.5
RO	30 802	46.5	-1.2	13 761	44.4	-7.1	8 381	52.8	-0.1	8 563	43.5	14.8
SI	9 765	37.0	2.6	4 807	30.8	2.5	2 842	44.5	3.5	2 088	41.2	3.2
SK	15 028	45.1	0.8	3 144	33.7	-7.9	3 732 i	52.6	-1.3 i	8 138	46.2	7.5
FI	58 257	:	1.7	32 993	:	1.9	7 408	:	0.3	17 362	:	2.2
SE	78 715	:	1.7	57 641	:	3.1	3 618	:	5.1	17 137	:	-2.9
UK	323 358 e	:	0.2 e	145 401	:	-2.8	20 415	37.0	-1.4	:	:	:
IS	3 226	39.2	2.7	1 530	33.8	3.5	849	41.2	4.0	742	44.7	0.0
NO	31 745 p	:	3.2 p	16 545	:	2.2	5 330	:	2.3	9 870	:	5.7
CH	52 250	:	:	33 085	:	:	810 i	:	0.3 i	18 355 e	:	4.2 e
HR	8 543	:	-9.9	2 228	:	-2.7	2 722	:	-2.6	3 579	:	-16.7
TR	54 444	30.8	14.5	18 029	22.4	26.3	9 702	23.4	12.9	26 713	39.1	9.7
CN	1 502 472 i	:	9.5 i	987 834 i	:	13.2 i	272 133 i	:	1.4 i	242 505 i	:	7.2 i
JP	921 173	:	0.8	609 808	:	2.1	62 975	:	0.1	234 052	:	-1.7
RU	916 509	:	-1.9	515 319	:	-3.7	297 880	:	1.4	100 990	:	-0.4

(1) Calcultated on R&D personnel expressed in FTE.

Exceptions to the refernce year: 2005: FR, IT, PT, UK, IS and JP; 2004: CH.

Flag 'i' FR and SK: defence excluded (all or mostly).
CH: federal or central government only.
CN: data do not comply with Frascati Manual recommendations.

Exceptions to the reference period: 2001-2005: FR, IT, PT, IS and JP; 2002-2004: CH; 2002-2005: UK; 2002-2006: MT, AT and HR; 2003-2006: LU.

R&D personnel in head count — HC

In terms of head count (HC), the number of R&D personnel exceeded 3 million persons in the EU-27, in line with the positive trends registered in previous years.

The leading countries in terms of R&D personnel expressed in HC were the same as for R&D personnel expressed in FTE — Germany, followed by France.

In 2005, the business enterprise sector (BES) accounted for the largest share of R&D personnel in the EU-27, with a headcount of 1.3 million, followed very closely by the higher education sector (HES). The difference between the number of persons engaged in R&D in the two sectors was more significant in FTE than in HC, which indicates that a larger share of R&D personnel is employed part-time in the HES than in the BES.

In 2005, the higher education sector accounted for more than 50 % of R&D personnel in Lithuania (70 %), Poland (68 %), Malta and Greece (both 66 %), Slovakia (59 %), Hungary and Latvia (both 58 %). With 378 000 persons employed (HC) in R&D activities, the government sector clearly lagged behind the BES and the HES at EU-27 level.

Overall, the government sector in the EU-27 reported the lowest share of personnel employed in R&D, amounting to 13 % of the total in 2005. However, the government sector in Bulgaria employed 58 % of total R&D personnel (in HC), far ahead of all other Member States.

Table 3.5: R&D personnel in HC, by sector of performance, EU-27 and selected countries, 2003–2005

	All sectors			Business enterprise sector			Government sector			Higher education sector		
	2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
EU-27	2 892 017 s	2 962 992 s	3 047 825 s	1 239 847 s	1 275 691 s	1 308 691 s	384 636 s	388 816 s	399 689 s	1 237 304 s	1 266 955 s	1 305 183 s
BE	73 629	76 340	78 509	37 812	37 249	38 391	3 916	3 896	4 028	31 284	34 596	35 515
BG	17 400	18 025	18 638	2 398	2 544	2 305	10 977	11 053	10 893	3 920	4 338	5 030
CZ	55 699	60 148	65 379	24 122	26 967	27 708	13 357	13 220	13 450	17 877	19 725	23 998
DK	60 525	65 994	67 267	35 726	40 346	39 443	5 010	4 882	4 874	19 406	20 348	22 376
DE	664 731	:	678 945	333 285	:	341 832	84 695	86 701	87 532	246 751	242 128	249 581
EE	7 600	7 882	7 955	1 529	1 735	2 249	1 145	1 099	991	4 813	4 894	4 591
IE	25 194	26 584	28 270	12 037	12 800	13 621	1 657	1 609	1 249	11 500	12 175	13 400
GR	56 708	:	61 454	12 259	:	12 896	9 148	:	7 861	35 088	:	40 486
ES	249 969	267 943	282 804	82 327	92 888	98 564	35 306	39 499	43 946	131 725	135 027	139 717
FR	415 061 i	421 312 i	432 602 i	203 264	206 955	208 116	50 690 i	51 284 i	56 347 i	153 131	155 347	160 552
IT	249 889	255 535	277 370	81 189	81 822	86 609	42 610	44 061	45 552	120 736	123 266	136 618 b
CY	2 102	2 235	2 470	567	571	634	724	705	724	601	757	885
LV	8 002	8 273	9 488	1 228	1 135	2 054	1 472	1 443	1 959	5 302	5 694	5 474
LT	14 534	16 436	16 323	781	1 309	1 559	3 301	3 330	3 259	10 452	11 797	11 505
LU	4 135	:	5 015	3 533	:	4 157	548	:	641	54 e	:	217
HU	48 681 i	49 615 b	49 723	9 438	8 870	9 394	11 474 i	11 483 b	11 627	27 769	29 262	28 702
MT	975	1 329 b	1 320 p	97	428 b	406 p	37	52	38	841	849	876
NL	106 980	118 104 ep	113 606 ep	57 442	68 286	64 404	15 957 bi	15 137 i	14 141 i	33 581	:	:
AT	:	74 191	:	:	38 737	:	:	5 531	:	:	29 358	:
PL	126 241	127 356	123 431	15 035	16 846	17 875	25 390	23 578	21 966	85 745	86 823	83 433
PT	44 036	44 311 e	44 585	9 882	9 653 e	9 423	7 273	7 317 e	7 360	21 488	22 000 e	22 512
RO	39 985	40 725	41 035	17 232	16 601	16 647	9 641	10 162	10 258	12 859	13 739	13 889
SI	9 506	10 155	12 600	4 278	4 638	5 033	1 926	2 022	2 841	3 265	3 450	4 695
SK	20 928	22 217	22 294	4 545	4 642	4 821	4 458 i	4 046 i	4 252 i	11 917	13 442	13 199
FI	74 773	76 687	77 275	40 089	40 674	40 802	9 903	9 943	9 926	24 049	25 298	25 793
SE	108 146	:	117 714	52 346	:	65 491	5 521	:	5 675	49 909	:	46 151
UK	:	:	:	:	:	149 585 e	22 761	22 578	22 292	:	:	:
IS	5 466	:	5 724	2 193	:	2 365	1 740	:	1 716	1 323	:	1 472
NO	51 175	:	54 341	22 572	23 865	23 310	6 642	:	6 826	21 961	:	24 205
CH	:	84 090	:	:	37 820	:	:	1 595 i	:	:	44 675 e	:
HR	17 216	19 739	:	2 237	3 233	:	5 487	6 398	:	9 492	10 108	:
TR	83 281 i	86 680 i	97 355	10 848	12 398	18 479	8 572	8 747	11 372	63 861 i	65 535 i	67 504
JP	1 081 099	1 096 078	1 122 680	653 380	659 343	683 705	72 367	72 388	72 499	335 983	345 274	349 034
RU	858 470 i	839 338 i	813 207 i	558 668 i	537 473 i	496 706 i	256 098 i	258 078 i	272 718 i	43 120 i	43 414 i	43 500 i

Flag 'i' FR, HU and SK: defence excluded (all or mostly).
CH: federal or central government only.
RU and TR: underestimated or based on underestimated data.

Researchers in full-time equivalent — FTE

In 2006, 1.3 million researchers (in FTE) were employed in the EU-27, accounting for 60 % of all persons employed in R&D (Table 3.4). In the EU-27, the number of researchers employed in full-time equivalent has increased by more than 77 000 over the past three years. This positive trend was also observed at country level, with the exception of Poland, Romania and Finland, where the number of researchers decreased over the same period.

At EU level, in absolute terms Germany (282 063) and Spain (115 798) counted the most researchers in FTE.

The majority of researchers in the EU-27 were employed in the business enterprise sector, followed by the higher education sector; the government sector employed 14 % of researchers at EU level.

At country level, the Baltic States, together with Greece, Spain, Cyprus, Malta, Poland and Slovakia, employed more researchers in the higher education sector than in the BES, while only Bulgaria registered a large share (59 %) of researchers in the government sector.

Table 3.6: Researchers in FTE, by sector of performance, EU-27 and selected countries, 2004–2006

	Total	Agriculture, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Services
EU-27	628 380 s	:	:	:	:	:	:
BE	16 769	133	34	12 804	66	242	3 490
BG	1 157	: c	: c	501	0	0	653
CZ	10 353 b	33 b	4 b	5 070 b	8 b	76 b	5 162 b
DK	17 624	52	: c	9 156	: c	54	8 325
DE	166 874	190	62	144 495	331	189	21 608
EE	883	2	: c	272	29	: c	576
IE	6 768	7	2	3 652	9	0	3 098
EL	6 033	35	69	2 837	3	38	3 050
ES	35 034	234	42	16 465	205	804	17 284
FR	108 814	1 154	443	87 695	1 758	401	17 363
IT	27 939	:	96	17 820	91	64	9 868
CY	130	2	0	49	3	0	75
LV	468	:	:	162	:	:	306
LT	716	:	4	440	5	6	261
LU	1 696	:	:	835	:	:	860
HU	5 008	118	2	3 152	47	22	1 667
MT	189 p	:	0	133 p	1 p	0 p	55 p
NL	22 745 p	205	388	14 359	100	517	7 176
AT	16 508	13	10	11 458	42	81	4 904
PL	9 412	25	1	4 558	56	0	4 772
PT	4 014	23	4	2 042	15	43	1 887
RO	10 319	1 215	342	6 727	548	87	1 400
SI	1 936	0	25	1 475	3	0	433
SK	1 947	55	0	547	: c	: c	1 339
FI	21 967	3	16	17 250	24	110	4 564
SE	36 697 bi	100	98	24 126	61	285	12 028
UK	93 717	: c	220	: c	179	478	23 432
IS	1 012	19	:	348	6	4	635
NO	10 692 i	76	449	4 276	46	54	5 791
CH	12 640	:	:	9 365	:	:	3 275
HR	1 015	21	0	222	:	23	749
TR	9 456	30	68	5 897	10	46	3 404

flag 'i' FR, and SK: defence excluded (all or mostly).
SE and NO : university graduates instead of reseachers.
CH: federal or central government only.
TR: underestimated or based on underestimated data.
NL: includes other classes.

In the EU-27, the number of researchers (in FTE) in all sectors and in the BES increased at an average annual growth rate of 2.8 % and 3.2 % respectively between 2001 and 2006.

From a global perspective, China, Japan and the United States also registered positive growth in the number of researchers employed full-time. However, the AAGR in China (10.5 %) was higher than the EU-27 average, while Japan (1.1 %) and the United States (1.4 %) remained below the EU average.

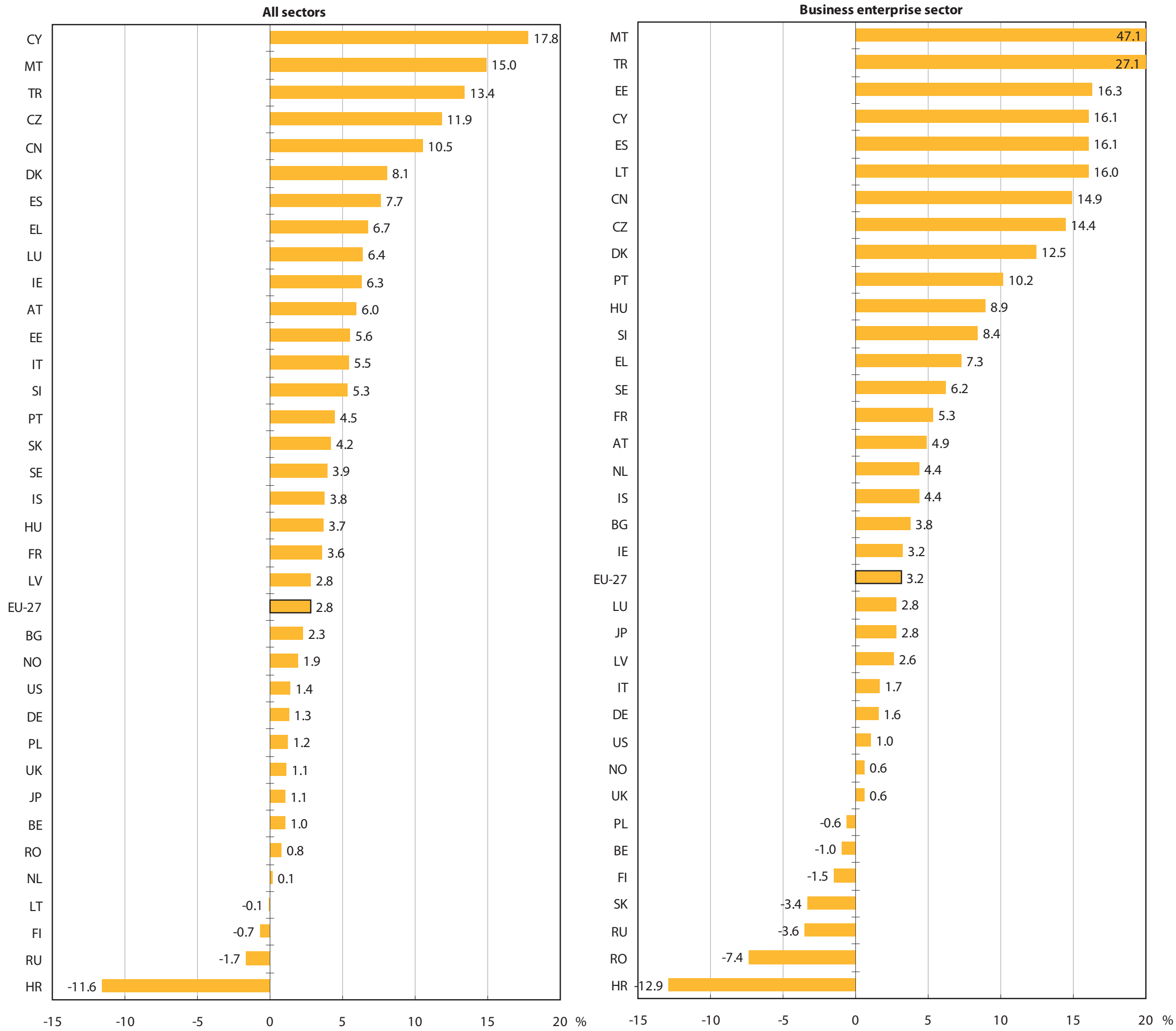
In all sectors, the highest increases in AAGR were observed in Cyprus (17.8 %), Malta (15.0 %), Turkey (13.4 %) and the Czech Republic (11.9 %). Nine Member States reported a lower AAGR than the EU-27 average. Among them, Lithuania and Finland recorded a decrease between 2001 and 2006.

At EU level, the number of researchers (in FTE) in the BES grew on average by 3.2 % a year. The highest growth rates were found in Malta (47.1 %), Estonia (16.3 %), Cyprus (16.1 %), Spain (16.1 %) and Lithuania (16.0 %).

In the business enterprise sector, ten European countries were below the EU-27 mean. Between 2001 and 2006, the largest drops in AAGR were recorded in Romania (-7.4 %) and Croatia (-12.9 %). Poland, Belgium, Finland and Slovakia also reported a decrease in AAGR over the same period.

Again, in the international context, growth in the number of researchers (in FTE) employed in the BES was stronger in the EU-27 than in Japan (2.8 %) and the United States (1.0 %), while the AAGR remained very strong in China (14.9 %).

Figure 3.7: Average annual growth rate (AAGR) of researchers in FTE, all sectors and business enterprise sector, EU-27 and selected countries, 2001–2006



EU-27: Eurostat estimation.
DE (BES), EL, LU, AT and US: national estimations.
BE, DK, DE (all sectors), EE, IE, IT (BES), CY, LU (all sectors), MT and NL: provisional data.

Exceptions to the reference period:
2001-2005: IT (all sectors), PT, IS, FR, NO (all sectors), US and JP
2002-2005: UK (all sectors)
2002-2006: MT, AT and HR
2003-2006: LU
2004-2006: FI.

Table 3.8: Researchers in HC and by qualification as a percentage, EU-27 and selected countries, 2005

	Total in HC	By qualification as a percentage			
		ISCED 5A	ISCED 5b	ISCED 6	Other
EU-27	1 857 947 s	:	:	:	:
BE	48 757	69	6	23	2
BG	11 920	44	2	53	1
CZ	37 542	49	1	43	7
DK	43 460	:	:	:	:
DE	411 784	:	:	:	:
EE	5 734	58	3	40	0
IE	17 653	:	:	36	:
EL	33 396	:	:	:	:
ES	140 407	54	0	44	1
FR	252 994 i	:	:	:	:
IT	125 534	:	:	:	:
CY	1 424	54	1	45	0
LV	5 748	:	:	48	:
LT	11 918	:	:	47	:
LU	2 443	:	:	:	:
HU	31 407	62 i	:	38	0
MT	977 p	55 p	0 p	45 p	0 p
NL	49 831 ep	:	:	:	:
AT	44 127	47	7	30	16
PL	97 875	37 i	:	63	0
PT	37 769	40	2	58	:
RO	29 608	67	5	28	:
SI	7 644	51	4	44	1
SK	17 526	49	:	48	3
FI	50 773	:	:	:	:
SE	82 496 i	:	:	:	:
UK	:	:	:	:	:
NO	36 998	:	:	27	:
HR	13 139	52	0	48	0
TR	83 856	56	1	43	1
RU	391 121 i	75 i	:	25 i	:

Exceptions to the reference year: 2001: ES
2004: AT and HR
2006: MT.

Flag 'i' FR: defence excluded (all or mostly).
SE: university graduates instead of reseachers.
HU and PL: includes other classes.
RU: underestimated or based on understimated data.

Meaning of qualification grades: see methodological notes.

In the EU-27, most researchers employed in HC have completed tertiary education (ISCED 5 and 6); Poland, Portugal and Bulgaria registered the highest shares of ISCED 6 graduates (63 %, 58 % and 53 % respectively), while the largest shares of researchers having completed the first stage of tertiary education (ISCED 5A) were found in Belgium (69 %), Romania (67 %) and Hungary (62 %).

In all countries for which data were available, less than 10 % of researchers had completed ISCED 5B education; ISCED 5B programmes generally include a more technical and vocational orientation than ISCED 5A programmes, which generally present a more theoretical approach.

Researchers by sex

Figure 3.9 shows the share of female researchers measured in head count (HC), both for all sectors and for the business enterprise sector (BES).

Female researchers are still under-represented in most EU-27 countries, especially in the business enterprise sector. Women accounted for 30 % of researchers in all sectors and 19 % in the BES.

Latvia was the only country where female researchers outnumbered male researchers in all sectors. The share of female researchers exceeded 40 % in six other Member States (Lithuania, Bulgaria, Portugal, Romania, Estonia and Slovakia). Aside from Portugal, these were all new Member States (2004 and 2007 enlargements). This share was also above 40 % in Croatia and in Russia.

At the other end of the scale, women account for less than 20 % of researchers in the Netherlands (18 %) and Luxembourg (18 %). This share was even lower in Japan (12 %).

A similar pattern can be observed in the business enterprise sector, but the share of female researchers was consistently lower in the BES than in other sectors. This was true for the EU-27 and all countries for which data are available.

In no country was the share of female researchers employed in the BES higher than 50 %. In this context, Bulgaria (49 %) and Latvia (46 %) accounted for the largest shares. As a rule, new Member States generally registered higher shares of women employed as researchers than the EU-27 average (with the exception of the Czech Republic).

Why are there so few women in decision-making positions in research and why is this a problem?

Only 15 % of full professors in European universities are women, and women are under-represented on scientific decision-making boards in almost all European countries. Such a situation must inevitably mean that the individual and collective opinions of women are less likely to be voiced in policy- and decision-making processes, which may lead to biased decision-making on topics of future research development. If women scientists are not visible and not seen to be succeeding in their careers, they cannot serve as role models to attract and retain young women in scientific professions.

We need a sincere commitment, particularly among leaders in science, to the goal of equality — for the benefit of quality. There is widespread ignorance and denial of the problem of gender inequality in science. Therefore, the national governments need encouragement from the EU to address the inequality issue in research, to support concrete measures with sufficient resources, and to assist in raising awareness among decision-makers, as well as the public, so that gender stereotyping can be resisted.

From imbalance to balance

Women are under-represented in practically all decision-making bodies, and at the professor/Grade A level in general, and have less access to decision-making positions than men. Therefore, (a) reasonable gender balance (e.g. 40:60) should be made mandatory in decision-making bodies, (b) the working environment in research should be updated to improve the current work-life balance for the benefit of both women and men, (c) the gender balance should be closely monitored (by the EU as well as national governments) and any imbalance must be justified.

From opacity to transparency

Funding, promotion and appointment procedures lack transparency, and this tends to disadvantage women, particularly in top positions in science. Therefore, transparent procedures should be implemented by the scientific community, and the criteria, success rates and evaluation reports must be made public.

From inequality to quality

Equality is part of quality in science. Inequality must therefore be addressed by taking measures to systematically introduce the gender perspective in human resource development and in future research.

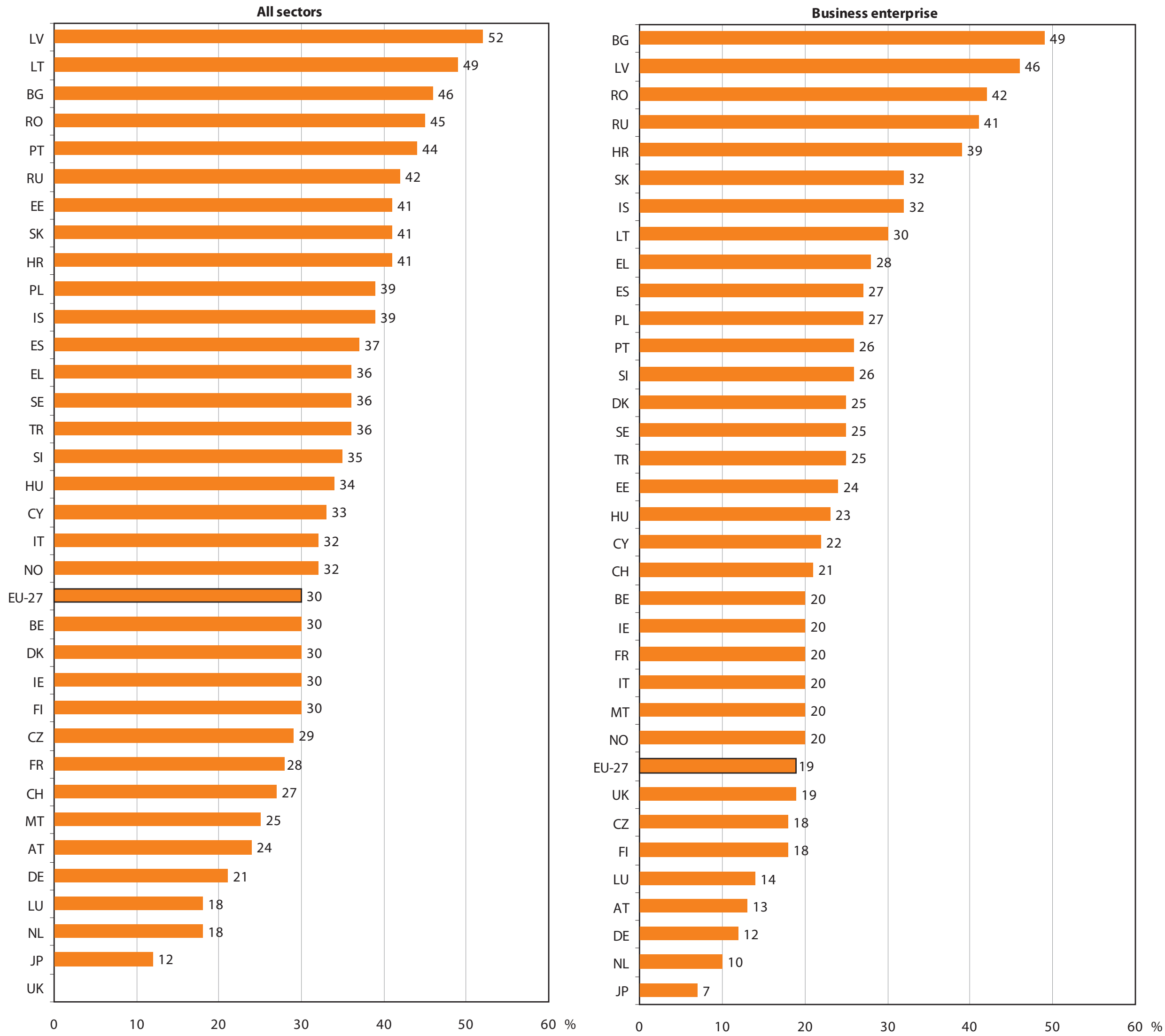
This includes training the decision-makers, which often includes peers, to avoid gender bias, and eradicating gender bias both in research and in recruitment and promotion procedures. There can be no quality without equality.

Finally, from complacency to urgency

European science is falling behind, the potential of our women in research is under-utilised, young people are staying away from science. The European Research Area needs women and the young. So we must act now.

Source: based on Mapping the Maze/Getting More Women to the top in Research. European Commission DG RTD

Figure 3.9: Percentage of female researchers (in HC), all sectors and business entreprise sector, EU-27 and selected countries, 2005



EU-27: Eurostat estimation.
MT: provisional data.
UK (BES): national estimations.
Exceptions to the reference year: 2004: AT, CH and HR.
RU: underestimated or based on underestimated data.
NO: university graduates instead of researchers.
NL (all sectors): national estimations and provisional data.

Researchers by economic activity

Table 3.10 provides a breakdown of business enterprise researchers in full-time equivalent (FTE) by sector of economic activity (NACE). In terms of the number of researchers, manufacturing was by far the most important sector of economic activity in 2005 in the EU-27. However, this distribution varied across Member States. In 10 Member States, plus Iceland and Norway, services employed more researchers than manufacturing.

The manufacturing sector employed more than 80 % of researchers in Germany and France, and more than 70 % in Belgium, Malta, Slovenia and Finland. In most countries the manufacturing sector was followed by services.

In Romania, a significant share of researchers in the BES were involved in the sector of agriculture and, to a lesser extent, mining and quarrying.

Table 3.10: Researchers in the BES in FTE, by economic activity (NACE Rev 1.1), EU-27 and selected countries, 2005

	Total	Agriculture, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Services
EU-27	628 380 s	:	:	:	:	:	:
BE	16 769	133	34	12 804	66	242	3 490
BG	1 157	: c	: c	501	0	0	653
CZ	10 353 b	33 b	4 b	5 070 b	8 b	76 b	5 162 b
DK	17 624	52	: c	9 156	: c	54	8 325
DE	166 874	190	62	144 495	331	189	21 608
EE	883	2	: c	272	29	: c	576
IE	6 768	7	2	3 652	9	0	3 098
EL	6 033	35	69	2 837	3	38	3 050
ES	35 034	234	42	16 465	205	804	17 284
FR	108 814	1 154	443	87 695	1 758	401	17 363
IT	27 939	:	96	17 820	91	64	9 868
CY	130	2	0	49	3	0	75
LV	468	:	:	162	:	:	306
LT	716	:	4	440	5	6	261
LU	1 696	:	:	835	:	:	860
HU	5 008	118	2	3 152	47	22	1 667
MT	189 p	:	0	133 p	1 p	0 p	55 p
NL	22 745 p	205	388	14 359	100	517	7 176
AT	16 508	13	10	11 458	42	81	4 904
PL	9 412	25	1	4 558	56	0	4 772
PT	4 014	23	4	2 042	15	43	1 887
RO	10 319	1 215	342	6 727	548	87	1 400
SI	1 936	0	25	1 475	3	0	433
SK	1 947	55	0	547	: c	: c	1 339
FI	21 967	3	16	17 250	24	110	4 564
SE	36 697 bi	100	98	24 126	61	285	12 028
UK	93 717	: c	220	: c	179	478	23 432
IS	1 012	19	:	348	6	4	635
NO	10 692 i	76	449	4 276	46	54	5 791
CH	12 640	:	:	9 365	:	:	3 275
HR	1 015	21	0	222	:	23	749
TR	9 456	30	68	5 897	10	46	3 404

Exceptions to the reference year: 2004: AT, CH and HR.
Flag 'i' SE and NO: university graduates instead of researchers.

Researchers by field of science

Large disparities were observed when considering the distribution of researchers in the government sector by field of science (Table 3.11). In 11 countries, the majority of researchers in the government sector were working in the field of natural sciences. The medical sciences sector ranked first in Denmark and Spain, while engineering employed the most researchers in Belgium and Luxembourg, and social sciences was the largest field of science in Malta, Austria and Romania.

Humanities registered the highest share of researchers in the government sector in Estonia (41.4 %).

Table 3.11: Researchers by field of science in FTE, government sector, EU-27 and selected countries, 2005

	Total	Agriculture	Engineering and technology	Medical sciences	Natural sciences	Social sciences	Humanities
EU-27	179 585 s	:	:	:	:	:	:
BE	2 274	395	1 123	51	312	129	263
BG	6 076	755	1 204	338	2 748	244	787
CZ	6 113 b	509 b	837 b	401 b	3 032 b	521 b	814 b
DK	2 105	384	375	473	434	261	178
DE	39 911	2 360	11 428	2 521	18 056	2 407	3 139
EE	474	36	38	85	102	17	196
IE	419	197	12	17	136	56	1
EL	2 076	:	:	:	:	:	:
ES	20 446	4 207	3 392	8 436	2 563	1 040	808
FR	25 889 i	:	:	:	:	:	:
IT	14 454	1 143	2 099	2 623	6 624	1 671	294
CY	107	31	4	7	29	20	16
LV	589	139	30	9	258	71	82
LT	1 805	175	305	11	832	172	310
LU	374	23	150	33	110	55	3
HU	4 959	633	413	484	2 006	573	850
MT	18	2	2	0	0	5	0
NL	7 030 i	:	:	:	:	:	:
AT	1 030	131	81	57	201	304	256
PL	12 175	1 582	3 327	1 487	4 559	531	688
PT	3 338	758	569	585	847	405	173
RO	7 082	288	1 756	571	2 029	2 096	342
SI	1 591	107	140	93	858	156	237
SK	2 503 i	255 i	400 i	335 i	935 i	373	204
FI	4 374	:	:	:	:	:	:
SE	3 018 bi	:	:	:	:	:	:
UK	9 311	:	:	:	:	:	:
NO	3 449 i	607	422	456	733	1 067	164
HR	2 420	149	70	604	774	524	299

Exceptions to the reference year: 2004: AT and HR.
Flag 'i' FR and SK: defence excluded (all or mostly).
SE and NO: university graduates instead of researchers.
NL: includes other classes.

As for the government sector, researchers in the higher education sector were for the most part employed in the field of natural sciences. This was notably the case in Cyprus (47.1 %), followed by Estonia (38.3 %) and Portugal (33.7 %). A number of discrepancies were nevertheless registered between countries, such as in Romania and Slovenia, where natural sciences employed only 8.5 % and 8.6 % of HES researchers respectively, while engineering and technology accounted for more than 40 % in both countries.

Overall, social sciences and humanities were not the most important fields of science; in this context only Hungary registered a non-negligible share of higher education researchers employed in humanities (24.8 %); Cyprus also registered 29.2 % of HES researchers employed in social sciences.

Table 3.12: Researchers by field of science in FTE, higher education sector, EU-27 and selected countries, 2005

	Total	Agriculture	Engineering and technology	Medical sciences	Natural sciences	Social sciences	Humanities
EU-27	455 630 s	:	:	:	:	:	:
BE	13 853	1 243	2 428	2 995	3 253	2 600	1 335
BG	2 607	134	1 211	222	236	659	145
CZ	7 575 b	578 b	2 514 b	1 487 b	1 109 b	1 274 b	614 b
DK	8 242	406	935	2 389	1 863	1 123	1 527
DE	70 843	2 345	14 519	11 469	22 101	8 365	12 045
EE	1 905	105	464	82	730	295	229
IE	4 400	90	910	750	1 400	770	470
EL	11 356	:	:	:	:	:	:
ES	54 028	1 165	11 004	9 181	11 048	12 479	9 151
FR	66 290	:	:	:	:	:	:
IT	37 073 b	1 499	5 300	5 696	11 629	7 048	5 749
CY	414	0	45	1	195	121	52
LV	2 224	165	332	135	724	450	418
LT	5 116	176	991	803	1 012	1 098	1 036
LU	157	0	64	0	30	40	23
HU	5 911	380	943	950	1 031	1 141	1 466
MT	225	2	28	74	26	64	31
NL	:	:	:	:	:	:	:
AT	8 281	245	1 341	1 834	2 711	1 220	930
PL	40 449	2 999	8 771	7 124	7 632	9 618	4 306
PT	10 956	592	2 609	771	3 695	1 971	1 318
RO	5 386	160	2 823	1 330	459	573	41
SI	1 695	203	689	268	145	265	125
SK	6 458	371	1 712	787	1 881	1 123	584
FI	12 879	:	:	:	:	:	:
SE	15 851	1 008	3 528	3 341	2 611	2 343	1 296
UK	:	:	:	:	:	:	:
IS	515	41 i	115 i	90 i	119 i	90 i	64 i
NO	7 512	281	846	2 160	1 611	1 722	892
HR	3 705	331	1 090	899	334	701	350
TR	25 434	1 866	4 964	6 734	2 977	5 707	3 186

Exceptions to the reference year: 2004: AT and HR
2001: SE and IS.
flag 'i' IS: unrevised breakdown not adding up to the revised total.

3.3 R&D personnel at regional level

In 2005, the leading EU region in terms of R&D personnel in full-time equivalent (Figure 3.13) was Île-de-France (FR), with 136 872 persons employed in R&D.

Oberbayern (DE) and Stuttgart (DE) ranked second and third, with 64 094 and 51 517 persons in FTE respectively, followed by Comunidad de Madrid (ES), with 44 480.

With six regions represented in the top 15, Germany was the leading country in terms of R&D personnel in FTE. Spain, Italy and France each had two regions in the top 15, while Belgium, Poland and Finland had one region.

A number of discrepancies appeared when comparing the total number of persons employed in R&D in FTE and R&D personnel as a share of total employment. Only Île-de-France (FR) and Stuttgart (DE) were represented in both rankings, but as a share of total employment the French region came in eleventh place (3.39 %), while the German region was ranked in fourteenth position (3.06 %).

Wien (AT) was the leading region as regards the share of R&D personnel in total employment, with 4.52 %. In absolute terms, this represented approximately 17 000 workers in R&D in FTE.

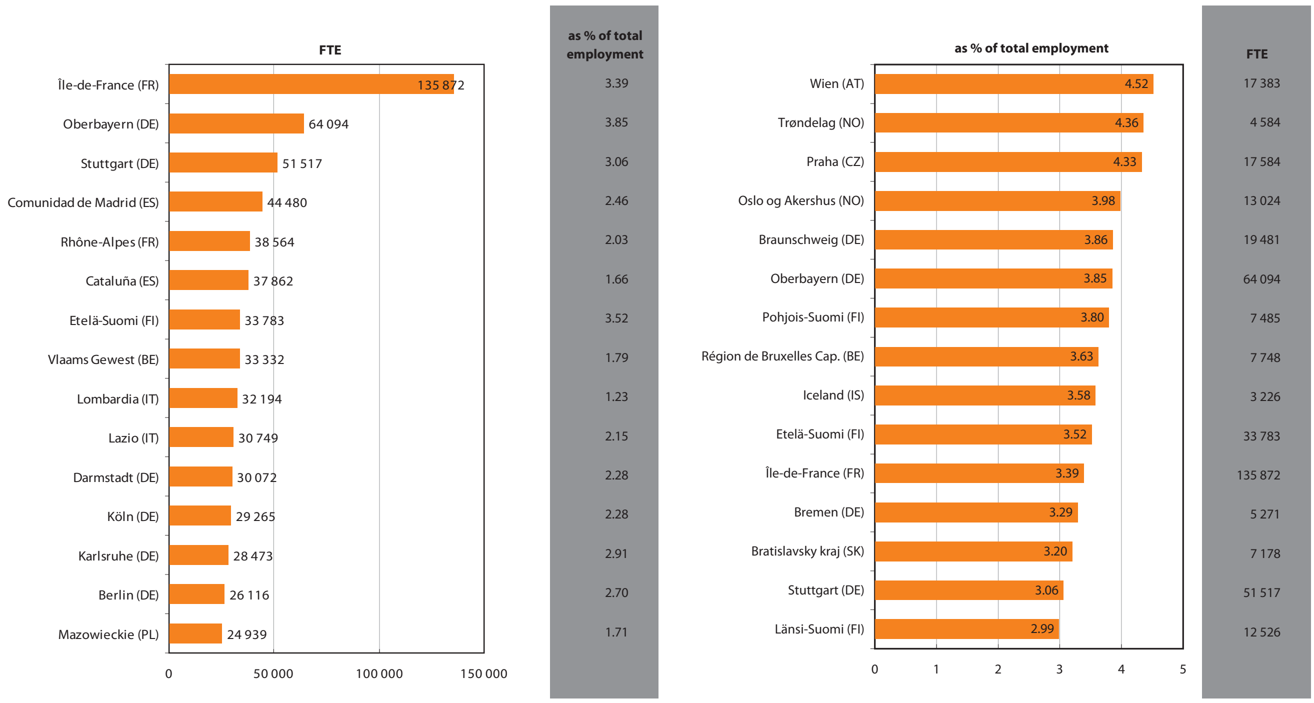
This was followed by the regions of Trøndelag (NO) (4.36 %) and Praha (CZ) (4.33 %). Praha (CZ) together with Bratislavsky kraj (SK) were the only regions from the new Member States represented in the ranking.

Again, Germany was the most represented country (with four regions), followed by Finland and Norway. Belgium was represented with only one region, and Iceland, which is also classified as a region at NUTS level 2, ranked ninth.

One of the salient features of the top 15 leading regions in relative terms is that seven of them are capital regions.

Map 3.14 provides an overview of the share of R&D personnel in total employment. Across all countries considered, 14 European regions from Austria, Norway, the Czech Republic, Germany, Finland, Belgium, Iceland, France and Slovakia registered shares above 3 % in 2005. A further 24 regions registered shares between 2 % and 3 %. All other European regions stood below 2 %.

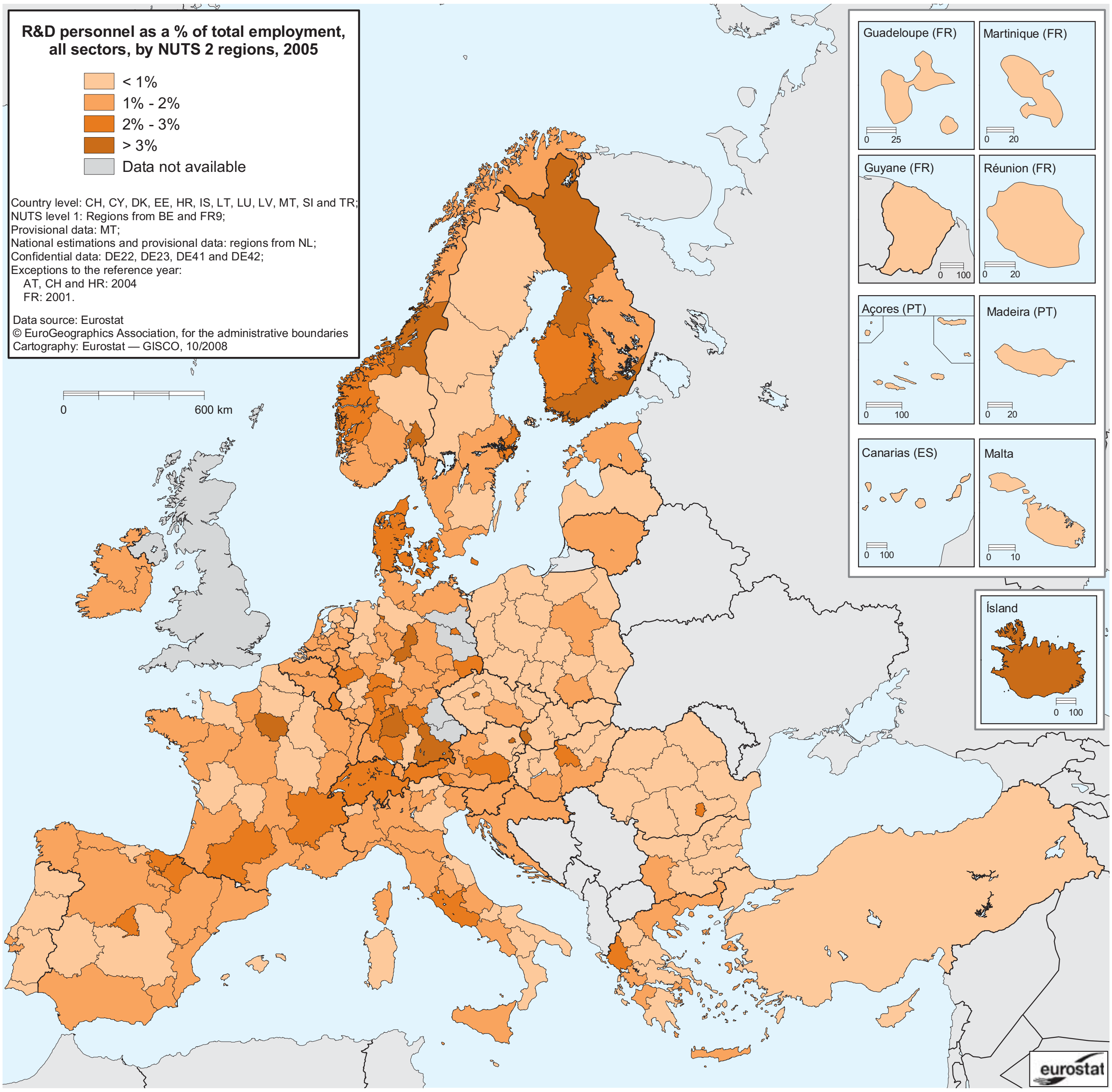
Figure 3.13: Top 15 regions in terms of R&D personnel in FTE and as a percentage of total employment (HC), all sectors, 2005



Exceptions to the reference year: 2004: AT and FR (in FTE)
2001: FR (as a % of total employment).

BE: NUTS level 1.

Map 3.14: R&D personnel as a percentage of total employment, all sectors, 2005 - NUTS 2



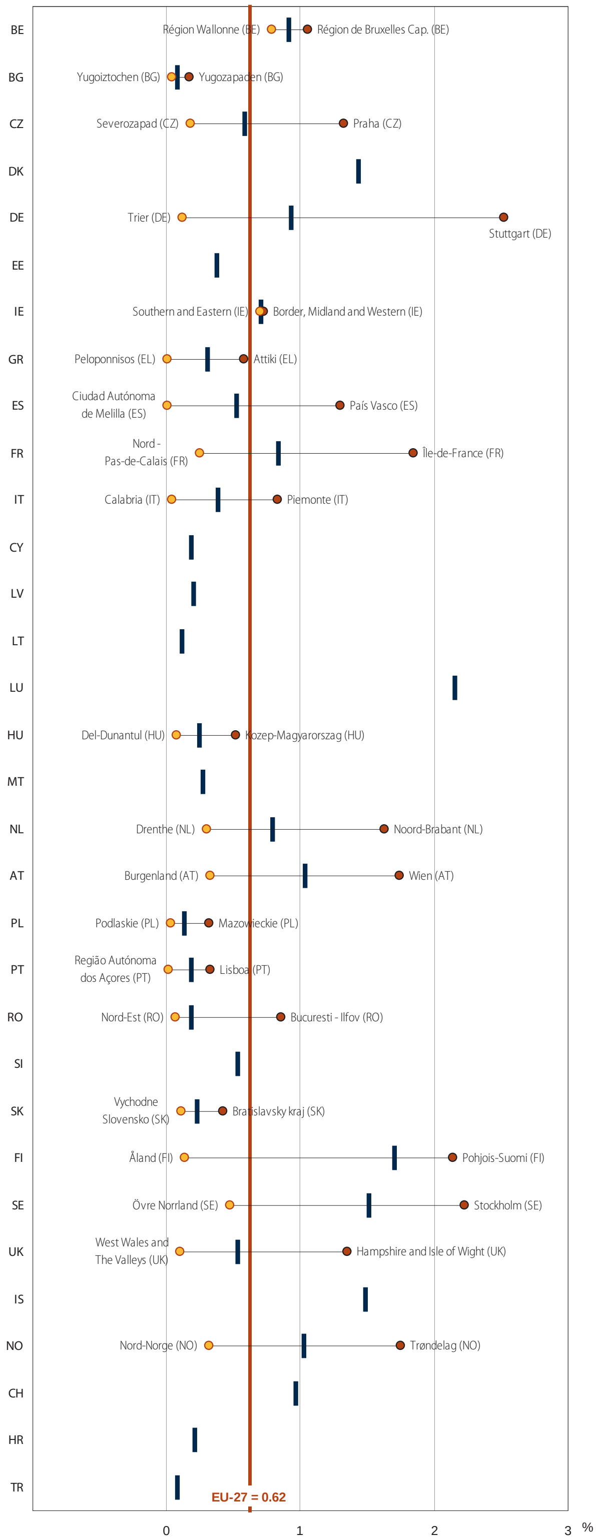
Regional disparities in R&D personnel

Figure 3.15 shows the regional disparities in business enterprise R&D personnel as a share of total employment.

More than 2.35 percentage points separate the top region of Germany, Stuttgart, from the top region of Bulgaria, Yugozapaden. The top region in Germany, Finland and Sweden registered more than 2 % of BES R&D personnel in total employment. The highest contrasts between regions in the same country were found in Germany, Sweden, Finland and France, while the smallest discrepancies were encountered in Ireland (0.03 percentage points) and Bulgaria (0.13 percentage points).

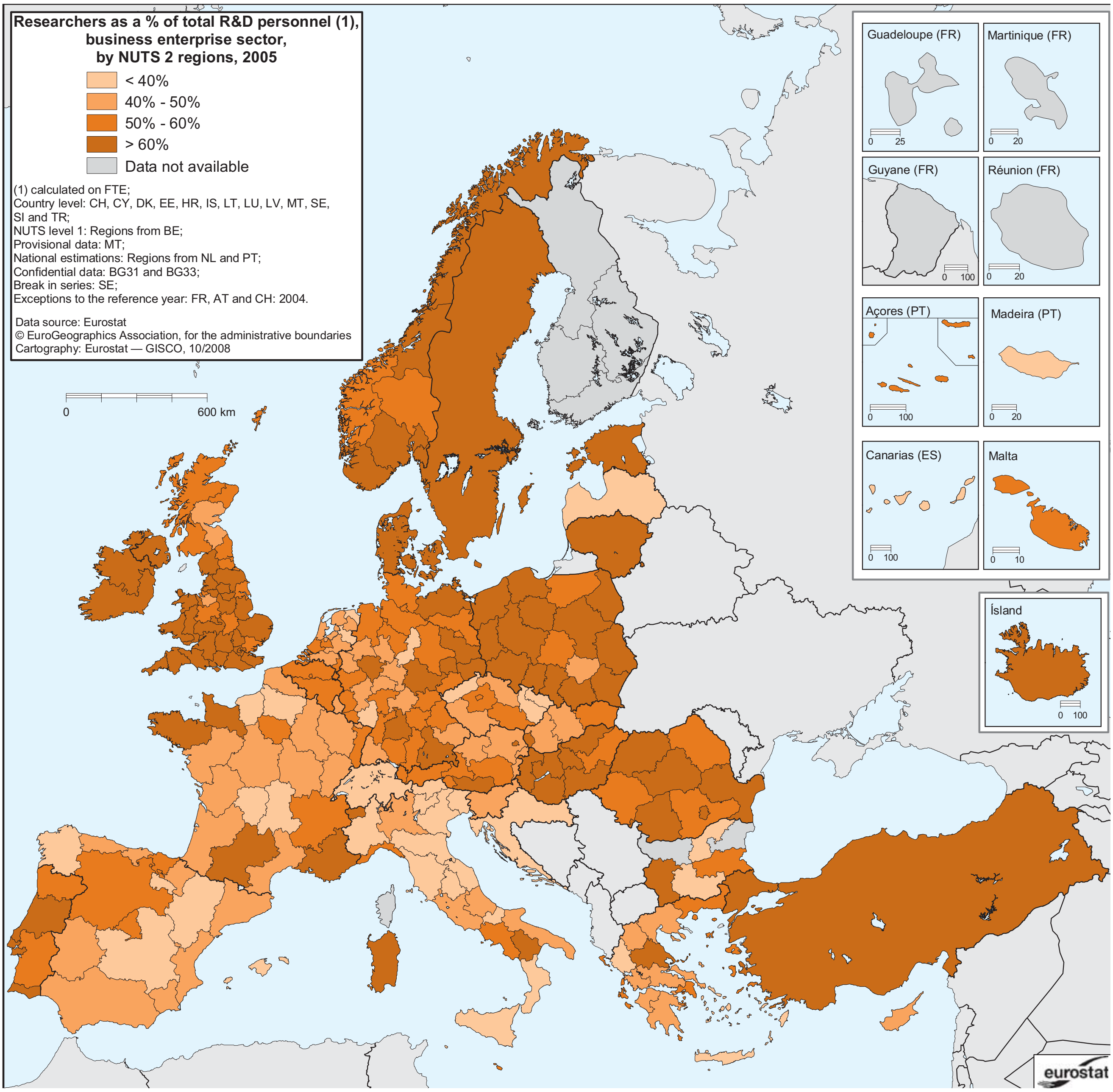
Map 3.16 presents the share of researchers in total R&D personnel employed in the business enterprise sector. In 23 European regions, more than 70 % of persons employed in the BES were researchers. France, Bulgaria, Greece and Italy each counted one region where this share stood below 30 %.

Figure 3.15: Regional disparities (NUTS 2) in R&D personnel as a percentage of total employment, business enterprise sector, EU-27 and selected countries, 2005



NUTS level 1: regions from BE.
Provisional data: MT.
National estimations: regions from NL, PT and UK.
Exceptions to the reference year: AT, CH and HR: 2004
2001: regions from FR.

Map 3.16: Researchers as a percentage of total R&D personnel[1], business enterprise sector, by NUTS 2 regions, 2005



4

Human resources
in science and technology

4.1 Introduction

Investment in research, development, education and skills is one of the European Union's central objectives, as these are essential to economic growth and to development of a knowledge-based economy.
In 2005, the *Relaunch of the Lisbon Strategy* established new EU policies aiming to strengthen growth and employment. This was to be achieved by a strong partnership for jobs and growth, based on the concept of 'knowledge for growth', between the EU, Member States and stakeholders.

Statistics on human resources in science and technology (HRST) are a key indicator for measuring the knowledge-based economy and how it is evolving. They show the supply of, and demand for, people highly qualified in science and technology. This chapter aims to examine three aspects in detail: education inflows, HRST stocks and HRST mobility.

To facilitate the analysis of HRST, a number of sub-categories, listed in Figure 4.1, have been defined in line with the recommendations made 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 Occupations (ISCO), giving the type of occupation.

Human resources in science and technology — 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 — ISCED 97 version levels 5a, 5b or 6,

and/or

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

To define HRSTE more precisely, based on the Canberra Manual (section 71), seven broad fields of S&T 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 in the Canberra Manual contains the letters 'S&T', the definition is not restricted to science and technology. 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).

One HRST sub-population of particular interest is 'Scientists and engineers' (SE). The categories 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) .

Data are calculated from two main sources:

- The inflows, which 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 — which is used for compiling data on stocks and mobility for HRST.

The education inflows described in Chapter 4.2 are a useful measure of the current and future supply of HRST, as individuals who have completed tertiary-level education are included in HRST stocks. Inflows can be sub-divided into various groups, each providing a different focus. Measurements are divided into participation in tertiary education (used to estimate potential future inflow rates into the labour market) and graduation from tertiary education (actual inflows).

The information on participation in higher education also includes data on foreign students. These data give an idea of the proportion of internationally mobile students in Europe. Lastly, the analysis will focus more closely on doctoral students and graduates, the most highly educated section of the population.

[1] Manual on the Measurement of Human Resources devoted to S&T, *Canberra Manual*, OECD, Paris, 1995.

[2] Scientists and engineers differ, however, 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; Proposed Standard Practice for Surveys on Research and Experimental Development — *Frascati Manual*, OECD, 2002, paragraph 302.

Meanwhile, the data on HRST stocks in Chapter 4.3 provide an indication of the number of HRST at a particular point in time. These can then be broken down to provide information on socioeconomic categories of interest, such as the gender ratio, age distribution, type of occupation or the sector of economic activity in which people are working.

Finally, the analysis of HRST mobility casts light on two different aspects: the job-to-job mobility of employed HRST (Chapter 4.4) and the international mobility of HRSTC in and outside the EU (Chapter 4.5). Job-to-job mobility illustrates the ability of HRST to move between different jobs and is based on the length of stay with the same employer. The indicator shows the number of employed HRST who have changed jobs in the last 12 months. A high intensity of HRST job-to-job mobility is considered a good stimulus for the economy of a country. The international mobility of HRSTC is based on whether or not the persons concerned were born in their country of residence.

Differences and similarities between R&D Personnel and HRST indicators

HRST and R&D personnel statistics both focus on the stock of qualified personnel, considered the main input for a knowledge economy.

The R&D personnel population is clearly much smaller than the HRST population. It excludes everyone not currently employed in R&D activities, which is the most common approach when investigating R&D personnel. On the other hand, the HRST population takes into account a much larger share of knowledge workers and also includes, for example, qualified persons working in non-R&D activities and suitably qualified former R&D personnel who are unemployed, retired or otherwise out of the labour force.

HRSTO is the sub-group of HRST most suitable for comparing HRST with R&D personnel. However, the key conclusion is that HRST statistics and R&D personnel statistics serve different purposes and do not provide answers to the same questions. Therefore, the methods, populations and sources are also different.

	HRST Stock	R&D Personnel
Indicators – Breakdowns available	Gender	Gender
	Age	Age
	Region	Region
	NACE	NACE
	Occupation (ISCO2, ISCO3, OTHER)	Occupation (RSE, TEC, OTH)
	Highest Field of Education (EF4, EF5, OTHER)	Field of Science
	Nationality	Citizenship
	Country of Birth	R&D performing sector (BES, GOV, PNP, HES)
		Qualification (ISCED level 6, 5a, 5b, 4, 3 and Other)
		Size class

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

As stated in the new Lisbon Strategy, education and training are crucial in the development of a knowledge-based economy. It is acknowledged that an adequate supply of qualified human resources is required to support growth and employment.

As science and technology have been recognised as key fields for European development, policymakers need to be able to assess the potential supply of human resources in science and technology (HRST). The tertiary education inflows described in this chapter provide a useful measure of the current and future supply of HRST on the labour market.

Table 4.2: Students participating in tertiary education, total and in selected fields of study, proportion of the population aged 20-29 and proportion of female students, EU-27 and selected countries, 2005

	Students participating in tertiary education, 2005								
	In any field			In science, mathematics and computing			In engineering, manufacturing and construction		
	Total	% of population aged 20-29	% female	Total	% of population aged 20-29	% female	Total	% of population aged 20-29	% female
EU-27	18 532 655	28.1	55.0 s	1 715 582 i	2.7 i	36.9 i	2 357 666 i	3.7 i	24.3 i
BE	389 547	29.9	54.4	24 016	1.9	33.6	40 451	3.1	21.0
BG	237 909	24.2	52.1	12 835	1.3	48.9	50 504	5.1	32.0
CZ	336 307	21.2	52.6	31 859	2.0	36.0	66 248	4.2	21.2
DK	232 255	37.4	57.4	18 955	3.1	31.7	24 005	3.9	33.1
DE	2 268 741	23.8	49.7	340 299	3.6	34.4	356 636	3.8	18.4
EE	67 760	35.4	61.5	7 025	3.7	38.8	8 269	4.3	27.5
IE	186 084	26.9	54.7	22 851	3.3	40.9	19 233	2.8	16.3
EL	646 587	44.1	51.1	101 504	6.9	38.6	106 528	7.3	27.7
ES	1 809 353	27.4	53.7	220 659	3.3	34.5	319 340	4.8	27.8
FR	2 187 383	27.5	55.2	:	:	:	:	:	:
IT	2 014 998	28.5	56.6	155 720	2.2	48.9	320 343	4.5	27.7
CY	20 078	19.4	52.0	2 575	2.5	34.8	1 009	1.0	12.9
LV	130 706	39.3	63.2	6 853	2.1	30.0	12 352	3.7	21.4
LT	195 405	40.9	60.1	12 197	2.6	34.9	36 376	7.6	26.0
LU	2 965	5.4	:	311	0.6	:	224	0.4	:
HU	436 012	29.5	58.4	23 771	1.6	32.5	53 965	3.7	19.1
MT	9 441	16.5	56.3	561	1.0	34.8	737	1.3	28.4
NL	564 983	29.0	51.0	42 844	2.2	19.9	44 475	2.3	13.5
AT	244 410	24.1	53.7	29 304	2.9	33.9	29 674	2.9	20.7
PL	2 118 081	34.9	57.5	174 751	2.9	32.7	248 542	4.1	25.6
PT	380 937	24.4	55.7	28 982	1.9	48.8	83 079	5.3	26.0
RO	738 806	21.9	54.6	34 713	1.0	56.2	150 203	4.4	29.3
SI	112 228	38.1	57.8	6 029	2.1	31.9	17 753	6.0	24.1
SK	181 419	19.7	55.3	16 419	1.8	33.4	31 521	3.4	28.0
FI	305 996	46.8	53.6	35 468	5.4	40.6	80 827	12.4	18.7
SE	426 723	40.0	59.6	40 520	3.8	42.0	70 089	6.6	28.0
UK	2 287 541	32.1	57.2	324 561	4.6	36.2	185 283	2.6	19.1
HR	134 658	26.9	53.8	10 285	2.1	41.7	21 891	4.4	24.7
MK	49 364	15.3	56.7	3 661	1.1	55.4	8 936	2.8	31.7
TR	2 106 351	15.7	41.9	157 930	1.2	40.3	292 623	2.2	18.2
IS	15 169	38.2	64.9	1 318	3.3	36.6	1 022	2.6	31.3
LI	527	12.0	28.8	:	:	:	135	3.1	31.1
NO	213 940	38.4	59.6	20 149	3.6	32.4	14 726	2.7	24.1
CH	199 696	22.1	46.0	22 230	2.5	28.3	26 376	2.9	14.2
JP	4 038 302	:	45.9	118 704	:	25.2	668 526	:	11.9
US	17 272 044	:	57.2	1 537 243	:	38.4	1 154 971	:	16.2

Flag 'i' EU-27 aggregate excluding FR for selected fields of study.
Exception to the reference year: 2002: LU.
%Tertiary students of all ages are divided by the population aged 20-29 years.

Participation in tertiary education

In 2005, every sixth student in the European Union was in tertiary education, giving an estimated 18.5 million students in higher education. Moreover, 28.1 % of persons aged between 20 and 29 (the majority of tertiary students are in this age bracket) in the EU-27 were in higher education.

Analysis of Table 4.2 reveals clear national disparities. In absolute numbers, six EU countries accounted for almost 70 % of students in tertiary education, mainly owing to the size of these countries and their large university networks. Relating to the population aged 20 to 29, Finland and Greece were the two EU Member States with the highest participation in tertiary education, with 46.8 % and 44.1 % respectively. At the other end of the scale, Luxembourg reported a share of only 5.4 %, owing to its lack of a complete national university network.

In 2005, out of all tertiary students in the EU-27, more than 4 million were specialising in either 'science, mathematics and computing' or 'engineering, manufacturing and construction'. Science and engineering (S&E) students comprised 6.4 % of the population aged 20 to 29.

Although science degrees attracted more than 1.7 million students in 2005, this field of education was less popular than engineering. In fact, engineering schools attracted almost 4 % of the population aged 20-29, whereas less than 3 % of this population took science degrees. This was reflected in most EU Member States, the exceptions being Ireland, Cyprus, Luxembourg, the United Kingdom and, of the non-EU countries, Iceland and Norway.

Greece had the highest share, relating to the population aged 20–29, studying science, mathematics and computing, with 6.9 %, while 7.3 % were studying engineering, manufacturing and construction. Finland, which fosters close cooperation between educational institutions and industry, had the highest proportion of engineering students in relation to the population aged 20–29, with 12.4 %.

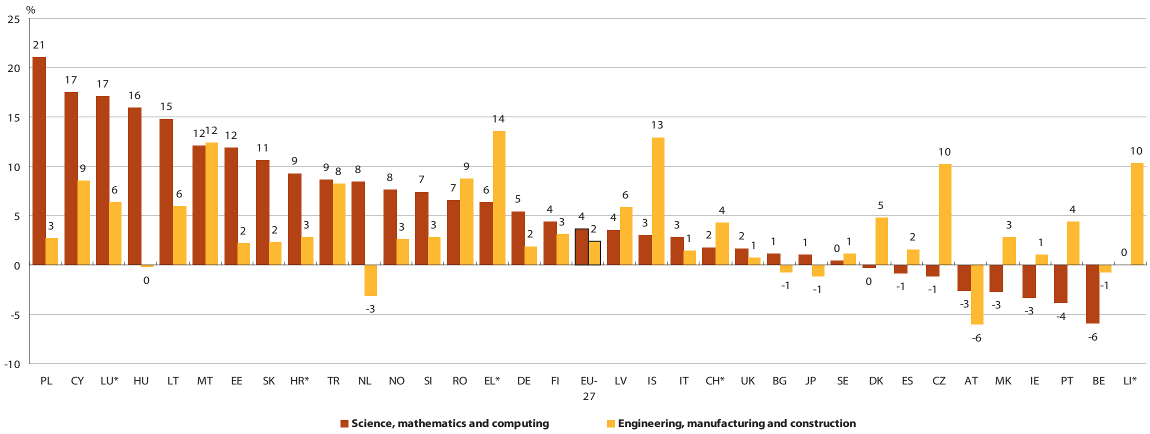
As shown in Figure 4.3, the overall number of tertiary students in S&E is growing. Nevertheless, there was a noticeable difference between the annual average growth rates of the two fields of study. Between 2000 and 2005, the number of engineering students in the EU-27 increased on average by 2 % a year, against 4 % for science students.

Over the same period, Poland recorded the highest average increase in the number of science students in the EU-27 (21 %) and Greece the highest in engineering students (14 %), closely followed by Iceland and Malta with 13 % and 12 % respectively. At the other end of the scale, the number of science and engineering students fell in Belgium and Austria.

As shown in Table 4.2, the distribution by sex reveals that more than half the students were women in every country surveyed, except Germany, Liechtenstein, Turkey, Switzerland and Japan. Nevertheless, the situation was slightly different in science and engineering. Romania and the former Yugoslav Republic of Macedonia were the only countries in Europe where women outnumbered men in science studies, although Bulgaria, Italy and Portugal came close to achieving parity. At EU level, around 37 % of science students were female, compared with 38.4 % in the United States and 25.2 % in Japan.

Within the EU, Denmark and Bulgaria ranked highest in terms of female participation in engineering studies, with 33.1 % and 32.0 % respectively. Cyprus recorded the lowest share of female students in engineering, with only 12.9 %. This tends to confirm that engineering studies remain less popular among female students in spite of gender equality policies.

Figure 4.3: Annual average growth rates in the number of tertiary education students in science and in engineering, EU-27 and selected countries, 2000–2005



EU-27 excluding FR.
Exceptions to the reference period: EL 2002/2005, LU 2000/2002, LI 2003/2005, CH 2003/2005 and HR 2003/2005.
* Data are not available for the entire reference period as this might lead to extreme values in AAGR.

Student mobility

Reforms are currently under way in Europe to establish a European Higher Education Area by 2010, not only by introducing a system of convergent curricula and degrees but also by means of various other reforms to extend student mobility. Promoting student mobility is generally viewed as a key objective in the development of higher education and is considered a good way of acquiring specialised skills via a multicultural approach.

Figure 4.4 shows the proportion of foreign students in tertiary education and studying science and engineering (S&E) in 2005. The proportion of foreign students among the total student population varies considerably from one EU Member State to another.

Cyprus recorded the largest share of foreign students in higher education, making up almost a quarter of the student population, followed by the United Kingdom with 7.3 %. Conversely, Poland and Lithuania reported the lowest shares of students from abroad, with only 0.5 % and 0.4 % respectively.

In the UK, the number of foreign S&E students grew on average by 10 % a year between 2000 and 2005, and more than 20 % of science and engineering students were from abroad.

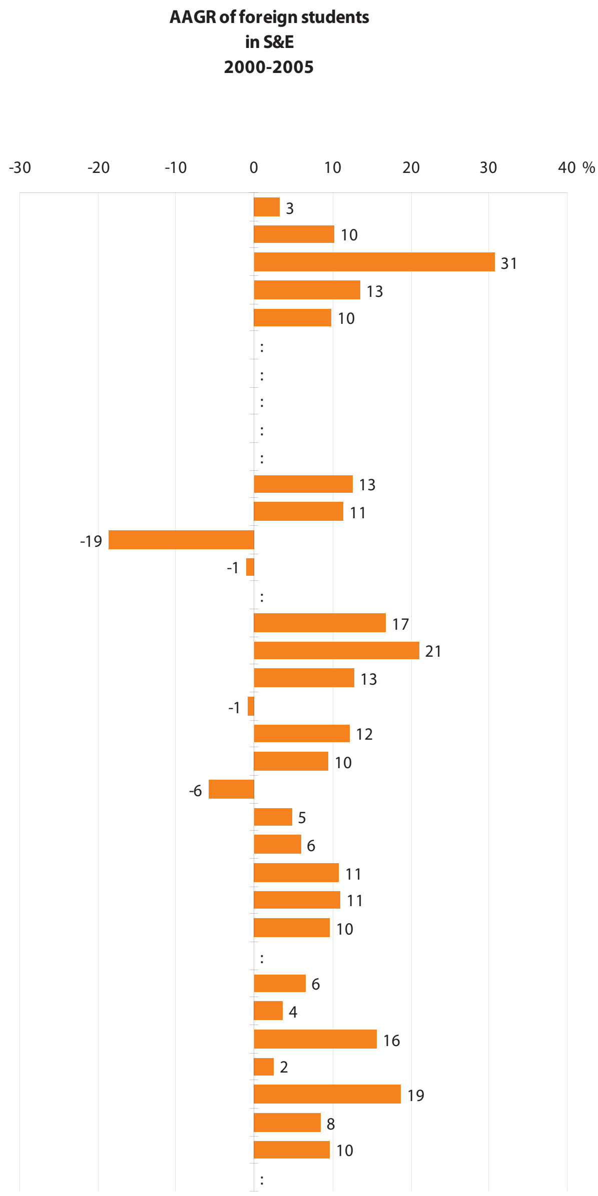
Moreover, specialisations by foreign students clearly emerge in some countries. In 2005, 41.2 % of all foreign students in Finland chose science and engineering degrees. This was higher than the popularity of S&E programmes for the total tertiary student population at national level indicated in Table 4.2 (38 %).

Figure 4.4 shows that the average number of foreign S&E students grew between 2000 and 2005 in all countries for which data are available, except Latvia (-19 %), Romania (-6 %), Lithuania (-1 %) and Austria (-1 %). The Czech Republic recorded the highest average annual increase in the number of foreign S&E students (31 %).

(3) See www.bologna-bergen2005.no/Docs/00-Main_doc/050520_Bergen_Communique.pdf

Figure 4.4: Foreign students in tertiary education in any field and in S&E, in total and in relation to student population, EU-27 and selected countries — 2005 and average annual growth rate of foreign students in S&E, 2000–2005

	Foreign students			
	In any field		In S&E	
	Total	As % of the respective student population	Total	As % of the respective student population
BE	38 242	9.8	6 489	10.1
BG	8 680	3.7	1 878	3.0
CZ	18 522	5.5	4 931	5.0
DK	17 430	7.5	5 387	12.5
DE	246 159	10.9	90 513	13.0
EE	1 090	1.7	:	:
IE	10 201	5.6	:	:
EL	14 361	2.4	:	:
ES	23 508	1.3	4 273	0.8
FR	237 587	:	:	:
IT	44 921	2.2	9 146	1.9
CY	4 901	24.4	510	14.2
LV	2 390	2.0	131	0.7
LT	857	0.4	92	0.2
LU	:	:	:	:
HU	13 601	3.1	2 748	3.5
MT	605	6.4	39	3.0
NL	31 584	5.6	5 175	5.9
AT	34 484	14.1	8 421	14.3
PL	10 185	0.5	995	0.2
PT	17 010	4.5	4 544	4.1
RO	9 730	1.5	923	0.5
SI	1 230	1.1	290	1.2
SK	1 678	0.9	307	0.6
FI	8 442	2.8	3 476	3.0
SE	39 298	9.2	13 669	12.4
UK	394 624	17.3	108 171	21.2
HR	748	0.6	:	:
MK	281	0.6	78	0.6
TR	18 166	0.9	4 189	0.9
IS	484	3.2	99	4.2
LI	470	89.2	128	94.8
NO	13 400	6.3	2 848	8.2
CH	36 827	18.4	11 239	23.1
JP	125 917	3.1	17 769	2.3
US	586 316	3.5	217 223	:



Exceptions to the reference year: EL 2004, FR 2004, EE 2003, IE 2003, LV 2003, RO 2003 and US 2003.
Exceptions to the reference period 2000/2005: 2000/2003: RO; 2000/2004: LV; 2001/2005: BE, CY; 2002/2005: CH; 2003/2005: LI; 2004/2005: ES.
Data for ES are not published for the entire reference period as this might lead to extreme values in AAGR.

Doctoral students

By definition (1), doctoral students are at a second stage of higher education (ISCED level 6) which should lead to an advanced research qualification such as a doctorate in biology, in geography or in physics. These programmes focus on advanced study and original research and are not based only on course work.

Table 4.5 shows the number of doctoral students by selected fields of study. These indicators paint an interesting picture of the potential stock of researchers at the highest level of education in each country. In the EU, with the exception of Germany and Luxembourg for which no data were available, 3.2 % of tertiary students in 2005 were following a doctoral programme. In absolute numbers this added up to approximately 523 000 doctoral students. Spain, France and the United Kingdom accounted for more than one third of them. As stated above, these countries have a large student population in tertiary education and offer a wide range of doctoral programmes and qualifications.

Looking at the distribution by sex, parity was almost achieved, as female students accounted for close to half of all doctoral students in the EU-27 (47.3 %).

Contrary to the total tertiary student population (see Table 4.2), 'science, mathematics and computing' degrees seem much more popular among doctoral students than 'engineering, manufacturing and construction' studies. In the EU, Cyprus and Greece had the highest proportion of science doctoral students, with 46.2 % and 44.0 % respectively. By contrast, almost 30 % of doctoral students in the Czech Republic took engineering degrees, against only 6 % in Cyprus. This table also highlights the fact that doctoral students in many new Member States and in Scandinavian countries tend to opt for engineering degrees.

Table 4.5: Doctoral students (ISCED level 6), in any field and in selected fields of study, in total, in proportion of the population aged 20-29 and proportion of female doctoral students, EU-27 and selected countries, 2005

	Doctoral students (ISCED level 6), 2005								
	In any field			In science, mathematics and computing			In engineering, manufacturing and construction		
	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female
EU-27	523 391 i	7.9 i	47.3 i	92 579 i	:	42.3 i	73 001 i	:	27.1 i
BE	7 391	5.7	40.3	2 375	1.8	39.3	1 014	0.8	22.0
BG	5 079	5.2	49.8	782	0.8	49.0	1 204	1.2	35.7
CZ	24 907	15.7	37.0	5 288	3.3	39.4	7 219	4.6	20.4
DK	4 385	7.1	45.5	726	1.2	35.5	942	1.5	25.4
DE	:	:	:	:	:	:	:	:	:
EE	1 800	9.4	52.6	495	2.6	44.2	257	1.3	32.7
IE	4 824	7.0	47.6	1 796	2.6	44.7	647	0.9	22.3
EL	22 314	15.2	43.3	9 813	6.7	36.6	2 671	1.8	32.3
ES	76 251	11.5	51.2	11 395	1.7	46.8	7 538	1.1	29.2
FR	82 696	10.4	47.8	:	:	:	:	:	:
IT	37 520	5.3	51.2	9 199	1.3	50.7	7 033	1.0	33.8
CY	251	2.4	50.2	116	1.1	50.0	15	0.1	13.3
LV	1 428	4.3	58.2	196	0.6	49.0	234	0.7	34.6
LT	2 815	5.9	56.9	516	1.1	53.7	607	1.3	32.9
LU	:	:	:	:	:	:	:	:	:
HU	7 941	5.4	44.5	1 686	1.1	35.3	785	0.5	24.2
MT	53	0.9	30.2	5	0.1	60.0	6	0.1	16.7
NL	7 443	3.8	41.4	:	:	:	:	:	:
AT	15 837	15.6	45.3	2 642	2.6	35.5	2 087	2.1	22.0
PL	33 040	5.4	48.3	5 030	0.8	52.2	6 586	1.1	28.4
PT	18 410	11.8	56.0	3 071	2.0	56.0	2 799	1.8	33.2
RO	22 348	6.6	47.3	2 704	0.8	57.8	5 073	1.5	31.7
SI	964	3.3	46.1	246	0.8	39.4	248	0.8	28.6
SK	10 290	11.1	40.9	1 473	1.6	42.4	2 510	2.7	24.7
FI	21 581	33.0	50.8	3 107	4.8	45.6	5 581	8.5	26.7
SE	22 216	20.8	47.9	4 433	4.2	39.6	4 846	4.5	29.5
UK	91 607	12.9	44.3	25 485	3.6	35.8	13 099	1.8	21.4
HR	954	1.9	48.6	107	0.2	50.5	215	0.4	34.4
MK	:	:	:	:	:	:	:	:	:
TR	27 393	2.0	40.0	4 134	0.3	42.5	5 148	0.4	31.8
IS	134	3.4	59.0	30	0.8	43.3	8	0.2	62.5
LI	:	:	:	:	:	:	:	:	:
NO	4 360	7.8	43.2	1 347	2.4	33.0	612	1.1	24.0
CH	16 592	18.3	39.3	4 781	5.3	33.9	1 831	2.0	19.8
JP	73 527	:	29.2	10 690	:	22.7	13 584	:	11.4
US	384 577	:	51.3	78 762	:	40.1	38 049	:	22.9

EU-27 aggregate excluding DE and LU and for selected fields of study also without FR and NL.
Doctoral students of all ages are divided by the population aged 20-29 years.

Graduation from tertiary education

Table 4.6 presents the total number of tertiary education graduates by country. Even though, as seen previously, student participation is a useful proxy for estimating future national HRST stocks, this should be supplemented by data on higher education graduates. This indicator provides a more precise analysis of the number of people effectively entering the pool of HRST.

In 2005, more than 3.7 million new graduates were registered in the EU-27. Almost half of them graduated in just three countries: the United Kingdom, France and Poland. Germany came fourth, accounting for 9.1 % of graduates in the EU.

The majority of graduates in the EU were women (58.7 %) and the share of female graduates was higher than the proportion of women participating in higher education (55 %). Moreover, in Latvia and Estonia more than 70 % of graduates were women. In fact, the three Baltic States recorded the highest shares of female graduates.

Balancing the number of new graduates against the young population, it emerges that the EU turned out close to 59 new graduates for every thousand 20 to 29-year-olds. However, this proportion varies from 90 new graduates per thousand in France to almost 33 in Austria.

Table 4.6: Graduates from tertiary education, total and in selected fields of study, proportion of the population aged 20-29 and proportion of female graduates, EU-27 and selected countries, 2005

	Graduates from tertiary education, 2005								
	In any field			In science, mathematics and computing			In engineering, manufacturing and construction		
	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female
EU-27	3 753 483 i	58.7 i	58.7 i	375 803 i	5.9 i	39.2 i	478 325 i	7.5 i	24.7 i
BE	79 612	61.2	58.4	6 538	5.0	31.9	7 589	5.8	23.4
BG	46 038	46.9	58.9	2 290	2.3	55.5	7 429	7.6	36.7
CZ	55 055	34.8	56.5	4 436	2.8	38.6	8 728	5.5	21.7
DK	49 704	80.1	58.9	4 160	6.7	32.8	5 221	8.4	34.8
DE	343 874	36.1	53.0	37 452	3.9	35.6	55 998	5.9	16.9
EE	11 793	61.5	70.2	1 251	6.5	48.0	1 133	5.9	38.7
IE	59 650	86.1	55.6	9 658	13.9	42.0	7 157	10.3	15.0
EL	59 872	40.9	61.5	8 951	6.1	42.6	7 374	5.0	38.9
ES	288 158	43.6	58.0	30 471	4.6	36.0	48 030	7.3	25.5
FR	664 711	90.0	55.9	81 783	11.1	36.3	97 198	13.2	21.7
IT	297 603	42.1	57.5	20 416	2.9	53.4	49 124	6.9	28.9
CY	3 676	35.6	61.0	357	3.5	43.7	66	0.6	7.6
LV	26 124	78.5	70.5	1 244	3.7	39.9	2 036	6.1	28.5
LT	41 466	86.9	66.4	2 142	4.5	42.5	6 890	14.4	32.9
LU	:	:	:	:	:	:	:	:	:
HU	73 769	49.8	64.5	2 638	1.8	39.5	5 217	3.5	25.2
MT	2 741	48.0	60.6	105	1.8	32.4	101	1.8	27.7
NL	106 684	54.8	56.5	7 983	4.1	25.2	8 940	4.6	15.9
AT	32 925	32.5	51.6	3 377	3.3	36.3	6 704	6.6	16.8
PL	501 393	82.7	65.9	33 531	5.5	43.6	37 304	6.2	30.3
PT	70 023	44.8	65.2	8 111	5.2	47.9	10 585	6.8	33.8
RO	156 565	46.3	57.1	7 769	2.3	60.8	27 501	8.1	34.1
SI	15 787	53.6	61.8	638	2.2	43.6	2 259	7.7	21.2
SK	36 337	39.4	57.1	3 300	3.6	41.4	6 085	6.6	32.0
FI	39 270	60.1	62.0	3 439	5.3	49.4	8 329	12.7	21.6
SE	57 611	54.0	63.3	4 704	4.4	44.1	10 623	10.0	29.2
UK	633 042	88.8	58.0	89 059	12.5	36.9	50 704	7.1	20.0
HR	19 548	39.0	58.8	1 179	2.4	49.0	2 319	4.6	24.5
MK	5 687	17.7	65.5	479	1.5	66.6	802	2.5	35.2
TR	271 841	20.3	43.7	25 308	1.9	45.2	51 145	3.8	20.3
IS	2 914	73.4	67.6	262	6.6	38.9	168	4.2	34.5
LI	132	30.0	25.0	10	2.3	70.0	46	10.5	19.6
NO	31 929	57.4	61.8	2 607	4.7	28.8	2 449	4.4	23.1
CH	63 372	70.0	42.6	5 935	6.6	26.0	8 639	9.5	10.5
JP	1 059 386	:	49.4	30 684	:	26.0	195 670	:	12.9
US	2 557 595	:	58.0	239 722	:	40.4	189 938	:	19.3

EU-27 aggregate excluding LU.
Graduates of all ages from tertiary education are divided by the population aged 20-29 years.

Regarding the distribution of graduates by specific field of study, almost 25 % of EU graduates in 2005 obtained their degree in either science or engineering-related disciplines. As seen in Table 4.2, engineering studies were more popular than science in most EU Member States.

Yet there are a number of specific national features. Lithuania, for example, had more than 14 new engineering graduates for every thousand persons aged 20–29, against under five in science studies. France, Finland and Sweden also had a high number of new engineers, with 13.2, 12.7 and 10.0 new graduates per thousand 20-29 year olds respectively. At the same time, a large proportion of new graduates in France held science degrees, with 11.1 science graduates for every thousand persons aged 20–29. These shares were much lower in Finland and Sweden (5.3‰ and 4.4‰ respectively).

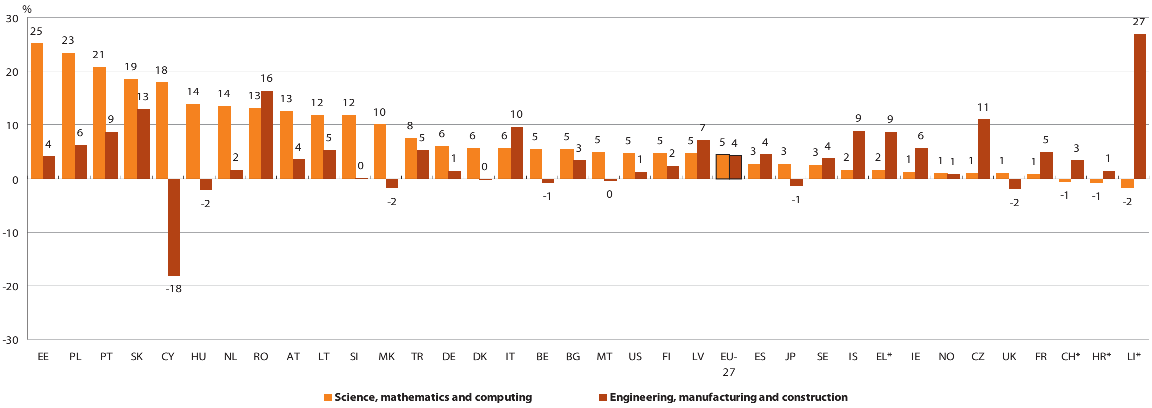
Conversely, the United Kingdom, with one of the highest shares of science graduates related to the 20-29 age group (12.5‰), recorded around 7 engineering graduates for every thousand persons aged 20-29. Ireland registered the highest share of new science graduates, with 13.9‰, along with a high share in engineering studies (10.3‰).

In the European Union, the share of female graduates was much higher in science (39.2 %) than in engineering (24.7 %). This trend confirms the rate of female participation shown in Table 4.2.

In 2005, Romania reported the largest proportion of female graduates in science, with 60.8 %. In Bulgaria and Italy women also accounted for more than half of all science graduates. Among non EU countries, the former Yugoslav Republic of Macedonia (66.6 %) and Liechtenstein (70.0 %) also recorded large shares of female science graduates.

However, women were significantly under-represented in engineering studies: the highest share of female graduates in this field was found in Greece (38.9 %).

Figure 4.7: Annual average growth rates of graduates from tertiary education in science and in engineering, EU-27 and selected countries, 2000–2005



Exception to the reference period: EL 2004/2005, LI and HR 2003/2005, CH 2002/2005.
EU-27: excluding LU.
* Data are not available for the entire reference period which might lead to extreme values for the AAGR.

Figure 4.7 shows the annual average growth rates for science and engineering graduates in EU Member States and other selected countries.

Within the EU, the number of new science and engineering graduates grew by 5 % and 4 % a year on average respectively. These figures can be seen as the result of current EU policies, especially on education. As the EU progresses towards an even more knowledge-based economy, the number of science and engineering graduates is increasing in most EU Member States. Students might have become more aware of the economic and social benefits of tertiary education, especially in these traditional subjects.

Nevertheless, national disparities are clearly marked. In the EU, Estonia achieved the highest growth rate in the number of science graduates between 2000 and 2005, with 25 %, against 4 % for engineering graduates. Romania recorded relatively high growth rates in both fields (13 % in science and 16 % in engineering). This could be the result of the major reform initiated by Romanian higher education institutions in 1990.

Eight countries were nevertheless exceptions to this trend, with a drop in the number of engineering graduates between 2000 and 2005. Over this period, the number of engineering graduates fell by 18 % in Cyprus.

Doctoral graduates

In 2005, out of the 3.8 million new graduates in the EU, more than 100 000 obtained a doctorate (see Table 4.8). This is almost twice as many as in the United States and over six times more than in Japan. In Europe, Germany and the United Kingdom were the leading EU Member States in absolute numbers, accounting together for 42 % of doctoral graduates in 2005. Among the total population aged 20–29, Finland reported the highest share of new doctoral graduates, with 3.0‰. Germany, Portugal and Sweden came close behind, where on average 2.7 out of every 1 000 persons aged 20-29 obtained a doctorate in 2005.

Looking at S&E fields of study, more than 40 000 students across the EU graduated with a PhD. Again, Finland recorded a high share of doctoral graduates in both science and engineering among the population aged 20-29: close to 1.2 out of every 1 000 persons aged 20-29 graduated with a PhD in these fields of study. Overall, science, mathematics and computing were more popular fields of doctoral study than engineering, manufacturing and construction.

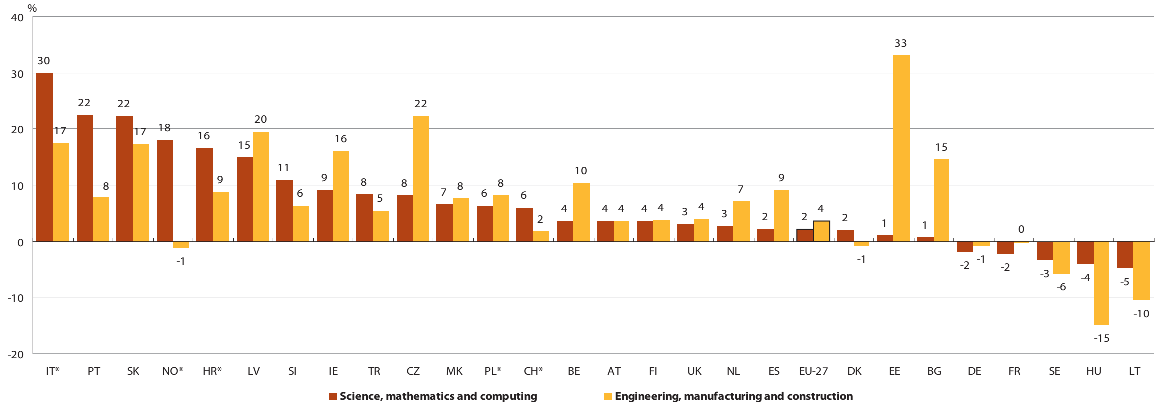
In 2005, 43.0 % of EU doctoral graduates were female. This proportion reached 80 % in Cyprus. Gender disparities also exist between specific fields of study. In science, seven EU Member States counted more female doctoral graduates than male. In engineering, men outnumbered women in every EU country except Latvia.

Table 4.8: Doctoral graduates (ISCED level 6), total and in selected fields of study, proportion of the population aged 20-29 and proportion of female doctorate graduates, EU-27 and selected countries, 2005

	Doctoral graduates (ISCED 6 level), 2005								
	In any field			In science, mathematics and computing			In engineering, manufacturing and construction		
	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female	Total	Per 1 000 population aged 20-29	% female
EU-27	100 347 i	1.4 i	43.0 i	27 450 i	0.4 i	38.4 i	13 395 i	0.2 i	22.4 i
BE	1 601	1.2	36.8	574	0.4	36.1	250	0.2	19.2
BG	528	0.5	48.3	89	0.1	49.4	85	0.1	38.8
CZ	1 908	1.2	34.4	482	0.3	34.4	502	0.3	17.5
DK	955	1.5	41.2	210	0.3	31.4	199	0.3	22.6
DE	25 952	2.7	39.6	6 691	0.7	32.3	2 345	0.2	13.7
EE	131	0.7	44.3	38	0.2	39.5	25	0.1	32.0
IE	810	1.2	45.2	359	0.5	46.8	103	0.1	19.4
EL	1 248	0.9	35.6	519	0.4	30.8	251	0.2	24.7
ES	6 902	1.0	46.7	1 962	0.3	48.5	628	0.1	25.8
FR	9 578	1.3	41.1	4 433	0.6	36.0	941	0.1	28.1
IT	8 466	1.2	51.5	2 337	0.3	53.6	1 539	0.2	33.9
CY	5	0.0	80.0	3	:	66.7	:	:	:
LV	114	0.3	58.8	20	0.1	45.0	39	0.1	56.4
LT	321	0.7	58.6	50	0.1	60.0	56	0.1	37.5
LU	:	:	:	:	:	:	:	:	:
HU	1 069	0.7	42.8	157	0.1	38.9	46	:	26.1
MT	5	0.1	:	:	:	:	:	:	:
NL	2 879	1.5	38.1	508	0.3	31.5	557	0.3	19.9
AT	2 228	2.2	43.7	492	0.5	39.0	405	0.4	23.7
PL	5 722	0.9	47.3	907	0.1	53.5	927	0.2	23.1
PT	4 150	2.7	56.6	1 117	0.7	53.2	610	0.4	35.1
RO	3 871	1.1	49.0	214	0.1	59.3	330	0.1	37.3
SI	369	1.3	47.7	92	0.3	45.7	87	0.3	27.6
SK	1 022	1.1	46.6	210	0.2	54.8	206	0.2	32.0
FI	1 957	3.0	46.6	410	0.6	41.0	386	0.6	20.7
SE	2 778	2.6	44.3	582	0.5	34.2	626	0.6	24.8
UK	15 778	2.2	43.3	4 994	0.7	38.5	2 252	0.3	20.8
HR	385	0.8	45.2	95	0.2	66.3	72	0.1	26.4
MK	92	0.3	47.8	11	0.0	54.5	13	0.0	38.5
TR	2 838	0.2	40.4	453	0.0	39.1	432	0.0	35.6
IS	14	0.4	57.1	1	0.0	:	1	0.0	:
LI	4	0.9	25.0	:	:	:	:	:	:
NO	838	1.5	39.6	247	0.4	33.2	124	0.2	21.8
CH	3 303	3.6	36.1	979	1.1	31.4	340	0.4	16.2
JP	15 286	:	26.2	2 404	:	20.8	3 341	:	10.2
US	52 631	:	48.8	11 987	:	37.0	6 780	:	19.2

Exception to the reference year: IT 2004.
EU-27: excluding LU and for selected fields of study also without MT for science, mathematics and computing and without MT and CY for engineering, manufacturing and construction.
Doctoral graduates of all ages are divided by the population aged 20-29 years.

Figure 4.9: Annual average growth rates of doctoral graduates in science and in engineering, EU-27 and selected countries, 2000–2005



Exception to the reference period: 2000/2004: IT; 2001/2005: PL; 2002/2005: CH; 2003/2005: HR and NO

* Data is not available for the whole reference period which might lead to extreme values for the AAGR especially as ISCED 6 graduates is small population. RO and EL data not published due to this.

EU-27 excluding LU and MT and also without CY for engineering, manufacturing and construction.

Data not available: CY, LU and MT.

Figure 4.9 shows the annual average growth rates in doctoral graduates in science and in engineering for the EU Member States and other selected countries. In the EU-27, the average increase in the number of new doctorate-holders ranged from 2 % in science to 4 % in engineering.

This increase was uneven across the various countries considered. In the EU, the highest growth rate in science doctoral graduates between 2000 and 2005 was noted in Italy, with 30 %, while at the same time the number of engineering graduates also grew at a relatively fast pace, by 17 %. The most marked increase in the number of engineering graduates was observed in Estonia, with 33 %.

The European Research Area

In 2000, the EU decided to create the European Research Area (ERA). The main aim of the Communication 'Towards a European Research Area' is to contribute to better integration and organisation of Europe's scientific and technological area and to creation of better overall framework conditions for research in Europe. The Communication was endorsed in the context of the 'Lisbon strategy' to boost Europe's competitiveness.

This means creating a unified area all across Europe which should:

- enable researchers to move and interact seamlessly, benefit from world-class infrastructure and work with excellent networks of research institutions;
- share, teach, value and use knowledge effectively for social, business and policy purposes;
- optimise and open European, national and regional research programmes in order to support the best research throughout Europe and coordinate these programmes to address major challenges together;
- develop strong links with partners around the world so that Europe benefits from the worldwide progress of knowledge, contributes to global development and takes a leading role in international initiatives to solve global issues.

There is overall agreement on the need to interlink a European Higher Education Area and a European Research Area as integration of PhDs into the Bologna process opens up further opportunities for networking research.

Seven years later, on 4 April 2007, 'some progress has been made,' stated the Commission's Green Paper on new perspectives for the ERA. 'However, there is still much further to go to build the ERA, particularly to overcome the fragmentation of research activities, programmes and policies across Europe,' it continued.

Source: EurActiv website, http://www.euractiv.com

4.3 Stocks of human resources in science and technology

Human resources, especially in science and technology, are a key ingredient of competitiveness and economic development. Potential users of HRST data include policymakers and analysts in government departments and related agencies, the private sector and academics.

Building on the analysis of the supply of human resources in science and technology in the form of tertiary education inflows, this section takes a closer look at demand for HRST. Forecasting demand is recognised as a difficult exercise which requires the evaluation of existing HRST stocks, notably for labour market analyses in the EU Member States.

The measurement of HRST stocks and of the various sub-categories — '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 stock of knowledge workers in European countries.

HRST stocks at national level

HRST stocks can be measured at many levels. Policymakers, for instance, are usually interested in national stocks.

Table 4.10 shows the various sub-categories of HRST stocks in 2006 and the average growth in HRST over time. In the EU, more than 85.4 million people were considered HRST in 2006, of which half were concentrated in only three countries. Germany, with more than 16 million HRST, and the United Kingdom and France, with more than 11 million each, accounted for the largest HRST populations in 2006.

A more detailed analysis of HRST sub-categories reveals that in the EU-27 more than 40 % of HRST were both educated to tertiary level and employed in S&T (HRSTC). The rest of the HRST population was split between persons possessing a tertiary qualification but not working in S&T (31.1 %) and those employed in S&T without having a higher education degree (28.6 %).

On the gender issue, the number of women in HRST in 2006 was generally in balance with their male counterparts in most EU Member States plus Iceland and Norway. Within the EU, Lithuania reported the highest proportion of female HRST, with 62.8 %. The two other Baltic countries, Estonia and Latvia, followed close behind, each with shares over 60 %. Conversely, this figure was only 40.9 % in Malta.

Considering trends in HRST stocks in the EU, most EU Member States saw their HRST population grow between 2001 and 2006. Ireland together with Portugal achieved the highest growth rates in male HRST stocks and the strongest growth in female HRST (6.5 % and 8.6 % respectively). At EU level, the average growth rate for human resources in S&T was 2.7 % for men and 4.1 % for women. Bulgaria was a notable exception as it saw a decrease in HRST both for men (-1.4 %) and women (-0.7 %). Outside the EU, a decrease in the number of male HRST was also observed in Norway over the same period.

Growth in HRST stocks was stronger among women in more than three quarters of the EU Member States. This could be due to the efforts made by many EU Member States to introduce positive action and measures to support women in science and engineering and promote gender equality.

Mind the gap

Pay discrimination between male and female scientists

[…] Discrimination against female scientists has cropped up elsewhere. One study — conducted in Sweden, of all places — showed that female medical-research scientists had to be twice as good as men to win research grants. These pieces of work, though, were relatively small-scale. Now, a much larger study has found that discrimination plays a role in the pay gap between male and female scientists at British universities.

Sara Connolly, a researcher at the University of East Anglia's School of Economics, […] has been analysing the results of a survey of over 7 000 scientists and she has just presented her findings at this year's meeting of the British Association for the Advancement of Science in Norwich. She found that the average pay gap between male and female academics working in science, engineering and technology is around £1 500 ($2 850) a year.

That is not, of course, irrefutable proof of discrimination. An alternative hypothesis is that the courses of men's and women's lives mean the gap is caused by something else; women taking 'career breaks' to have children, for example, and thus rising more slowly through the hierarchy. Unfortunately for that idea, Dr Connolly found that men are also likely to earn more within any given grade of the hierarchy. Male professors, for example, earn over £4 000 a year more than female ones. […]

Source: The Economist, 7 September 2006 - http://www.economist.com/science/displaystory.cfm?story_id=7880036

Table 4.10: Human resources in Science and Technology stocks, 25-64 years old, by HRST category, proportion of women and annual average growth rate of HRST, 2001 to 2006, EU-27 and selected countries, 2006

	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 HRST 2001-2006	
	1 000s	% female	1 000s	% female	1 000s	% female	1 000s	% female	% male	% female
EU-27	85 423	50.1	34 453	51.5	26 567	48.5	24 403	49.9	2.7	4.1
BE	2 183	49.6	919	52.6	880	50.9	384	39.3	2.9	4.1
BG	1 069	59.2	488	67.6	434	54.4	147	44.9	-1.4	-0.7
CZ	1 736	51.6	537	45.6	269	45.0	930	56.9	2.9	3.3
DK	1 333	51.7	676	55.9	350	46.9	307	47.9	2.7	3.9
DE	16 708	47.1	6 416	43.5	4 233	38.6	6 058	56.8	0.3	2.0
EE	281	61.9	106	71.7	129	52.7	46	65.2	3.1	1.4
IE	772	52.7	324	54.0	353	53.3	95	45.3	6.5	8.6
EL	1 496	48.3	754	48.9	525	48.0	216	47.2	4.9	6.5
ES	8 442	48.7	3 519	51.2	4 007	49.0	916	37.3	6.4	7.9
FR	11 122	50.4	4 567	51.9	3 823	54.8	2 732	41.6	3.0	4.7
IT	8 359	49.1	2 633	51.2	1 573	57.1	4 152	44.8	3.4	5.9
CY	143	48.3	65	49.2	59	52.5	20	30.0	3.5	5.8
LV	365	62.7	142	68.3	115	58.3	108	60.2	2.5	2.1
LT	588	62.8	245	71.4	234	48.7	108	73.1	2.9	3.1
LU	89	47.2	45	46.7	16	50.0	29	48.3	3.8	8.4
HU	1 402	58.3	569	56.9	415	53.3	418	65.3	3.9	3.9
MT	44	40.9	17	47.1	9	55.6	18	33.3	3.4	6.7
NL	3 716	48.4	1 640	47.7	998	45.0	1 079	52.5	1.1	3.5
AT	1 432	45.0	443	46.7	357	37.0	632	48.1	4.2	5.2
PL	5 051	58.4	2 194	60.4	1 475	51.9	1 383	62.3	4.8	4.9
PT	1 105	52.9	524	60.5	263	55.9	318	37.7	6.5	7.3
RO	2 095	53.9	935	52.4	443	41.1	717	63.7	1.4	2.1
SI	368	54.3	162	60.5	83	49.4	124	49.2	5.4	6.6
SK	797	55.7	274	50.4	163	45.4	360	64.4	4.8	3.0
FI	1 234	54.5	550	58.9	445	54.6	239	44.4	1.2	0.1
SE	2 098	51.6	1 005	59.2	456	51.5	636	39.6	1.5	3.2
UK	11 395	47.9	4 704	51.8	4 460	46.9	2 231	42.0	2.5	4.1
HR	:	:	:	:	:	:	:	:	:	:
MK	:	:	:	:	:	:	:	:	:	:
TR	4 216	33.4	1 488	37.2	1 794	36.7	934	21.1	:	:
IS	61	55.7	22	54.5	11	54.5	28	57.1	2.4	4.7
LI	:	:	:	:	:	:	:	:	:	:
NO	1 079	51.0	565	55.9	271	49.8	244	40.2	-0.1	2.0
CH	1 883	42.4	763	35.8	487	35.1	633	56.1	1.7	3.7

Break in series 2006 for all Member States, with the exception of BE and LU that might affect the values for the AAGR.

Highly qualified human resources employed in S&T

HRSTC is a core group which is both qualified to tertiary level and working in science and technology. Figure 4.11 shows the trend in HRSTC stocks between 2001 and 2006 along with their share in the total labour force. At EU level, HRSTC stocks accounted for 17 % of the total labour force in 2006. Although HRSTC stocks grew on average by 2.9 % per year between 2001 and 2006, big differences persist between Member States.

The highest annual average growth rate in HRSTC was recorded in Slovenia (9.8 %), where HRSTC also accounted for a high share of the labour force (18.2 %). By comparison, Germany, with a similar share of HRSTC among the labour force (17.8 %), recorded one of the lowest average HRSTC growth rates in the EU, at only 1.4 %. Iceland was the only country to record a drop in HRSTC stocks between 2001 and 2006, with an annual average downturn of close to 1.9 %.

More than a quarter of the total labour force in Denmark and Norway consisted of HRSTC, accounting for the largest shares in Europe. At the other end of the scale, the share of HRSTC in the workforce was only around 11 % in Romania, Portugal and the Czech Republic. However, HRSTC stocks in Norway grew on average by less than 1.3 % a year between 2001 and 2006.

Figure 4.11: Annual average growth rates of HRSTC, 2001–2006, and their proportion of the labour force, EU-27 and selected countries — 2006

Data for LI, HR and MK are not available.

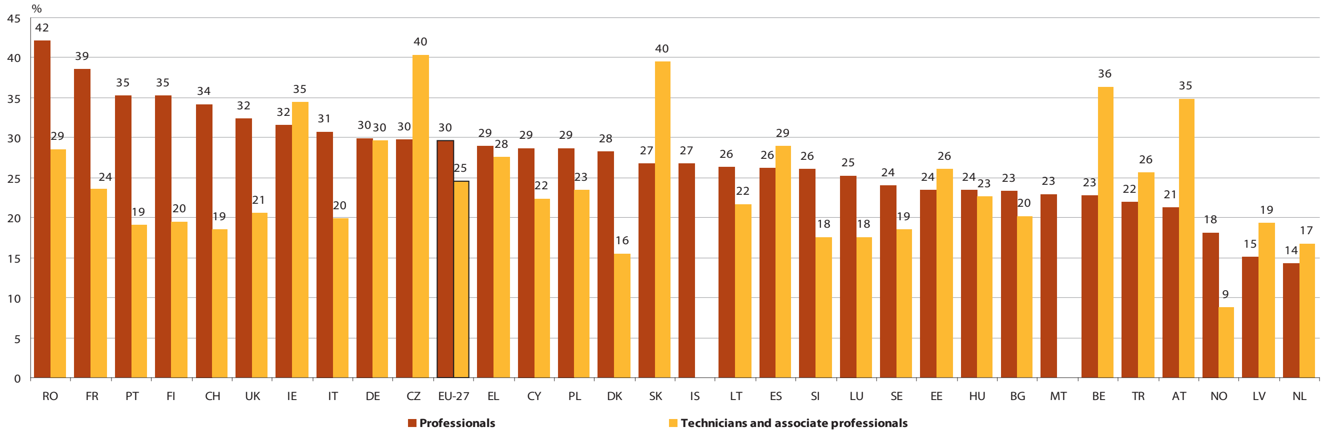
Highly qualified persons employed in S&T by occupation

Figure 4.12 looks at persons working in an S&T occupation and the share with third-level education in science or engineering. Persons employed in an S&T occupation are allocated to one of two groups: either professionals or technicians and associate professionals. By definition, the first group conducts research, improves or develops concepts, theories and operational methods or applies knowledge relating to different areas of science. Technicians and associate professionals perform mostly technical and related tasks connected with research and application of scientific and artistic concepts and operational methods and government or business regulations and teach at certain levels.

The EU average for HRST with tertiary education in science or engineering as a percentage of persons working as professionals or technicians was 30 %, compared with 25 % in 2006. In most countries, persons with tertiary education in these fields were more likely to work as professionals than as technicians. Romania reported the highest share of tertiary education graduates among its professionals (42 %), followed by France (39 %), Finland and Portugal (both 35 %).

Despite this, ten countries had a larger share of science and engineering graduates among technicians than among professionals. This was especially the case in the Czech Republic and Slovakia, where 40 % of all technicians were tertiary education graduates in science or engineering. Similar shares were also found in Belgium and Austria.

Figure 4.12: Employed HRST with tertiary education in science and engineering, by selected fields of occupation, as a percentage of selected labour force, EU-27 and selected countries, 2006



Exceptions to the reference year: 2005: IE and NO.
EU-27 aggregate excludes IE.
Data for Technicians are not published for MT and IS because of lacking reliability due to reduced sample size.
Data lack reliability due to reduced sample size but are publishable: MT for Professionals; EE, LT and LU for Technicians.
Data for LI, HR and MK not available.

Scientists and Engineers

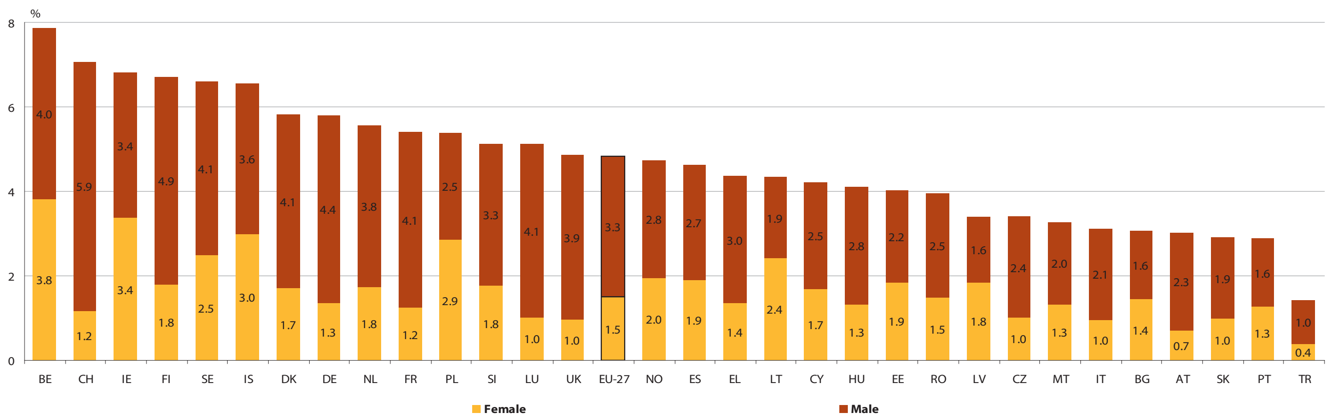
Scientists and engineers (SE) are an HRST sub-set of particular interest. By definition, it encompasses persons working in 'physical, mathematical and engineering' occupations (ISCO-88, COM code 21), such as mathematicians or civil engineers, and in 'life science and health' occupations (ISCO-88, COM code 22), such as biologists or doctors of medicine (see the methodological notes for further details).

Figure 4.13 shows the distribution by sex of scientists and engineers as a percentage of the total labour force in 2006. It clearly highlights that in most countries scientists and engineers were more likely to be male than female. Switzerland had the highest proportion of men (5.9 %) compared with women (1.2 %) working as scientists and engineers. Luxembourg and the United Kingdom were close behind with a gender ratio of around four male scientists or engineers to one female.

Nevertheless, female scientists and engineers outnumbered their male counterparts in Latvia, Poland and Lithuania. Ireland was the only EU Member State which achieved gender parity in SE in 2006. The same Member State also showed a high share of scientists and engineers among the labour force, with 6.8 %.

The highest proportion of scientists and engineers in 2006 was found in Belgium, where almost 8 % of the labour force were employed as scientists or engineers. At the other end of the scale, Turkey had the lowest share of scientists and engineers in the workforce, with 1.4 %.

Figure 4.13: Breakdown of Scientists and Engineers (SE), 25-64 years old, by sex, as a percentage of the total labour force, EU-27 and selected countries, 2006



Data lack reliability due to reduced sample size but publishable: EE and MT for women and EE, LT for men.

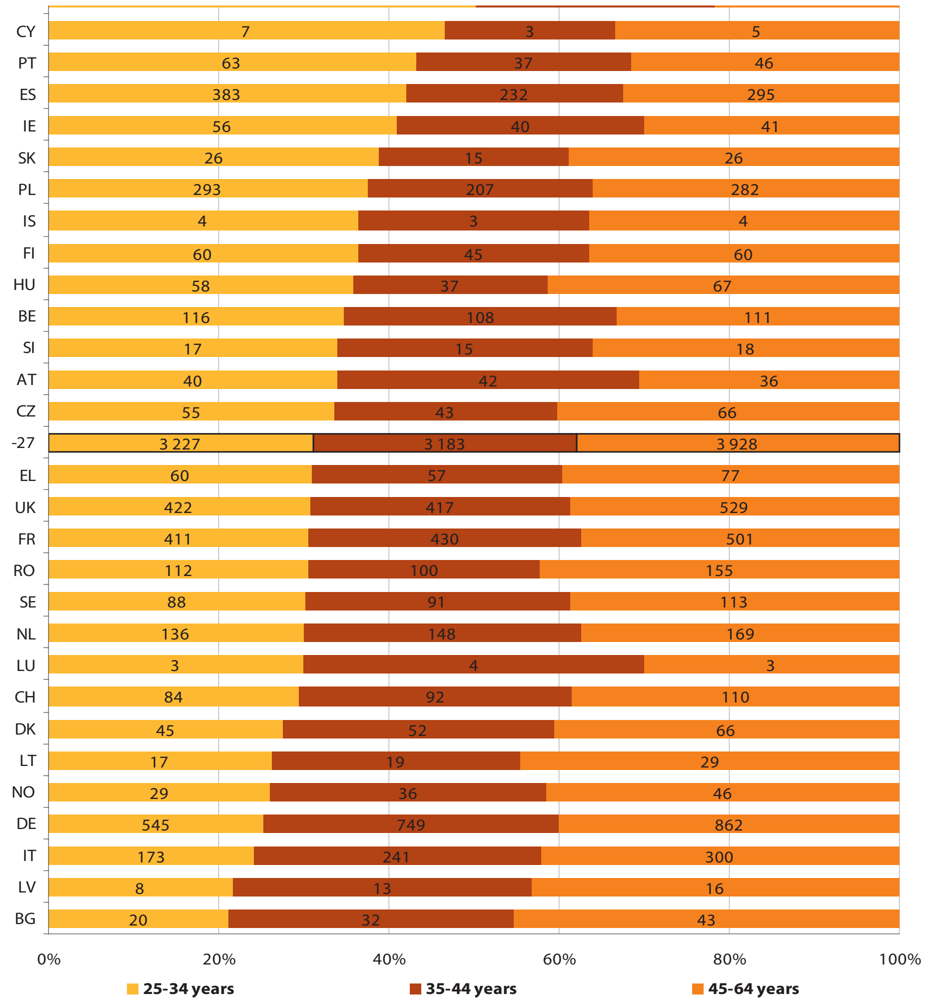
Data for LI, HR and MK are not available.

Figure 4.14 shows the national distribution by age group for scientists and engineers (SE) in 2006. At EU level, the SE population had a larger share of people aged 25-44 than aged 45-64. In fact, out of the 10.4 million scientists and engineers in the EU, 62 % were aged between 25 and 44 and 38 % were 45 to 64 years old.

Between the individual countries, fairly significant disparities were identified. For example, Turkey had a low share of scientists and engineers in the total workforce (1.4 %) (see Figure 4.13), but the largest share of young scientists and engineers in 2006, with half of the SE population aged 25 to 34. This youthfulness could potentially mean that SE occupations have gained popularity with the young generation and allow Turkey to catch up with the others in terms of share of SE in the labour force. Cyprus followed close behind, with 47 % of persons employed as scientists and engineers in this age group.

The smallest share of scientists and engineers aged 45-64 years was recorded in Bulgaria and Lithuania.

Figure 4.14: Age distribution of Scientists and Engineers (SE) aged 25-64 in thousands and in percentage, EU-27 and selected countries, 2006



Data for this breakdown are not published for EE and MT because of lacking reliability due to reduced sample size.
Data lack reliability due to reduced sample size but are publishable: LT for 35-44 and 45-64 years.
Data for LI, HR and MK are not available.

Table 4.15: Persons employed in S&T with a tertiary level education (HRSTC), as a percentage of total employment, 25-64 years old, in selected sectors of economic activity, EU-27 and selected countries, 2006

	HRSTC intensity — share of employed 25-64 year old HRSTC in total employment — in sectors of economic activity					
	Manufacturing		Services			
	High and medium high-tech	Medium low and low-tech	Knowledge-intensive services (KIS)	of which Education	of which Health and social work	Less knowledge-intensive services (LKIS)
EU-27	16.8	6.5	36.8	59.8	33.8	9.9
BE	18.0	10.0	45.1	70.8	46.4	9.0
BG	9.8	4.3	49.8	64.8	56.9	11.3
CZ	8.7	4.0	29.6	47.0	21.3	6.9
DK	25.5	12.1	45.0	70.5	43.3	15.8
DE	21.3	7.1	33.9	62.7	31.9	11.9
EE	u	u	40.5	52.8	41.1 u	15.3
IE	20.7	7.0	40.2	67.6	41.0	6.1
EL	15.2	5.7	54.6	81.5	52.6	7.8
ES	19.7	8.6	47.6	79.6	47.7	9.4
FR	24.9	8.5	35.7	59.5	32.7	11.2
IT	7.8	3.0	30.9	44.9	34.5	4.5
CY	15.1 u	7.1	50.8	76.6	56.7	9.4
LV	u	6.2	35.7	48.5	28.6	12.2
LT	u	7.4 u	41.9	53.5	37.3	15.6
LU	u	13.6	38.3	71.5	25.8	17.4
HU	8.0	3.9	37.2	59.7	23.4	8.8
MT	u	u	33.0	62.2	28.0 u	4.7 u
NL	18.9	9.0	38.8	71.8	30.9	13.2
AT	12.2	5.8	28.2	59.5	24.4	6.3
PL	13.6	6.0	42.0	64.6	28.2	12.5
PT	8.0	2.9	35.8	59.1	28.8	5.6
RO	11.4	5.2	36.1	50.3	24.7	11.7
SI	14.4	6.7	40.9	61.1	35.9	16.0
SK	8.0	4.0	33.2	50.0	21.0	7.6
FI	27.6	12.8	38.9	63.5	37.5	16.8
SE	16.4	6.4	39.7	61.2	33.4	15.8
UK	14.9	8.2	33.0	51.5	32.4	8.8
HR	:	:	:	:	:	:
MK	:	:	:	:	:	:
TR	6.1	2.4	41.8	70.3	44.1	4.9
IS	u	u	29.4	48.7	26.8	8.5
LI	:	:	:	:	:	:
NO	17.1	8.2	44.6	72.5	37.7	15.3
CH	24.9	8.8	35.5	51.6	28.3	13.1

HRSTC intensity in a specific sector of economic activity can be defined as the share of degree-holders in the population employed in S&T in an individual sector.

Table 4.15 gives details of HRSTC intensity in specific sectors of economic activity classified, in accordance with NACE Rev.1.1, into manufacturing and services.

More than one third of the employees in knowledge-intensive services (KIS) — which cover activities related, for example, to post and telecommunications, IT and related activities and research and development (see methodological notes) — had tertiary education. In this respect Greece recorded the highest rate at 54.6 %, followed by Cyprus (50.8 %), Bulgaria (49.8 %) and Spain (47.6 %). By contrast, the corresponding share in Austria stood at only 28.2 %.

The KIS sub-categories covered in this table are 'education' and 'health and social work'. At EU level, both sub-categories featured high rates of HRSTC among total employment in the EU (59.8 % and 33.8 % respectively). Greece achieved the highest HRSTC intensity in 'education', with 81.5 %, whereas 56.9 % of HRSTC in Bulgaria were engaged in 'health and social work'.

At the same time, 'high and medium high-tech manufacturing', with an EU average of 16.8 %, employed more HRSTC than LKIS, but fewer than KIS. In Finland, 27.6 % of employees in this sector had tertiary education. Denmark and France followed with 25.5 % and 24.9 % respectively. By contrast, the lowest HRST intensity in 'high and medium high-tech manufacturing' was observed in Italy, with only 7.8 %. Italy also reported relatively low HRSTC shares overall. One of the reasons for this could be the comparatively low number of graduates in this country.

Unemployment

Figure 4.16 provides information on unemployment rates for human resources in S&T with and without tertiary education (HRSTU and NON_HRSTU respectively).

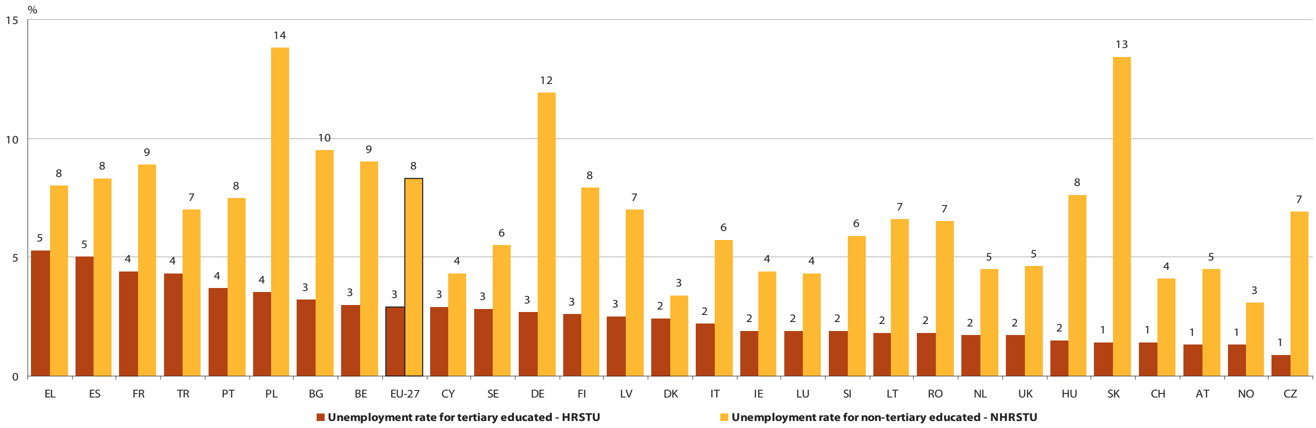
The EU-27 unemployment rate for the tertiary-educated population stood at only 3 % in 2006, compared with 8 % for the non-tertiary-educated. Consequently, finding a job without a tertiary-level education seems to be more difficult.

The lowest unemployment rates for the non-tertiary-educated population were found in Denmark and in Norway (both 3 %). But in Poland, this rate was as high as 14 %. Slovakia and Germany also had high unemployment rates for human resources in S&T without tertiary education (13 % and 12 % respectively). It is notable that the unemployment rate for Slovakians with a higher education degree is much lower (1 %) than for Slovakians without higher education.

Across all Member States, the unemployment rate for highly qualified HRST was much lower. The highest unemployment rate for HRSTU was found in Greece, with 5 %, against 1 % in the Czech Republic. This could be due to the reforms introduced in the Czech Republic to develop the market economy and to encourage high education levels[4].

[4] eua.uni-graz.at/trends2-FULL.pdf

Figure 4.16: Unemployment rates for tertiary and non-tertiary educated population, 25-64 years old, EU-27 and selected countries, 2006



Data lack reliability due to reduced sample size but are publishable: LT.
Data for this breakdown are not published for EE and MT because of lacking reliability due to reduced sample size.
Data for LI, HR and MK are not available.

HRST stocks at regional level

This section describes the stocks of human resources in S&T (HRST) at regional level. It reveals that regional dynamism varies considerably across Europe.

Particular attention needs to be paid to the quality of regional results. Samples, which are intended to provide a representative estimate of the population of the region, can become too small. This is especially true when data are disaggregated by sector of economic activity. This is why data by sector of economic activity are presented only at NUTS 1 regional level in Table 4.18.

In any case, the guidelines set by the *European Union Labour Force Survey* on the minimum levels at which data can be considered reliable were strictly applied. In most cases, the sample size was well above the minimum set by the *European Union Labour Force Survey*. Data are flagged as unreliable when this was not the case.

Regional picture of HRST among the labour force in the European Union

Map 4.17 illustrates the regional distribution of human resources employed in S&T (HRSTO), as a percentage of the total labour force, at NUTS 2 level in 2006. European regions are not equally endowed with HRST stocks.

Map 4.17 reveals marked differences, with certain regions concentrating larger shares of HRSTO among the workforce. The Prague region in the Czech Republic recorded the highest proportion of HRSTO among the labour force, on 50.2 % in 2006. The highest concentrations of HRSTO were found in capital regions, in south-western Germany, Switzerland and in the Benelux (ranging from 29.0 % to 41.9 %) and Nordic countries (from 28.1 % to 47.5 %). In the Netherlands and Norway too, the percentage of persons employed in S&T was higher than 30 %.

By contrast, the lowest shares of HRSTO were found in Turkey, Greece, Portugal and Romania.

In Turkey, this percentage ranged from 6.8 % to 17.6 % in Ankara, with a national average of 10.1 %. In Romania, the regional shares ranged from 13.5 % to 18.9 %, except in the capital region, where it rose to 34.9 %.

Portugal and Greece also returned similar results, with HRSTO shares under 20 %, except in the capital regions, where the figure rose to 26.1 % and 26.5 % respectively.

Comparing the proportions of HRST and HRSTO in 2006 over the continent, the Inner London region ranked first in terms of HRST share (with 57.2 %) (see Science, technology and innovation in Europe, European Commission, 2008 edition) but ranked only 23rd here, with 35.7 % of the labour force employed in S&T.

Regional Innovation Strategy Projects

'Since 1994, more than 120 European regions have received support from the European Commission for carrying out Regional Innovation Strategy (RIS) projects. These projects aim to support regions in developing regional innovation strategies that enhance regional innovation and competitiveness by optimising innovation policies and infrastructure.

The RIS projects were funded by the Directorate-General for Regional Policy. 32 regions have been supported to formulate regional innovation strategies with RIS projects.

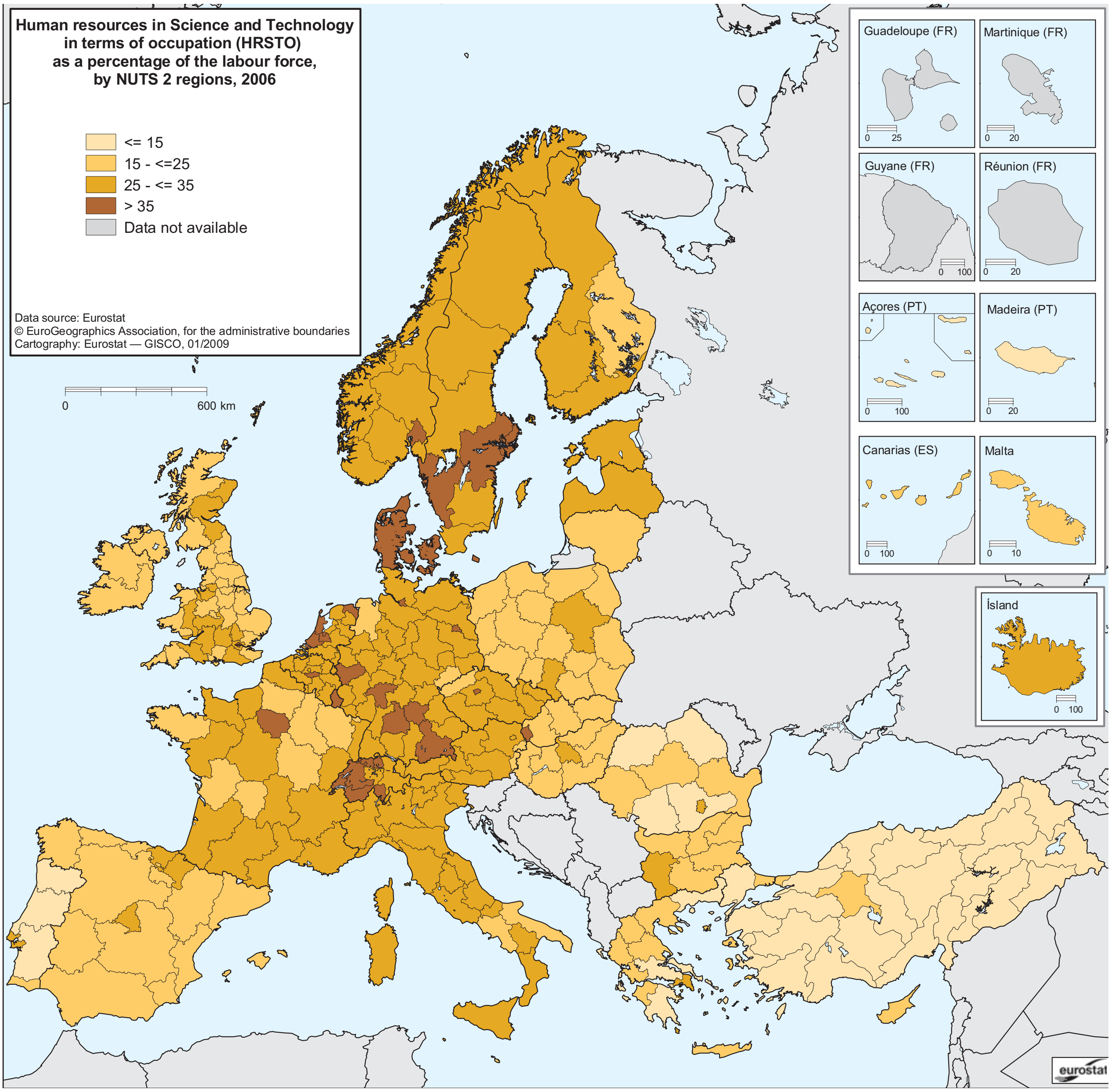
The projects used a common method based on three main elements: consensus-building among key players in the regional innovation system, analysis of the regional innovation system and development of widely endorsed policies and strategic frameworks on innovation support. They enabled regions to implement new initiatives and services that meet regional needs, in particular those of SMEs.'

Current Regional Innovation Strategy projects:

'Several generations of RIS projects have been implemented. In 2005, 33 new RIS projects were launched in regions in the new Member States and associated countries. The projects, which are funded by the Directorate-General for Enterprise and Industry, cover regions in Bulgaria, the Czech Republic, Estonia, Hungary, Israel, Lithuania, Malta, Norway, Poland, Romania, Slovakia, Switzerland and Turkey. Each region is partnered by at least one other region that has already undertaken a RIS project, which allows them to take full advantage of previous experience.'

Source: Innovating Regions in Europe website, http://www.innovating-regions.org

Map 4.17: Human resources in Science and Technology in terms of occupation (HRSTO) as a percentage of the labour force (NUTS level 2), 2006



Regional differences by sector of economic activity

Table 4.18 gives a ranking of the top 30 regions in the EU, Iceland, Norway, Switzerland and Turkey in order of the proportion of persons with tertiary education and employed in S&T (HRSTC) in total employment in the manufacturing and services sectors. Results are given at NUTS 1 regional level for 2006. The share of HRSTC working in the services sector was much higher than in manufacturing. The EU average for HRSTC among total employment in the services sector was 35.1 %, against 9.6 % in manufacturing.

Bruxelles-Capital (BE) reported the highest proportion of HRSTC employed in the services sector (30.8 %). Île-de-France (FR) recorded the highest proportion of HRSTC employed in manufacturing industry as a whole, with 30.9 %. In the services sector, this region ranked seventh in terms of HRSTC share among total employment (29.0 %).

Six of the top 10 regions with the highest proportion of HRSTC in the population working in total manufacturing were also among the top 10 regions in services: Île-de-France (FR), Berlin (DE), Comunidad de Madrid (ES), Bruxelles-Capitale (BE), Sachsen (DE) and Östra Sverige (SE).

Méditerranée (FR) ranked sixth for total employment in manufacturing, with a high share of HRSTC, but did not feature in the top 30 in services. This may be an indication that the manufacturing industry in the Méditerranée region relies on a highly educated and skilled workforce. The services sector may also play a crucial role, as in all regions, but does not seem to be as dependent on highly educated and skilled persons. The region is also influenced by several large branches of industry, especially aeronautics, chemicals and microelectronics (for instance, the Sophia Antipolis Foundation). A similar situation was also observed in Hessen (DE).

Conversely, Centralny (PL) came ninth in services, but was not among the top 30 in manufacturing. This region specialises in trade, telecommunications, financial services and insurance[5].

[5] circa.europa.eu/irc/dsis/regportraits/info/data/en/pl0c_eco.htm

Table 4.18: The top 30 regions in the EU and selected countries ranked according to the proportion of employed HRSTC, in thousands and as a share of total employment in manufacturing and in services, 2006

		Region — NUTS 1	Total manufacturing: 1 000s	Total manufacturing: As % of total employment in manufacturing
		EU-27	3 731	9.6
1	FR	Île-de-France	156	30.9
2	DE	Berlin	46	27.8
3	UK	London	57	24.9
4	ES	Comunidad de Madrid	71	23.1
5	BE	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	6	22.4
6	FR	Méditerranée	47	20.7
7	FI	Manner-Suomi	74	16.8
8	DE	Sachsen	66	16.5
9	SE	Östra Sverige	31	16.1
10	DE	Hessen	86	16.0
11	DK	Danmark	68	15.8
12	FR	Centre-Est	81	15.4
13	DE	Baden-Württemberg	242	15.3
14	CH	Schweiz/Suisses/Svizzera	87	14.5
15	DE	Thüringen	32	14.3
16	ES	Noreste	65	14.1
17	DE	Bayern	215	13.7
18	BE	Région Wallonne	24	13.5
19	UK	South East	66	13.5
20	LU	Luxembourg (Grand-Duché)	2	13.3
21	FR	Sud-Ouest	46	12.9
22	IE	Ireland	33	12.4
23	NL	West-Nederland	45	12.4
24	UK	East of England	42	12.2
25	BE	Vlaams Gewest	60	11.7
26	NL	Zuid-Nederland	35	11.3
27	FR	Nord - Pas-de-Calais	31	11.2
28	NO	Norge	30	11.0
29	FR	Est	57	11.0
30	EL	Attiki	26	11.0

		Region — NUTS 1	Total services: 1 000s	Total services: As % of total employment in services
		EU-27	24 567	35.1
1	BE	Région de Bruxelles-Capitale / Brussels Hoofdstedelijk	99	30.8
2	SE	Östra Sverige	419	30.4
3	ES	Noreste	379	30.3
4	NO	Norge	537	30.1
5	DE	Berlin	361	29.7
6	DK	Danmark	602	29.2
7	FR	Île-de-France	1 197	29.0
8	DE	Sachsen	347	28.6
9	PL	Centralny	543	28.6
10	ES	Comunidad de Madrid	637	28.2
11	BE	Région Wallonne	266	28.1
12	LU	Luxembourg (Grand-Duché)	44	27.6
13	SE	Södra Sverige	382	27.4
14	UK	London	815	27.2
15	BE	Vlaams Gewest	503	27.1
16	ES	Noroeste	311	27.1
17	BG	Yugozapadna I Yuzhna Tsentralna Bulgaria	253	27.0
18	FI	Manner-Suomi	458	27.0
19	LT	Lietuva	233	26.9
20	NL	West-Nederland	809	26.8
21	HU	Kozep-Magyarorszag	247	26.6
22	EL	Voreia Ellada	218	26.3
23	SE	Norra Sverige	150	26.1
24	SI	Slovenija	137	26.1
25	EE	Eesti	102	25.6
26	GR	Attiki	326	25.6
27	DE	Thüringen	171	25.2
28	PL	Wschodni	298	25.1
29	PL	Poludniowy	407	25.0
30	DE	Brandenburg	201	24.9

At NUTS level 1 the following countries are classified as regions CZ, DK, EE, IE, CY, LV, LT, LU, MT, SI, SK, IS, NO and CH.

Data for LI, HR and MK not available.

4.4 Mobility

This section analyses the mobility of highly qualified individuals. 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 include:

- persons who have successfully completed tertiary education and are employed in any type of occupation;
- persons who are not formally qualified as stated above but are employed in an S&T occupation.

Table 4.17 shows the number of employed HRST aged 25-64 years who changed jobs in 2006, broken down by age group and sex, both in absolute numbers and as a share of the total HRST population.

Table 4.19: Job-to-job mobility of employed HRST, broken down by age group and by sex, in thousands and as a percentage of employed HRST population, EU-27 and selected countries, 2006

	Job-to-job mobile HRST									
	25 to 34 years old		35 to 44 years old		45 to 64 years old		Female		Male	
	1000s	As % of HRST total	1000s	As % of HRST total	1000s	As % of HRST total	1000s	As % of HRST total	1000s	As % of HRST total
EU-27	: i	10.6	: i	6.0	: i	2.9	: i	5.9	: i	6.5
BE	61	10.1	32	5.2	16	2.4	50	5.6	59	6.0
BG	u	u	u	u	u	u	u	u	u	u
CZ	32	6.5	17	3.6	17	2.6	31	3.8	35	4.4
DK	51	16.1	49	13.3	41	7.9	67	11.0	74	12.5
DE	370	10.8	300	5.8	154	2.3	371	5.3	452	5.5
EE	u	u	u	u	u	u	10	6.6	7	7.3
IE	u	u	u	u	u	u	u	u	u	u
EL	27	6.3	12	2.8	7	1.7	24	4.2	22	3.1
ES	447	15.9	176	7.7	62	3.0	291	8.8	394	10.2
FR	385	11.7	179	6.2	77	2.3	285	6.1	357	7.2
IT	187	9.0	132	5.1	56	1.9	198	5.6	176	4.4
CY	5	10.2	3	7.0	2	3.8	5	7.9	5	6.7
LV	9	8.5	8	8.5	6 u	4.7 u	15	7.3	8	6.5
LT	16 u	8.8 u	7 u	4.7 u	u	u	17	5.0	13	6.5
LU	2	8.4	1 u	5.5 u	u	u	2	4.9	2	5.3
HU	26	6.4	12	3.6	8	1.7	22	3.2	24	4.5
MT	u	u	u	u	u	u	u	u	u	u
NL	119	12.8	67	6.2	45	3.3	99	6.2	132	7.5
AT	39	10.2	31	6.5	15	3.1	36	6.1	48	6.6
PL	155	8.9	40	3.5	36	2.3	114	4.5	117	6.2
PT	33	8.5	11	3.6	u	u	24	4.7	25	5.2
RO	40	5.9	17	3.3	18	2.5	40	3.9	35	4.0
SI	6	5.8	3 u	2.6 u	2 u	1.8 u	6	3.0	6	3.6
SK	13	5.2	7	3.2	6	2.3	13	3.3	12	3.7
FI	41	14.5	30	9.4	21	4.3	50	8.7	42	8.3
SE	23	4.9	17	3.4	10	1.2	23	2.5	27	3.0
UK	378	12.4	293	9.3	241	5.9	415	8.6	497	9.1
HR	:	:	:	:	:	:	:	:	:	:
MK	:	:	:	:	:	:	:	:	:	:
TR	173	10.0	44	4.2	25	4.0	63	6.5	179	7.3
IS	3	17.8	2	13.6	2	7.4	4	11.1	4	13.6
LI	:	:	:	:	:	:	:	:	:	:
NO	42	15.4	24	7.9	15	3.6	36	7.2	45	9.1
CH	u	u	u	u	u	u	u	u	u	u

flag i: EU-27 aggregate in thousands is not published as data for too many countries are unavailable. It is therefore only shown in percentage.

As expected, young HRST seem more mobile in terms of employment than HRST who are reaching the end of their career. As shown in Table 4.19, in 2006 people in the 25-34 age group were most likely to move from one job to another. At EU level, 10.6 % of the total HRST population aged 25-34 were mobile, against only 2.9 % of HRST aged 45-64.

In absolute numbers, Spain, France and the United Kingdom reported the highest number of mobile HRST aged 25-34, with a combined total of more than 1.2 million. Furthermore, counting these three countries together, 54 % of the HRST who changed jobs in 2006 were aged 25-34, whereas only 17 % were aged between 45 and 64. Germany also counted a large number of mobile HRST, but only 45 % were aged 25-34.

Looking at HRST mobility in relation to the total HRST population in the EU, Denmark had the most mobile 25-34 year old HRST population, with 16.1 %. Denmark also reported the highest shares of mobile HRST for the 35-44 and 45-64 age groups, with 13.3 % and 7.9 % respectively. However, the non-EU country Iceland showed higher shares for the 25-34 and 35-44 age groups with 17.8 % and 13.6 %.

The reason why HRST in Denmark are the most mobile probably lies in the national labour market conditions and policies in force, which play a major role in job-to-job mobility. This result could be explained by the flexicurity concept implemented in Denmark, which fosters mobility by combining loose legislation on employment protection with a generous social safety net for the unemployed and high spending on labour market policies.

Turning to the gender distribution, there was little difference between male and female job-to-job mobility. At EU level, female HRST were slightly less mobile than their male counterparts (5.9 % against 6.5 %). However, in five countries female HRST were more mobile than male HRST. Among them the most notable discrepancies were found in Greece, Italy and Cyprus.

4.5 International mobility

Science for Export

Brain-drain of highly qualified individuals in Poland

'The post-accession wave of emigration from Poland has included scientific researchers, yet a lack of statistics makes it hard to tell just how many of them have left, or ultimately for how long. However, the scale of the phenomenon can be gauged via qualitative studies focusing on the nature of researchers' mobility.

As one of the central planks of the European Research Area concept, greater mobility was intended to boost the scientific potential of the EU – which according to the European Commission requires 'more abundant and more mobile human resources in science.' The Commission has on the one hand concentrated on overcoming administrative and legal obstacles to researchers' mobility (such as by issuing the European Researchers' Charter) and on the other launched large-scale programmes directly assisting mobility (such as the Marie Curie programme, mobility portals and the ERA-MORE network of mobility centres).'

'International researcher mobility is a phenomenon that starts with short, one-day or even several-hour visits paid to foreign research establishments, and scaling up through […] several-month grants, it can lead to several-year stays and even contracts to stay abroad permanently.'

'The issue that concerns the general public most is whether researchers will return to their home country. According to a questionnaire-based study, 26 % of Polish researchers currently residing in Germany and 34 % in the United Kingdom reported that they desired or strongly desired to return and obtain research positions in Poland. A desire to remain abroad, in turn, was reported by 27 % of Polish researchers in Germany and 14 % in the United Kingdom. It is noteworthy that the largest segment of both groups remains undecided, responding 'I don't know' when asked about their plans to return to Poland. Only a small group of those who have gone abroad are specifically planning never to return, and so there is great potential for policies to encourage researchers to return to Poland.

Polish researchers vary somewhat in terms of their overall plans for further mobility: 60 % of those abroad v. 54 % of those working in Poland plan future moves for research purposes, with the most frequently mentioned target countries being the UK, the USA and Germany. On the other hand, it is interesting that as many as one in four Polish researchers who have already worked abroad state that they were definitely not planning any more such moves. Such mobility plans were are also correlated to researchers' type of employment, age and degree of professional advancement.'

Source: A. Kicinger, Academia, Research in Progress Demography, Researchers' mobility in the enlarging EU, Central European Forum for Migration Research, Warsaw, www.cefmr.pan.pl, 2007

The international mobility of core human resources in science and technology (HRSTC) is presented in Table 4.20, which compares the HRSTC labour force born in the country of residence with the HRSTC born abroad (for more details see methodological notes).

In Poland, around 30 % of the foreign-born labour force were HRSTC, against around 15 % of the labour force born in Poland. Denmark recorded high and evenly distributed shares of HRSTC born in Denmark and abroad, at 27.6 % and 28.2 % respectively.

In Luxembourg, the vast majority of foreign-born HRSTC were born within the EU-27 (91.3 %). This can partly be explained by Luxembourg's relatively small size, its geographical location and the presence of EU institutions requiring qualified human resources from the various Member States.

Conversely, in Estonia, 93.8 % of the foreign-born HRSTC were born outside the EU. The same can be said of Latvia. Indeed, the majority of the foreign-born populations in these countries are thought to be of ethnic Russian origin. They settled as internal migrants during the Soviet era and became international migrants with the fall of the Soviet Union.

Table 4.20: Core Human Resources in Science and Technology (HRSTC), age group 25-64, by country of birth, in thousands and as a percentage of labour force and distribution of foreign-born persons by country of birth (EU and non-EU-born), EU-27 and selected countries, 2006

	Born in home country		Born in foreign country		% of foreign-born	
	1000s	% of HRSTC in respective labour force	1000s	% of HRSTC in respective labour force	Born in an EU-27 country	Born outside EU-27
BE	829	22.8	90	16.8	52.2	47.8
BG	485	15.8	u	u	u	u
CZ	524	11.4	13	13.7	61.5	30.8 u
DK	633	27.6	40	28.2	42.5	60.0
DE	5 833	18.7	:	:	:	:
EE	91	18.7	16	15.7	6.3 u	93.8 u
IE	271	18.2	:	:	:	:
EL	736	18.2	18	5.0	50.0	50.0
ES	3 254	20.2	266	9.4	39.1	60.5
FR	4 100	19.1	426	15.5	28.9	71.1
IT	:	:	:	:	:	:
CY	56	21.1	9	15.0	55.6	44.4
LV	127	14.8	15	12.4	u	u
LT	236	17.4	9 u	12.5 u	11.1 u	88.9 u
LU	22	21.7	23	26.4	91.3	8.7
HU	552	14.5	17	24.3	70.6	29.4
MT	16	12.8	u	u	u	u
NL	1 499	24.0	140	16.7	32.1	67.9
AT	373	12.8	71	12.1	66.2	33.8
PL	2 180	14.9	14 u	29.6 u	50.0 u	57.1 u
PT	468	10.8	56	14.7	32.1	69.6
RO	933	10.9	u	u	u	u
SI	155	18.9	7	10.2	u	u
SK	271	11.6	3	18.0	u	u
FI	539	24.3	11	15.5	45.5	54.5
SE	893	25.3	112	19.7	46.4	52.7
UK	4 122	18.9	582	20.1	25.6	74.4
HR	201	14.9	23	12.3	:	:
MK	:	:	:	:	:	:
TR	1 422	7.6	:	:	:	:
IS	20	15.8	2	20.7	u	u
LI	:	:	:	:	:	:
NO	522	27.6	43	25.7	53.5	44.2
CH	568	22.1	194	20.7	67.5	32.5

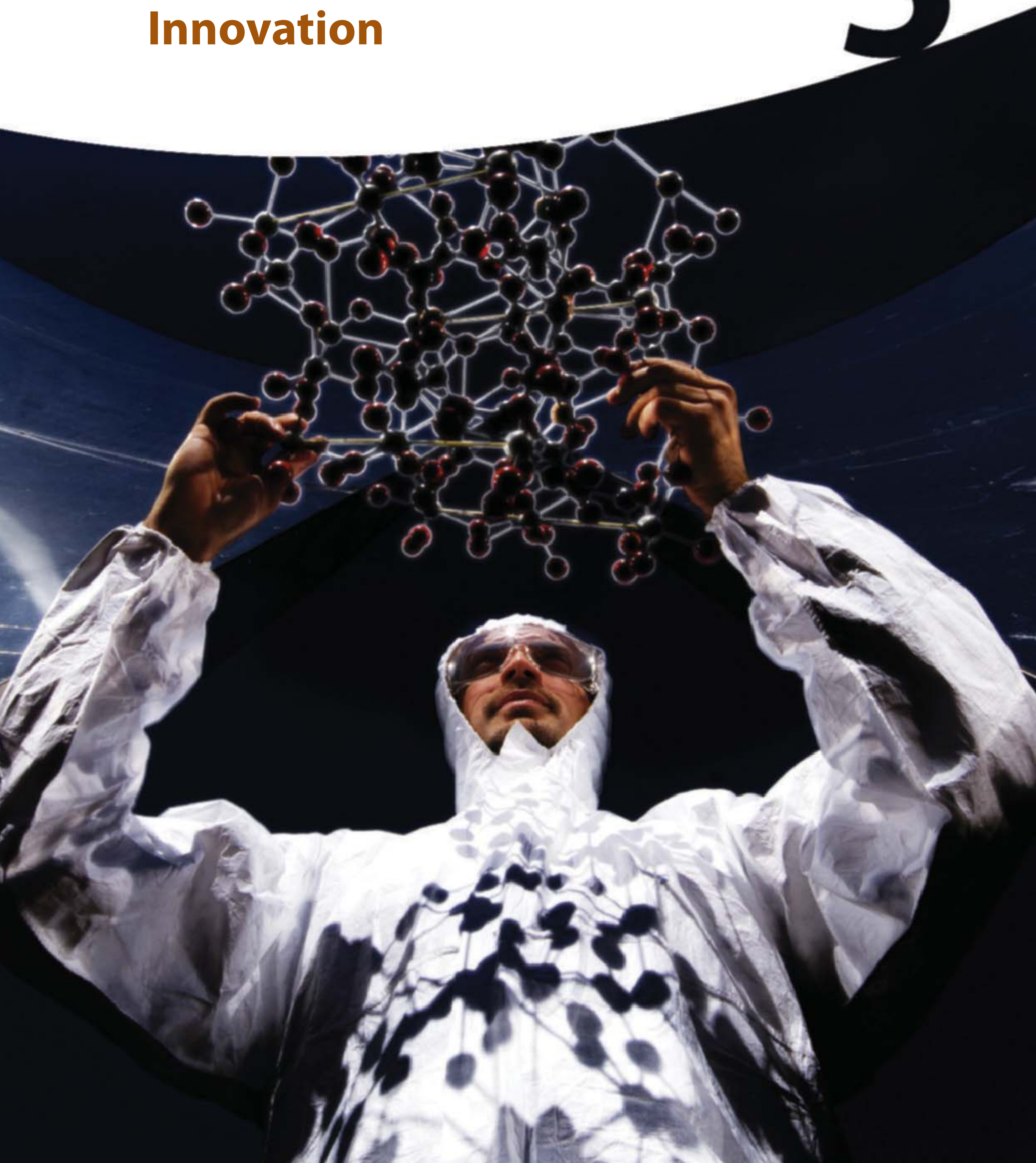
Owing to many missing or unreliable data, the EU aggregates were not calculated.

Part 3

Productivity and competitiveness

5

Innovation



5.1 Introduction

The European Innovation Scoreboard (EIS) is a statistical instrument developed at the initiative of the European Commission in the framework of the Lisbon Strategy to provide a comparative assessment of the innovation performance of EU Member States. To provide a broader picture of the status of innovation, the assessment also includes the United States, Japan and other European countries.

Overall innovation performance is calculated on the basis of 25 indicators covering five dimensions of innovation, the first three relating to innovation inputs, the last two relating to the output and effects of innovation:

1) Innovation drivers: the structural conditions required for innovation potential;
2) Knowledge creation: investment in R&D activities;
3) Innovation & entrepreneurship: innovation efforts at firm level;
4) Applications: performance expressed in terms of labour and business activities and their value added in innovative sectors;
5) Intellectual property: the results achieved in terms of successful know-how.

The Summary Innovation Index (SII) gives an overview of aggregate national innovation performance by presenting 25 indicators for each country studied.

Alongside this instrument, the Community Innovation Survey (CIS) of innovation activities in enterprises covering EU Member States, candidate countries, Iceland and Norway, is carried out by each country every second year.

Overall, the EIS has revealed a general process of convergence of EU countries towards the EU average.

It appears that the gap between the best and poorest EU performers will not be closed in the next 30 years. No major changes were observed in the country grouping distribution, with only Cyprus moving up from the catching–up group to the moderate innovators. There was a general upward trend in countries below the EU-27 average, e.g. Cyprus, the Czech Republic, Estonia, Lithuania and Slovenia, which are in a position to close the innovation gap in a shorter period of time.

Taking a closer look at the available data, it can be concluded that:

- The European economy is increasingly based on services, which are major contributors to GDP and employment. The sector requires better-adapted policies to improve the innovative capabilities of service firms.
- In spite of the overall trend of convergence in innovation performance, discrepancies still clearly remain between EU countries. Beyond GDP, differing levels of innovation performance are chiefly explained by differences in human resources and technology flows.
- Transforming innovation inputs into outputs would improve results in most Member States. Innovation performance in the EIS is measured as the average performance on both innovation inputs and innovation outputs. Innovation efficiency could be stepped up in all Member States by taking both indicators into account.
- Non-R&D-based innovation is also essential. Innovation does not always go hand-in-hand with R&D. Half of European firms labelled as innovative do not actually carry out any R&D; but have nevertheless succeeded in introducing new products or services. This is especially true for the least innovative countries, which have the highest shares of non-R&D innovators.
- The EU is gradually catching up with the United States and Japan in terms of innovation performance; however, the gap still remains significant. Although the EU is increasing its lead over the United States in some indicators such as S&E graduates, employment in medium-high-tech and high-tech manufacturing companies and community trademarks, the United States was ahead in 11 out of 15 indicators and Japan in 12 out of 14. Generally speaking, innovation imbalances are decreasing, but the gap with the US is increasing in public R&D expenditure and high-tech exports.

European Institute of Innovation and Technology (EIT) begins its work

The European Institute of Innovation and Technology (EIT), the EU's flagship initiative for boosting innovation in Europe, has marked the launch of its activities with the first meeting of its recently appointed Governing Board on 15 September 2008. The meeting took place in the Institute's host city of Budapest […]

At the meeting, the Governing Board members unanimously elected Prof. Dr. Martin Schuurmans, a Professor of Physics and former Executive Vice President of Philips Research, as Chairman of the EIT's independent decision making body.

EIT: Mission and main features

Innovation is the key to growth, competitiveness and thus social well-being in the 21st century.

The European Institute of Innovation and Technology (EIT) is a new initiative which aims to become a flagship for excellence in European innovation in order to face the challenges of globalisation.

Although Europe already has excellent education and research institutions, their representatives are often isolated from the business world and do not obtain together the 'critical mass' necessary for innovation.

The EIT is the first European initiative to integrate fully the three sides of the 'Knowledge Triangle' (Higher Education, Research, Business-Innovation) and will seek to stand out as a world-class innovation-orientated reference model, inspiring and driving change in existing education and research institutions.

By boosting the EU's capacity to transform education and research results into tangible commercial innovation opportunities, the EIT will further bridge the innovation gap between the EU and its major international competitors.

The EIT will favour sustainable economic growth and job creation throughout the Union by generating new products, services and markets responding both to public demand and to the needs of the knowledge economy.

Based on partnerships known as 'Knowledge and Innovation Communities' (KICs) – highly integrated public-private networks of universities, research organisations and businesses – the EIT's activities will be coordinated by a Governing Board ensuring its strategic management. Direct involvement of business stakeholders, including SMEs, in all strategic, operational and financial aspects of the Institute is the cornerstone of the initiative.

The EIT: transforming innovative ideas into reality.

Serving the EU's strategic priorities

Operating across Europe, the KICs will be selected by the EIT Governing Board on a strategic basis as responses to the foremost challenges currently facing the Union. The first areas covered by the Institute are likely to include -amongst others - climate change, renewable energies and the next generation of information and communication technologies. […]

Connecting European business and research

Businesses stand to gain as they will be given fresh opportunities to commercialise the most up-to-date and relevant research findings, potentially giving Europe first-mover advantage in the latest technological fields. In return, research organisations will benefit from additional resources, an enhanced networking capacity and new research perspectives stressing interdisciplinary approaches in areas with strong societal and economic importance.

Higher education and the EIT: a new approach to learning

Until now, higher education has notoriously been the absent member of innovation partnerships. However, new skills and talents will be crucial to the concrete exploitation of Europe's innovation potential and the EIT will advocate the change of mindset required to make this possible. […]

An incremental development path

The EIT represents a novel approach to innovation at the EU level. For this reason it needs to be set up gradually, based on a phased implementation in view of its long-term development perspectives. During the first phase, two or three KICs will be established. Subsequent partnerships will follow after the adoption of the first Strategic Innovation Agenda.

Leverage for businesses

An initial Community budget contribution of over EUR 300 million will help to launch the EIT during the 2008-2013 period and will provide the support structure and the conditions necessary for integrated knowledge transfer and networking. In turn, in order to profit from the considerable returns which the initiative is likely to generate, businesses will be expected to buy into the EIT and be willing to lead the way in the unleashing of Europe's innovation potential.

Source: http://ec.europa.eu/eit/

5.2 European Innovation Scoreboard 2007

Results at European level

The 2007 EIS includes innovation indicators and trend analyses for the 27 EU Member States and for Croatia, Turkey, Iceland, Norway, Switzerland, Japan, the United States, Australia, Canada and Israel.

Based on their innovation performance, the countries included in the 2007 EIS are divided into the following country groups:

- The innovation leaders are among the best performers in all five dimensions. They include Denmark, Finland, Germany, Israel, Japan, Sweden, Switzerland, the United Kingdom and the United States. Sweden stands out as the most innovative country, largely due to strong innovation inputs, although it was less efficient than some other countries in transforming these into innovation outputs.
- The innovation followers group comprises countries whose performance is above average in almost all dimensions, and includes Austria, Belgium, Canada, France, Iceland, Ireland, Luxembourg, and the Netherlands.
- The moderate innovators are close to or below average across all dimensions. Australia, Cyprus, Czech Republic, Estonia, Italy, Norway, Slovenia and Spain belong to this group.
- The catching-up countries are below the EU average in all dimensions and include Bulgaria, Croatia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania and Slovakia. Turkey's innovation performance is currently well below that of other countries included in the EIS.

These country groups appear to have been relatively stable over the past five years. Within the groups, countries have changed their relative ranking but it is rare for a country to have moved between groups. Only Luxembourg seems to be on the verge of entering the group of innovation leaders.

Although group membership tends to be stable, some changes have been observed:

- Luxembourg is in the process of moving from the innovation followers to the innovation leaders;
- Cyprus has moved from the catching-up countries to the moderate innovators;
- Latvia and Romania were initially on a par with Turkey before moving up to the catching-up countries.

The SII indicator for Australia, Canada, Croatia, Israel, Japan, Turkey and the United States is an estimate based on a more limited set of indicators. The relative position of these countries should thus be interpreted with care.

TThe Summary Innovation Index (SII) gives an overview of aggregate national innovation performance. Figure 5.1 shows the 2007 SII results by country and in relation to their respective growth rates.

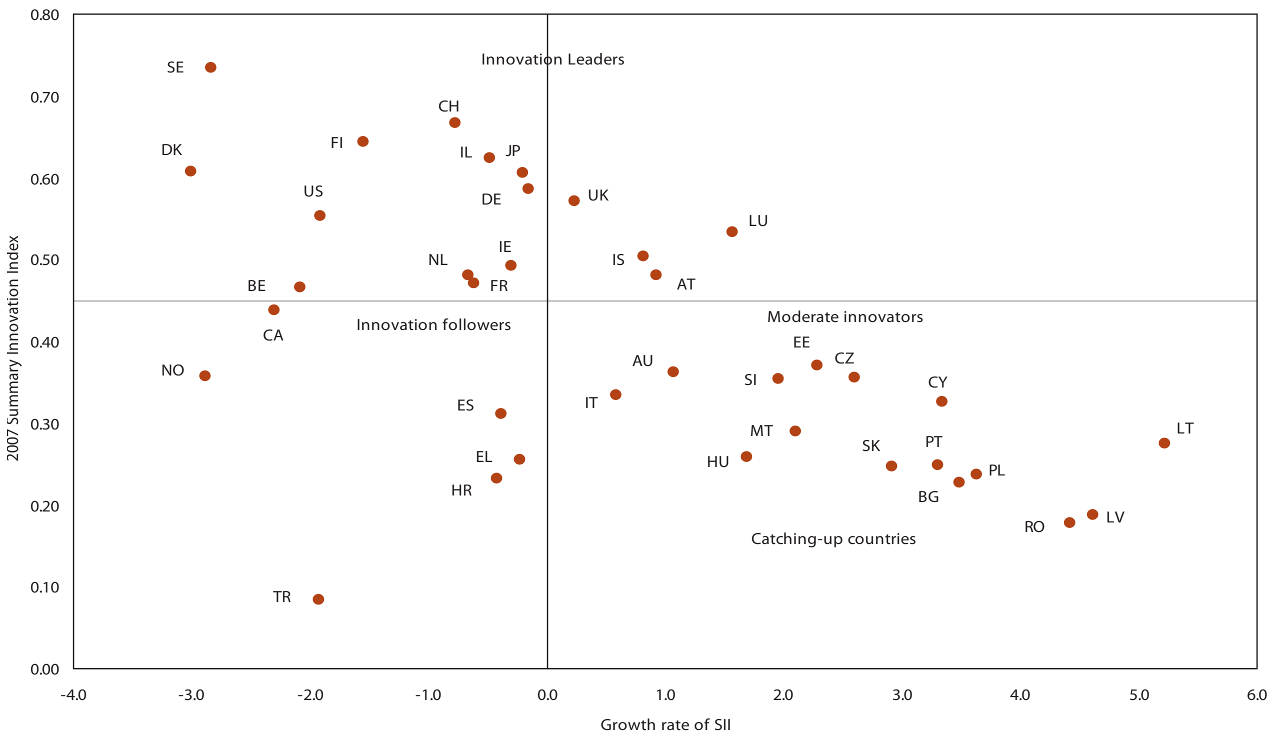
As already mentioned, for Australia, Canada, Croatia, Israel, Japan, Turkey and the US, the SII is an estimate based on a more limited set of indicators. The relative position of these countries should therefore be interpreted with care.

The SII is calculated using the most recent statistics available from Eurostat and other internationally recognised sources at the time of analysis. International sources have been used wherever possible to improve comparability between countries. Note that the data relate to actual performance in years previous to 2007. As a consequence, the 2007 SII captures neither the most recent changes in innovation performance, nor the impact of policies introduced in recent years, which may yet take some time to have an impact on innovation performance.

Within the groups of innovation leaders and innovation followers, the tendency points towards slowing average SII growth rates, mostly below 0.0, except for the United Kingdom, Iceland, Austria and Luxembourg.

On the other hand, most countries with below average SII (moderate innovators and catching up countries) achieved positive SII growth rates. This was most remarkable in Lithuania, with a growth rate of more than 5.0 points.

Figure 5.1: Summary Innovation Index (SII) in 2007 and growth rate of SII, EU-27 and selected countries



Dotted lines show EU mean performance.

Source: Eurostat based on EIS 2007

Table 5.2: EIS 2007 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	Broadband penetration rate (number of broadband lines per 100 population)	Eurostat, OECD
1.4	Participation in life-long learning per 100 population aged 25-64	Eurostat
1.5	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	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	Eurostat, OECD
2.4	Share of enterprises receiving public funding for innovation	Eurostat (CIS 4)
	INPUT – Innovation & entrepreneurship	
3.1	SMEs innovating in-house (% of all SMEs)	Eurostat (CIS 4)
3.2	Innovative SMEs co-operating with others (% of all SMEs)	Eurostat (CIS 4)
3.3	Innovation expenditures (% of total turnover)	Eurostat (CIS 4)
3.4	Early-stage venture capital (% of GDP)	Eurostat
3.5	ICT expenditures (% of GDP)	Eurostat, World Bank
3.6	SMEs using organisational innovation (% of all SMEs)	Eurostat (CIS 4)
	OUTPUT – Applications	
4.1	Employment in high-tech services (% of total workforce)	Eurostat
4.2	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)
4.4	Sales of new-to-firm products (% of total turnover)	Eurostat (CIS 4)
4.5	Employment in medium-high and high-tech manufacturing (% of total workforce)	Eurostat, OECD
	OUTPUT – Intellectual property	
5.1	EPO patents per million population	Eurostat, OECD
5.2	USPTO patents per million population	Eurostat, OECD
5.3	Triadic patent families per million population	Eurostat, OECD
5.4	New community trademarks per million population	OHIM, Eurostat, OECD
5.5	New community designs per million population	OHIM, Eurostat, OECD

Source: Eurostat based on EIS 2007

The 25 innovation indicators in the 2007 EIS have been split into five dimensions to better capture the various aspects of the innovation process. Innovation drivers are the structural conditions required for innovation potential, knowledge creation is investment in R&D activities, innovation & entrepreneurship represents innovation efforts at firm level, applications represents performance expressed in terms of labour and business activities and their value added in innovative sectors, and intellectual property represents the results achieved in terms of successful know-how.

Table 5.3: SII trend over time for innovation leaders

Innovation leaders	2003	2004	2005	2006	2007
Denmark	0.68	0.66	0.65	0.64	0.61
Germany	0.59	0.59	0.59	0.59	0.59
Sweden	0.82	0.80	0.78	0.76	0.73
Finland	0.69	0.68	0.65	0.67	0.64
United Kingdom	0.57	0.57	0.56	0.55	0.57
Switzerland	0.68	0.69	0.68	0.67	0.67
Israel	0.63	0.63	0.64	0.63	0.62
Japan	0.60	0.61	0.61	0.60	0.60
United States	0.60	0.59	0.57	0.55	0.55

Source: Eurostat based on EIS 2007

Except for the United Kingdom, a decreasing trend can be generally observed in the group of 'innovation leaders' over the period considered.

Nordic countries (Sweden, Finland and Denmark) came out as the leading innovators in Europe.

Sweden stands out as the most innovative country, and recorded the highest SII of all countries, although its growth performance was below that of the EU average, mainly due to its weaknesses in terms of innovation outputs. Switzerland came in second place followed by Finland, which has lost potential in innovation and entrepreneurship.

Israel, which was recently included in the European Innovation Scoreboard, ranked high in the innovation leaders group, displaying strong capacity for innovation.

In the 2007 SII, Japan and Denmark recorded similar innovation scores, although the latter has experienced a strong decline from last year's SII.

Germany's innovation index was relatively stable over the past five years. Thanks to positive SII growth rates, the United Kingdom moved up one place compared with 2006 particularly due to strong performance on indicators of innovation and entrepreneurship. The United States came in last position among the innovation leaders, as a result of a declining SII trend in recent years on the basis of the available indicators (but note that some indicators, particularly those from the CIS, are not available for the US). Innovation capacity in the US is growing more slowly than in the EU, leading to a reduction in the innovation gap between the EU and the US.

Table 5.4: SII trend over time for innovation followers

Innovation followers	2003	2004	2005	2006	2007
Belgium	0.51	0.49	0.49	0.48	0.47
Ireland	0.50	0.49	0.50	0.49	0.49
France	0.48	0.48	0.48	0.48	0.47
Luxembourg	0.50	0.50	0.53	0.57	0.53
Netherlands	0.50	0.49	0.49	0.48	0.48
Austria	0.47	0.46	0.48	0.48	0.48
Iceland	0.49	0.50	0.49	0.49	0.50
Canada	0.48	0.48	0.45	0.44	0.44

Source: Eurostat based on EIS 2007

Luxembourg, Iceland, Ireland, Austria, the Netherlands, France, Belgium and Canada comprise the group of innovation followers, with innovation performance levels below those of the innovation leaders but equal to or above that of the EU-27.

Luxembourg's innovation performance has been rising in recent years compared with the EU average, and it is close to joining the group of innovation leaders, although its SII for 2007 was lower than in the previous year.

In recent years, a positive overall trend was also observed in Iceland, which ranks second in the list.

The trend in Ireland's innovation performance over the past five years has somewhat slowed, but has kept up with the EU average.

Austria and the Netherlands achieved similar levels of innovation performance in 2007, but while innovation rose by more than the average in Austria, the trend in the Netherlands was below the EU average.

France's innovation performance is in line with the general trend, but has slightly decreased between 2006 and 2007.

In the past five years, Belgium's innovation performance has declined relative to the average EU growth rate, dropping from 0.51 in 2003 to 0.47 in 2007.

Belgium, France and the Netherlands are in danger of falling back to the EU average within a relatively short period of time.

Table 5.5: SII trend over time for moderate innovators

Moderate innovators	2003	2004	2005	2006	2007
Czech Republic	0.32	0.33	0.33	0.34	0.36
Estonia	0.35	0.34	0.35	0.37	0.37
Spain	0.32	0.31	0.32	0.32	0.31
Italy	0.32	0.33	0.33	0.33	0.33
Cyprus	0.29	0.29	0.30	0.32	0.33
Slovenia	0.32	0.34	0.34	0.36	0.35
Norway	0.40	0.39	0.38	0.37	0.36
Australia	0.35	0.35	0.35	0.35	0.36

Source: Eurostat based on EIS 2007

In the short run, Estonia, the Czech Republic, Slovenia and Cyprus are likely candidates to complete their catching-up process in the short term.

Estonia's innovation performance has been increasing over the past five years in relation to the EU average, taking the lead of the moderate innovators' group in 2007. If this trend continues into the next decade, Estonia will be in a position to catch up with the EU average.

The same applies to innovation performance in the Czech Republic, which has been growing steadily in recent years and is drawing closer to EU average levels.

Australia's innovation performance has been stable in recent years and registered an increase from 2006 to 2007.

Slovenia's innovation performance was higher than in some EU-15 Member States. It has been growing relative to the EU average over the past four years but fell back in 2007.

Innovation performance was stable in Italy and grew only slightly over the last five years relative to the EU average. Italy's weaknesses should be taken into account to achieve higher innovation performance.

Cyprus, which recently joined the group of moderate innovators, ranked higher than Spain in the 2007 SII.

The trend in Spain's innovation performance generally matched the EU average trend over the past five years.

Table 5.6: SII trend over time for catching-up countries

Catching-up countries	2003	2004	2005	2006	2007
Bulgaria	0.20	0.21	0.20	0.22	0.23
Greece	0.26	0.26	0.26	0.25	0.26
Latvia	0.16	0.16	0.17	0.18	0.19
Lithuania	0.23	0.24	0.24	0.26	0.27
Malta	0.27	0.27	0.28	0.29	0.29
Hungary	0.24	0.25	0.25	0.25	0.26
Poland	0.21	0.21	0.22	0.23	0.24
Portugal	0.21	0.24	0.23	0.25	0.25
Slovakia	0.23	0.22	0.23	0.24	0.25
Romania	0.16	0.15	0.16	0.17	0.18
Croatia	0.24	0.23	0.23	0.23	0.23

Source: Eurostat based on EIS 2007

Although innovation performance in catching-up countries was significantly below the EU average, SII in catching-up countries has been increasing in the past five years faster than the EU average, with the exception of Croatia and Greece.

Malta remained ahead of the catching-up group and has made efforts in the past five years to maintain this position. If this trend continues, it could soon move up to the group of moderate innovators.

Lithuania maintained its 2006 position in terms of innovation performance and could close the innovation gap in a relatively short period of time.

Hungary and Greece achieved similar levels of innovation performance in 2007, followed by Portugal and Slovakia. Over the period considered, innovation performance in Greece has remained stable in relation to the EU average, while that of Hungary has increased.

Innovation performance in Slovakia and Portugal has increased in relation to other Member States. If current trends continue, the EU average could be reached within 20 years.

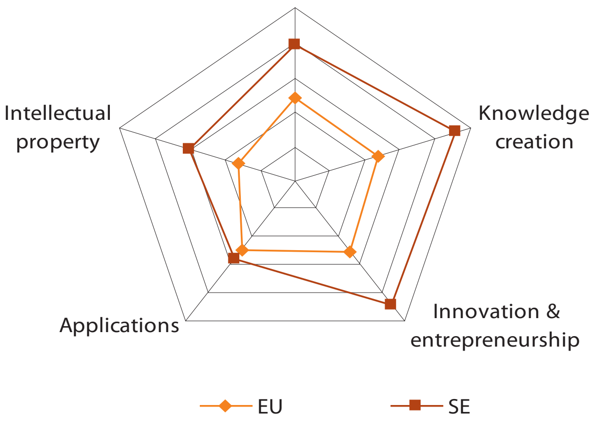
The remaining five countries (Poland, Croatia, Bulgaria, Latvia and Romania), although still at the bottom of the league, have registered an increase in relation to previous years, which will help in improving their position.

Results at national level

Innovation Leaders

Sweden

Figure 5.7: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Sweden recorded the highest overall level of innovation performance of all countries included in the European Innovation Scoreboard. Other EU countries with comparable levels of performance include Finland, Denmark, Germany and the UK. However, in recent years the growth rate of innovation performance in Sweden has been below the average EU trend.

Among the five dimensions under scrutiny, Sweden performed particularly strongly on Knowledge creation and on Innovation & entrepreneurship: in both cases it was the best performing country. Its performance was poorer, although still above the EU average, in Applications. The analysis of innovation efficiency indicates that Sweden was relatively inefficient in transforming innovation inputs into outputs.

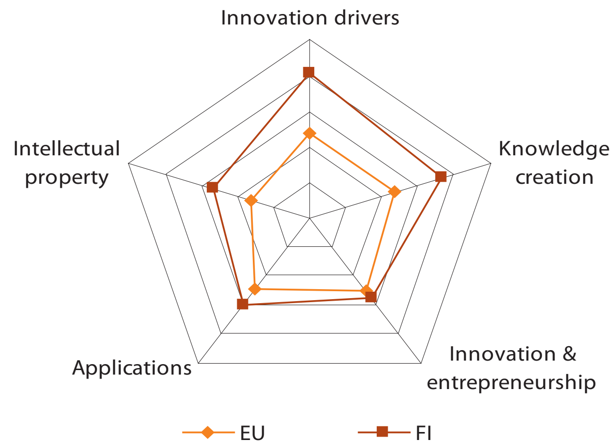
'Sweden has a model of innovation governance based on a thin ministerial layer in charge of drawing up policies.

Powers of implementation are transferred to a complex array of agencies, which are also responsible for the design of policy instruments. In recent years, there has been a growing policy debate about the status of the innovation system, which has stimulated a change in the policy mix in favour of innovation.

Key measures can be divided into research-oriented instruments on the one hand, and market-oriented instruments on the other. The former include measures to create international competitive research environments, more funding for strategic research (life sciences, engineering and sustainable development) as well as improving graduate schools. Market-oriented measures include improved transfer of technology and structures for the commercialisation of research, as well as an improved supply of seed financing through the Innovation Bridge.' [1]

Finland

Figure 5.8: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Finland ranks behind Sweden as the second most innovative country in the EU, and is among the group of innovation leaders. Besides Sweden, other EU countries with comparable performance in innovation include Denmark, Germany and the UK. Finland's innovation performance has decreased over the last five years relative to the average EU trend.

'Finland counts among the top three EU countries in the dimensions of Innovation Drivers, Knowledge Creation and Applications; it also ranks among the top three European countries when considering Tertiary education, Public and business R&D expenditures, Early-stage venture capital, and Patenting. Its weakest performance was registered in the key dimension of Intellectual property, owing to the fact that Finland was below the EU average in terms of Community industrial designs. However, the analysis reveals that Finland ranked above average when it comes to transforming innovation inputs into outputs.

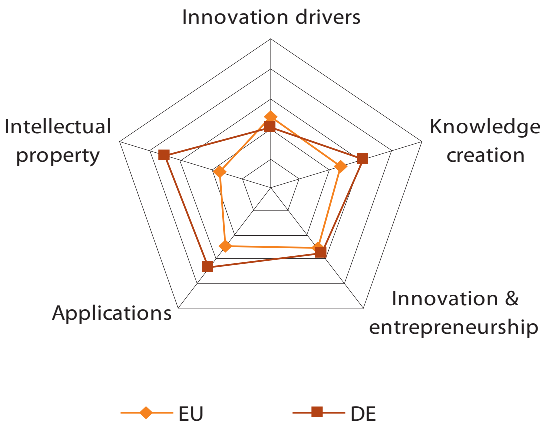
The Government Resolution on the development of the public research structure (7 April 2005) defines the framework for the renewal of its innovation system. According to the Resolution, the public research system will be mainly developed on the existing basis. It also includes a clear action plan for strengthening decision making and guidance in science, technology and innovation policy. The Science and Technology Policy Council will be developed as the principal expert body in all major questions of science, technology and innovation policy.' [2]

(1) Source: Country Report Sweden- Inno Policy Trendchart: http://www.proinno-europe.eu/

(2) Source: Country Report Finland- Inno Policy Trendchart: http://www.proinno-europe.eu/

Germany

Figure 5.9: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Germany's strengths reside in Applications and Intellectual property, where it recorded high performances in Sales of new to market products and Employment in medium-high-tech and high-tech manufacturing as well as strong performances in Patenting. However, it ranked below the EU average in Innovation drivers, most notably for S&E graduates, Participation in life-long learning and Youth education attainment level. Germany recorded one of the highest efficiencies in the EU in terms of transforming innovation inputs into outputs.

'*Innovation governance in Germany is characterised by a federal system involving stakeholders at federal government level and at the level of the federal states (Länder).*

The federal government follows three main policy lines in innovation policy:

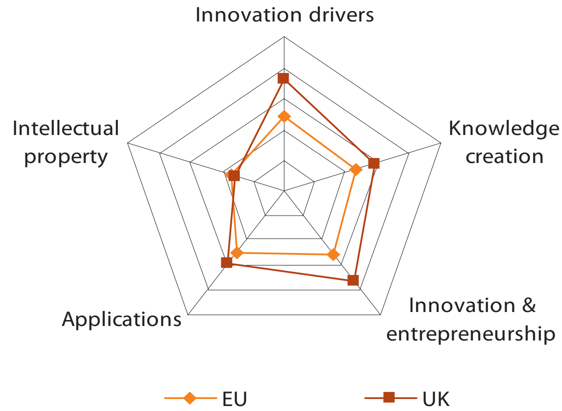
*- Improving **framework conditions** for innovation, notably by simplifying the tax system and reducing the tax burden on firms, and by cutting administrative procedures that may hamper innovation and the creation of new enterprises.*

*- Improving the **education and science system** in order to tackle shortages in the supply of qualified labour, to improve companies' access to highly qualified personnel, including vocational and on the job training, and to provide a public research base as a partner in innovation projects.*

*- Promoting **innovation activities in firms** by means of financial aid (subsidies, R&D grants for research in high-tech areas, R&D grants for cooperative research by SMEs, financial support for innovation projects in technology-oriented SMEs, provided either as loans or as venture capital).*'[3]

United Kingdom

Figure 5.10: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

The trend in the UK's innovation performance over recent years has been more or less consistent with the EU average growth rate.

Regarding the five key dimensions of innovation performance, the UK performed particularly strongly in Innovation & entrepreneurship, with relatively high shares in Early-stage venture capital. Its performance was below the EU average in Intellectual property, with relatively low levels for the indicators of Triadic patents and Community designs. An analysis of innovation efficiency suggests that the UK was above the EU average in transforming innovation inputs into Applications, but below average in transforming such inputs into Intellectual property outputs.

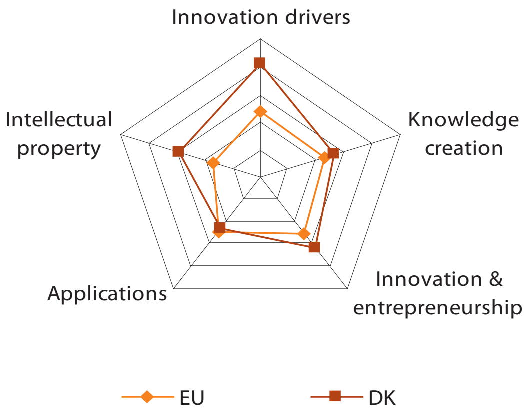
'*One major challenge in the governance system is that business-university engagement remains inconsistent across industries and regions. The government, together with the Higher Education Funding Council for England (HEFCE), is taking steps to promote best practice in business-university interaction. Another two challenges highlighted in this report are that the UK has not always been effective in translating the products of excellent research into economic gain; and public and private investment in R&D remains lower than that of many leading competitors. In order to help effectively translate excellent research into economic gain, there appear to be a number of opportunities to create a more favourable environment for science and innovation, ensuring that the UK maintains its position among the innovation leaders*'.[4]

(3) Source: Country Report Germany- Inno Policy Trendchart: http://www.proinno-europe.eu/

(4) Source: UK tresury- http://www.hm-treasury.gov.uk/media/7/8/bud06_science_332v1.pdf

Denmark

Figure 5.11: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Denmark's innovation performance declined over the past five years compared with the EU average.

Denmark ranked first in Innovation drivers, with particularly high shares for Population with tertiary education, Broadband penetration rate and Participation in life-long learning. However, its performance in Applications was below the EU average, particularly in Exports of high technology products, Sales of new-to market products, Sales of new-to-firm products and Employment in medium-high-tech and high-tech manufacturing. Denmark did better than the EU average in its efficiency in transforming innovation inputs into outputs (both Applications and Intellectual Property).

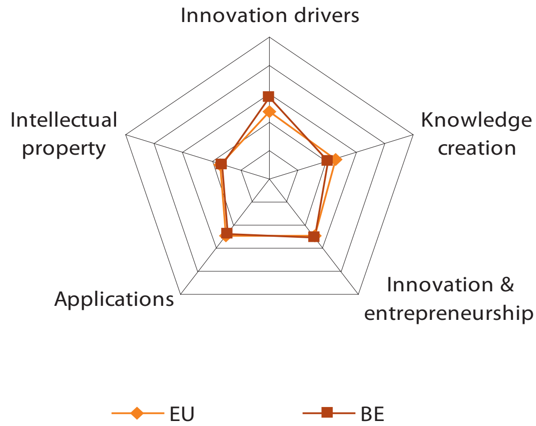
'*Denmark does not have a specific innovation policy. Innovation is rather seen as a cross disciplinary theme influencing a number of policy areas. Danish innovation policy is characterised by strong stakeholder involvement in policy formulation and a strong tradition of consensus. There is interaction with all key stakeholders and consultation and partnerships increasingly feature on the agenda. Coordination among the different organisations involved in policymaking related to innovation plays an important role. Inter-ministerial committees were recently established to further improve this coordination.*

The Globalisation Strategy was presented in March 2006, aiming to ensure that 'Denmark is to be among the countries where it is best to live and work – also in ten to twenty years' time.'[(5)]

Innovation Followers

Belgium

Figure 5.12: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Within the five key dimensions of innovation, Belgium performed below EU average in 'Knowledge creation', with discrepancies between skill requirements and needs. Belgium remained close to the EU average in Innovation drivers, Innovation and entrepreneurship, and Intellectual property. Belgium was, however, above average in transforming innovation inputs into Applications, but below average in transforming inputs into Intellectual Property.

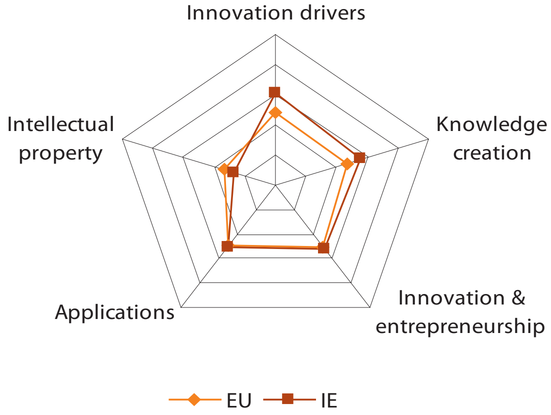
'*Belgian authorities are fully aware of the need for boosting innovation and entrepreneurship in order to improve the flagging competitiveness of the economy. As a highly decentralised country, Belgium offers an interesting insight into how regionalisation of competences for innovation and economic development can lead to divergent paths in the policy mix adopted by each authority. Equally, synergies between the interventions of the Federal Government (in terms of innovation policy on fiscal measures, reducing administrative and legislative barriers to entrepreneurship and intellectual property policies) and the regional governments have been sought.*'[(6)]

(5) Source: Country Report Denmark- Inno Policy Trendchart: http://www.proinno-europe.eu/

(6) Source: Country Report Belgium - Inno Policy Trendchart: http://www.proinno-europe.eu/

Ireland

Figure 5.13: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

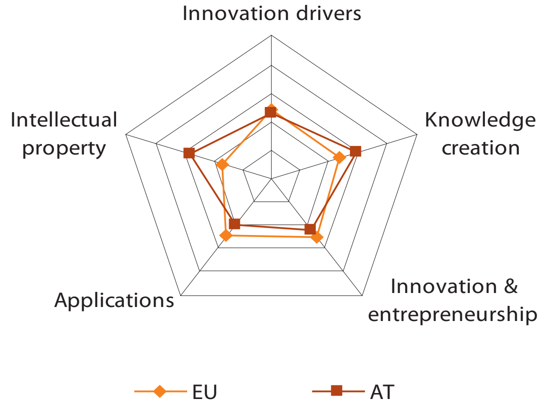
Among the five dimensions of innovation, Ireland registered strong performance in Innovation drivers, performing well above the EU average in terms of S&E graduates. However, it was relatively weak on Intellectual property, where it scored below the EU average for the indicators of patent applications and Community industrial designs. The analysis reveals that Ireland registered above average efficiency in transforming innovation inputs into Applications, but was below average in transforming such inputs into Intellectual Property.

'*A new National Development Plan entitled 'Transforming Ireland – A Better Quality of Life for All' has been drawn up for the period 2007-2013. This corresponds with the stated aim of the Irish Government of achieving a transformation of Ireland to deliver a better quality of life for all its citizens. This plan, which was launched on 26 January 2007, sets out the roadmap to Ireland's future.*

Within the next seven years, Ireland's economy and society will undergo a transformation almost as radical as the changes it has experienced in the past decade of record levels of growth and development. In the course of the next seven years, the new National Development Plan will provide for some EUR 184 billion in investments – including over EUR 13.6 billion provided by the Department of Enterprise, Trade and Employment (DETE) – in securing the next step in Ireland's economic and social transformation.' [7]

Austria

Figure 5.14: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Within the five key dimensions of innovation, Austria performed well above the EU average in Knowledge creation and Intellectual Property, with relatively high levels in terms of R&D expenditure, Patenting and the number of Community trademarks and industrial designs. However, Austria recorded relative weaknesses in Innovation drivers, owing to relatively low levels of Participation in tertiary education and life-long learning. This was also the case in Applications, stemming from low employment in high-tech services and low sales shares in new to firm and new to market products. Austria's performance in transforming innovation inputs into outputs was above the EU average.

'*Austria counts among the group of innovation followers, with innovation performance above the EU average, but below that of the innovation leaders. Other EU countries in this group with therefore similar levels of performance include Belgium, France, Ireland, Luxembourg and the Netherlands. Austria's innovation performance has improved over the past five years in relation to the EU average.*

In order to strengthen the quality of the innovation system, most measures in Austrian innovation policy concentrated on the following areas:

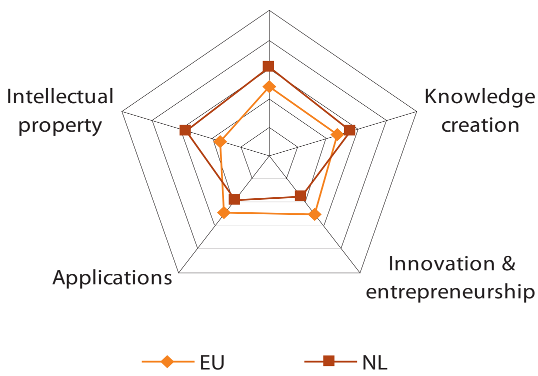
- *strengthening cooperation between science and the economy,*
- *investing in highly qualified human resources,*
- *creating an investment-friendly environment,*
- *increasing financial incentives for R&D.*'[8]

[7] Source: Country Report Ireland- Inno Policy Trendchart: http://www.proinno-europe.eu/

[8] Source: Country Report Austria- Inno Policy Trendchart: http://www.proinno-europe.eu/

The Netherlands

Figure 5.15: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Innovation performance in the Netherlands has been on a par with the EU average over the past five years.

Among the five key dimensions of innovation performance, the Netherlands performed relatively strongly in Intellectual property, where it scored well above the EU average in terms of Triadic patents. In contrast, it performed relatively poorly in Innovation & entrepreneurship and Applications. Analysis indicates that the Netherlands was above the EU average in its efficiency in transforming innovation inputs into outputs.

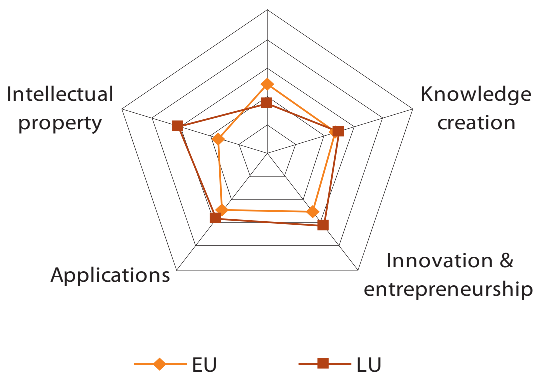
'*The administrative structure for regional innovation systems is divided into three levels: the national level, the provincial (regional) level and the municipal (local) level.*

In order to better address the challenges of the Dutch innovation system, the Ministry of Economic Affairs has renewed and restructured its instruments and their implementation. The aim of the proposed reform of the policy mix is to achieve greater flexibility and tailor made solutions to meet the needs of businesses. The accessibility of the instruments is improved by reducing the number of access points and by means of a substantial reduction in the preparation costs and administrative burden. Financial and non-financial measures should motivate entrepreneurs to deliver 'top performances.'[9]

[9] Source: Country Report The Netherlands- Inno Policy Trendchart http://www.proinno-europe.eu/

Luxembourg

Figure 5.16: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Luxembourg ranks among the innovation followers, with an overall performance above the EU average but below that of the innovation leaders.

Luxembourg has relative strengths in Innovation & entrepreneurship, Applications, and Intellectual property and it recorded particularly high levels for the indicators of Enterprises receiving public funding, Exports of high-technology products, Triadic patents and Community trademarks. It appears from the analysis that Luxembourg is among the most efficient EU countries in terms of transforming innovation inputs into outputs.

'*The innovation system in Luxembourg does not comprise many levels. Policy is made at the national level, with three Ministries involved.*

Luxembourg has initiated strong measures to increase innovation financing. Currently, the paramount need is for Luxembourg to integrate the set of existing measures in a broad plan fixing objectives and orientations for a future innovation policy in order to increase the efficiency of each measure and to create a coherent set of measures.

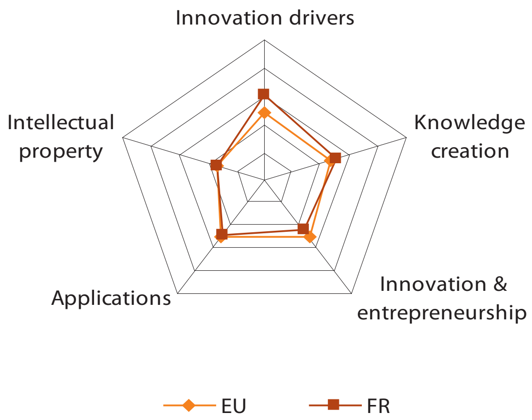
Its strategic goals are to create international excellence in a few selected fields, while maintaining and leveraging its position in the Greater Region, so as to compensate for its small size and resource base.

Current policies are more project-like than programme-like, and without a policy framework they will remain less effective than they could be if they were part of a coherent programme within a broader national strategy.'[10]

[10] Source: Country Report Luxembourg- Inno Policy Trendchart: http://www.proinno-europe.eu/

France

Figure 5.17 Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

France's overall innovation performance places it among the innovation followers, with a performance that is above the EU average but below that of the innovation leaders. The trend in France's innovation performance over the last five years has remained close to the EU average.

In the five key dimensions of innovation performance, France ranked above the EU average for Innovation drivers and Knowledge creation, but was marginally below average on Innovation & Entrepreneurship, Applications and Intellectual property. The analysis suggests that France was efficient in transforming innovation inputs into Application outputs, but below average in transforming such inputs into Intellectual Property outputs.

'*In the course of the past years, the French innovation and research institutional framework has changed radically.*

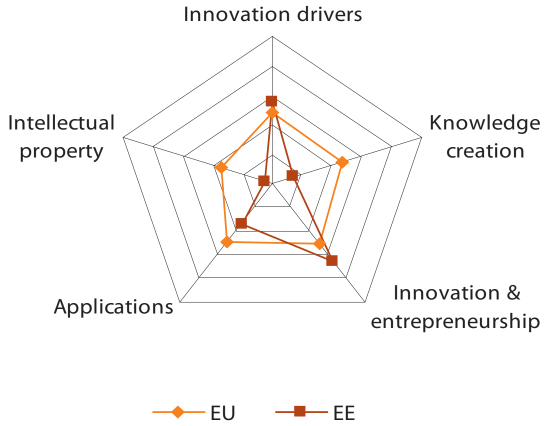
In order to distinguish policy orientation strategies as regards research and innovation from the implementation and effective support, two major new agencies were added to the French national research and innovation system: the National Agency for Research and the Agency for Industrial Innovation. These two bodies are responsible for financing innovation and research.

The recent developments in the French research and innovation system have been carried out to address crucial challenges identified at national level. Strong emphasis is placed on reinforcing public and private linkages and the relationships between producers and users of knowledge.'[11]

Moderate Innovators

Estonia

Figure 5.18: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Estonia's innovation performance is on track to reach the EU average within 10 years if current trends continue.

Estonia ranked fourth among EU countries in Innovation & Entrepreneurship, with performance well above the EU average for SMEs innovating in-house, ICT expenditure and SMEs using organisational innovation. Estonia also demonstrated relative strengths in Innovation drivers, where it was above the EU average for Population with tertiary education, Broadband penetration rate and Youth education attainment level.

However, Estonia's performance in Knowledge creation was relatively weak, with indicators of Business R&D expenditure and Share of enterprises receiving public funding for innovation well below average. Estonia was also relatively weak in Intellectual property and its efficiency in transforming innovation inputs into outputs was below the EU average (both in Applications and in Intellectual Property).

'*Knowledge-based Estonia', the Estonian Research and Development and Innovation Strategy for the period 2007–2013, focuses on sustainable development of the society by means of research, development and innovation. This contributes to Estonia's long-term strategy for development, entitled 'Sustainable Estonia 21', and to the Lisbon strategy for growth and jobs.*

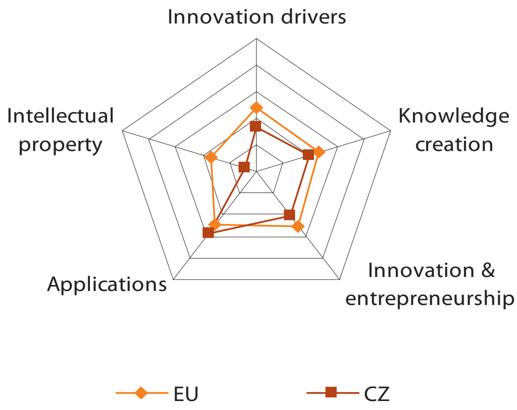
As for general innovation strategy indicators, total expenditure on research and development is planned to be increased to 1.5 % of GDP by 2008, 1.9 % by 2010, and 3 % of GDP by 2014.'[12]

(11) Source: Country Report France- Inno Policy Trendchart: http://www.proinno-europe.eu/

(12) Source: Country Report Estonia- Inno Policy Trendchart: http://www.proinno-europe.eu/

Czech Republic

Figure 5.19: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

The Czech Republic's innovation performance has improved over the last five years against the EU average; if current trends continue, its performance will converge with the EU average in about 10 years.

The Czech Republic performed relatively well in Applications, with high scores in Sales of new-to-market products, Sales of new-to-firm products and Employment in medium-high and high-tech manufacturing. However it recorded poorer scores in Innovation drivers and Intellectual Property. The Czech Republic's efficiency in transforming innovation inputs into Application outputs was above the EU average, but was below average in transforming such inputs into Intellectual Property outputs.

'The first National Innovation Policy (2005–2010) was adopted by the Czech government in July 2005. Its strategic objectives include:

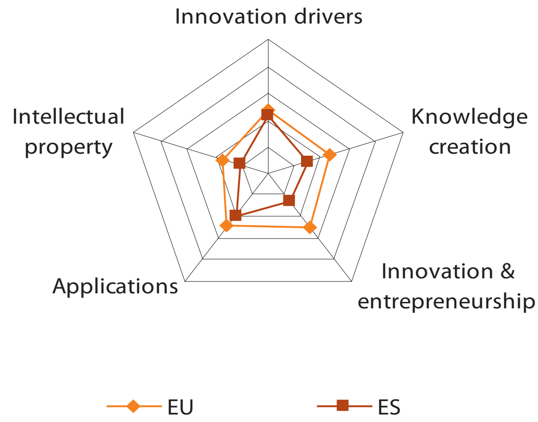
- *strengthened research and development as a source of innovation,*
- *working cooperation between the public and private sector,*
- *sufficient human resources for innovation,*
- *better performance of government and the public sector in research, development and innovation.*

In total, 48 concrete measures have been defined to achieve these objectives, including the allocation of responsibilities, deadlines and performance indicators.'[13]

[13] Source: Country Report Czech Republic- Inno Policy Trendchart http://www.proinno-europe.eu/

Spain

Figure 5.20: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Spain's overall innovation performance places it in the group of moderate innovators. Over the past five years, the trend in Spain's innovation performance has remained close to the EU average.

Within the five dimensions of innovation performance, Spain performed relatively well in Innovation drivers, most notably for the indicators Population with tertiary education and Participation in life-long learning. It was relatively weak in Innovation & entrepreneurship, with low scores recorded for Innovation expenditures. The analysis of innovation efficiency reveals that Spain was above average in transforming innovation inputs into Intellectual Property outputs, but below average in transforming such inputs into Applications.

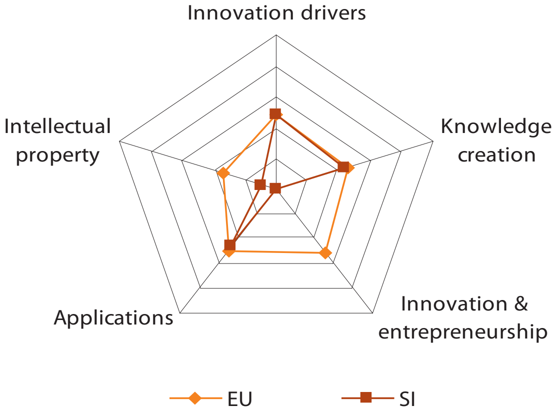
'The Spanish innovation policy-making and delivery structures cannot be understood without considering the regional governments of Spain's Autonomous Communities and Cities. The decision of when and how to launch R&D and innovation policies lies entirely with the regional governments themselves, who are free to design their strategies in line with their preferences and available financial resources.

The Spanish regulatory framework for R&D and innovation is undergoing important changes which also affect governance models for universities and public research centres. At least six new laws (or revisions of existing laws) affecting the Spanish national innovation system (NIS) have been tabled since 2004 and are either already being debated or soon to be put before Parliament. They include the forthcoming reform of the Organic Law on Universities, the proposed Biomedical Research Law and Public Contracts Law, as well as the recently approved Public Agencies Law, Venture Capital Law and the tax reform.'[14]

[14] Source: Country Report Spain- Inno Policy Trendchart: http://www.proinno-europe.eu/

Slovenia

Figure 5.21: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Slovenia's innovation performance has been increasing in relation to the EU average over the past five years; if these trends continue, Slovenia will catch up with the EU average in around 13 years.

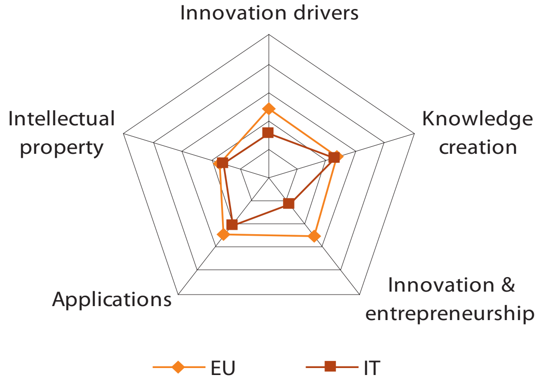
Regarding the five key dimensions of innovation performance, Slovenia did particularly well in Innovation drivers, with performances above the EU average, especially in Participation in life-long learning. It was, however, relatively weak in Intellectual property with low levels for the indicators of US and Triadic patents. The analysis indicates that Slovenia was below average in transforming innovation inputs into outputs.

'*The key challenge for innovation policy is to build a coherent and stable national innovation system and to increase the transparency and coordination of government innovation support measures.*

The Slovenian innovation system seems to be characterised by high-quality innovation policy documents, but challenges remain for these to be effectively implemented. There is also relatively little attention to Soft innovation or innovation in the innovation support measures.'[15]

Italy

Figure 5.22: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Italy's overall performance has marginally increased compared with the EU average over the past five years.

Italy has relative strengths in Knowledge creation and Intellectual property, where its performance was close to the EU average. Within these dimensions Italy was above average in the indicators for Share of medium-tech and high-tech R&D, Enterprises receiving public funding for innovation and Community industrial designs. Italy's innovation performance was weakest in Innovation drivers and Innovation & entrepreneurship. The analysis suggests that it was highly efficient in transforming innovation inputs into Intellectual Property outputs, but was less efficient in transforming such inputs into Application outputs.

'*The public support system for R&D and innovation is based on a funding scheme of direct aid to enterprises. The system is articulated around a large number of measures adopted at national and regional level. In recent years the role of regional policies has increased, especially in less favoured areas, mainly as support to innovation and technology transfer initiatives.*

The government's policy regarding innovation and R&D has focused on three main lines of action: (i) the concentration of (scarce) resources on specific technology areas; (ii) the creation of clusters (favouring the aggregation of SMEs to overcome disadvantages linked to their size but also fostering public-private cooperation) and (iii) the promotion of technology transfer.

Both in terms of policy makers and public-private innovation intermediaries, the Italian national innovation system (NIS), is characterised by a large number of entities and a high level of fragmentation. Low levels of coordination and cultural barriers to public-private cooperation have characterised the whole innovation system in the past, mainly affected by the lack of links and interaction between the main NIS players.'[16]

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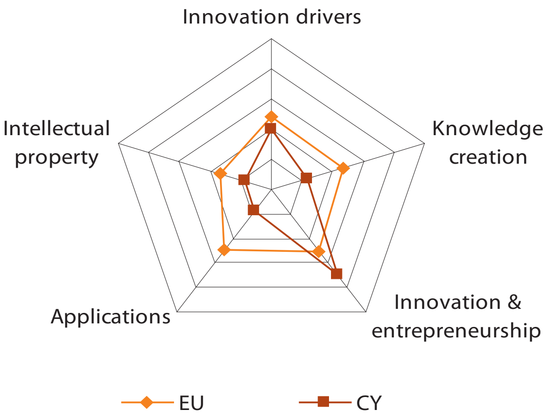
(15) Source: Country Report Slovenia- Inno Policy Trendchart: http://www.proinno-europe.eu/

(16) Source: Country Report Italy- Inno Policy Trendchart: http://www.proinno-europe.eu/

Cyprus

Figure 5.23: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Innovation performance in Cyprus has improved over the last five years compared to the EU average and its performance should converge with the EU average in about 10 years if current trends continue.

Cyprus recorded a comparatively strong performance in Innovation & Entrepreneurship, where it ranked third among Member States. In particular, its indicators for SMEs innovating in-house, innovative SMEs cooperating with others, innovation expenditure and SMEs using organisational innovation. Cyprus performed less well in Applications, with low scores for Employment in high-tech services, Sales of new-to-market products, Sales of new-to-firm products and Employment in medium-high and high-tech manufacturing. Cyprus' efficiency in transforming innovation inputs into Intellectual Property outputs was above average, but it lagged behind in terms of Application outputs.

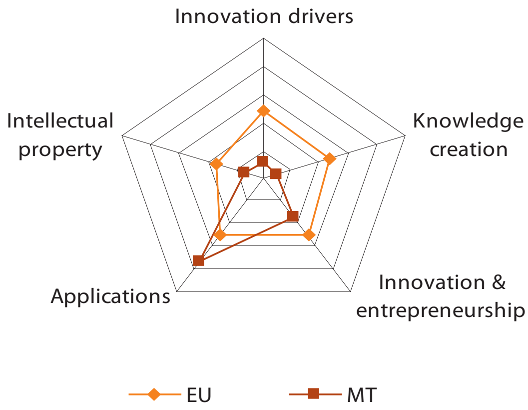
'The innovation policy mix in Cyprus was until very recently based on measures which, in spite of including innovation directly or indirectly in their scope and objectives, had not been designed to cope with specific deficiencies or challenges of the national innovation system. However, this is progressively changing; an innovation policy agenda has been adopted following an extensive analysis of the national innovation system and the policy mix has been expanded towards a more coherent approach for the promotion of innovation.'[17]

[17] Source:Country Report Cyprus- Inno Policy Trendchart: http://www.proinno-europe.eu/

Catching-up Countries

Malta

Figure 5.24: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Malta's innovation performance has been improving in the past five years; if this trend continues it should reach the EU average in around 20 years.

Malta's innovation performance was high in Applications, ranking first among EU Member States, and performing well above the EU average in Exports of high-technology products, Sales of new-to-market products and Sales of new-to-firm products. However, its performance was weaker in Innovation drivers and Knowledge creation.

'As the smallest economy in the EU, Malta's innovation performance relies solely on one or two firms. This probably explains its good performance registered in Innovation expenditures, High technology exports and ICT expenditures. The challenge for Malta is to create an environment for more broadly based innovation performance, including higher levels of implementation of new technology.

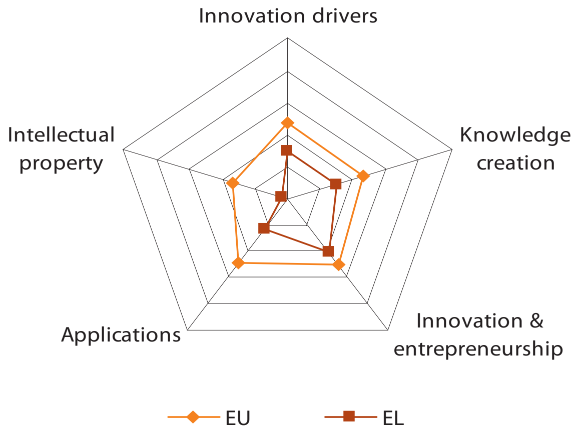
Education is key here, with a primary goal of improving all education indicators, which stand approximately at 50 % of the EU average.

The current policy mix is such that most measures take the form of State Aid to enterprises through tax credits and soft loans. A number of separate measures are aimed at groups of innovation stakeholders with the objective of improving cooperation and collaboration, and consequently the functioning of the innovation system.'[18]

[18] Source: Country Report Malta- Inno Policy Trendchart: http://www.proinno-europe.eu/

Greece

Figure 5.25: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

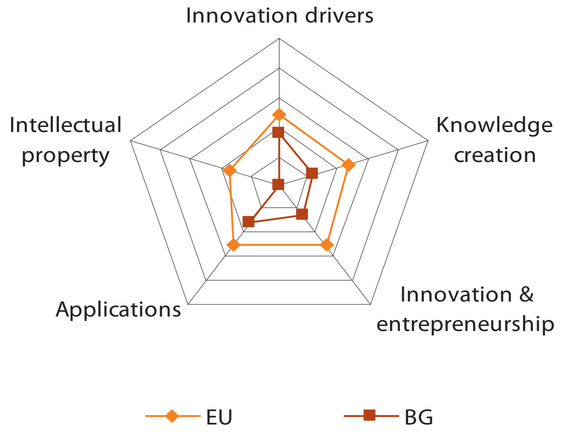
Greece recorded a relatively strong performance in Innovation & Entrepreneurship, specifically in SMEs innovating in-house, Innovation expenditure, and SMEs using organisational innovation. However, Greece was relatively weak in Applications and Intellectual Property, and seems to be below the EU average in its efficiency in transforming innovation inputs into outputs (both Applications and Intellectual Property).

'*Public policies in Greece endeavour to foster the emerging awareness of the importance of competitiveness and to further encourage creativity and entrepreneurship as a source of individual wealth. New industries demonstrate higher innovativeness and researchers have good records in their participation in competitive selection procedures for European programmes. Exposure to global competition combined with EU Structural Programmes, contributing financial resources and managerial know-how create opportunities for accelerating change and adapting to the new economic context.*

Most Research, Technology Development and Innovation (RTDI) policies implemented have been based on the principle of co-financing private R&D, in which private sector participation is leveraged by public-sector investment.'[19]

Bulgaria

Figure 5.26: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Although it stands below the EU average, Bulgaria's innovation performance over the last five years has improved relative to that average; if current trends continue, it could converge with the EU average in around 20 years.

In Innovation drivers, Bulgaria's performance was above the EU average for Youth education attainment level, but very weak in Intellectual Property. Bulgaria was also below the EU average in transforming innovation inputs into Applications and Intellectual Property outputs. Bulgaria has a high level of non-R&D innovators (companies that innovate without conducting formal R&D activities).

'*The main challenges for Bulgaria's future innovation policy include ensuring the most effective linkages between public and private institutions dealing with innovation, integrating the Bulgarian innovation system into the European innovation infrastructure, reforming public R&D and innovation support to better focus on the market needs of Bulgarian enterprises.*

Bulgaria has set up a list of actions and their implementation has already begun. In the past years, there has been a certain improvement in strategic planning in the national innovation policy.

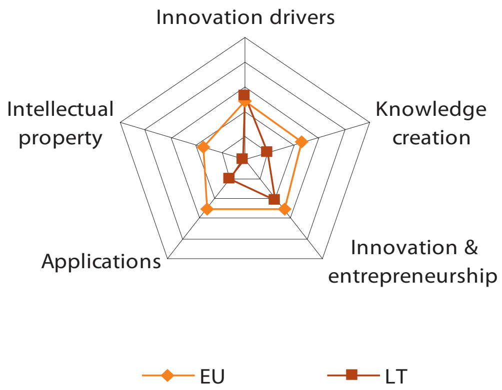
This is also boosted by an improved institutional structure for policy formulation and implementation. These measures are gradually progressing and financing for the various measures is increasing, mainly via the structural funds.'[20]

[19] Source: Country Report Greece- Inno Policy Trendchart: http://www.proinno-europe.eu/

[20] Source: Country Report Bulgaria- Inno Policy Trendchart: http://www.proinno-europe.eu/

Lithuania

Figure 5.27: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Lithuania's overall innovation performance places it among the catching-up countries, with a performance that is well below the EU average but increasing towards the EU average over time.

Lithuania performed particularly strongly in Innovation drivers, where it was above the EU average for S&E graduates, Population with tertiary education and Youth education attainment level. In contrast, it recorded comparatively weak results in Intellectual property. The analysis indicates that Lithuania was below the EU average in transforming innovation inputs into outputs.

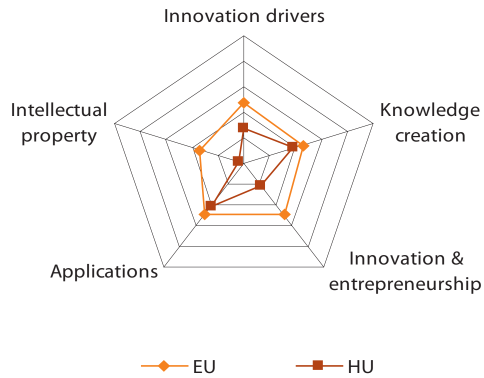
'*Recent developments in national innovation policy have highlighted Lithuania's attempts to improve coordination and implementation. The previously separated Science and Technology Commission and Education and Science Commission of the government of Lithuania were merged into the Science, Technology and Innovation Commission in spring 2005. Innovation policy-making and implementation positions were strengthened with the establishment of the Investments and Innovation Department at the Ministry of Economy, thus transferring innovation policy-making to the upper ministerial level. This used to be carried out at unit level only.*

Most innovation policy measures have been continued since 2004, according to the tasks set out by the Structural Funds programme in the period 2004–2006. Broader changes are expected with the introduction of a new programme for the period 2007–2013. Still, the Ministry of Economy has launched several new measures under the Innovation and Competitiveness programme, targeted at the protection of Intellectual Property Rights (IPR) in enterprises, business-knowledge development, etc.'[(21)]

[(21)] Source: Country Report Lithuania- Inno Policy Trendchart: http://www.proinno-europe.eu/

Hungary

Figure 5.28: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Hungary's overall innovation performance places it in the group of catching-up countries, with an overall performance that is below the EU average.

Hungary recorded a relatively strong performance in Knowledge creation and Applications, where it was almost on a par with the EU average. Hungary outperformed the EU average in Share of medium-high-tech and high-tech R&D, Employment in high-tech services, Exports of high technology products and Employment in medium-high-tech and high-tech manufacturing. In contrast, Hungary demonstrated relative weaknesses in Innovation & entrepreneurship, particularly in terms of SMEs innovating in-house and SMEs using organisational innovation.

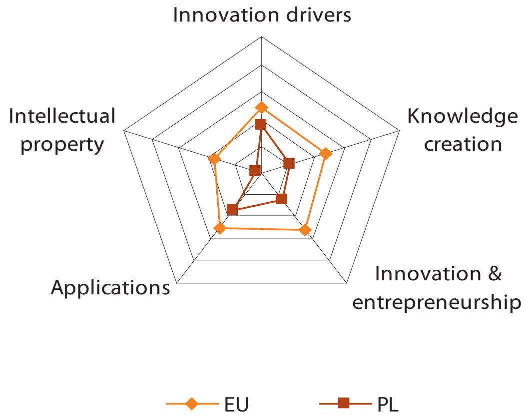
'*The Hungarian national Innovation system has gone through a significant transition process since the early 1990s, marked by rapid and widespread privatisation. The expansion of business R&D, both in terms of total expenditure and the number of business R&D units, has created a stronger base on which innovation capacities can be improved, albeit from a low level. But the low share of innovative firms and the huge difference between the innovation activities of foreign-owned and national firms highlight the major challenges of the innovation system.*

The Hungarian national innovation system is characterised by the pressing need for a transition from the dominance of low-cost economic activities towards an innovation-driven economy. Several weaknesses in the current NIS inhibit this fundamental strategic move: low demand for innovation and R&D, slow diffusion of innovations, poor cooperation capabilities, and ineffective governance.'[(22)]

[(22)] Source: Country Report Hungary - Inno Policy Trendchart: http://www.proinno-europe.eu/

Poland

Figure 5.29: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

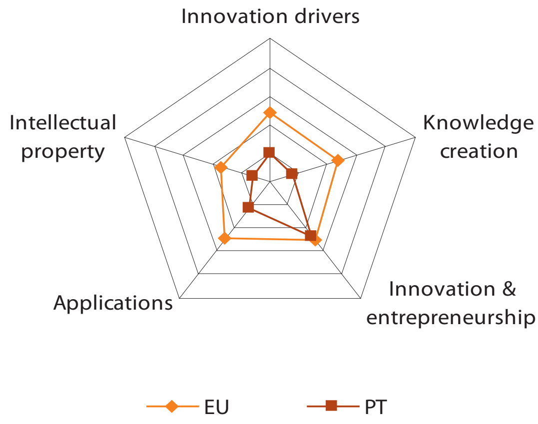
Poland's innovation performance has increased relative to the EU average over the past five years. If current trends continue it should reach the EU average within 20 years.

Poland has a relatively even level of performance across the five dimensions of innovation. It demonstrated relative strengths in Youth education attainment level, ICT expenditures, and Sales of new-to-market products. However, it was well below the EU average in Business R&D expenditures, Early-stage venture capital, and Patenting activities. The analysis indicates that Poland's efficiency in transforming innovation inputs into outputs was below average.

'*Over the past few years Poland has put much more emphasis on innovation-related actions than ever before. However, this was largely due to developments at EU level and planning processes linked to Structural Funds programming. Nevertheless, innovation is now high on the policy agenda and much more advanced in operational planning. The wide array of actions set out for the period 2007–2013 clearly reveals a comprehensive approach towards innovation. Policy makers attempt to plan mutually supportive actions in many inter-related fields. Importantly, the notion of innovation includes not only high-tech and research driven actions, but also non-technological aspects such as organisational changes and innovation in services.*'[23]

Portugal

Figure 5.30: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Portugal's innovation performance has been increasing relative to the average EU trend over the past five years.

Portugal did well in Innovation & entrepreneurship, especially in Share of SMEs innovating in-house, ICT expenditure and Share of SMEs using organisational innovation. Portugal's weaker dimensions were Knowledge creation and Intellectual property, in particular Business R&D expenditures and all forms of Patenting. Despite its weak performance in Intellectual Property, Portugal was highly efficient in transforming inputs into outputs. Conversely, its efficiency in transforming inputs into Application outputs was below average.

'*The main development in innovation policy in the period under review was the launch of the Technological Plan. This was designed as a flagship programme to promote competitiveness and innovation by providing a new orientation for science and innovation policy.*

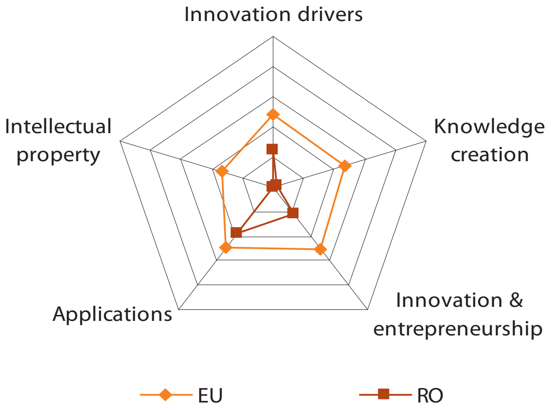
Guidelines for future innovation policies are provided in the Technological Plan. Some of them will materialise in the 2007–2013 Operational Programme on competitiveness factors. Others, however, have already been implemented following the alignment of PRIME (SME support initiative) with the Technological Plan. One of the features of this alignment was the decision to encourage innovation through grants, instead of reimbursable loans, as it has been the case since 2002. Another was the launch of specific application calls with a limited term and focussing on issues considered as particularly relevant, such as the modernisation of traditional industries (associated to the DINAMO programme, which targets traditional industries) and the development of innovation clusters on wind energy.'[24]

[23] Source: Country Report Poland- Inno Policy Trendchart: http://www.proinno-europe.eu/

[24] Source: Country Report Portugal- Inno Policy Trendchart: http://www.proinno-europe.eu/

Romania

Figure 5.31: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Romania's innovation performance has been increasing significantly faster than the EU average over the past five years.

Romania performed relatively well in Applications, where it was above the EU average in terms of Sales of new-to-firm products. It performed less well in Knowledge creation and Intellectual Property. The analysis reveals that Romania is relatively efficient in transforming innovation inputs into Application outputs, but inefficient at transforming such inputs into Intellectual Property outputs.

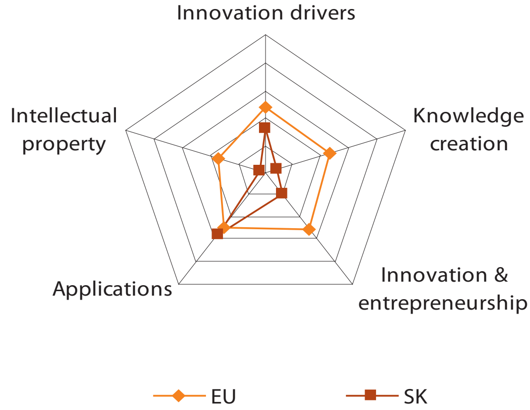
'*Innovation policy has only recently become a priority, after sustained efforts to restructure research organisations and the productive sector.*

The Ministry of Education and Research (MER) plays a crucial role in terms of innovation policy; its mission is to implement the Government Programme in the area of R&D and Innovation (according to Chapter 6 of the 2005–2008 Governing Programme) by designing, implementing, monitoring and evaluating research, development and innovation policies.

One recent development in the Research, Development and Innovation system is the increased orientation of policies and funding instruments towards the consolidation of human resources and infrastructures for R&D and innovation, strengthening links between university, industry and R&D institutions and the participation of the private sector in R&D activities, as well as the international visibility of Romanian researchers.'[25]

Slovakia

Figure 5.32: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Slovakia's innovation performance has been increasing over the past five years in relation to the EU average; if these trends continue it should reach the EU average in around 20 years.

Among the five key dimensions of innovation performance, Slovakia did well in Applications, particularly in Sales of new to market products and Employment in medium-high and high-tech manufacturing. It was less impressive in Knowledge creation, notably due to low results in Business R&D expenditure. The analysis shows that Slovakia was relatively efficient in transforming innovation input into application outputs, but below average in transforming such inputs into intellectual property outputs.

'*The Slovak government has very recently approved the Slovak innovation policy for the period 2008–2010. It implements parts of the broader 2008–2013 Innovation Strategy and makes reference to the National Reform Programme, and the National Strategic Reference Framework.*

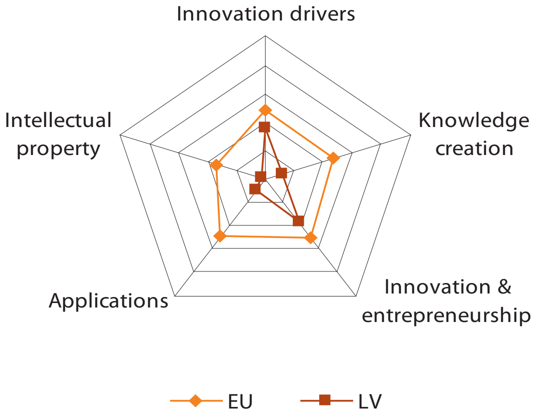
The main priority set by the Innovation Policy is to 'create a support framework for the development of regional innovation structures, innovative enterprises and partnerships between industry and academia'. The new framework is intended to raise the competitiveness of the business sector, improve the flexibility of the labour market and support regional development.'[26]

(25) Source: Country Report Romania- Inno Policy Trendchart: http://www.proinno-europe.eu/

(26) Source: Country Report Slovakia- Inno Policy Trendchart: http://www.proinno-europe.eu/

Latvia

Figure 5.33: Country performance in relation to the EU average by key dimensions



Source: Eurostat based on EIS 2007

Latvia's overall innovation performance places it among the group of catching-up countries, with a performance that is well below the EU average, but increasing towards the EU average.

Latvia ranks relatively high on the dimension of Innovation drivers where it is above the EU average on the indicator of youth education attainment level. It performs relatively weakly on the dimension of Applications, where it is well below the EU average on the indicators of Exports of high technology products, Sales of new-to-firm products and Medium-high/high-tech manufacturing employment.

'*Innovation policy developments continue to gain momentum with of the involvement of more stakeholders in the NIS. There is more emphasis on innovative development on a political level, with more policy measures and funding aimed at boosting innovation in public and private sectors.*

With the new planning period of EU Structural Funds (SFs), the years 2007-2013 will mark the next milestone in Latvia's efforts to reach EU and Lisbon objectives, or come close to them. This requires improved efficiency of innovation governance, more intense use of evaluation and benchmarking practices in policy making and learning, reinforcement of innovative activities at the regional level, and highly determined policy responses to identified challenges. While many actions have already been taken, future policy could be orientated towards IPR protection, development of innovation poles and networks, and more university-industry partnerships in R&D.'[27]

[27] Source: Country Report Latvia - Inno Policy Trendchart http://www.proinno-europe.eu/.

Other countries

Iceland is grouped with the 'innovation followers' and its innovation performance ranked above the EU average.

Within the five dimensions of innovation, Iceland performed well in Innovation drivers and Knowledge creation, with relatively high levels in life-long learning, broadband penetration and public R&D expenditure. Iceland was relatively weaker in Intellectual property, due to low levels of Triadic patents and Community designs. Iceland was below the EU average in transforming innovation inputs into outputs.

Data availability for Iceland is more limited than for other countries. As data are missing for six indicators, in particular Knowledge creation and Innovation & entrepreneurship, comparisons with EU countries should be interpreted with care.

Norway is part of the group of 'moderate innovators' and its innovation performance is below the EU average.

Within the five dimensions of innovation, Norway scored highly in Innovation drivers, with relatively high performance in Population with tertiary education, Broadband penetration rate and Participation in life-long learning. Norway's relative weaknesses were in Innovation & entrepreneurship and Intellectual property, due to low levels of Early-stage venture capital, Community trademarks and Community designs. Norway's efficiency was also below average in transforming innovation inputs into application outputs, but above average in transforming such inputs into intellectual property outputs.

Switzerland ranked behind Sweden as the second most innovative country in Europe, and is in the innovation leaders group. Switzerland's innovation performance has decreased over the past five years relative to the EU trend.

Switzerland's strong innovation performance is driven by its exceptional performance in Intellectual property, clearly outperforming all other countries in this dimension. Relative weaknesses were found in the share of Enterprises receiving public funds for innovative activities and the availability of Early-stage venture capital, although the latter may also be explained in relative terms by a sharp increase in the average EU performance. The analysis also reveals that it ranked above average in transforming innovation inputs into outputs.

Israel has been included for the first time in the EIS. Data availability for Israel is limited to 17 indicators, only two of which are in Innovation & entrepreneurship. Comparisons with EU countries should therefore be interpreted with care.

Israel's overall level of innovation performance places it among the innovation leaders; only Sweden, Switzerland and Finland recorded higher levels. The trend in Israel's innovation performance over recent years has been more or less on a par with the EU average.

In the five key dimensions of innovation performance, Israel did particularly well in Knowledge creation, with a very high level of Business R&D expenditure. The supply of S&E graduates was below the EU average and appears to be the weakest indicator in Innovation drivers. Israel's patent performance was well above average, contrasting with relatively weaker results in Community trademarks and designs. The analysis indicates that Israel's efficiency in transforming innovation inputs into application outputs was above average.

Australia has been included for the first time in the EIS. Data availability for Australia is limited to 16 indicators, only one of which is in Applications. Hence, comparisons with EU countries should be interpreted with care.

Australia is among the moderate innovators. Its innovation performance was below the EU average, but it has remained stable over the past five years in relation to the EU average.

Canada has been included for the first time in the EIS. Data availability for Canada is limited to 13 indicators, with little data available in Innovation drivers (only two indicators), Innovation & entrepreneurship (one indicator) and Applications (two indicators). Comparisons with EU countries should therefore be interpreted with care.

Canada belongs to the group of innovation followers and its innovation performance hovered just below the EU average. Its innovation performance has decreased over the past five years compared to the EU average.

5.3 Outlook: CIS 2006 and CIS 2008

The Community Innovation Survey (CIS) is a survey of innovation activity in enterprises covering EU Member States, candidate countries, Iceland and Norway.

Community legislation on innovation statistics has increased the frequency for compiling Community Innovation Statistics from four years to two years. In 2006, Eurostat — in close cooperation with the Member States — therefore continued preparatory work on the next CIS based on the reference year 2006 ('CIS 2006'). It was decided that CIS 2006 should take a fairly conservative approach, keeping the harmonised survey questionnaire and the harmonised survey methodology used for CIS 4 (2004).

The main features of CIS 2006 are that it:

- keeps the main features of CIS 4 (the survey questionnaire and the survey methodology);
- faces to be implemented on a wider scale at national level, often on a voluntary basis;
- adds pilot modules on organisational and marketing innovation and on knowledge flows, with a view to preparing for CIS 2008;
- faces broader implementation of these pilot modules in many countries;
- will be disseminated from mid-2008 onwards.

CIS 2006 was launched at national level in 2007. The deadline for data transmission listed in the annex to the Commission Regulation on innovation statistics was 30 June 2008.

As the questionnaire and methodology have been left unchanged from CIS 4 (2004) to CIS 2006, it will be possible to compare data and analyse trends by looking at the results from CIS 3, CIS 4 and CIS 2006.

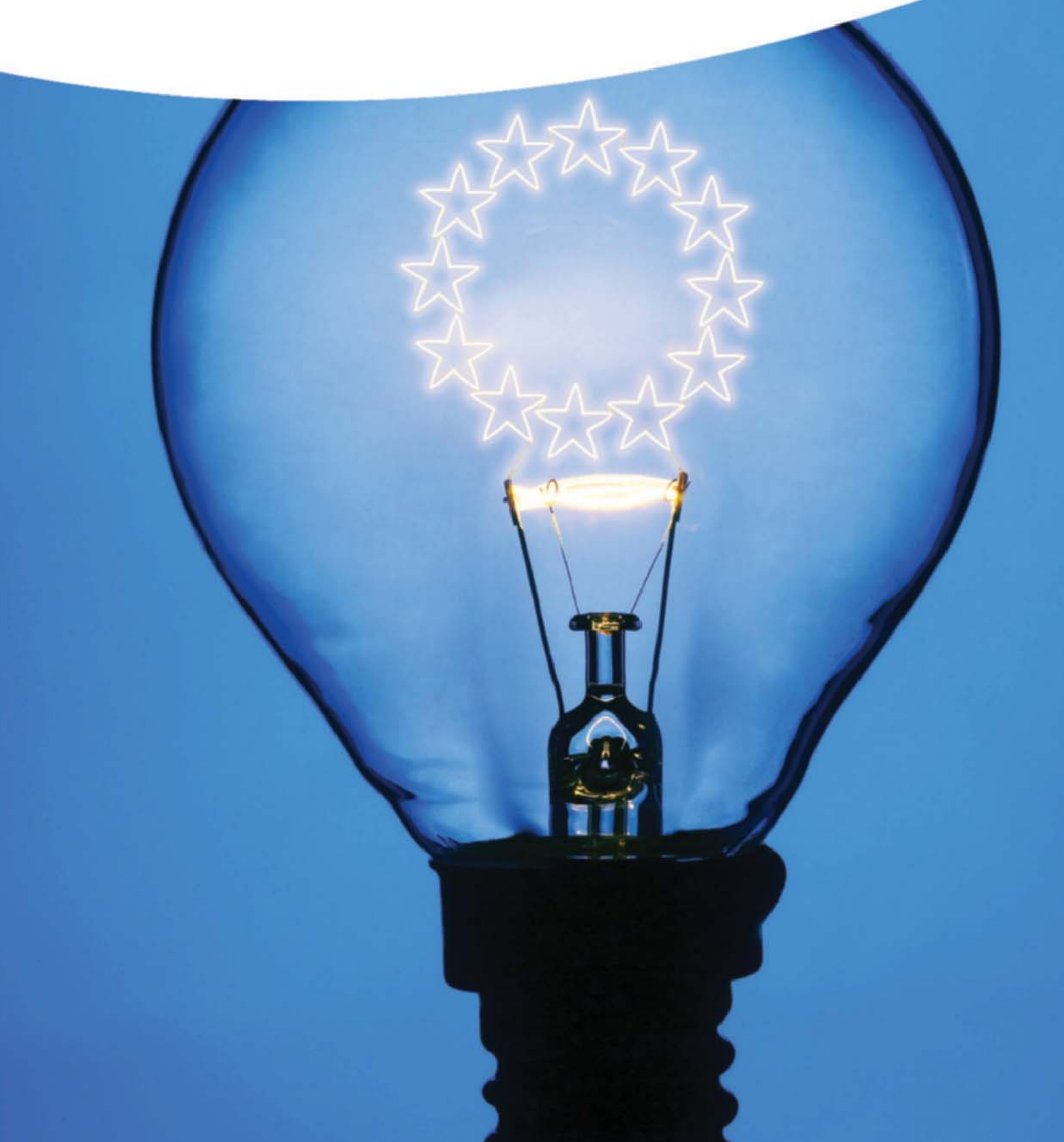
The pilot modules on marketing and organisational innovations include questions on whether these new types are integrated or linked with product or process innovations. This type of data can potentially provide a number of insights on how innovation activities (and thus also knowledge transfer) are linked across firms and to what extent innovation projects span more than one 'area'.

In addition to CIS 2006, Eurostat — in close cooperation with Member States — has started to prepare for CIS 2008, which will include the following points:

- the new Oslo Manual 2005 needs to be implemented in CIS 2008, to better record organisational and marketing innovation;
- there is also a high level of interest in the eco-innovation topic which will be part of the CIS 2008 data collection.

6

Patents



6.1 Introduction

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

Patent statistics have made rapid progress in recent years. They are being used increasingly by decision-makers in innovation policy or in patent offices in order to monitor trends. The Worldwide Patent Statistics Database (PATSTAT), produced by the European Patent Office (EPO), offers a unique tool for analysts and producers of patent data and indicators. PATSTAT is published twice a year, in March and October.

An invention has to fulfil 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 comprise the following: 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.

However, creations that cannot be protected by a patent may be protected by other intellectual property rights (IPR), such as copyright, trademark or industrial design.

A patent is an intellectual property right for inventions of a technical nature. A patent is valid in a country if it is granted by that country's national patent office; the validity period is usually 20 years. A patent application to the EPO can be valid in more than one country and at most in all of the Contracting States of the European Patent Convention. In January 2008, the Convention was in force in 34 countries (all EU Member States plus Switzerland, Iceland, Liechtenstein, Norway, Monaco, Croatia and Turkey). In addition to the Contracting States, four other countries (Albania, the former Yugoslav Republic of Macedonia, Serbia and Bosnia and Herzegovina) have concluded an 'extension agreement' with the EPO, by which these states can also be designated in a European patent application.

Although patents do not cover every kind of innovation, they do include many of them. Patents have become one of the most widely used sources of data in the construction of indicators on inventive output, as they are closely linked to invention and they provide detailed information in relatively long time-series.

Nevertheless, patent indicators also have several shortcomings and therefore need to be combined with other Science & Technology (S&T) output indicators in order to obtain a full picture of innovation activities in individual countries and regions. Two major drawbacks are that not all inventions are patented and that not all patents have the same value. It is widely recognised that the value distribution of patents is skewed: a few patents have a high value, whereas the majority have lower values. However, as there are no generally recognised, easily applicable methods for measuring the value of patents, this chapter does no more than enumerate the number of patents that meet the various criteria. Another drawback is that only some of the patents granted have commercial applications and/or lead to major technological improvements.

This chapter analyses the structure and development of patenting in the EU-27, Iceland, Liechtenstein, Norway, Switzerland, the candidate countries (Croatia and Turkey), Japan and the United States. Several tables and graphs also present data for Australia, Canada, China, India, Israel, South Korea, Russia, and Taiwan. The countries were selected on the basis of their economic size and/or their high patent activity. For some tables and graphs, the low number of patent applications per country explains why it was impossible to show the data, as the analysis would not have been representative. In these cases a cut-off number is given underneath the table or graph.

Priority is given to data on patent applications to the EPO. Nearly all indicators for patents granted by the United States Patent and Trademark Office (USPTO) are also available from Eurostat. In this edition, few USPTO data are shown due to a lack of space. On the other hand, providing the entire dataset for USPTO data would not provide the user with much more information.

The chapter starts with a look at the 'triadic patent families' and then focuses on performance at national level, using EPO and some USPTO data. The analysis covers the period from 1994 to 2004 for the EPO data, whereas the USPTO and triadic patent family time-series cover the period from 1992 to 2001. Patent statistics are very sensitive to the type of data collected and to the methods used in counting the patents. Data from the period following the reference years are not comparable because they are incomplete. Data are revised in the months following the publication of an update of PATSTAT. As revisions involve changes in many years — and not only recent years — Eurostat replaces the entire time series at every update.

The EPO data refer to patent applications by priority year, whereas the USPTO data refer to patents granted. The 'priority year' is the year in which the first application was submitted. In general, inventors first apply for a patent at their national patent office. Thereafter, they also have 12 months to apply to another patent office, such as the EPO or the USPTO.

Although patents are not systematically granted, each application nevertheless represents the inventor's technical efforts. Patent applications can therefore be considered as 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 to refer to 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. It takes between two and five years for a patent to be granted at the USPTO. 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 filed at the European Patent Office (EPO), the Japan Patent Office (JPO), and granted by the United States Patent and Trademark Office (USPTO).

Regarding data at international level, readers should bear in mind that thanks to 'home advantage' European countries are leaders in the European patent system, whereas the United States has the advantage in the US patent system. Figures may also be influenced by the countries' industrial structures, since different industries have a different propensity to patent. Some of these problems are less visible in the triadic patent family indicators, as they only take into account patent applications that have been filed at the EPO and the JPO, and those granted by the USPTO. Besides improving the 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, owing 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. Because of 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, please refer to the methodological notes or to the section on patent statistics on Eurostat's website.

Industrial Property Rights:
Commission launches strategy to drive innovation from the laboratory to the marketplace

On 16 July 2008 the European Commission adopted a Communication on a new industrial property rights strategy for Europe. Together with the creation of a Community patent and integrated patent jurisdiction, the Communication outlines a number of actions as the keystone to maintaining a high quality industrial property rights system for the EU in the 21st century. It sets out to support inventors in making informed choices on the protection of their industrial property rights and calls for robust enforcement against counterfeiting and piracy. The Communication also aims to ensure that industrial property rights in Europe are of high quality and that they are accessible to all innovators, particularly small- and medium-sized enterprises (SMEs). […]

A strong industrial property rights system is a driving force for innovation, stimulating R&D investment and facilitating the transfer of knowledge from the laboratory to the marketplace. Along with the urgent adoption of the Community patent proposal and creation of an integrated EU-wide jurisdiction for patents, the actions proposed will ensure Europe has a high-quality industrial property rights system in the years to come:

• Effective enforcement on the ground against counterfeiting and piracy. This phenomenon is reaching alarming levels with damaging effects on job creation in Europe and the heath and safety of consumers. In addition to improving coordination between key enforcement actors at a national level, the Commission will work towards effective cooperation between Member States in intelligence gathering and rapid information exchange on counterfeit and pirated goods. Furthermore, the Commission will help facilitate agreements involving both the public and private sectors to crack down on blatant violations of intellectual property rights.

• Ensuring high-quality industrial property rights in Europe that are accessible to all innovators, including SMEs. To achieve this, the Commission will undertake studies on the quality of the patent system and on the overall functioning of the trademark systems in the EU. This would also include the Community trademark, which the Office for Harmonisation of the Internal Market has been successfully registering for over 10 years.

• Facilitating exploitation by SMEs of industrial property rights. The Communication outlines measures to facilitate access to industrial property rights and dispute resolution procedures, and to improve awareness among SMEs of the management of industrial property as an integral element within an overall business plan.

More information on Industrial Property is available at:

http://ec.europa.eu/internal_market/indprop/rights/index_en.htm

6.2 Triadic patent families

High concentration of triadic patent families

A patent is considered as a member of the triadic patent family only if it has been applied for and filed at the European Patent Office (EPO) and at the Japan Patent Office (JPO), and if it has been granted by the United States 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. In terms of geographical distribution (see Figure 6.1), the EU and Japan accounted for respectively 26 % and 31 % of all triadic patent families in 2001. The largest share was held by the United States, with 36 %, and the smallest by the rest of the world, with 7 %. Triadic patent family applications and grants are mainly concentrated in the US, Japan and the EU-27.

The picture is quite different when triadic patenting activity is compared to the population size (see Figure 6.2). Looking at triadic patent families per million inhabitants, in the period between 1992 and 2001 Japan led by a wide margin. The United States ranked second, followed by the EU-27. Whereas this trend was more or less stable in the United States and the EU-27, in Japan this indicator fell very slightly in the early 1990s before experiencing a strong recovery and a stable increase until 2000. In 2001, the EU-27 registered 16.4 triadic patent families per million inhabitants, having fallen below 20 after many years above this mark. In 2000 Japan reached a peak at 100.2 triadic patent families per million inhabitants - more than twice as much as in the United States (45.5) in the same year.

Figure 6.1: Distribution of triadic patent families, as a percentage of total, EU-27, Japan, the United States and other, 2001

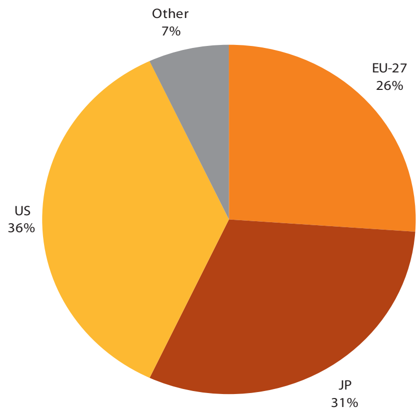
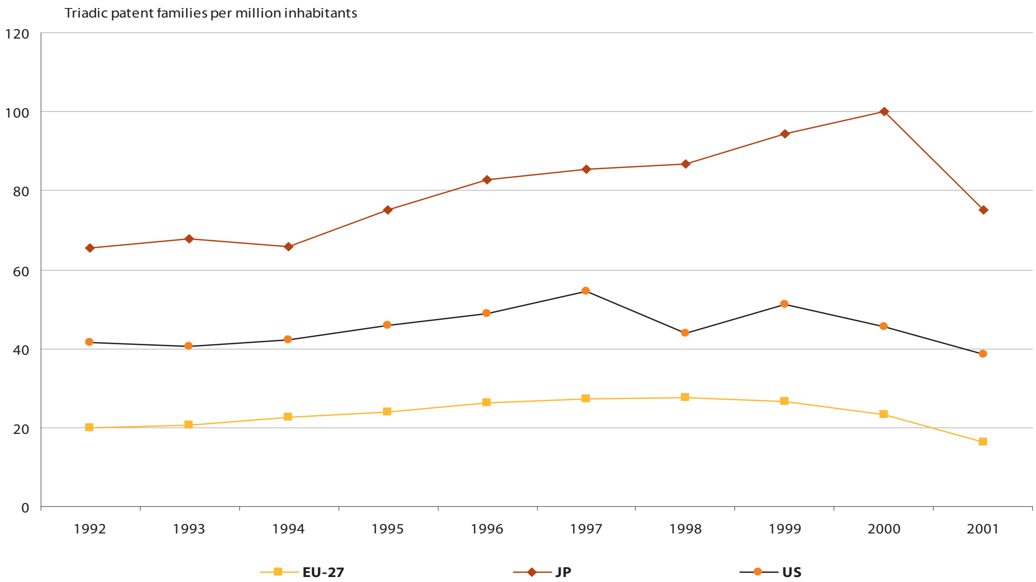


Figure 6.2: Triadic patent families per million inhabitants, EU-27, Japan and the United States, 1992–2001



6.3 Total patent applications to the EPO and patents granted by the USPTO

Germany was the leading European country in terms of patent applications in 2004

The intensity of patenting activity varies considerably from one country to another. As explained in the introduction, patenting procedures differ between Europe and the United States. USPTO statistics are based on patents granted, while EPO statistics are founded on patent applications filed. Given the different underlying methodologies, data relating to these two patent offices should not be compared.

Table 6.3: Patent applications to the EPO: total number and as a percentage of GDP, EU-27 and selected countries, 2004, and Patents granted by the USPTO: total number and as a percentage of GDP, EU-27 and selected countries, 2001

	Patent applications to the EPO 2004		Patents granted by the USPTO 2001	
	Total	As a % of GDP	Total	As a % of GDP
EU-27	54 011	5.1	24 594	2.6
BE	1 468	5.1	584	2.3
BG	19	0.9	4	0.3
CZ	111	1.3	45	0.6
DK	1 000	5.1	393	2.2
DE	22 619	10.2	10 686	5.1
EE	9	0.9	3	0.4
IE	258	1.7	188	1.6
EL	65	0.3	14	0.1
ES	1 193	1.4	326	0.5
FR	8 240	5.0	3 320	2.2
IT	4 551	3.3	1 634	1.3
CY	6	0.5	2	0.2
LV	10	0.9	1	0.1
LT	14	0.8	2	0.1
LU	113	4.1	52	2.3
HU	152	1.9	46	0.8
MT	5	1.0	2	0.5
NL	3 584	7.3	1 269	2.8
AT	1 408	6.0	589	2.8
PL	116	0.6	38	0.2
PT	56	0.4	21	0.2
RO	22	0.4	11	0.2
SI	110	4.0	15	0.7
SK	20	0.6	3	0.1
FI	1 367	9.0	802	5.7
SE	2 178	7.6	1 177	4.7
UK	5 318	3.0	3 368	2.1
IS	22	2.1	15	1.7
LI	23	8.4	17	6.2
NO	376	1.8	203	1.1
CH	2 951	10.1	1 229	4.3
HR	30	1.0	16	0.7
TR	124	0.4	19	0.1
AU	1 076	2.1	794	2.0
CA	2 125	2.7	3 823	4.8
CN	974	0.6	528	0.4
IL	1 131	11.5	1 168	8.8
IN	534	:	504	:
JP	21 989	5.9	35 170	7.7
KR	4 375	8.0	5 067	9.4
RU	236	0.5	197	0.6
TW	587	2.2	6 374	20.3
US	33 122	3.5	95 375	8.4

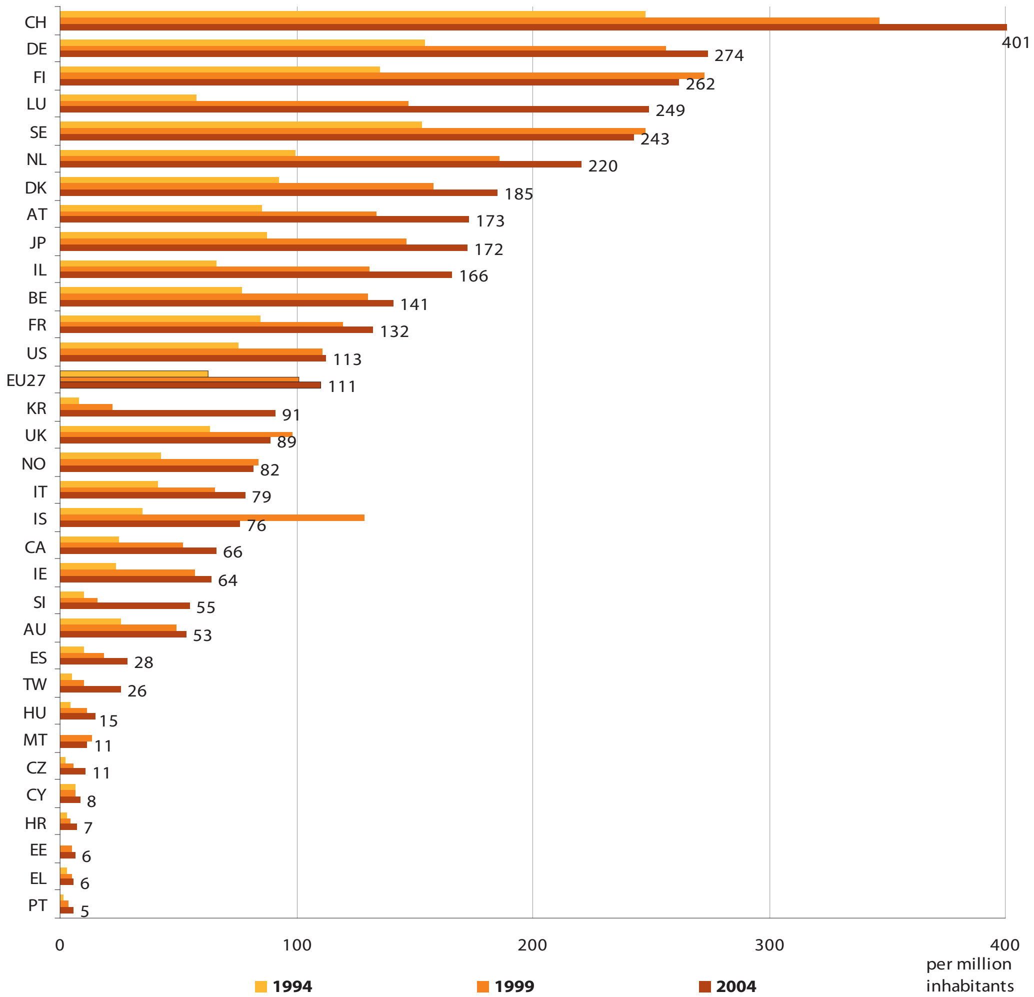
With 54 011 patent applications to the EPO in 2004, the EU-27 was the most active world economy in patents taken at the EPO. Among EU Member States, Germany was the undeniable leader, with 22 619 patent applications filed, followed by France (8 240) and the United Kingdom (5 318). Germany also led in relative terms, with patent applications accounting for 10.2 % of GDP, followed by Finland and Sweden, with respectively 9.0 % and 7.6 % of GDP. None of the new Member States (2004 and 2007 enlargements) reached the average EU-27 ratio of 5.1 % of GDP.

The leading non-EU countries in patent applications to the EPO were Israel (11.5 % of GDP), Switzerland (10.1 %), Liechtenstein (8.4 %) and South Korea (8.0 %).

The lower numbers of patents granted by the USPTO to EU Member States can be explained by the 'home advantage' of the United States. Besides the United States (95 375 patents granted in 2001), other countries were also very active in patenting, as shown by the number of patents granted by the USPTO: Japan (35 170), Taiwan (5 067) and Canada (3 823).

Looking at the data for 1994, 1999 and 2004, patenting activity per million inhabitants increased significantly in almost all European countries over the period under review. The only exceptions were the Nordic countries (Finland, Sweden, Norway, and Iceland) and the United Kingdom, where the number of patent applications per million inhabitants rose strongly from 1994 to 1999, but then fell back slightly in 2004. Compared with 1999, Finland lost its first place at EU level in 2004. Among the EU-27 countries, Germany ranked first in 2004, with 274 patent applications per million inhabitants to the EPO, followed by Finland (261) and Luxembourg (249). This number was even higher in Switzerland, with 401 patent applications per million inhabitants to the EPO (see Figure 6.4). Most new Member States registered low levels of patenting activity in terms of EPO patent applications per million inhabitants. Slovenia was an exception to the rule, with 55 patent applications per million inhabitants in 2004.

Figure 6.4: Patent applications to the EPO per million inhabitants, EU-27 and selected countries, 1994, 1999 and 2004



Cut-off: at least 5 patent applications per million inhabitants in 2004

An Industrial Property Rights Strategy for Europe Patents

The quality of patents in Europe is generally perceived to be high. Nevertheless, stakeholders are concerned about maintaining and improving patent quality in Europe and avoiding shortcomings of some other patent offices. This concern is also shared in the European Parliament. For example, large numbers of overlapping patent rights can create additional barriers to commercialise new technologies that already exist in 'patent thickets'. Poor quality rights can also contribute to problems with 'patent trolls' that have arisen in the US judicial system.

Europe is no exception to the worldwide trend of continually rising numbers of patent applications. In 2006, the number of patent applications filed at the European Patent Office (EPO) in a year exceeded 200 000 for the first time and grew by 5.6 %. Applications are also becoming more voluminous, with both the number of claims and pages of applications to the EPO doubling over the past 20 years. The increase in numbers and complexity of patent applications worldwide has resulted in rising backlogs of pending applications, increasing market uncertainty caused by other factors such as unused patents. In addition, a greater proportion of prior art is published in non-European languages such as Chinese and Korean. Along with applications in new fields of technology, these trends pose particular challenges to patent offices. There is also a need for improved access to patent information for companies and innovators.

It is vital that patents are awarded only where a true inventive contribution is made. The granting of poor quality patent rights has a negative effect, contributing to economic and legal uncertainty. The EPO is 'raising the bar' concerning its future workload, and patent offices in Europe should work together, e.g. by mutual exploitation of work to maintain high quality rights and avoid patents being granted in fields which are not patentable, such as software and business methods. Examiners also need to be kept abreast with the latest developments in their field through continuing professional development. Furthermore, the role of patent offices includes refusing applications which should be accounted for properly when measuring their performance. In addition, stakeholders have an important role to play to prevent patent offices receiving too many applications with no inventive step. Initiatives such as patent peer review schemes by fellow experts and voluntary codes of best practice to improve the standard of incoming applications are encouraging ways of improving patent quality against the background of increasing demand.

Source: 16.7.2008, COM(2008) 465 final

Patent applications to the EPO by IPC section

Patents are classified in accordance with the International Patent Classification (IPC). The IPC is based on a 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 function takes precedence. A patent may cover several technical aspects and may therefore be assigned to several IPC classes. If a patent spans several technological fields, 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.

Table 6.5 presents patent applications by IPC section. The following analysis only considers countries with more than 100 patent applications to the EPO. The focus is on relative specialisation at national level in one IPC section. In many countries, 25 % or more of all national applications were registered in one IPC section. Denmark, Ireland, Slovenia, Israel and Australia specialised in patenting linked to 'human necessities' (IPC section A). 'Performing operations; transporting' (section B) accounted for the highest shares in Germany, Spain, Italy, Austria and Luxembourg; and 25 % or more of national patent applications from Belgium, the Czech Republic, Hungary, Poland and India were filed in 'chemistry; metallurgy' (section C). In contrast, patenting activity was lower in 'textiles; paper' (section D) and 'fixed constructions' (section E). More than one in three Turkish patent applications concerned 'mechanical engineering; lighting; heating; weapons; blasting' (section F). In the Netherlands, the most patent applications were filed in the field of 'physics' (section G). In Finland, a majority of patent applications were taken out in the field of 'electricity' (section H). 'Electricity' was also the most important IPC section in Sweden, Canada, China and South Korea.

The absolute figures are not shown here, but they are noteworthy as they provide the basis for Table 6.5. At EU-27 level, Germany registered the highest number of patent applications overall, followed by France, the United Kingdom and Italy. IPC section D 'textiles; paper' was the exception, with Italy taking second place after Finland.

Germany recorded more patent applications than the United Stated in four IPC sections (B, D, E and F).

Table 6.5: Breakdown of patent applications to the EPO by IPC section, total number and as a percentage of total, EU-27 and selected countries, 2004

	Total	IPC section							
		Human necessities	Performing operations; transporting	Chemistry; metallurgy	Textiles; paper	Fixed construc-tions	Mechanical engineering; lighting; heating; weapons; blasting	Physics	Electricity
EU-27	54 011	14.9	21.4	13.5	1.9	4.8	11.1	16.2	16.2
BE	1 468	14.7	19.9	26.5	3.0	4.6	4.2	13.1	14.1
BG	19	16.0	16.0	12.4	:	10.6	16.0	13.5	15.5
CZ	111	12.4	16.4	28.5	2.7	5.9	8.1	19.0	7.0
DK	1 000	25.9	14.5	19.0	0.9	5.9	10.2	10.4	12.9
DE	22 619	12.3	24.0	13.3	2.0	4.9	14.1	15.0	14.5
EE	9	23.0	:	23.0	:	:	0.0	30.9	11.5
IE	258	25.1	13.8	11.9	:	4.0	6.8	18.0	19.3
EL	65	10.1	34.7	7.0	1.5	9.2	13.1	11.0	13.2
ES	1 193	20.5	23.1	17.9	1.6	9.4	9.7	9.4	8.4
FR	8 240	16.5	20.3	12.2	1.1	3.8	11.2	16.7	18.2
IT	4 551	18.9	26.4	11.1	3.5	5.9	12.4	10.8	10.9
CY	6	16.7	16.7	16.7	:	16.7	0.0	16.7	0.0
LV	10	27.5	10.2	42.0	:	:	:	:	:
LT	14	7.3	9.6	5.6	:	:	0.0	68.5	1.8
LU	113	4.9	39.4	14.7	1.0	3.1	15.6	11.3	10.0
HU	152	12.1	14.3	35.4	0.0	2.0	5.0	10.7	20.6
MT	5	:	5.6	:	0.0	:	:	44.4	:
NL	3 584	14.8	14.9	12.8	1.4	3.6	4.1	28.4	19.8
AT	1 408	12.9	24.8	10.3	3.2	10.1	11.5	13.5	13.7
PL	116	19.3	11.7	27.0	1.1	3.0	14.9	9.0	14.0
PT	56	21.5	19.4	19.7	0.0	17.8	3.6	11.1	6.8
RO	22	18.4	9.2	7.8	:	18.4	6.1	27.4	12.7
SI	110	28.8	10.0	24.1	:	10.6	8.1	7.3	9.3
SK	20	11.5	5.1	20.1	0.0	5.1	30.6	11.9	15.7
FI	1 367	6.9	13.9	6.2	4.8	2.0	3.7	21.4	41.1
SE	2 178	15.9	20.2	9.2	1.9	4.6	10.0	13.3	24.9
UK	5 318	18.5	15.5	16.5	1.0	3.8	7.0	21.1	16.4
IS	22	67.9	4.5	16.3	:	0.0	0.0	11.3	0.0
LI	23	24.2	23.4	15.5	:	4.3	12.8	14.6	5.3
NO	376	19.6	17.1	16.4	0.4	8.1	9.8	16.2	12.5
CH	2 951	19.4	20.8	15.2	2.3	3.9	7.1	19.1	12.1
HR	30	33.3	3.3	22.1	:	11.1	10.0	11.1	9.1
TR	124	19.2	6.3	4.7	9.7	6.4	36.5	9.5	7.7
AU	1 076	26.0	15.3	16.4	0.6	6.1	6.8	20.2	8.6
CA	2 125	14.9	10.8	14.9	0.4	2.2	5.8	22.3	28.7
CN	974	12.0	8.2	11.5	1.6	1.1	4.5	12.0	49.1
IL	1 131	34.0	7.7	13.8	0.2	1.0	4.2	23.7	15.2
IN	534	23.7	3.9	43.1	1.6	0.2	1.5	14.2	11.5
JP	21 989	9.0	16.9	14.6	1.0	0.7	9.0	24.4	24.5
KR	4 375	6.1	5.9	7.7	3.8	1.1	7.8	25.0	42.5
RU	236	20.9	18.3	21.5	0.0	1.8	7.3	15.9	14.3
TW	587	16.5	16.5	7.0	2.4	4.3	8.3	22.2	22.8
US	33 122	22.5	12.4	16.7	1.0	1.4	5.4	22.2	18.3

Patenting in the European Union is highly concentrated in a few Member States. In 2004, Germany generated the most patent applications (see also Table 6.3), accounting for more than 40 % of overall patent activity in the EU-27. France followed in second place, with about 15 %, and the United Kingdom ranked third, with 10 %. These three countries accounted for two thirds of all patent applications to the EPO from the EU-27. The EU-27 aggregate is to a large extent influenced by the German figures.

Patent applications to the EPO by economic activity (NACE)

Patent applications to the EPO can also be broken down by economic activity, using 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 allocated to patent applications are exclusively those of manufacturing industries.

In 2004, at EU-27 level, the two main manufacturing activities involved in patenting were 'manufacture of electrical and optical equipment' (34.1 %), followed by 'manufacture of chemicals, chemical products and man-made fibres' (21.9 %). Two other sections ('manufacture of transport equipment' and 'manufacture of machinery and equipment n.e.c.' accounted for similar shares of patent applications, with around 13 %. Patenting activity in all 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-27 and selected countries, 2004

		Manufacturing of													
	Total	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	Coke, refined petroleum products and nuclear fuel	Chemicals, chemical products and man-made fibres	Rubber and plastic products	Other non-metallic mineral products	Basic metals and fabricated metal products	Machinery and equipment n.e.c.	Electrical and optical equipment	Transport equipment	not elsewhere classified
EU-27	54 011	2.3	0.5	0.2	0.1	1.2	1.5	21.9	2.2	1.8	5.2	12.8	34.1	13.8	1.6
BE	1 468	3.4	0.5	0.1	0.1	1.5	2.2	32.8	2.6	2.3	4.4	10.3	30.0	7.9	1.6
BG	19	2.2	0.4	0.1	0.1	1.0	1.3	25.0	2.4	1.0	6.3	17.1	30.7	11.7	0.8
CZ	111	2.4	0.4	0.1	0.3	1.3	1.4	32.2	2.0	2.6	5.5	11.7	26.2	11.0	2.0
DK	1 000	4.3	0.5	0.1	0.1	1.4	1.2	33.0	1.8	1.7	4.3	10.8	29.6	8.7	1.7
DE	22 619	2.0	0.5	0.2	0.1	1.2	1.5	20.4	2.3	1.8	5.7	14.2	31.4	16.6	1.4
EE	9	1.1	0.3	0.2	0.0	0.8	5.6	19.0	0.7	0.9	2.0	4.3	54.7	3.9	6.7
IE	258	1.9	0.5	0.1	0.1	1.4	1.2	22.4	1.8	1.4	3.7	9.8	45.6	6.9	1.5
EL	65	2.4	0.4	0.1	0.2	1.4	1.3	18.5	3.3	3.7	11.0	12.0	29.2	14.3	0.7
ES	1 193	3.5	0.6	0.2	0.3	1.3	1.2	29.3	2.6	1.9	6.2	12.5	23.6	13.4	3.0
FR	8 240	2.2	0.5	0.2	0.1	1.1	1.5	21.9	2.3	1.7	4.8	11.0	35.3	14.8	1.6
IT	4 551	2.7	0.6	0.4	0.1	1.4	1.7	20.9	2.9	2.0	6.2	16.5	28.5	13.2	2.7
CY	6	2.4	1.5	0.1	0.2	2.5	2.5	29.1	6.1	1.5	8.6	11.7	10.4	6.2	0.7
LV	10	3.3	0.4	0.1	0.1	1.6	0.8	44.4	3.3	3.2	3.3	11.3	12.0	14.9	1.2
LT	14	0.7	0.3	0.0	0.0	3.7	1.1	13.0	0.5	0.8	1.2	7.0	68.5	2.7	0.5
LU	113	1.4	0.6	0.2	0.1	1.7	1.4	16.1	6.1	4.0	8.4	12.4	25.3	21.6	0.7
HU	152	3.4	0.3	0.1	0.0	0.9	1.2	39.9	1.8	1.0	3.8	6.6	31.7	8.3	1.0
MT	5	1.9	0.3	0.2	0.0	0.5	1.0	17.1	0.8	2.0	3.3	16.5	38.8	16.9	0.7
NL	3 584	3.9	0.4	0.1	0.1	1.1	1.6	20.7	1.7	1.6	3.8	10.1	45.5	7.6	1.4
AT	1 408	1.8	0.6	0.2	0.2	1.5	1.3	18.9	2.6	2.5	7.0	15.3	30.7	14.1	2.9
PL	116	4.1	0.5	0.1	0.0	1.1	2.7	31.7	1.7	1.5	3.6	9.7	30.5	12.0	1.0
PT	56	2.1	0.5	0.2	0.5	1.2	1.5	26.5	2.2	2.3	8.7	17.7	21.7	10.8	3.8
RO	22	1.3	0.4	0.1	0.1	1.3	4.1	17.8	1.6	1.1	4.9	15.0	40.1	11.8	0.6
SI	110	3.0	0.3	0.1	0.3	0.9	1.0	40.4	1.2	1.4	6.3	12.3	20.0	8.8	2.2
SK	20	1.9	0.4	0.2	0.1	0.6	1.4	31.6	1.7	3.5	3.5	10.2	26.5	18.0	0.3
FI	1 367	1.3	0.4	0.1	0.1	1.4	1.0	12.6	1.1	1.5	3.2	9.9	57.1	7.8	1.1
SE	2 178	1.6	0.4	0.1	0.1	1.3	0.9	17.8	1.7	1.5	5.2	12.1	41.7	13.9	1.4
UK	5 318	2.6	0.4	0.1	0.1	1.3	1.6	26.2	2.1	1.4	4.0	9.9	37.7	9.8	1.7
IS	22	3.0	0.5	0.0	0.0	1.8	1.4	45.0	0.6	0.7	2.2	17.7	22.2	3.4	1.4
LI	23	1.8	0.5	0.9	0.1	1.2	1.7	28.8	2.6	1.4	6.8	14.7	23.4	13.4	2.9
NO	376	2.7	0.5	0.2	0.2	1.0	3.7	26.0	2.1	1.7	5.1	14.3	28.7	10.0	3.4
CH	2 951	2.4	0.5	0.1	0.1	1.5	1.5	25.2	2.1	1.9	5.0	12.6	35.1	9.3	1.8
HR	30	2.8	0.4	0.2	0.1	0.8	2.8	37.2	1.0	1.7	4.2	9.6	21.9	11.1	6.3
TR	124	3.9	0.3	0.2	0.1	0.8	0.8	13.5	2.2	2.3	5.9	24.1	30.2	14.2	1.6
AU	1 076	3.1	0.5	0.2	0.2	1.3	1.5	26.7	2.0	1.7	5.4	10.3	33.8	8.9	2.6
CA	2 125	2.1	0.3	0.1	0.1	0.9	1.2	23.6	1.4	1.2	3.2	7.6	47.9	8.3	1.3
CN	974	1.6	0.4	0.2	0.0	0.7	1.1	17.6	0.9	0.9	2.7	6.8	57.6	6.9	2.0
IL	1 131	2.5	0.3	0.1	0.0	1.3	0.9	30.0	0.9	1.1	2.8	6.3	44.7	6.0	1.3
IN	534	4.4	0.3	0.0	0.0	0.9	1.8	54.6	0.9	0.8	1.6	3.4	26.5	3.5	0.2
JP	21 989	1.5	0.4	0.1	0.1	1.0	1.3	18.8	1.6	1.5	4.0	9.3	46.5	12.1	1.2
KR	4 375	1.2	0.3	0.1	0.0	0.6	0.8	12.1	0.7	1.2	2.5	9.6	63.0	6.6	0.9
RU	236	3.7	0.4	0.1	0.1	1.4	2.5	30.8	1.5	2.0	5.6	10.6	29.6	9.0	2.0
TW	587	1.2	0.6	0.4	0.1	1.2	0.8	15.1	1.7	1.3	5.8	10.4	45.8	11.0	4.1
US	33 122	2.3	0.4	0.1	0.1	1.3	1.5	27.7	1.4	1.4	3.2	7.8	42.0	7.8	1.3

In 19 Member States, 'manufacture of electrical and optical equipment' was the main manufacturing activity in terms of patent applications, followed by 'manufacture of chemicals, chemical products and man-made fibres'. In eight other Member States the above order was reversed.

In most Member States the shares at national level are close to the European average. Significantly higher shares were found almost exclusively in countries with low patent activity.

Patent applications to the EPO by institutional sector

Table 6.7: Breakdown of patent applications to the EPO by institutional sector, total number and as a percentage of total, EU-27 and selected countries, 2004

	Total	Business enterprise sector	Government sector	Hospitals	Individual applicants	Private non profit sector	Higher education sector	Sector unknown
EU-27	54 011	86.0	1.1	0.1	6.9	1.7	1.5	2.6
BE	1 468	81.6	0.4	0.0	6.2	1.8	6.9	3.0
BG	19	50.0	1.4	0.0	47.9	0.0	0.7	0.0
CZ	111	75.4	0.1	0.0	19.6	0.9	0.4	3.6
DK	1 000	80.5	0.5	0.2	6.0	0.6	1.7	10.4
DE	22 619	90.3	0.1	0.1	6.1	2.1	0.9	0.4
EE	9	30.0	0.0	0.0	11.5	0.0	23.0	35.5
IE	258	73.3	1.6	0.0	15.9	0.4	7.9	1.1
EL	65	55.0	1.2	2.1	36.5	0.4	1.3	3.6
ES	1 193	69.9	1.1	0.1	16.9	1.8	3.6	6.5
FR	8 240	76.5	5.0	0.1	5.4	1.7	1.4	9.9
IT	4 551	84.8	0.6	0.1	10.7	0.5	1.6	1.6
CY	6	83.3	0.0	0.0	16.7	0.0	0.0	0.0
LV	10	36.8	0.0	0.0	50.9	0.0	10.2	2.0
LT	14	79.9	0.0	0.0	12.1	0.0	0.7	7.3
LU	113	89.8	0.0	0.0	5.7	0.0	0.0	4.5
HU	152	59.4	0.1	0.7	19.5	0.5	1.8	18.0
MT	5	77.8	0.0	0.0	22.2	0.0	0.0	0.0
NL	3 584	88.8	0.3	0.2	3.4	4.5	1.4	1.4
AT	1 408	82.8	0.1	0.0	14.8	0.4	0.8	1.1
PL	116	48.5	0.1	0.0	21.6	9.6	7.0	13.2
PT	56	56.1	0.0	0.3	7.6	6.4	18.6	11.0
RO	22	56.7	2.5	0.0	31.2	4.1	0.4	5.0
SI	110	63.4	0.0	0.0	22.5	0.9	0.0	13.2
SK	20	81.7	0.0	0.0	18.3	0.0	0.0	0.0
FI	1 367	95.7	0.0	0.0	2.8	1.2	0.1	0.3
SE	2 178	93.1	0.1	0.0	5.9	0.2	0.1	0.6
UK	5 318	86.5	2.1	0.2	7.2	0.3	3.1	0.6
IS	22	74.3	0.0	0.0	13.5	0.0	0.9	11.3
LI	23	83.0	0.0	0.0	17.0	0.0	0.0	0.0
NO	376	84.3	0.0	0.5	11.0	0.5	1.5	2.1
CH	2 951	89.0	0.1	0.0	7.1	1.1	1.8	0.9
HR	30	55.5	0.0	0.0	32.1	11.3	0.0	1.1
TR	124	32.0	0.0	0.0	12.1	1.1	0.2	54.6
AU	1 076	77.6	1.9	0.3	12.4	2.1	4.8	0.8
CA	2 125	87.3	2.0	0.3	6.0	0.8	3.0	0.6
CN	974	79.4	0.4	0.0	13.3	2.3	3.7	0.9
IL	1 131	82.4	1.6	0.2	8.4	0.5	6.0	0.9
IN	534	81.8	6.3	0.0	8.6	1.5	1.3	0.5
JP	21 989	96.5	0.6	0.0	1.4	0.5	0.9	0.1
KR	4 375	90.7	0.8	0.0	4.2	2.5	1.3	0.4
RU	236	53.9	0.6	0.0	23.3	4.7	1.0	16.5
TW	587	65.9	1.1	0.1	29.5	1.8	1.3	0.4
US	33 122	89.6	1.2	0.5	4.3	0.7	3.4	0.3

Data in Table 6.7 are based on a study conducted in collaboration with the Faculty of Economics & Applied Economics, K.U. Leuven (Steunpunt O&O Statistieken and Research Division Incentim) in order to define a method for the allocation of patents to institutional sectors[1]. In terms of sector allocation, a dual method combining a rule-based and case-based logic is applied to the names of the applicants. Patent applications can thus be broken down into seven groups. Four of these groups correspond to the sector classification mainly used by Eurostat and the OECD for surveys on research and experimental development outlined in the *Frascati Manual* (2002)[2]. These include the 'business enterprise sector (BES)', 'government sector (GOV)', 'higher education sector (HES)' and 'private non-profit sector (PNP)'. As it is not possible to infer from the applicant's name if a hospital is part of the private or public sector, and as a some hospitals have a mixed status, these applicants are kept as a separate group entitled 'hospitals (HOS)'. In many patent applications the applicant and the inventor are the same person, which means that it is difficult to assign the individual to an economic sector.

(1) Data Production Methods for harmonised Patent Statistics: Assignee Sector Allocation, Working papers and studies, Eurostat, 2006, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-AV-06-001/EN/KS-AV-06-001-EN.PDF

(2) Standard method proposed for research and experimental development surveys — Frascati Manual, OECD, 2002

The sector allocation method is applied to the patent data after their quality has been improved by means of a name harmonisation method[3]. The main steps in the harmonisation of applicants' names involve cleaning and standardising characters, removing the indication of the company's legal form, removing non-significant characters, approximate string searching, keyword searching, etc. The name harmonisation method enables a considerable reduction in the diversity of names, but leaves out a number of applicants which cannot be allocated to a specific sector. This explains the existence of the last group 'sector unknown'.

Table 6.7 shows that a large majority of patent applications are filed by the business enterprise sector. However, it should also be noted that the decision to classify an applicant in an institutional sector is not always straightforward. Many patent applications are the result of cooperation between institutions in two or more sectors. For instance, a scientific project may be financed by the business enterprise sector but executed by a state-owned university.

The shares of individual applicants vary considerably across countries. It seems that, in general, countries with highly institutionalised patenting activity have lower shares of individual applicants.

(3) Data Production Methods for Harmonised Patent Statistics: Patentee Name Harmonisation, Working papers and studies, Eurostat, 2006, http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-AV-06-002/EN/KS-AV-06-002-EN.PDF

Foreign ownership

Foreign ownership of domestic inventions in patent applications is one of three indicators of international cooperation in patenting. The other two are domestic ownership of foreign inventions in patent applications and patent applications with foreign co-inventors.

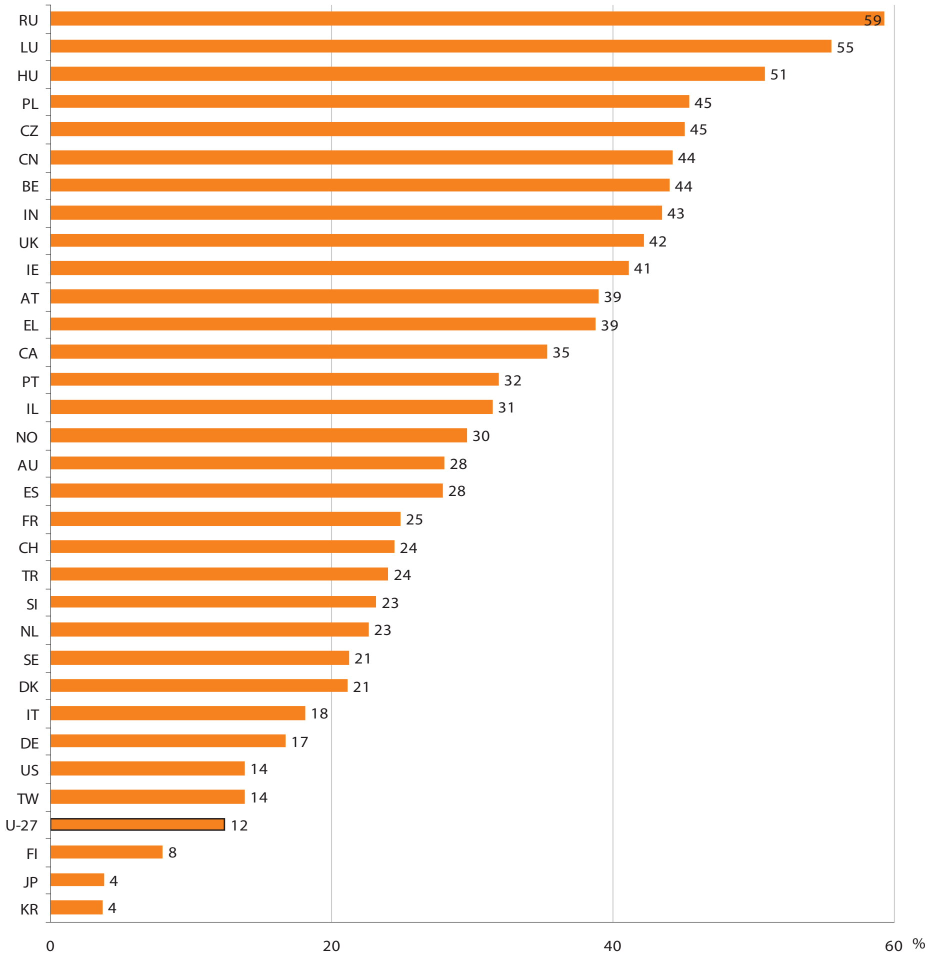
These indicators simply count each patent application from both the inventor country or countries and the applicant country or countries. It should be noted that it is not the nationality of the inventor or applicant that is taken into account, but the place of residence. The total number of patent applications from each country therefore comprises all applications in which the country is involved, whether as an applicant or as an 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 particular case of cooperation. Also, these patent indicators should not be compared with previous ones, where fractional counting rather than simple counting was applied. Furthermore, these indicators should not be aggregated 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 foreign inventor). Figure 6.8 shows foreign ownership of domestic inventions in patent applications to the EPO as a percentage of all applications to the EPO from countries that submitted more than 50 patent applications in 2004.

At EU level, Luxembourg registered by far the highest rate (55 %), followed by Hungary (51 %), Poland and the Czech Republic (both 45 %). Outside Europe, Russia (59 %) and China (44 %) registered the highest rates of foreign ownership of domestic inventions in patent applications to the EPO. The rate for the EU-12 is relatively low because those patent applications are counted as having one or more inventors living in the EU and one or more applicants residing in a non-EU country. For example, a patent application with a German inventor and a French applicant is not counted at EU level, but only recorded in the data for Germany.

Finland recorded the lowest rate at EU level, in with only 8 %. South Korea and Japan were also at the low end of the scale, both with 4 %.

Figure 6.8: Foreign ownership of domestic inventions in patent applications to the EPO, as a percentage of all national applications, selected countries, 2004



Cut-off: at least 50 patent applications in 2004

PCT applications

The Patent Cooperation Treaty (PCT) was signed in Washington on 19 June 1970 and came into force on 1 June 1978. It was amended on 28 September 1979, 3 February 1984 and 3 October 2001.

The PCT enables an international patent application to have the same effect as a national application in each of the contracting states (of which there were 139 in October 2008) designated in the application.

In the cases where the EPO is designated, the patent is known as a Euro-PCT patent. The PCT system is superimposed on the national and European systems, but patents are always granted nationally and/or regionally.

All PCT applications are centralised through the World Intellectual Property Organisation (WIPO)[4] . In October 2008, 184 States were members of the WIPO.

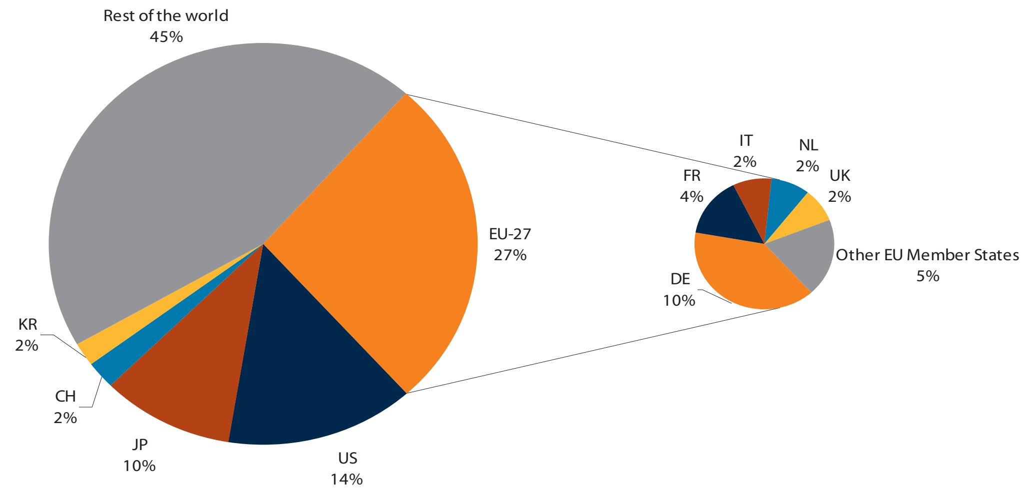
[4] http://www.wipo.int

For a patent application filed as Euro-PCT, two phases are identified: the international phase and the national or regional (European) phase. During the international phase, a search is carried out and, eighteen months after the priority date (the date of the first application at any patent office), the application is published. When the international search report is finalised, the applicant has to choose between three options: transferring the application to a national or regional patent office among those designated in the application (in which case it will enter the national or regional phase); choosing an international preliminary examination; or withdrawing the application. If the application enters the regional or national phase, a formal search and substantive examination are undertaken, ending with the application being either granted, refused, or withdrawn by the applicant.

Owing to the methodological differences explained above, the data shown in Figure 6.9 cannot be compared with the data on patent applications to the EPO.

In 2004, more than a quarter of all PCT applications designated the EPO as the receiving office. More than one third of these applications came from Germany.

Figure 6.9: Breakdown of PCT applications designating the EPO as receiving office, by main countries, 2004



6.4 Patent applications in technological fields

The IPC makes it possible to aggregate patents allocated to certain IPC classes into technological fields. In 2008, Eurostat slightly modified the methodology for the allocation of patent applications in these fields. Previously, only the 'main IPC' code was taken into account in the allocation of a patent application to a technical field. As a patent application can be linked to several domains, and as more than one IPC code is often used to describe the application, the concept of designing one main IPC code became a contentious issue. On the basis of this discussion, Eurostat decided that the allocation to technical fields should take into account all IPC codes listed in a patent application.

High-tech patent applications

One of these technical fields is 'high technology'[5].

In 2004, most high-tech patent applications to the EPO came from Germany (3 465), followed by France (1 832) and the United Kingdom (1 333). In terms of high-tech patent applications per million inhabitants, Finland led by a wide margin, with 128 applications. Sweden and the Netherlands both ranked second with 62 applications. Countries with fewer than 100 high-tech patent applications are not taken into consideration in the analysis below. High technology accounted for 19.3 % of all patent applications filed by the EU-27. The leading countries in this respect were Finland (49.0 %) and the Netherlands (28.1 %).

Whereas in the first observation period (1994 to 1999) the average annual growth rates were often higher for high-tech patent applications than for total patent applications, this was no longer the case during the second observation period (1999 to 2004). Countries with only very few high-tech patent applications cannot be taken into consideration due to excessive fluctuations in growth rates.

A number of countries performed better than the EU-27 average (18.8 %) in the first observation period. Between 1994 and 1999, growth rates in high-tech patent applications were particularly high in Finland (26.3 %) and in the Netherlands (24.4 %). Between 1999 and 2004, the EU-27 AAGR in high-tech patent applications was slightly negative. The comparatively good performance of Italy (7.1 %) and Austria (4.8 %) in the second observation period should also be highlighted here.

Between 1994 and 1999, average annual growth rates in terms of total patent applications to the EPO were were significantly higher than the EU-27 average (10.4 %) in Spain (13.3 %), the Netherlands (13.9 %) and Finland (15.5 %). Between 1999 and 2004 only Spain (10.3 %) and Austria (5.6 %) performed well above the EU-27 average (2.0 %), which also slipped back considerably.

The 'high-tech patent applications' aggregate can be broken down into six groups[6]:

- AVI — Aviation;
- CAB — Computer and automated business equipment;
- CTE — Communications technology;
- LSR — Lasers;
- MGE — Micro-organisms and genetic engineering;
- SMC — Semi-conductors.

(5) The definition and the IPC codes used can be found in the methodological notes.

(6) Data broken down by high-tech group are available in Eurostat's reference database.

Table 6.10: High-tech patent applications to the EPO and annual average growth rates, EU-27 and selected countries, 1994–2004

	High-tech patent applications in 2004			Annual average growth rates in %			
				High-tech patents		All patents	
	Total	Per million inhabitants	As % of all patents	1994-99	1999-2004	1994-99	1999-2004
EU-27	10 398	21	19.3	18.6	-0.4	10.4	2.0
BE	319	31	21.7	19.5	1.0	11.3	2.0
BG	2	0	13.0	:	36.8	21.7	18.6
CZ	13	1	11.7	49.2	21.1	19.4	13.1
DK	227	42	22.7	22.9	0.3	11.8	3.6
DE	3 465	42	15.3	21.5	-0.6	10.9	1.5
EE	2	2	26.8	68.2	5.9	45.1	3.6
IE	53	13	20.5	29.9	-1.9	20.5	4.0
EL	15	1	23.0	20.9	9.0	10.4	4.7
ES	139	3	11.7	21.9	2.9	13.3	10.3
FR	1 832	29	22.2	13.9	0.4	7.6	2.8
IT	506	9	11.1	6.3	7.1	9.8	4.1
CY	:	:	:	:	:	0.9	7.4
LV	:	:	:	:	:	:	42.0
LT	0	0	1.8	71.9	-30.1	22.2	35.7
LU	10	22	9.0	24.6	27.7	22.3	12.4
HU	27	3	17.9	28.0	-0.1	21.2	5.6
MT			:	:	:	:	-2.1
NL	1 006	62	28.1	24.4	0.8	13.9	4.1
AT	184	23	13.1	14.2	4.8	9.5	5.6
PL	21	1	18.0	-4.3	57.1	12.5	27.3
PT	6	1	10.9	65.3	-0.2	21.1	9.2
RO	3	0	11.6	-19.6	30.4	-2.2	24.9
SI	2	1	1.8	-20.4	11.3	10.4	28.5
SK	3	1	17.0	24.5	-6.2	17.0	4.9
FI	669	128	49.0	26.3	-1.3	15.5	-0.6
SE	559	62	25.7	21.1	-2.6	10.4	-0.1
UK	1 333	22	25.1	15.0	-4.5	9.4	-1.5
IS	3	12	15.4	39.7	-29.7	30.8	-9.0
LI	1	15	2.1	:	-24.2	-3.5	3.3
NO	75	16	19.8	36.7	5.9	15.1	0.2
CH	407	55	13.8	14.4	1.9	7.4	3.6
HR	1	0	4.7	-6.2	1.0	8.3	10.4
TR	5	0	4.3	37.1	17.1	44.4	41.4
AU	267	13	24.8	26.5	-5.0	15.6	2.8
CA	876	27	41.2	23.4	10.7	17.2	6.0
CN	496	0	50.9	62.9	63.2	36.3	39.5
IL	355	52	31.4	25.8	-0.2	17.6	7.1
IN	132		24.8	43.9	42.7	49.1	30.1
JP	6 898	54	31.4	12.1	3.0	11.0	3.5
KR	2 014	42	46.0	26.8	36.9	23.2	33.4
RU	47	0	19.7	21.0	0.1	8.8	2.0
TW	183	8	31.2	17.6	26.3	16.4	20.9
US	9 981	34	30.1	12.8	-1.8	9.1	1.9

ICT patent applications

The technological field of Information and Communication Technology (ICT)[(7)] can be divided into four sub-categories:

- consumer electronics;
- computers, office machinery;
- other ICT;
- telecommunications.

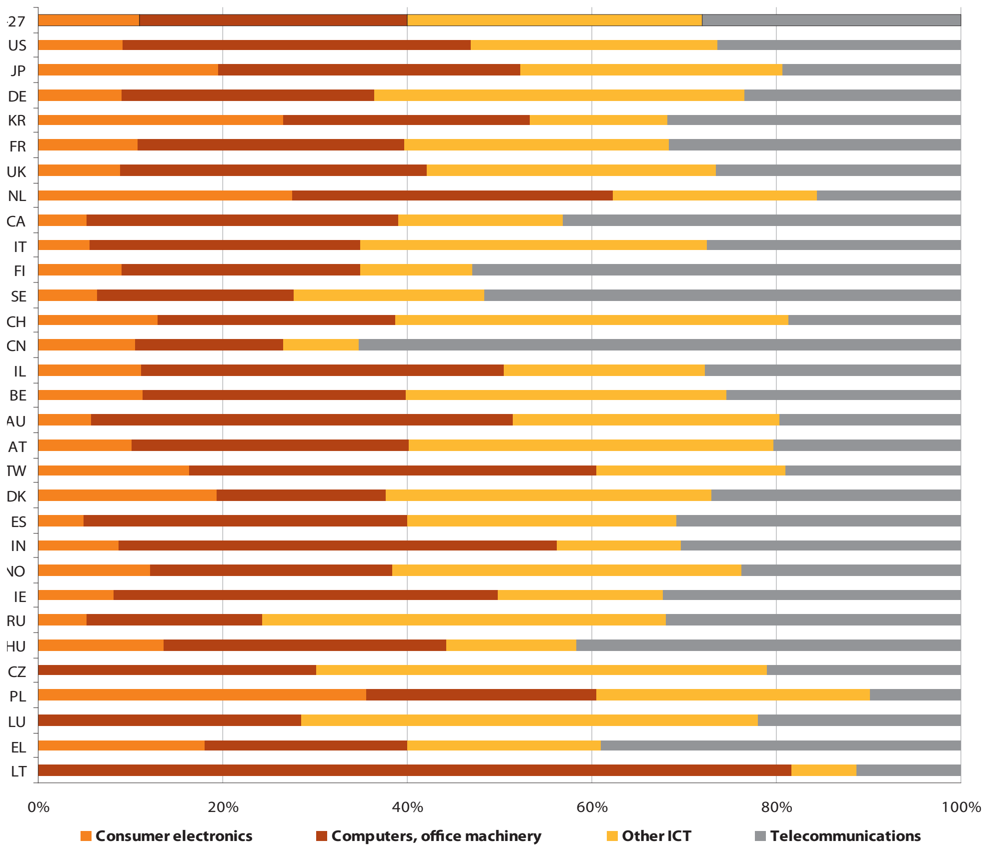
In 2004, the three major economies — the US, Japan and the EU-27 — led in terms of their total number of ICT patent applications to the EPO.

In the EU-27, patenting in 'consumer electronics' played a minor role, but the shares of patent applications in the other three groups were very similar, at around 30 % each. However, this overall picture masks discrepancies at national level. In the Netherlands, the second-largest ICT group in terms of patenting was 'consumer electronics'.

Finland and Sweden filed respectively 61 % and 57 % of all ICT patent applications in ICT group 'telecommunications', denoting a clear specialisation in this field. China and Canada also specialised in this group, whereas close to half of all the ICT patent applications submitted by Australia, India and Taiwan dealt with 'computers, office machinery'.

(7) The definition and the IPC codes used can be found in the methodological notes.

Figure 6.11: Breakdown of ICT patent applications to the EPO by sub-category, as a percentage of total, EU-27 and selected countries, 2004



Cut-off: at least 10 ICT patent applications in 2004

Biotechnology patent applications

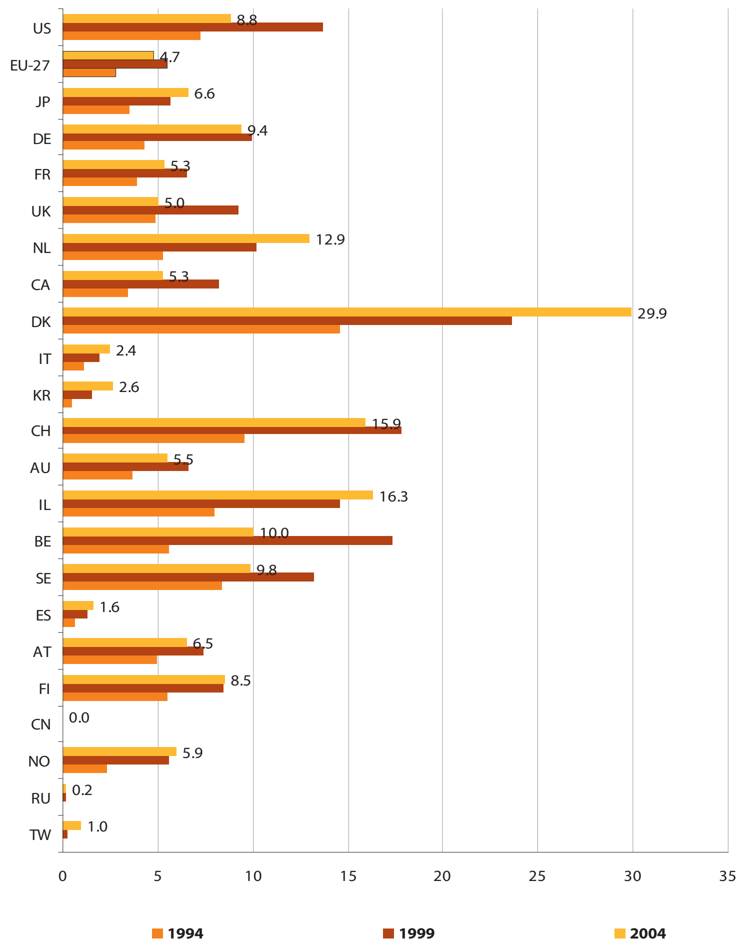
'Biotechnology'[8] is another interesting field in terms of patent applications. Looking at the number of biotechnology patent applications to the EPO in 2004, the United States was in the lead, followed by the EU-27 and Japan.

However, the ratio per million inhabitants reveals a very different ranking, with Denmark far ahead of other countries, followed by Israel and Switzerland.

A closer look at the results for 1994, 1999 and 2004 reveals a mixed picture. Whereas increases were observed across the board between 1994 and 1999, the comparison of data for 1999 and 2004 brings no common trend to light. In some countries this ratio increased, while in others it stagnated.

(8) The definition and the IPC codes used can be found in the methodological notes.

Figure 6.12: Biotechnology patent applications to the EPO, total number and per million inhabitants, EU-27 and selected countries, 1994, 1999 and 2004



Cut-off: at least 20 biotech patent applications in 2004

Eco-Patent Commons

Objectives of the Eco-Patent Commons

- To provide an avenue by which innovations and solutions may be easily shared to accelerate and facilitate implementations to protect the environment and perhaps lead to further innovation.
- To promote and encourage cooperation and collaboration between businesses that pledge patents and potential users to foster further joint innovations and the advancement and development of solutions that benefit the environment.

The Eco-Patent Commons provides a unique leadership opportunity for global business to make a difference – sharing their innovations in support of sustainable development.

How the Eco-Patent Commons will work

The patents will be identified in a searchable Web site hosted by the World Business Council for Sustainable Development (WBCSD). The Commons will be open to all – with global participation by businesses in various industry sectors. It will be supplied with initial and subsequent patent pledges by companies that become members of the Commons. Through the Commons, the patents will be made available for free use by all, subject to defensive termination.

Which patents may be pledged

- Which patents a business wishes to offer the Commons is left to the discretion of each business.
- The patents must be for innovations that provide 'environmental benefits.' These 'environmental benefits' may be a direct purpose of the patents, such as a technology to accelerate groundwater remediation, but can also be less direct as in manufacturing or business processes that lead to a reduction in hazardous waste generation or energy consumption.
- Businesses can pledge any number of patents in order to participate in the Commons. To join the Commons, only one patent needs to be pledged by a business. While the Commons is intended to grow over time and include a large number of patents, businesses which hold only one or a small number of relevant patents are welcome to participate and support this global initiative.

Examples of environmental benefits patented inventions may provide

- Energy conservation or efficiency
- Pollution prevention (source reduction, waste reduction)
- Use of environmentally preferable materials or substances
- Materials reduction
- Increased recycling ability

Benefits for patent users and our planet

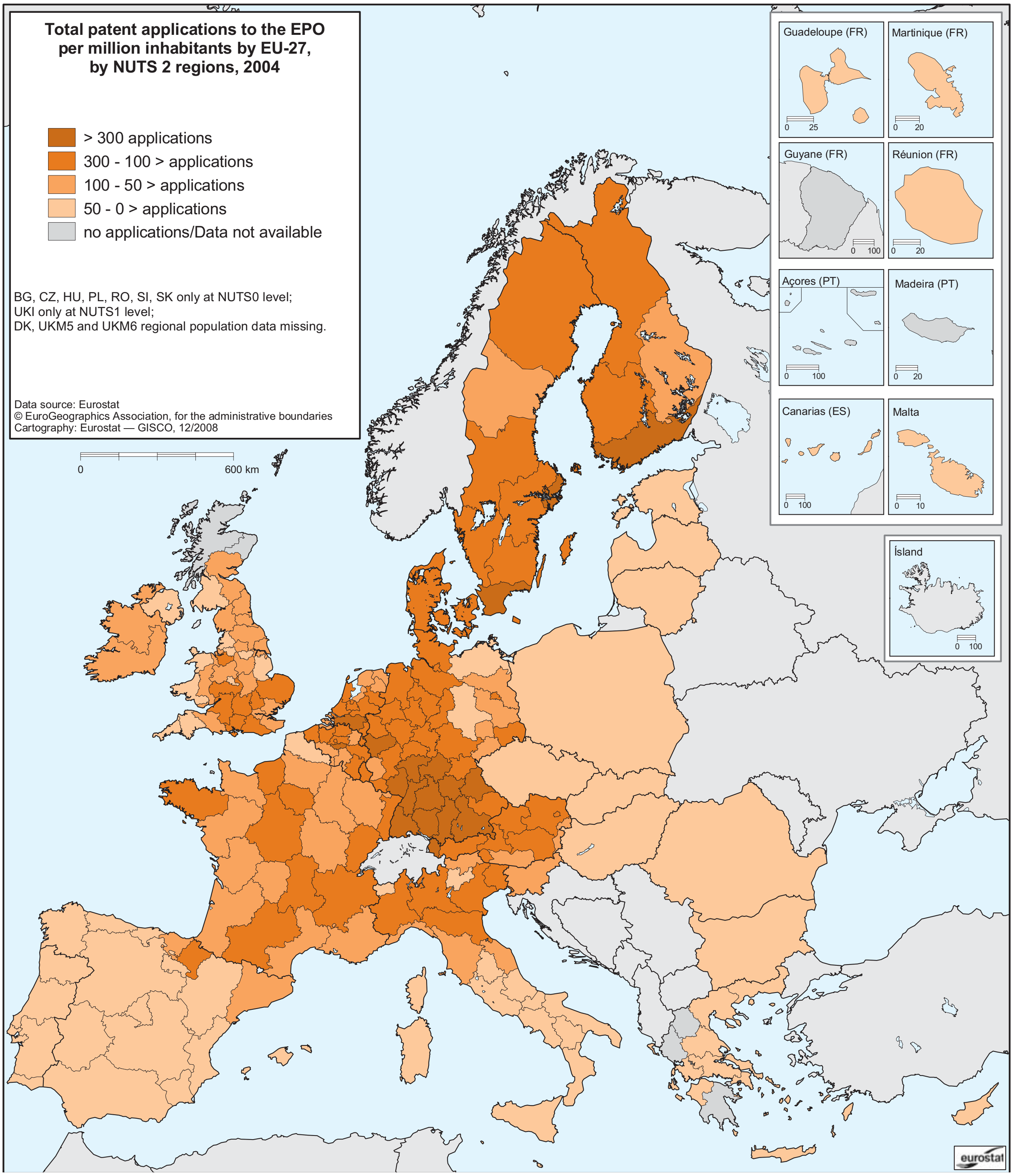
- The Eco-Patent Commons will provide free access to patents that can be leveraged by others to improve the environmental aspects of their operations.
- The information will be readily available in one easily accessible place.
- The Commons will constitute a forum which can be used by those who are facing an environmental challenge to liaise with those who have already successfully overcome such a challenge.

Source: epc@wbcsd.org

6.5 Performance at regional level

Total patent applications to the EPO

Map 6.13: Patent applications to the EPO per million inhabitants by EU-27 region (NUTS 2), 2004



High concentration of patenting activity at regional level

Map 6.13 illustrates regional patenting activity in the EU. In most European countries, national patenting is concentrated in certain regions. Regions that are active in patenting are often situated close together, forming 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 a total of 100–300 applications and with more than 300 applications per million inhabitants) are situated in the Nordic countries and in the centre of the EU-27.

Table 6.14: Patent applications to the EPO, top three regions by country (NUTS 2), total number and per million inhabitants, 2004

	Total number		Per million inhabitants	
BE	Prov. Antwerpen	326	Région de Bruxelles-Capitale/Brussels Hoofdstedelijk Gewest	130.7
	Prov. Vlaams Brabant	213	Prov. West-Vlaanderen	127.4
	Prov. Oost-Vlaanderen	201	Prov. Vlaams Brabant	206.0
BG	Bulgaria (NUTS0)	19	Bulgaria (NUTS0)	2.4
CZ	Czech Republic (NUTS0)	111	Czech Republic (NUTS0)	10.9
DK	Hovedstaden	540	Denmark (NUTS0)	185.1
	Midtjylland	159		
	Syddanmark	154		
DE	Stuttgart	2573	Stuttgart	644.2
	Oberbayern	2371	Oberbayern	565.0
	Darmstadt	1487	Karlsruhe	520.9
EE	Estonia	9	Estonia	6.4
IE	Border, Midlands and Western	66	Border, Midlands and Western	61.5
	Southern and Eastern	189	Southern and Eastern	64.1
EL	Attiki	42	Attiki	10.6
	Kentriki Makedonia	9	Kriti	6.4
	Thessalia	4	Thessalia	6.0
ES	Cataluña	470	Comunidad Foral de Navarra	110.1
	Comunidad de Madrid	207	Cataluña	70.9
	Comunidad Valenciana	114	Pais Vasco	51.9
FR	Île-de-France	3297	Île-de-France	291.3
	Rhône-Alpes	1334	Rhône-Alpes	225.8
	Provence-Alpes-Côte d'Azur	454	Alsace	173.4
IT	Lombardia	1421	Emilia-Romagna	168.3
	Emilia-Romagna	687	Lombardia	153.7
	Piemonte	616	Piemonte	144.4
CY	Cyprus	6	Cyprus	8.2
LV	Latvia	10	Latvia	4.2
LT	Lithuania	14	Lithuania	4.0
LU	Luxembourg	112	Luxembourg	246.6
HU	Hungary (NUTS0)	152	Hungary (NUTS0)	15.1
MT	Malta	5	Malta	11.3
NL	Noord-Brabant	1831	Noord-Brabant	760.8
	Zuid-Holland	426	Limburg (NL)	194.8
	Noord-Holland	327	Utrecht	151.4
AT	Wien	304	Vorarlberg	410.1
	Oberösterreich	287	Oberösterreich	206.8
	Niederösterreich	211	Wien	190.0
PL	Poland (NUTS0)	116	Poland (NUTS0)	3.0
PT	Norte	23	Norte	6.2
	Lisboa	16	Lisboa	5.8
	Centro (PT)	14	Centro (PT)	5.7
RO	Romania (NUTS0)	22	Romania (NUTS0)	1.0
SI	Slovenia (NUTS0)	110	Slovenia (NUTS0)	55.0
SK	Slovakia (NUTS0)	20	Slovakia (NUTS0)	3.6
FI	Etelä-Suomi	822	Etelä-Suomi	320.0
	Länsi-Suomi	394	Länsi-Suomi	297.4
	Pohjois-Suomi	103	Pohjois-Suomi	163.3
SE	Stockholm	641	Stockholm	344.4
	Västsverige	516	Sydsverige	321.3
	Sydsverige	419	Västsverige	287.5
UK	East Anglia	464	East Anglia	208.1
	Berkshire, Bucks and Oxfordshire	419	Berkshire, Bucks and Oxfordshire	198.0
	Surrey, East and West Sussex	386	Surrey, East and West Sussex	149.8

BG, CZ, HU, PL, RO, SI, SK only at NUTS0 level.
UKI only at NUTS1 level - DK, UKM5 and UKM6 regional population and labour force data missing.

Table 6.14 shows the three leading regions in terms of patent applications to the EPO. The leading regions may vary depending on the measurement criterion chosen (total number or per million inhabitants). However, regional data are not available for all EU-27 countries, as smaller countries are considered together as regions (NUTS 2 level). This is the case for Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta.

Regional breakdowns for some countries were not available at the time of going to press, but may become available in the near future. These countries include Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovenia and Slovakia.

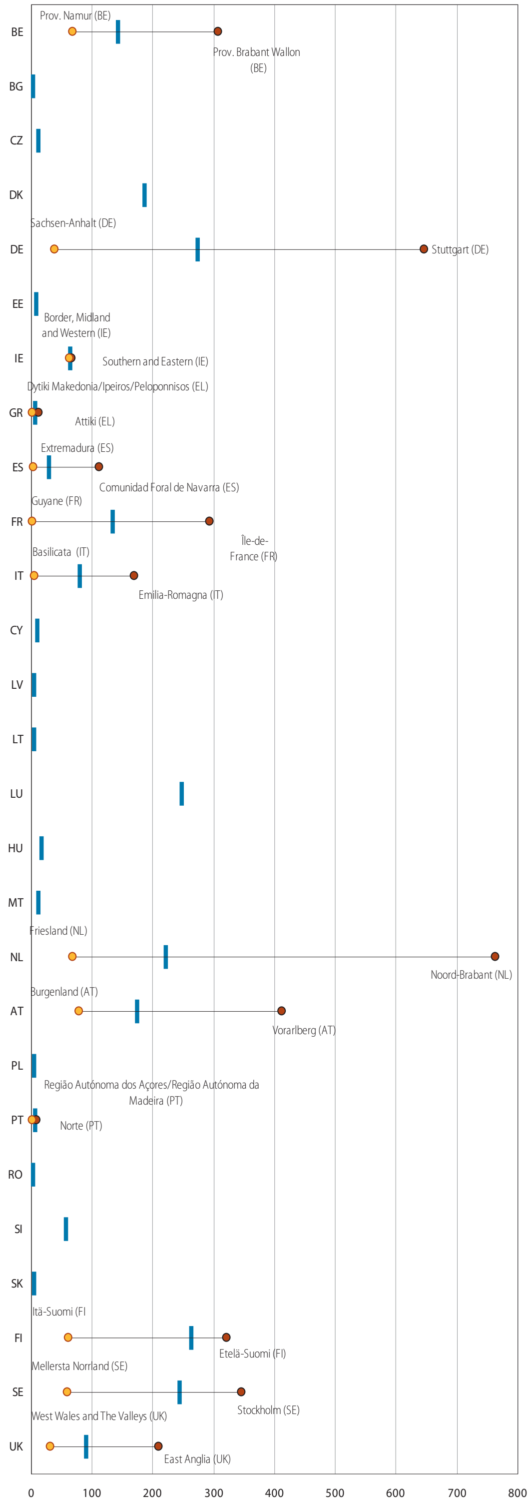
Patent activity varies not only across countries but also across regions. In 2004, Île-de-France (FR) was the foremost EU region in terms of the total number of patent applications (3 297), while Noord-Brabant (NL) was in the lead in terms of patent applications per million inhabitants (761).

Figure 6.15 presents regional disparities by country. Large disparities were observed in Germany between Stuttgart, the leading region in the south, and Sachsen-Anhalt, in the east, which was the worst-performing region. In the Netherlands, regional discrepancies are even wider between Noord-Brabant and Friesland. Regional disparities are much lower in countries with comparable national averages, such as Finland and Sweden.

Map 6.16 provides an overview of regional performance in high-tech patent applications.

Only very few regions registered more than 100 high-tech patent applications per million inhabitants to the EPO.

Figure 6.15: Patent applications to the EPO per million inhabitants, regional disparities (best and worst performing region) and national average by country (NUTS 2), 2004



Map 6.16: High-tech patent applications to the EPO per million inhabitants by EU-27 region (NUTS 2), 2004

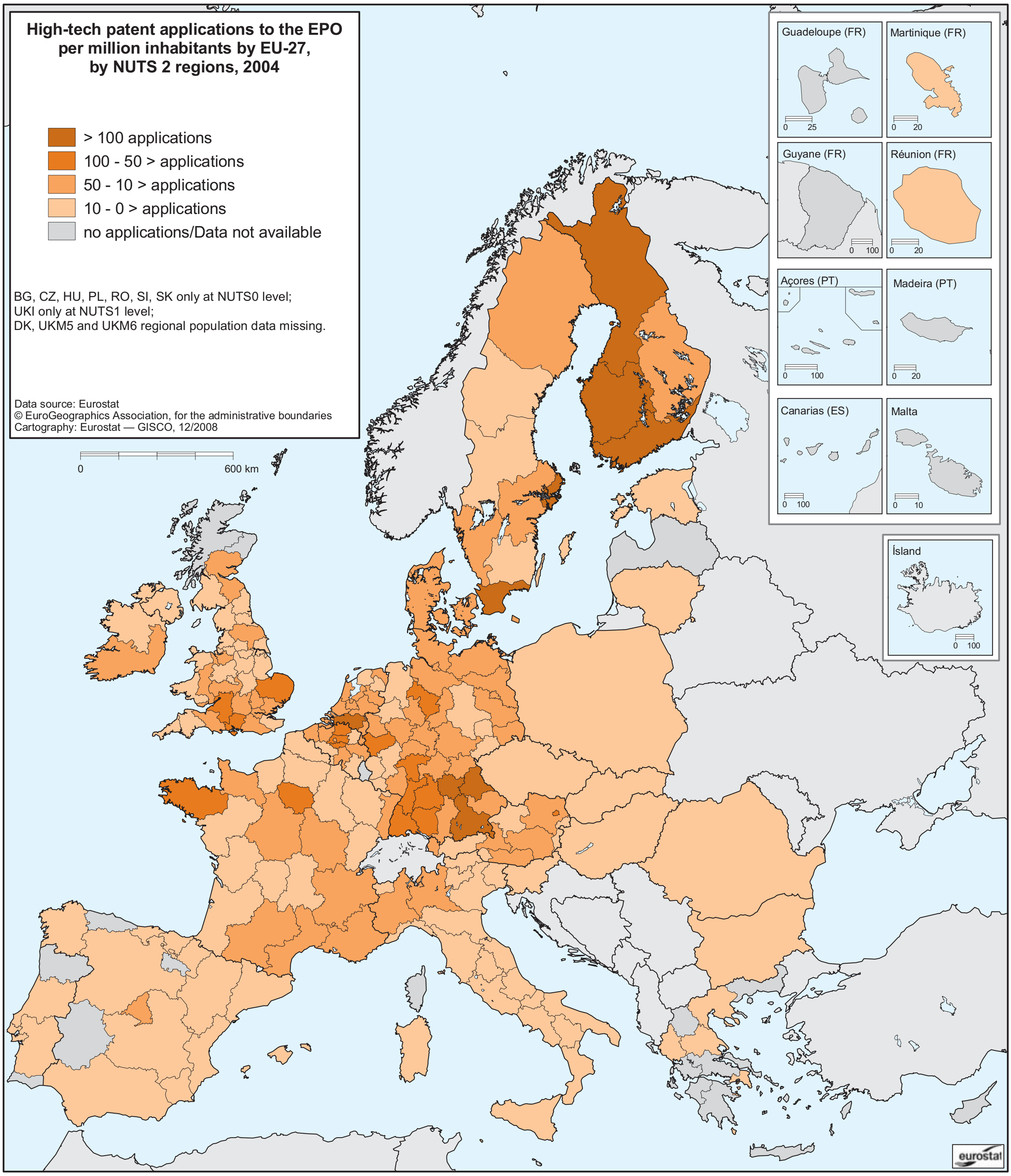


Table 6.17: High-tech patent applications to the EPO in the leading EU-27 regions (NUTS 2), total number and by high-tech group in percentage of the total, 2004

	Leading high-tech region (or country)	Total high tech	Computer and automated business equipment	Micro-organism and genetic engineering	Aviation	Communication technology	Semiconductors	Laser
BE	Prov. Antwerpen	91	41.6	9.7	:	45.1	5.9	:
BG	Bulgaria	2	84.0	5.7	:	10.2	:	:
CZ	Czech Republic	13	38.1	30.9	:	34.8	:	:
DK	Hovedstaden	158	11.9	55.0	:	33.0	2.0	1.9
DE	Oberbayern	585	28.2	11.8	1.5	53.2	8.0	1.0
EE	Estonia	2	42.9	14.2	:	42.9	:	:
IE	Southern and Eastern	46	39.0	5.3	2.2	46.7	4.6	3.3
EL	Attiki	12	15.0	20.1	:	69.7	:	:
ES	Comunidad de Madrid	61	9.4	40.5	14.0	36.1	2.0	:
FR	Île de France	855	29.4	12.1	3.4	53.6	4.3	2.5
IT	Lombardia	170	34.4	9.5	2.9	43.3	15.5	0.6
CY	Cyprus	:	:	:	:	:	:	:
LV	Latvia	:	:	:	:	:	:	:
LT	Lithuania	0	:	:	:	:	100.0	:
LU	Luxembourg (Grand-Duché)	10	50.8	19.7	:	19.7	9.8	:
HU	Hungary	27	18.3	15.9	3.7	65.8	:	:
MT	Malta	:	:	:	:	:	:	:
NL	Noord-Brabant	697	38.0	1.6	0.3	46.1	17.5	0.7
AT	Wien	102	38.3	13.8	2.0	45.1	6.2	0.5
PL	Poland	21	17.1	33.2	:	38.2	11.5	4.8
PT	Lisboa	4	:	38.3	:	61.7	:	:
RO	Romania	3	60.5	:	:	66.0	:	:
SI	Slovenia	2	:	:	:	100.0	:	:
SK	Slovakia	3	:	27.6	:	72.7	:	:
FI	Etelä-Suomi	402	22.9	4.7	:	77.9	3.0	0.2
SE	Stockholm	240	14.0	6.1	:	79.1	5.2	0.8
UK	East Anglia	183	32.6	13.1	0.5	43.9	12.4	1.2

Table 6.17 provides another perspective on regional patenting. On the one hand, the table shows the leading region in terms of the number of high-tech patent applications at NUTS level for each Member State. Several small countries are considered as a single NUTS 2 region (Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta). For other countries only data at country level are currently available (Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovenia and Slovakia). Looking at these leading regions, Île-de-France (FR, 855) ranked first, followed by Noord-Brabant (NL, 697) and Oberbayern (DE, 585). Etelä-Suomi (FI, 402) and Stockholm (SE, 240) followed with more than 200 high-tech patent applications per region.

On the other hand, the table provides a breakdown by high-tech group. Six high-tech groups can be identified:

- computer and automated business equipment;
- micro-organism and genetic engineering;
- aviation;
- communication technology;
- semiconductors;
- lasers.

In countries with few high-tech patent applications not all groups are concerned by the breakdown.

The breakdown reveals a specialisation of Stockholm (SE) and Etelä-Suomi (FI), and to a lesser extent of Île-de-France (FR) and Oberbayern (DE), in patent applications in 'communication technology'. Hovedstaden, the leading Danish region in high-tech applications, specialised in 'micro-organism and genetic engineering'.

Figure 6.18: Top fifteen EU-27 regions in terms of high-tech patent applications to the EPO, total number and per million inhabitants, 2004

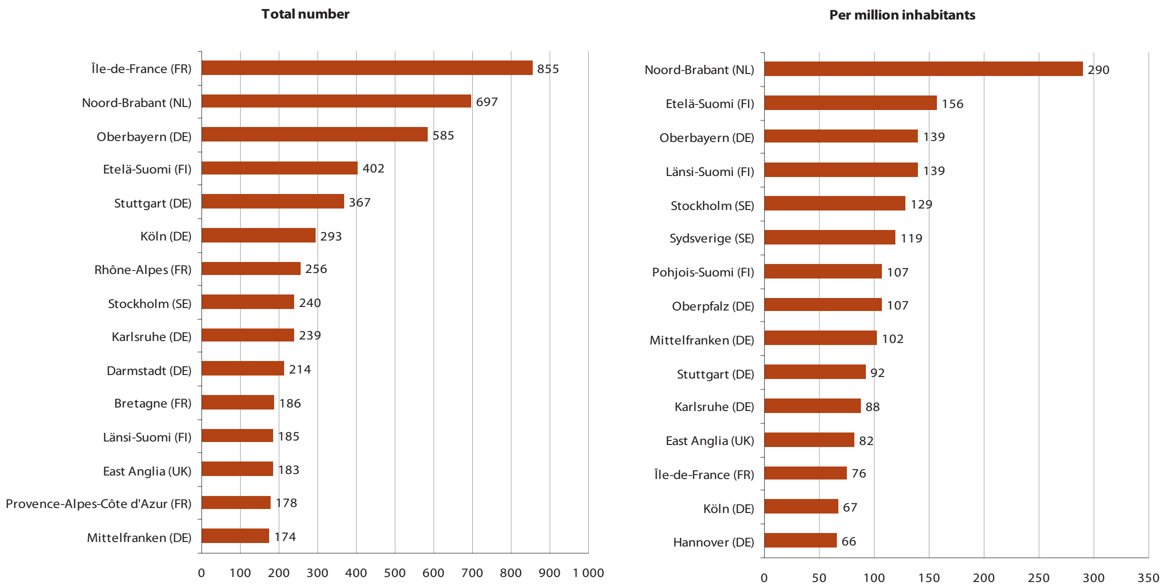


Figure 6.18 compares the top fifteen EU regions in high-tech patent applications by total number and per million inhabitants.

The top fifteen regions by total number of patent applications included six regions in Germany, four in France, two in Finland and one region in the Netherlands, Sweden and the United Kingdom. In contrast, the top fifteen regions by patent applications per million inhabitants included seven regions in Germany, three in Finland, two in Sweden and one region in the Netherlands, the United Kingdom and France.

In 2004, Île-de-France (FR) recorded the highest number of high-tech patent applications (855), followed by the Dutch region of Noord-Brabant (697) and the German region of Oberbayern (585).

Noord-Brabant was the undisputed leader in terms of high-tech patent applications per million inhabitants (290). The Finnish region of Etelä-Suomi ranked second with 156 high-tech patent applications per million inhabitants, and Oberbayern (DE, 139) again ranked third.

Figure 6.19: Top 10 EU-27 regions (NUTS 2) in terms of ICT patent applications to the EPO, total number and breakdown by sub-category, 2004

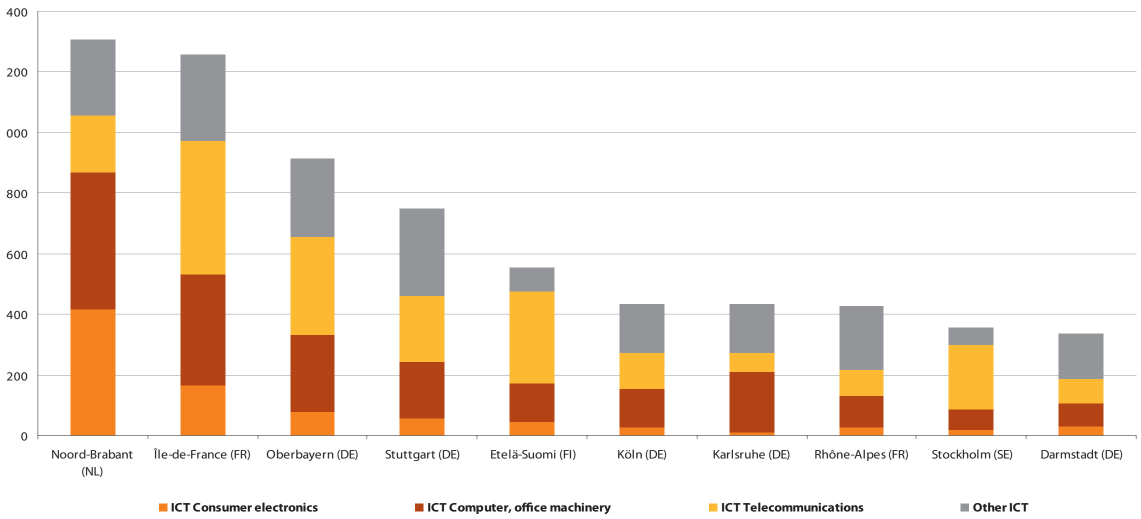


Figure 6.19 shows the top 10 regions in terms of ICT patent applications to the EPO broken down into four subcategories:

- telecommunications;
- other ICT;
- computers, office machinery;
- consumer electronics.

In terms of total ICT patent applications, Noord-Brabant (NL) was in the lead, followed by Île-de-France (FR) and Oberbayern (DE), with each region accounting for more than 800 ICT patent applications. The following regions submitted 700 or fewer ICT patent applications to the EPO.

The breakdown by subcategories varies substantially according to the region considered. While 35 % of all ICT patent applications from Noord-Brabant (NL) were submitted for 'consumer electronics', 'telecommunications' accounted for 38 % and 39 % of ICT patent applications in Île-de-France (FR) and Oberbayern (DE) respectively. Stockholm, the Swedish capital region, and the Finnish region of Etelä-Suomi were most active in the sub-category of 'telecommunications', accounting for respectively 66 % and 62 % of ICT patent applications for each region.

Close to half of all ICT patent applications from Karlsruhe (DE) were devoted to 'computer, office machinery', whereas more than one in two ICT patent applications from Rhône-Alpes (FR) were submitted in the sub-category 'other ICT'.

Table 6.20: Leading EU-27 regions (NUTS2) in terms of ICT patent applications to the EPO, 2004

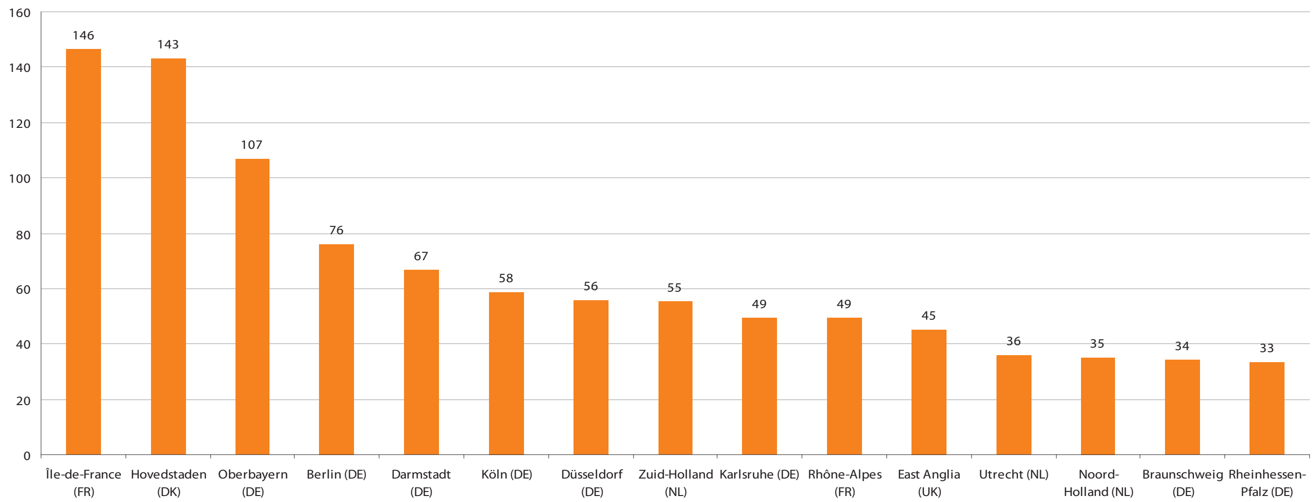
Leading ICT region (or country)		Total number of ICT patent applications per region	Region's share of all ICT patent applications	Per million inhabitants	Per million labour force
BE	Prov. Antwerpen	105	27.2	62.6	142.5
BG	Bulgaria	4	100.0	0.5	1.1
CZ	Czech Republic	26	100.0	0.5	5.1
DK	Hovedstaden	123	55.4	:	:
DE	Oberbayern	835	15.7	199.0	389.5
EE	Estonia	6	100.0	4.2	8.6
IE	Southern and Eastern	82	87.7	27.7	56.4
EL	Attiki	14	87.8	3.6	7.9
ES	Cataluña	67	38.1	10.2	19.6
FR	Île de France	1140	46.5	100.7	208.4
IT	Lombardia	294	35.5	31.8	68.0
CY	Cyprus	1	100.0	1.4	2.8
LV	Latvia	:	:	:	:
LT	Lithuania	12	100.0	3.4	7.2
LU	Luxembourg (Grand-Duché)	18	100.0	39.9	91.5
HU	Hungary	34	100.0	3.4	8.3
MT	Malta	2	100.0	5.0	12.6
NL	Noord-Brabant	1191	79.9	494.7	932.9
AT	Wien	121	40.3	75.9	155.2
PL	Poland	19	100.0	0.5	1.1
PT	Lisboa	3	37.4	1.3	2.4
RO	Romania	8	100.0	0.4	0.8
SI	Slovenia	8	100.0	4.0	7.9
SK	Slovakia	5	100.0	0.9	1.9
FI	Etelä-Suomi	487	59.8	189.4	362.6
SE	Stockholm	325	40.9	174.8	321.6
UK	East Anglia	244	13.2	109.7	215.9

Table 6.20 provides more detailed information on ICT patent applications. Apart from the number of ICT patent applications in the leading region of each country, the table also presents the share of each leading region relative to the country. This share amounts to 100 % in Member States which are counted at NUTS 2 level and in those where no regional breakdown is available. In the remaining countries this percentage may be used as a proxy to measure the concentration of ICT patent activity in the country.

With close to 80 % of all ICT patent applications, it appears that ICT patent activity in the Netherlands is concentrated in only one region: Noord-Brabant.

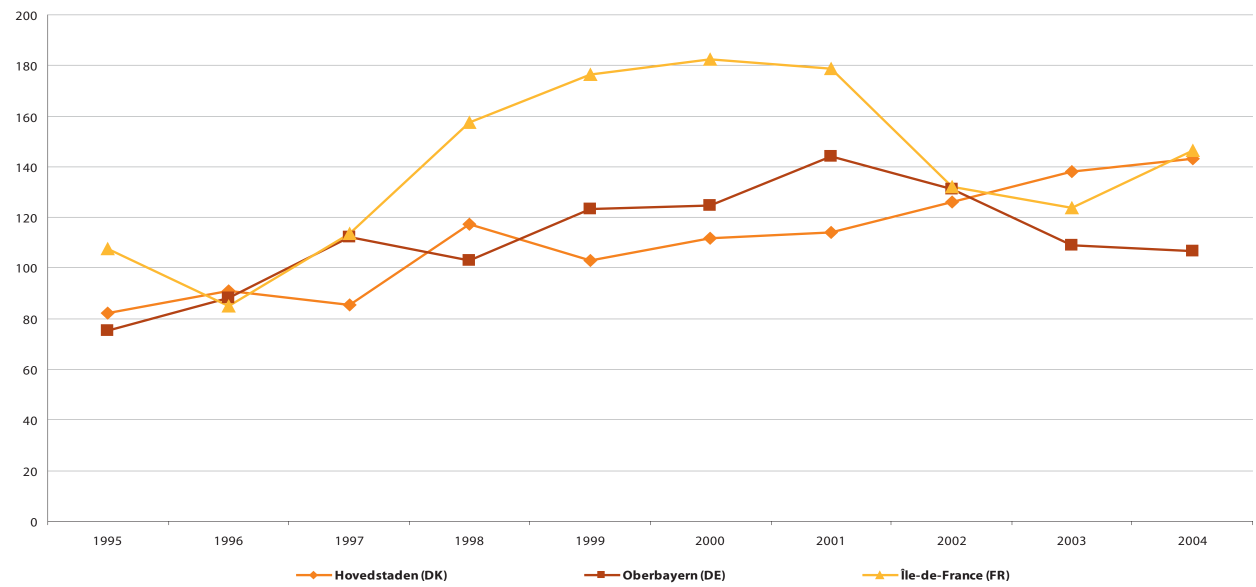
As shown in the following examples, patent activity is not always concentrated in the leading region. In 2004, only 16 % of all German ICT patent applications were filed in Oberbayern and only 13 % of all British ICT patent applications were filed in East Anglia.

Figure 6.21: Top fifteen EU-27 regions (NUTS 2) in terms of biotechnology patent applications to the EPO, total number, 2004



Biotechnology patenting can also be measured at regional level. Among the top fifteen regions in biotech patenting in the EU, eight are German, three are Dutch, two are French, one is British and one is Danish. Eight of the top fifteen regions in biotechnology are also among the overall top three patenting regions per country (see Figure 6.14). The German region of Stuttgart and the Dutch region of Noord-Brabant, which were strongly represented in the previous analysis, did not feature among the top fifteen regions specialised in biotechnology patent applications to the EPO.

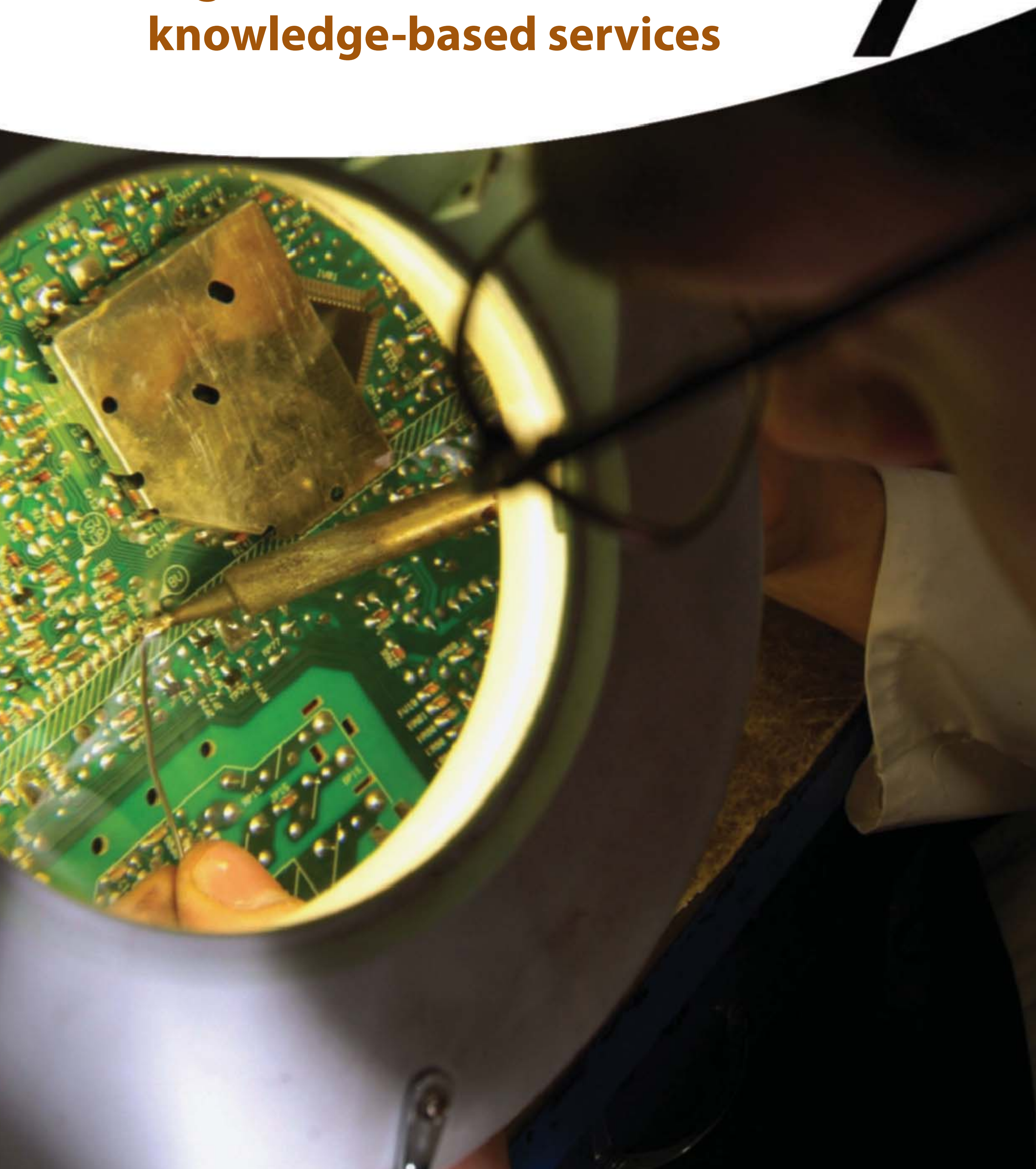
Figure 6.22: Top three EU-27 regions (NUTS 2) in terms of biotechnology patent applications to the EPO, total number, 1995–2004



As Figure 6.22 shows, the trends over 10 years for the top three EU-27 regions in terms of biotechnology patent applications are quite different. Whereas Île-de-France registered a sharp increase in the number of patent applications in biotechnology in 1996 and 1997, the other two regions progressed at a slower pace.

High-tech industries and knowledge-based services

7



7.1 Introduction

Creating, exploiting and commercialising new technologies has become essential in the global race for competitiveness. High-technology sectors are key drivers of economic growth, productivity and welfare, and are generally a source of high value added and well-paid employment.

Technology-intensive enterprises are often referred to as high technology — or 'high-tech' — companies. They are vital to the competitive position of a country because:

- They are associated with innovation and hence tend to gain larger market shares, create new product and service markets, and use resources more efficiently. Environmental aspects play an increasingly important role in this context.
- 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 aims to provide an insight into the performance of high-tech industries and knowledge-intensive services in Europe by considering various aspects relating to statistics on enterprises (value added, production value, etc.), venture capital investments, high-tech trade and employment in high-tech.

Section 7.2 examines structural statistics on enterprises by analysing the performance of high-tech industries and high-tech knowledge-intensive services (KIS) sectors.

Section 7.3 presents statistics on venture capital investments (VCI) at the early stage, at the expansion and replacement stage and at the buyout stage.

Section 7.4 will analyse the patterns of international high-tech trade, which makes up a considerable proportion of total trade in many advanced economies.

Section 7.5 will consider the employment situation in high-tech manufacturing and high-tech knowledge-intensive services sectors, at both national and regional levels. In this context, regional data are analysed at NUTS 2 level.

Joint Technology Initiatives

'The Spring European Council in 2005 underlined the core role of knowledge and innovation as engines of sustainable growth and stated that 'the European area of knowledge should enable undertakings to build new competitive factors, consumers to benefit from new goods and services and workers to acquire new skills. With that in mind, it is important to develop research, education and all forms of innovation insofar as they make it possible to turn knowledge into added value and create more and better jobs'.

'To realise this ambition and to ensure a solid industrial fabric throughout the European territory, a **stronger link between research and industry** is particularly important. Industry has, clearly, a key role to play in this endeavour.'

'**Increasing the scale and impact of research investment, enhancing the coordination of research** in Europe and **raising the technology content of industrial activity** are critical if Europe is to strengthen its position as a technologically innovative economy with the capacity to develop a comparative advantage in new areas.'

'**Public-private partnerships** involving industry, the research community and public authorities can play a significant role in meeting these challenges.'

'Joint Technology Initiatives can serve to implement a specific part or the entirety of a European Technology Platform.'

'The objectives of Joint Technology Initiatives include the following:

– ensuring **coherent implementation of European research efforts** in the strategic technological fields for the future;

– **accelerating the generation of new knowledge**, innovation and the uptake of research into strategic technologies, leading to enhanced productivity and strengthened industrial competitiveness;

-concentrating efforts on key projects that can help **meet Europe's industrial competitiveness goals**;

– **enhancing the technology verification process** in order to identify and remove obstacles to future market penetration;

– pooling user requirements to guide investment in research and development towards **operational and marketable solutions.'**

Source: Report on European Technology Platforms and Joint Technology Initiatives: Fostering Public-Private R&D Partnerships to Boost Europe's Industrial Competitiveness-2006
http://ec.europa.eu/research/fp7/pdf/tp_report_council.pdf

7.2 Enterprises in high-tech industries and knowledge-intensive services

Table 7.1: Economic statistics on high-tech sectors(1), EU-27, 2004

	High-tech manufacturing					High-tech knowledge-intensive services (KIS)				
	Number of enterprises	Turnover in EUR million	Prod. value in EUR million	Value added in EUR million	Gross invest. in tangible goods in EUR million	Number of enterprises	Turnover in EUR million	Prod. value in EUR million	Value added in EUR million	Gross invest. in tangible goods in EUR million
EU-27	139 453 s	658 427 s	596 534 s	199 339 s	23 313 s	600 312	845 954	783 489	419 315	59 481 s
BE	1 958	15 173	16 589	6 459	395	14 648	23 426	23 448	11 426	1 197
BG	1 265	514	466	: c	: c	3 790	1 775	1 685	1 004	340
CZ	8 682	9 013	8 689	1 556	320	24 868	7 344	6 746	3 561	629
DK	1 112	8 914	8 976	3 917	723	8 481	15 227	13 967	7 264	1 414
DE	19 992	150 823	129 355	49 671	5 707	57 527	158 784	139 123	84 122	10 275
EE	256	: c	: c	: c	: c	955	772	742	352	54
IE	309	30 458	30 036	8 714	810	6 045	16 348	11 205	8 077	763
EL	2 074	1 890	1 815	806	92	10 859	9 943	12 579	5 058	1 325
ES	7 922	22 890	21 366	6 375	1 045	34 787	56 007	44 536	27 388	4 212
FR	16 391	141 886	132 319	31 747	3 755	56 943	123 425	120 051	61 666	6 632
IT	32 098	60 621	58 873	18 887	2 534	101 056	98 236	97 580	45 823	6 510
CY	85	90	89	37	6	231	538	525	429	97
LV	242	:	:	:	:	1 216	832	770	463	100
LT	363	379	384	125	49	1 325	998	876	420	99
LU	62	: c	: c	: c	: c	1 095	2 210	1 964	1 211	: c
HU	6 029	15 887	14 818	2 899	922	27 224	8 032	5 316	3 163	792
MT	:	:	:	:	:	684	314	312	230	67
NL	3 040	:	:	:	:	24 075	39 598	38 738	19 678	2 157
AT	1 829	11 344	10 031	4 192	528	13 908	15 570	11 164	7 179	1 180
PL	14 874	7 266	6 701	2 226	375	31 541	14 106	12 629	7 350	1 226
PT	1 302	5 042	4 890	1 214	262	3 665	10 292	9 603	4 513	909
RO	1 784	1 121	1 005	359	159	12 132	3 933	3 581	1 965	827
SI	913	2 022	1 882	908	202	3 061	1 980	1 690	873	239
SK	401	1 658	1 579	179	86	1 373	2 257	2 050	1 085	360
FI	1 253	29 588	17 787	6 469	334	5 297	12 909	12 530	4 832	640
SE	3 625	24 299	25 831	10 591	742	32 588	28 659	26 945	12 550	2 162
UK	11 552	90 228	81 435	35 073	3 287	120 938	192 438	183 135	97 636	14 819

(1) High-tech sectors include high-tech manufacturing and high-tech KIS sectors.
Exceptions to the reference year high-tech manufacturing: 2003: IE and SI; 2002: LT; 2001: CY.
Exceptions to the reference year high-tech KIS: 2002: CY, LU and MT.

In 2004, the EU-27 counted almost 140 000 enterprises in high-tech manufacturing and over 600 000 enterprises in high-tech knowledge-intensive services.

High-tech manufacturers were most numerous in Italy, Germany, France and Poland, accounting together for around two thirds of the high-tech sector in the EU-27.

The United Kingdom recorded the most enterprises in the high-tech KIS sector (120 938), representing almost one fifth of the EU-27 total, followed by Italy, Germany and France.

However, a different picture emerges when considering turnover: Germany led the way in 2004, with a total turnover of EUR 150 billion in high-tech manufacturing, ahead of France (EUR 141 billion), which led the field in 2003.

The United Kingdom ranked third (EUR 90 billion), although its turnover was down from the 2003 level. One of the main reasons for this is that the high-tech manufacturing sector in the UK was smaller than that of its main EU counterparts. This is particularly relevant when compared to Italy, which had almost three times as many enterprises as the UK in high-tech manufacturing.

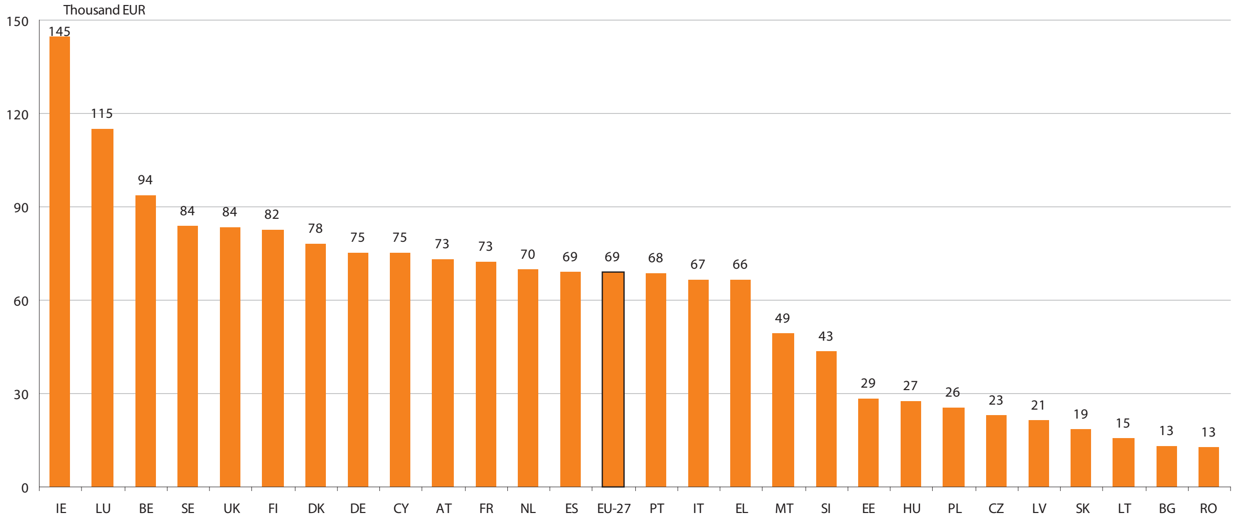
Considering the high-tech KIS sector, it is striking that turnover, production value and value added in the United Kingdom were all nearly twice as high as in Italy.

Germany, with almost EUR 50 billion, was well ahead in terms of the value added generated by high-tech manufacturing, while the UK, with just under EUR 100 billion, was ahead in KIS.

In 2004, the average labour productivity in high tech sectors in the EU-27 stood at EUR 69 000. However, labour productivity in individual Member States varied considerably from this average.

As in the previous year Ireland remained in first position, with an average labour productivity of EUR 145 000, followed by Luxembourg with EUR 115 000. Of the new Member States, only Cyprus was above the EU-27 average, with EUR 75 000, while labour productivity in Portugal, Italy and Greece hovered just below the EU average.

Figure 7.2: Labour productivity (value added at factor cost per person employed) in thousand EUR, high-tech sectors[1], EU-27, 2004



(1) High-tech sectors include high-tech manufacturing and high-tech KIS sectors. Exceptions are:
High-tech KIS only: EE, LV, LU, MT and NL.
Eurostat estimate: EU-27.
Exceptions to the reference year high-tech manufacturing: 2003: BG, IE and SI; 2002: LT; 2001: CY.
Exceptions to the reference year high-tech KIS: 2002: CY, LU and MT.

The KIS (Knowledge intensive services) Innovation Platform

The The KIS–IP is **a new initiative** funded under the Europe INNOVA programme, the aim of which is to accelerate the take-up of services innovations in Europe. The initiative focuses on innovative service solutions in the technological and industrial fields by developing and testing new or better innovation support mechanisms for innovative small and medium-sized enterprises (SMEs).

The **objective of the KIS–IP** is to foster technological as well as non-technological innovation in services by helping innovative SMEs to better exploit research results and to facilitate the search for investors and business partners. The KIS–IP will develop new tools for innovation support, addressing in particular the needs of innovative service companies with the ambition to grow and internationalise fast.

The KIS–IP brings together **public and private partners** from different countries willing to cooperate in developing new forms of support for innovation, taking into account the specific needs of 'born global' service companies. This requires designing and testing not only of new service packages, but also of new forms of service delivery that are specifically tailored to the strong market orientation of service companies. Traditional innovation support mechanisms are often biased towards technological innovation in manufacturing. The KIS–IP accepts the challenge of changing this.

The KIS–IP is open for cooperation with other initiatives and will maximise its efforts to develop and test a set of new innovation support services that can ultimately be integrated into regional and national innovation support programmes. Specific attention will be paid to leveraging proven and tested solutions into the **Enterprise Europe Network**, that offers great potential to strengthen the impact of new service concepts developed under Europe INNOVA.

Source: Europe INNOVA-2008, http://www.europe-innova.org/

7.3 Venture capital investments

Venture capital investment (VCI) is defined as private equity to help launch and develop new companies.

Venture capital investments are generally used to finance start-ups and fast-growing enterprises. These investments are often risky, but where they succeed they can yield substantial returns. For smaller and medium-sized enterprises, having access to venture capital investments is regarded as crucial for growth and employment.

Venture capital data are broken down into two investment stages: early stage, and expansion and replacement stage. Buyout data are also considered in parallel with these two stages.

Early stage venture capital is raised at the seed and start-up stages of a business (i.e. at or before the launch of the business). Venture capital investment at the expansion and replacement stage supports enterprises at a later stage of their business development, and buyout provides funds to enable an enterprise to acquire another enterprise, product line or business.

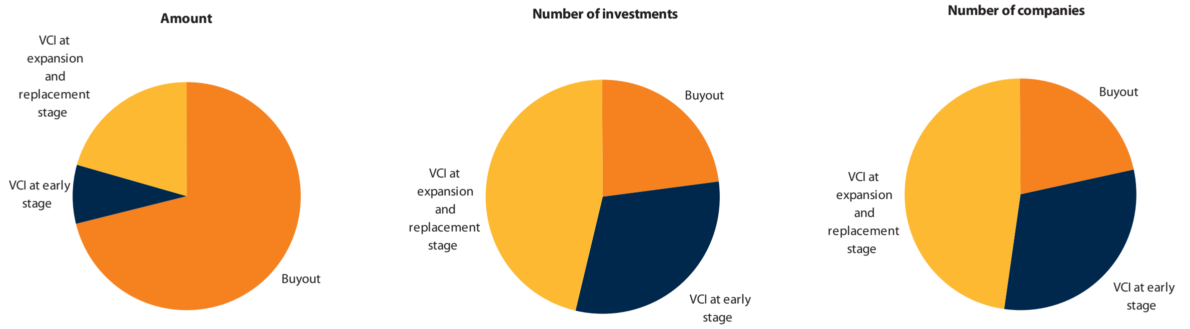
Expansion capital helps to fund the growth and expansion of a company, which may or may not break even or trade profitably, while replacement capital refers to the purchase of existing shares in a company from another private equity investment organisation or from other shareholder(s).

Looking at Figure 7.3, the buyout stage accounted for 71 % of all venture capital investments in 2006, although the number of investments and the number of companies involved accounted for less than one quarter of the total at that stage. This can be explained by the fact that not all start-up companies are able to reach the buyout stage, but when they are bought out, the value of the company is already high.

For the majority of companies, most investments are done at the expansion and replacement stage, although the amount invested accounts for only 21 % of the total.

Early-stage VCI amounted to 8 % of total investment, with 2162 companies being involved in 2006.

Figure 7.3: Share of investments by stage of development in terms of amounts invested, number of investments and number of companies, EU-15, 2006



VCI at the expansion and replacement stage in the EU-15 during 2006 (Table 7.4) amounted to slightly more than EUR 14.3 billion (0.13 % of GDP), well short of the EUR 49.3 billion (0.45 % of GDP) invested in buyouts and the EUR 5.7 billion (0.05 % of GDP) for early-stage VCI.

The United Kingdom was the leading country for early stage VCI, investing EUR 4.2 billion in 591 companies, making a total of 823 investments.

France and Germany invested in a similar number of companies — 335 and 337 respectively — although the total amount invested by France was almost twice that of Germany (EUR 536 million against EUR 264 million).

Countries such as the Czech Republic and Slovakia are slowly beginning to use venture capital as a source of financing.

Regional Venture Capital Funds in the UK

'Regional Venture Capital Funds (RVCFs) are an England-wide programme to provide risk capital finance to small and medium size enterprises (SMEs) who demonstrate growth potential. There is an acknowledged 'equity gap' at the lower end of the market. The government's intervention is designed to be the minimum necessary to stimulate private sector investors to provide small-scale risk finance for SMEs with growth potential.

Objective

to establish at least one viable, commercial fund in each of the nine English regions – which increase the amount of equity gap venture capital available to the SME market and which does not displace any existing fund activity in this segment of the market'.

Source: Department for Business enterprise and regulatory Reforms-UK, http://www.berr.gov.uk/

The United Kingdom was also far ahead of its counterparts for VCI at the expansion and replacement stages in terms of amounts invested, number of investments and number of companies; the UK was followed by France and Italy in terms of amounts invested and by France and Germany in terms of number of investments and number of companies. The case of Italy is worthy of note, as EUR 1.1 billion of VCI was paid out to only 119 companies at the expansion and replacement stage.

The United States also accounted for very high investments in VCI at the expansion and replacement stage (EUR 16.9 billion).

in terms of buyouts, the United Kingdom was ahead, with more than half of the EU-15 total (EUR 28.9 billion). Germany, Spain, France, Italy, the Netherlands and Sweden together accounted for 40 % of total EU-15 expenditure on buyouts.

Table 7.4: Description of venture capital investments (VCI) at early stage, expansion and replacement stage and buyout stage, EU-15 and selected countries, 2006

	VCI at early stage				VCI at expansion and replacement stage				Buyout			
	Amount invested		Number of investments	Number of companies	Amount invested		Number of investments	Number of companies	Amount invested		Number of investments	Number of companies
	EUR million	percentage of GDP			EUR million	percentage of GDP			EUR million	percentage of GDP		
EU-15	5 746.6	0.053	3 141	2 162	14 307.4	0.132	4 751	3 418	49 373.4	0.455	2 358	1 556
BE	39.2	0.012	42	33	494.1	0.156	206	139	406.9	0.129	101	72
CZ	0.3	0.000	1	1	1.0	0.001	6	3	11.1	0.010	4	4
DK	32.0	0.015	21	14	147.6	0.067	86	67	190.7	0.087	41	20
DE	264.3	0.011	529	337	773.4	0.033	653	541	2 480.3	0.107	107	91
IE	25.6	0.015	37	32	69.4	0.040	57	46	12.8	0.007	4	4
EL	3.0	0.001	5	5	12.0	0.006	4	4	0.0	0.000	1	1
ES	266.0	0.027	251	247	974.4	0.099	403	335	1 574.7	0.161	58	51
FR	536.0	0.030	717	335	1 489.4	0.083	1 099	677	8 074.6	0.451	580	362
IT	28.6	0.002	62	57	1 131.1	0.076	128	119	2 255.5	0.152	98	67
HU	4.2	0.005	14	14	31.6	0.035	29	29	0.0	0.000	0	0
NL	64.6	0.012	72	65	480.3	0.090	213	162	1 847.8	0.346	110	85
AT	8.9	0.003	21	12	85.3	0.033	161	130	63.8	0.025	52	48
PL	2.5	0.001	12	8	21.3	0.008	22	17	269.9	0.099	12	12
PT	15.0	0.010	73	44	59.7	0.038	99	72	98.2	0.063	36	30
RO	4.2	0.004	11	11	65.6	0.067	10	9	26.7	0.027	16	9
SK	0.4	0.001	7	7	0.5	0.001	8	3	0.5	0.001	2	1
FI	45.3	0.027	185	149	141.9	0.085	113	69	78.6	0.047	50	30
SE	177.6	0.057	303	241	760.2	0.243	284	213	3 321.1	1.060	153	92
UK	4 240.4	0.222	823	591	7 688.7	0.402	1 245	844	28 968.3	1.515	967	603
NO	34.3	0.013	35	28	205.4	0.077	107	74	222.4	0.083	65	51
CH	72.4	0.023	36	31	331.3	0.107	103	78	432.9	0.140	27	21
US	4 187.9	0.032	1 265	:	16 957.7	0.129	2 365	:	:	:	:	:

Exception to the reference year: 2005: SK.

The European Private Equity and Venture Capital Industry: An Active Partner for Sustainable Economic Growth and the Competitiveness of European Companies

'The private equity and venture capital industry consists primarily of venture capital funds, which invest directly in seed and start up businesses and buyout and buy-in funds, which acquire existing companies and focus on re-energising or revitalising them:

Venture capital firms not only fund but also proactively support the development of high-potential companies in the early stages of their development and growth, often creating highly skilled employment in new and innovative areas where other sources of finance are hard to access.

Buyout/in firms facilitate the transfer of ownership of existing companies; this includes facilitating the generational change of family owned businesses, helping to grow smaller companies into larger ones, or investing in viable businesses which are spun-out of existing companies, including units which are no longer considered core or strategic businesses by its partners.'

Source: EVCA Public Policy Priorities 2005, http://www.evca.eu/

7.4 Trade in high-tech products

In 2006, aside from the world's four leading economies, among which the EU is counted as a single economy, only ten other countries (entities) recorded a market share of high-tech products above 1 % of global exports (see Figure 7.5).

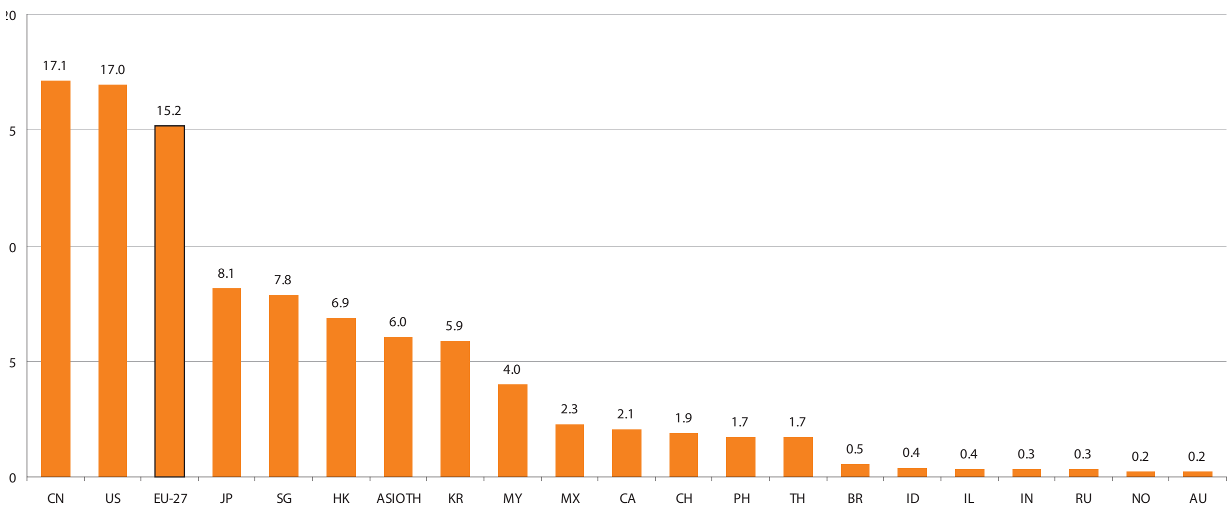
The four leaders at world level were China (17.1 %), the United States (17.0 %), the EU-27 (15.2 %) and Japan (8.1 %).

Singapore, Hong Kong, 'other Asian countries' (see methodological notes) and South Korea each accounted for more than 5 % of high-tech exports. Behind this group of countries came Malaysia, with 4 %, and a group comprising Mexico, Canada, Switzerland, the Philippines and Thailand, with around 2 % of global exports.

Brazil, Indonesia, Israel, India, Russia, Norway and Australia recorded global export shares in high-tech products ranging between 0.5 % and 0.2 %.

In 2006, the 21 largest exporting countries (entities) accounted for 99 % of global exports in high-tech products.

Figure 7.5: World market share of high-tech exports, leading high-tech trading countries, 2006



EU-27: excluding intra-EU trade.
CN: excluding Hong Kong.

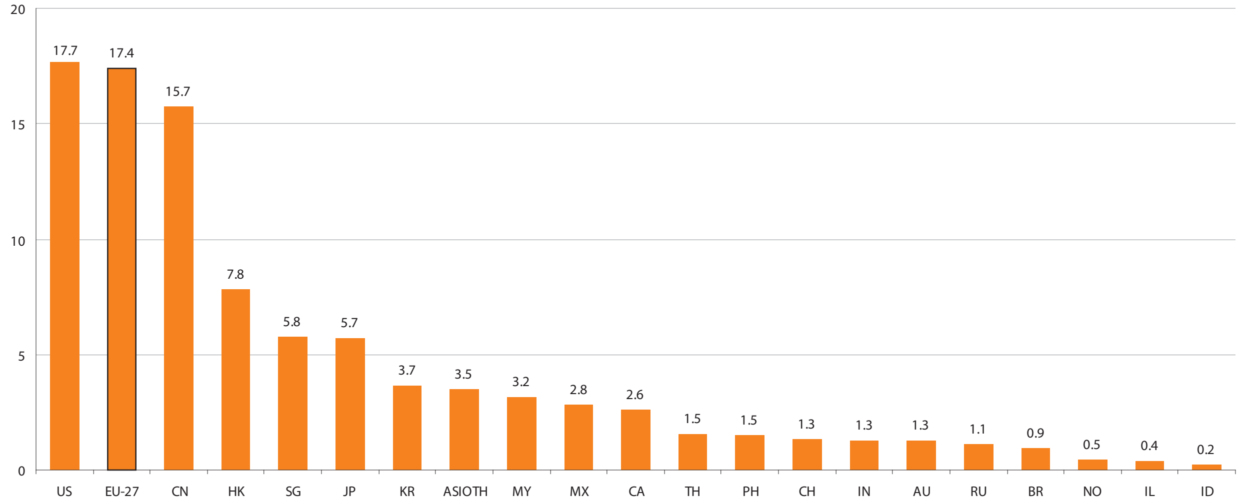
Figure 7.6 shows the respective shares of the world market in high-tech imports in 2006. The United States was only marginally ahead of the EU-27, with shares of 17.7 % and 17.4 % respectively, followed by China (15.7 %). Hong Kong came in fourth position (on 7.8 %), ahead of Singapore (5.8 %) and Japan (5.7 %).

Korea, 'other Asian countries' (see methodological notes) and Malaysia each accounted for more than 3 % of high-tech imports, followed by Mexico (2.8 % and Canada (2.6 %).

Moreover, the EU was the third largest exporter and second largest importer of high-tech products worldwide

High-tech imports were higher than exports in the United States, the EU, China, Mexico, Canada, the Philippines, India, Australia, Russia, Brazil and Norway. In countries such as Hong Kong, Singapore, Japan, Korea, 'other Asian countries', Malaysia, Thailand, Switzerland and Indonesia, on the other hand, the level of exports exceeds imports. Only Israel maintained a balance (0.4 %) between imports and exports.

Figure 7.6: World market share of high-tech imports, leading high-tech trading countries, 2006



EU-27: excluding intra-EU trade. CN: excluding Hong Kong.

In 2006, Germany was the only Member State where high-tech exports and imports exceeded EUR 100 billion. France, the United Kingdom and the Netherlands each exported and imported more than EUR 60 billion in high-tech products. Apart from being the largest traders in high-tech products at EU level, these four Member States also enjoyed a positive high-tech trade balance.

Seven other EU Member States — Denmark, Ireland, Luxembourg, Hungary, Malta, Finland and Sweden — were also net exporters of high-tech products, as was Switzerland. Of all EU Member States, the United Kingdom registered the highest positive high-tech trade balance (EUR 19.1 billion).

However, at European level high-tech trade registered a deficit of EUR 38.3 billion in 2006, falling by EUR 7 billion in relation to 2005. It should be noted that EU aggregates (imports, exports and trade balance) do not correspond to the sum of individual Member States, because they exclude intra-EU trade.

The most significant negative high-tech trade balances were recorded in Spain (EUR -16.0 billion) and Italy (EUR -11.3 billion).

In 2006, Malta recorded the highest shares of total exports and imports in high-tech trade, with 54.6 % and 31.5 % respectively.

In Luxembourg, high-tech trade accounted for over 40 % of total exports and 33.5 % of imports.

At European level, high-tech exports grew at an annual average rate of 0.5 %, while high-tech imports declined by 0.1 % a year between 2001 and 2006, resulting in an improvement of the negative EU high-tech trade balance during the same period.

Cyprus experienced the highest growth in high-tech exports (63.5 %), followed by Latvia (32.7 %), Slovakia (32.0 %) and Bulgaria (31.2 %); the largest increase in high-tech imports (26.7 %) was in Slovakia.

Apart from the EU, high-tech exports also exceeded EUR 100 billion in the United States, China and Japan.

Only the United States and China registered import levels in excess of EUR 200 billion, compared to trade in high-tech imports in India, Russia and Australia, for example, which failed to reach EUR 20 billion.

However, the ranking was entirely different regarding the high-tech trade balance. Japan — with EUR 29 billion — was the leading net exporter of high-tech products. It was followed by South Korea and Singapore, with EUR 27 billion and EUR 20 billion respectively.

The EU-27 recorded the largest high-tech trade deficit (EUR 38 billion), followed by the United States with a deficit of EUR 16 billion.

Figure 7.8 presents the total high-tech exports and imports in EUR million, broken down by group of products for each country.

In 2006, 'electronics and telecommunications' accounted for the largest share of high-tech exports in 18 Member States plus Norway, Croatia and FYROM. This was also the leading group of products in terms of high-tech exports in Australia, Canada, Japan, South Korea, Singapore and the United States.

In France, the third-largest EU exporter of high-tech products, the 'aerospace' sector accounted for the highest share of high-tech exports with 41 %. Iceland posted even higher results with 69 %. 'Aerospace' also accounted for a sizeable share of exports in Canada (30 %), Russia (40 %), and the United States (24 %).

Luxembourg, Ireland, the Czech Republic, the Netherlands, and China recorded export shares of over 40 % in 'computer and office machinery', while 'pharmacy' accounted for high export shares in Belgium, Denmark, Slovenia and Switzerland. The breakdown of high-tech imports by group of products was less diversified across countries than for high-tech exports.

The largest share of high-tech imports for the EU-27 as a whole was in the field of 'electronics and telecommunications'. This was also the case for most EU Member States, with the exception of the Czech Republic, Ireland, Luxembourg, the Netherlands and Slovakia, plus Norway, Croatia, FYROM and Turkey. The other selected countries also registered high imports in the 'electronics and telecommunications' sector.

'Computers and office machinery' comprised the core of high-tech imports in the Czech Republic, Ireland, Luxembourg and the Netherlands. 'Aerospace' products dominated in Iceland and 'scientific instruments' accounted for the highest share of high-tech imports in Slovakia.

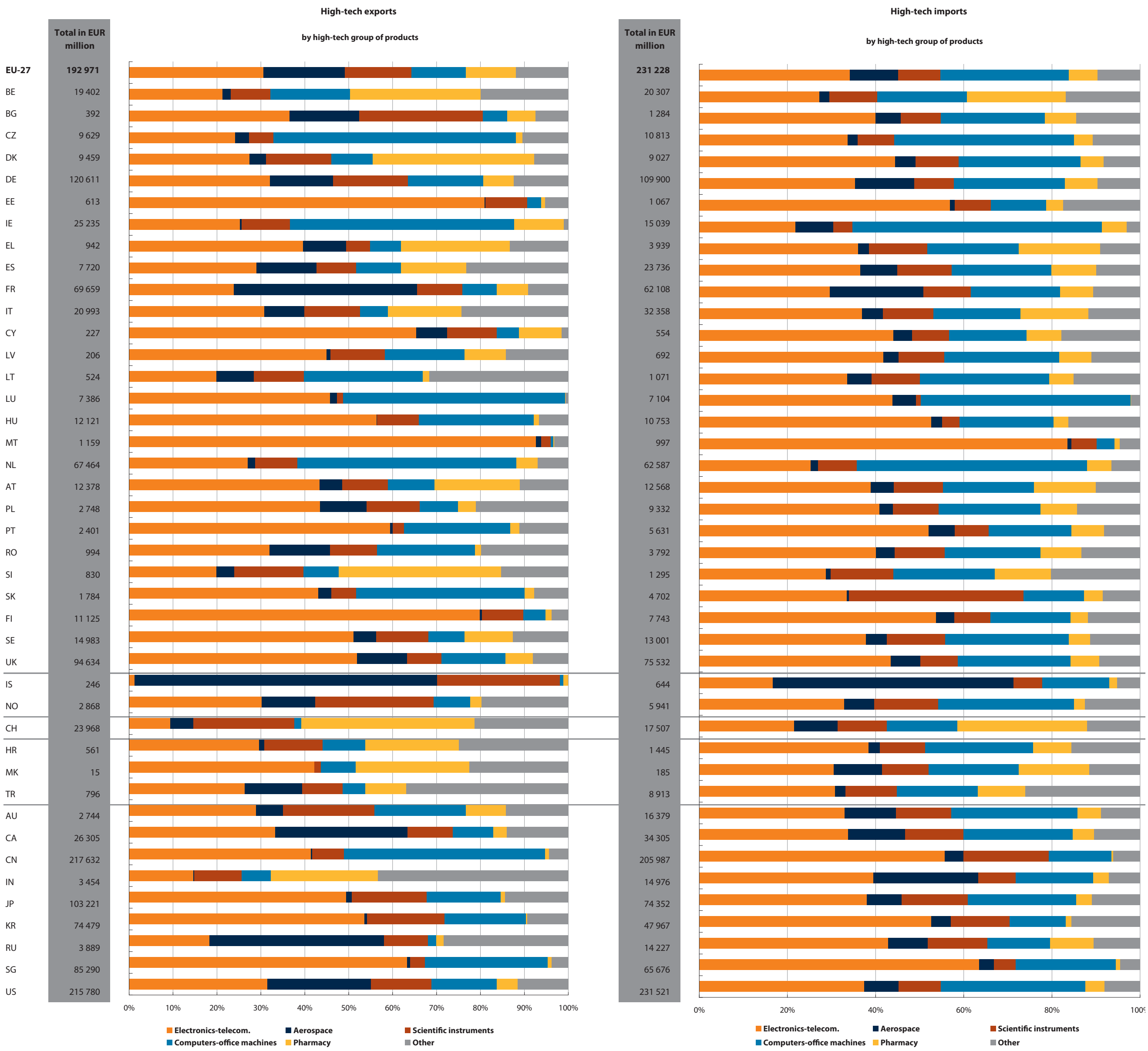
Switzerland was the only country where 'pharmacy' accounted for the largest share of high-tech imports (29 %), although this group of products was also significant in Belgium (22 %).

Table 7.7: High-tech trade in 2006, in EUR million, as a share of total exports, share of extra EU-27 trade and AAGR 2001–2006, EU-27 and selected countries

	Imports				Balance	Exports			
	EUR million	as a % of total imports	% of extra EU-27 imports	AAGR 2001-2006	EUR million	EUR million	as a % of total exports	% of extra EU-27 exports	AAGR 2001-2006
EU-27	231 228 i	17.1 i	100 i	-0.1 i	-38 257 i	192 971 i	16.7 i	100 i	0.5 i
BE	20 307	7.2	35.5	-1.2	-905	19 402	6.6	28.3	0.3
BG	1 284	8.3	51.8	12.1	-891	392	3.3	26.7	31.2
CZ	10 813	14.6	22.9	12.3	-1 184	9 629	12.7	20.0	23.3
DK	9 027	13.3	31.7	3.0	432	9 459	12.8	41.2	3.2
DE	109 900	15.2	56.7	2.1	10 711	120 611	13.6	42.6	3.6
EE	1 067	10.1	31.9	12.7	-454	613	8.1	34.0	-0.6
IE	15 039	25.9	51.3	-7.5	10 196	25 235	28.9	41.1	-7.7
EL	3 939	7.8	18.1	-0.2	-2 997	942	5.7	19.1	3.4
ES	23 736	9.4	26.7	5.4	-16 017	7 720	4.7	33.8	-0.6
FR	62 108	14.6	36.3	-6.4	7 551	69 659	17.8	48.4	-5.5
IT	32 358	9.3	34.4	-0.3	-11 365	20 993	6.4	47.2	-2.2
CY	554	10.0	25.9	3.9	-328	227	21.4	22.8	63.5
LV	692	7.5	16.8	15.8	-486	206	4.2	46.2	32.7
LT	1 071	6.9	20.2	14.5	-548	524	4.7	34.8	30.3
LU	7 104	33.5	73.1	14.8	282	7 386	40.6	5.5	19.4
HU	10 753	17.3	45.8	7.2	1 368	12 121	20.2	34.0	11.8
MT	997	31.5	52.4	-1.2	162	1 159	54.6	61.8	-0.4
NL	62 587	18.9	70.7	3.5	4 877	67 464	18.3	23.0	3.3
AT	12 568	11.5	34.5	-0.1	-191	12 378	11.3	35.8	1.4
PL	9 332	9.2	20.6	7.3	-6 585	2 748	3.1	31.6	20.4
PT	5 631	10.6	14.2	2.2	-3 230	2 401	7.0	68.0	5.1
RO	3 792	9.3	51.1	15.3	-2 798	994	3.9	23.4	9.5
SI	1 295	6.7	19.2	6.2	-465	830	4.5	56.8	10.7
SK	4 702	12.9	35.8	26.7	-2 919	1 784	5.4	16.5	32.0
FI	7 743	14.1	41.0	3.1	3 382	11 125	18.1	56.4	1.7
SE	13 001	12.9	32.7	2.5	1 982	14 983	12.8	55.8	4.5
UK	75 532	15.8	43.9	-2.6	19 101	94 634	26.5	31.2	0.9
IS	644	13.5	:	16.7	-398	246	8.9	:	52.1
NO	5 941	11.6	:	0.5	-3 073	2 868	3.0	:	2.0
CH	17 507	15.6	:	0.9	6 461	23 968	20.4	:	4.3
HR	1 445	8.5	:	7.4	-884	561	6.8	:	4.8
MK	185	6.2	:	6.7	-170	15	0.8	:	6.9
TR	8 913	9.5	:	13.2	-8 117	796	1.4	:	-8.6
AU	16 379	15.5	:	6.3	-13 635	2 744	2.8	:	-1.8
CA	34 305	12.3	:	-3.0	-8 000	26 305	8.5	:	-2.7
CN	205 987	32.7	:	25.2	11 645	217 632	28.2	:	31.5
IN	14 976	12.4	:	32.3	-11 522	3 454	4.2	:	7.9
JP	74 352	16.1	:	0.6	28 869	103 221	20.0	:	-1.5
KR	47 967	19.5	:	6.2	26 512	74 479	28.7	:	10.5
RU	14 227	13.0	:	23.4	-10 338	3 889	1.6	:	1.3
SG	65 676	40.8	:	4.4	19 614	85 290	46.2	:	4.9
US	231 521	15.2	:	-1.0	-15 742	215 780	26.1	:	-1.6

(i) EU-27 does not include intra-EU trade and therefore does not correspond to the sum of Member States.
Exceptions to the reference year 2006: 2005: TR, IN and SG.
Exceptions to the reference period 2001-2006: 2001-2005: TR, IN and SG; 2002-2006: HR and MK.

Figure 7.8: High-tech trade by high-tech group of products, EU-27 and selected countries, 2006



EU-27 does not include intra-EU trade and therefore does not correspond to the sum of Member States.
(1) 'Other' includes 'electrical machinery', 'chemistry', 'non-electrical machinery' and 'armament'.
Exceptions to the reference year: 2005: TR, IN and SG.

7.5 Employment in high-tech industries and in knowledge-intensive services

Performance at national level in Europe

In 2006, 39 million people were employed in the manufacturing sector in the EU-27, representing 18.2 % of total employment in the EU. Germany employed the most workers in manufacturing, with more than 8 million, followed by Italy and the United Kingdom.

Of these 39 million workers, almost 12 million were employed in medium high-tech manufacturing and only 2.3 million in high-tech manufacturing.

In the EU-27, women accounted for 30.8 % of employment in manufacturing. Across all EU Member States, the share of women employed in the manufacturing sector was below 50 %, although Bulgaria and Romania came close to achieving gender parity (49.6 % and 48.0 % respectively); this ratio often tended to be higher in the new Member States.

The share of female employment in medium high-tech manufacturing was lower than in high-tech manufacturing (23.8 % and 34.8 % respectively), and women in the latter sector outnumbered their male counterparts in Bulgaria, Hungary and Slovakia.

European employment in total manufacturing increased slightly between 2001 and 2006. This was also true for the medium high-tech manufacturing sector. However, the number of jobs in high-tech manufacturing decreased on average by 1.7 % a year during the same period. At Member State level, employment in this sector rose in nine Member States, with the largest increases being recorded in Slovakia and Poland. In general, the new Member States (2004 and 2007 enlargements) recorded increases in employment in high-tech manufacturing. This was also the case in Spain and Turkey.

Conversely, in Sweden and the Netherlands, employment in high-tech manufacturing between 2001 and 2006 fell by more than 10 % over the same period.

Table 7.9: Employment in manufacturing in 2006, by selected sectors, in thousands, percentage of women and AAGR 2001-2006, EU-27 and selected countries

	Total manufacturing				Medium high-tech manufacturing				High-tech manufacturing			
	1000's	as a % of total employment	% of women	AAGR 2001-2006	1000's	as a % of total employment	% of women	AAGR 2001-2006	1000's	as a % of total employment	% of women	AAGR 2001-2006
EU-27	38 866	18.2	30.8	0.5	11 795	5.5	23.8	0.6	2 295 s	1.1 s	34.8 s	-1.7 s
BE	715	16.8	24.0	-1.1	241	5.7	22.1	-0.1	28	0.7	33.2	-5.6
BG	745	24.0	49.6	2.4	136	4.4	32.5	-0.1	16	0.5	52.8 u	1.5
CZ	1 361	28.2	37.2	0.7	420	8.7	33.9	3.4	81	1.7	49.1	1.9
DK	429	15.3	30.7	-2.7	146	5.2	27.3	-2.1	22	0.8	42.4	-4.0
DE	8 188	22.0	28.5	-1.0	3 358	9.0	21.9	-0.2	635	1.7	31.8	-2.1
EE	136	21.1	45.6	-0.3	17	2.7	:	-4.9	7 u	1.1 u	:	3.7 u
IE	266	13.3	30.3	-2.3	61	3.0	33.7	-1.1	53	2.7	40.9	-2.7
EL	561	12.6	27.5	-0.6	90	2.0	21.0	2.4	11	0.2	24.9 u	2.8
ES	3 130	15.9	24.6	0.7	796	4.0	21.3	0.2	88	0.4	32.5	-1.4
FR	3 790	15.2	28.9	-2.9	1 200	4.8	23.4	-2.5	277	1.1	34.0	-3.7
IT	4 820	21.0	28.8	-0.2	1 447	6.3	22.8	1.4	294	1.3	31.6	4.8
CY	37	10.5	32.7	-1.1	3	0.9	37.8 u	1.0	1 u	0.1 u	:	:
LV	161	14.8	44.2	-0.7	17	1.6	36.7 u	2.5	:	:	:	:
LT	265	17.7	47.9	1.3	28 u	1.9 u	29.2 u	-4.2 u	9 u	0.6 u	:	3.1 u
LU	16	8.2	16.9	-5.1	2	1.0	:	2.2	:	:	:	:
HU	868	22.1	38.5	-1.9	235	6.0	30.4	0.0	98	2.5	51.2	-0.8
MT	27	17.4	25.4	-3.3	5	3.4	:	-5.8	5	3.1	44.0 u	-0.1
NL	1 043	12.8	22.0	-1.0	205	2.5	17.1	-4.2	51	0.6	21.1	-11.0
AT	741	18.9	26.3	0.1	219	5.6	20.2	4.8	53	1.4	30.5	-4.2
PL	2 971	20.4	33.5	3.5	661	4.5	25.3	5.0	84	0.6	43.7	10.6
PT	978	19.3	42.3	-2.1	147	2.9	29.2	-1.1	22	0.4	43.6	-3.4
RO	1 978	21.3	48.0	-0.1	478	5.1	34.2	-0.7	29	0.3	37.7 u	-3.7
SI	268	28.0	35.7	-0.7	72	7.6	34.6	0.1	10	1.1	47.3	5.4
SK	609	26.5	37.5	2.4	179	7.8	33.5	7.9	41	1.8	59.9	15.2
FI	444	18.0	28.7	-1.4	116	4.7	19.8	-1.6	51	2.1	29.1	-0.5
SE	660	14.9	25.3	-2.7	240	5.4	23.4	-1.6	40	0.9	32.0	-11.8
UK	3 660	13.0	25.7	-3.8	1 272	4.5	20.7	-3.6	288	1.0	29.8	-7.0
IS	20	11.9	30.3	-3.2	2	1.3	:	-2.9	:	:	:	:
NO	275	11.7	24.3	-0.9	94	4.0	15.6	3.6	12	0.5	41.7 u	-6.3
CH	601	14.9	28.2	-2.0	202	5.0	22.9	-1.3	92	2.3	35.7	-2.2
HR	302	19.2	36.2	-0.7	66	4.2	20.0 u	0.8	8 u	0.5 u	44.4 u	5.6 u
TR	4 189	18.8	19.8	:	750	3.4	11.2	:	58	0.3	18.8	:

Exceptions to the reference period: 2002-2006: HR, 2004-2006: PL.

The services sector — representing two thirds of EU employment in 2006 — accounted for more than 140 million jobs, almost half of which were in knowledge-intensive services (KIS). Germany ranked first, with 25 million persons employed in services, followed by the United Kingdom. The same ranking was found in the KIS sector. Only 10 % of jobs in KIS were in fact high-tech KIS (7 million). Germany and the United Kingdom were the only Member States where the number of persons employed in high-tech KIS exceeded 1 million.

In the EU-27, women accounted for more than half (53.7 %) of all persons employed in services in 2006.

In KIS, the share of female employment (60.5 %) was even higher than in services. The only countries that did not achieve gender parity were Malta and Turkey.

By contrast, a lower ratio of female employment was observed in high-tech KIS (32.9 %). The only country to exceed 50 % was Lithuania.

Employment in total services between 2001 and 2006 increased not only at EU level, but also in each individual Member State.

As for employment in the KIS sector, the trend was the same as that observed in total services, with employment in KIS growing in all Member States.

Employment in high-tech KIS also grew in the EU-27, albeit less vigorously than in total services. Nine EU Member States, plus Iceland, Norway, Switzerland and Croatia, recorded a drop in employment in high-tech KIS.

Table 7.10: Employment in services in 2006, by selected sectors, in thousands, share of women and AAGR 2001–2006, EU-27 and selected countries

	Total services				Knowledge intensive services (KIS)				High-tech KIS			
	1000's	as a % of total employment	% of women	AAGR 2001-2006	1000's	as a % of total employment	% of women	AAGR 2001-2006	1000's	as a % of total employment	% of women	AAGR 2001-2006
EU-27	141 848	66.4	53.7	3.2	69 975	32.8	60.5	3.7	7 077	3.3	32.9 s	1.8
BE	3 121	73.3	52.7	1.3	1 653	38.8	59.6	1.5	167	3.9	29.7	0.4
BG	1 784	57.4	53.7	2.4	683	22.0	64.9	1.4	80	2.6	47.4	1.5
CZ	2 711	56.2	54.0	1.2	1 209	25.1	63.6	1.4	142	2.9	43.1	-1.2
DK	2 061	73.5	55.1	1.4	1 220	43.5	62.6	1.0	123	4.4	33.9	-1.7
DE	25 296	67.9	55.1	1.4	12 718	34.1	60.6	2.4	1 294	3.5	32.5	2.0
EE	397	61.4	61.2	3.2	185	28.6	69.1	2.8	16	2.5	:	-3.6
IE	1 349	67.1	55.3	4.2	702	34.9	61.3	5.1	78	3.9	28.0	2.1
EL	2 932	66.0	45.2	3.3	1 109	25.0	52.8	3.8	88	2.0	31.0	5.2
ES	12 968	65.7	52.5	5.4	5 514	27.9	56.9	6.7	589	3.0	31.6	6.5
FR	18 194	73.1	55.3	1.9	9 187	36.9	62.2	2.1	968	3.9	37.3	0.1
IT	15 050	65.6	48.0	2.3	6 975	30.4	55.8	4.0	702	3.1	34.4	1.5
CY	260	73.2	52.3	3.4	101	28.3	60.1	4.3	7	2.0	31.1	4.5
LV	673	61.9	59.9	3.6	277	25.5	68.8	3.1	27	2.5	48.9	5.5
LT	867	57.9	60.2	2.5	383	25.6	70.2	0.8	31	2.1	54.0 u	1.7
LU	159	81.4	49.6	2.2	85	43.5	54.7	5.1	6	3.3	27.0	2.5
HU	2 471	62.9	55.4	1.5	1 117	28.4	64.6	1.9	134	3.4	40.5	1.6
MT	107	70.1	38.0	1.7	47	31.0	47.9	2.9	5	3.1	:	2.5
NL	6 000	73.5	52.5	0.9	3 432	42.0	59.5	1.3	312	3.8	26.1	-1.4
AT	2 602	66.4	55.3	1.7	1 194	30.4	59.6	2.0	108	2.8	28.5	-0.8
PL	7 836	53.8	55.6	3.9	3 589	24.7	65.9	4.0	346	2.4	39.5	8.9
PT	2 966	58.5	54.8	1.8	1 171	23.1	63.2	3.5	94	1.9	32.7	5.3
RO	3 595	38.7	51.0	2.3	1 356	14.6	63.0	2.7	150	1.6	46.3	-0.7
SI	525	55.0	55.6	2.5	250	26.2	63.0	3.5	26	2.7	28.6	1.1
SK	1 306	56.7	56.3	1.7	573	24.9	65.4	1.3	59	2.6	43.7	-1.6
FI	1 707	69.4	59.2	1.2	1 011	41.1	65.8	1.5	113	4.6	36.2	1.3
SE	3 350	75.6	56.1	1.0	2 111	47.7	62.5	1.1	224	5.1	31.7	-0.1
UK	21 562	76.5	54.6	1.4	12 126	43.0	59.8	1.9	1 186	4.2	24.2	-1.6
IS	121	72.0	55.6	2.0	71	42.5	63.9	2.0	7	4.1	42.3	-4.4
NO	1 780	75.7	56.4	1.1	1 084	46.1	62.8	1.8	92	3.9	36.9	-1.5
CH	2 950	73.2	53.2	1.2	1 665	41.3	55.4	1.7	153	3.8	33.0	-2.0
HR	893	56.7	54.0	1.8	363	23.0	62.2	2.5	33	2.1	41.3 u	-3.7
TR	10 555	47.4	20.1	:	2 843	12.8	35.4	:	178	0.8	17.2	:

Exceptions to the reference period: 2002-2006: HR, 2004-2006: PL.

Technicians and professionals normally require formal qualifications, but this is not compulsory. Therefore, Figure 7.11 presents the share of tertiary-educated people in high-tech sectors compared to all sectors of the economy. The high-tech sectors comprise high-tech manufacturing and high-tech KIS.

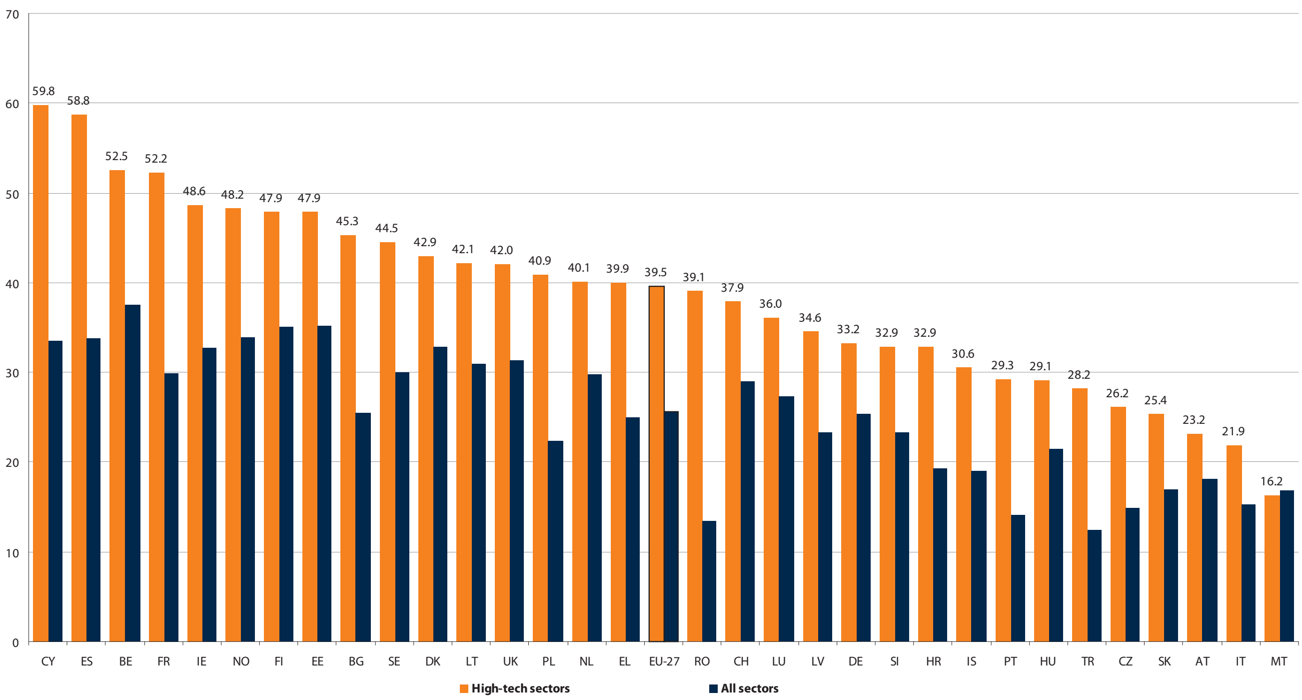
On average, 39.5 % of people employed in high-tech sectors in the EU in 2006 had completed tertiary education. By comparison, only one in four persons had completed tertiary education when considering employment across all sectors of the economy. With the exception of Malta, this share was greater in high-tech sectors than in the economy as a whole in all of the countries considered. The largest discrepancy was found in Cyprus and in Romania, with respectively 59.8 % and 39.1 % of high-tech workers having completed tertiary education, against 34.0 % and 13.5 % for the economy as a whole.

In Cyprus, Spain, Belgium and France, more than half of all high-tech workers were tertiary-educated. Eleven other Member States, plus Norway, were above the EU average (39.5 %).

At the other end of the scale, fewer than one in four persons working in high-tech sectors in Austria, Italy and Malta had tertiary education.

However, a different picture emerges when considering the economy as a whole, with Belgium accounting for the highest share of tertiary educated people in all sectors (38 %), followed by Estonia, Finland, Norway and Spain.

Figure 7.11: Share of tertiary-educated persons in all sectors and high-tech sectors(1), EU-27 and selected countries, 2006



(1) High-tech sectors include high-tech manufacturing and high-tech KIS sectors.
Data for high-tech sectors lack reliability due to small sample size in EE, LT, MT and HR.

Figure 7.12 shows the share of technicians and professionals in high-tech sectors compared to all sectors of the economy.

In 2006, an average 47.9 % of persons employed in high-tech sectors were technicians and professionals.

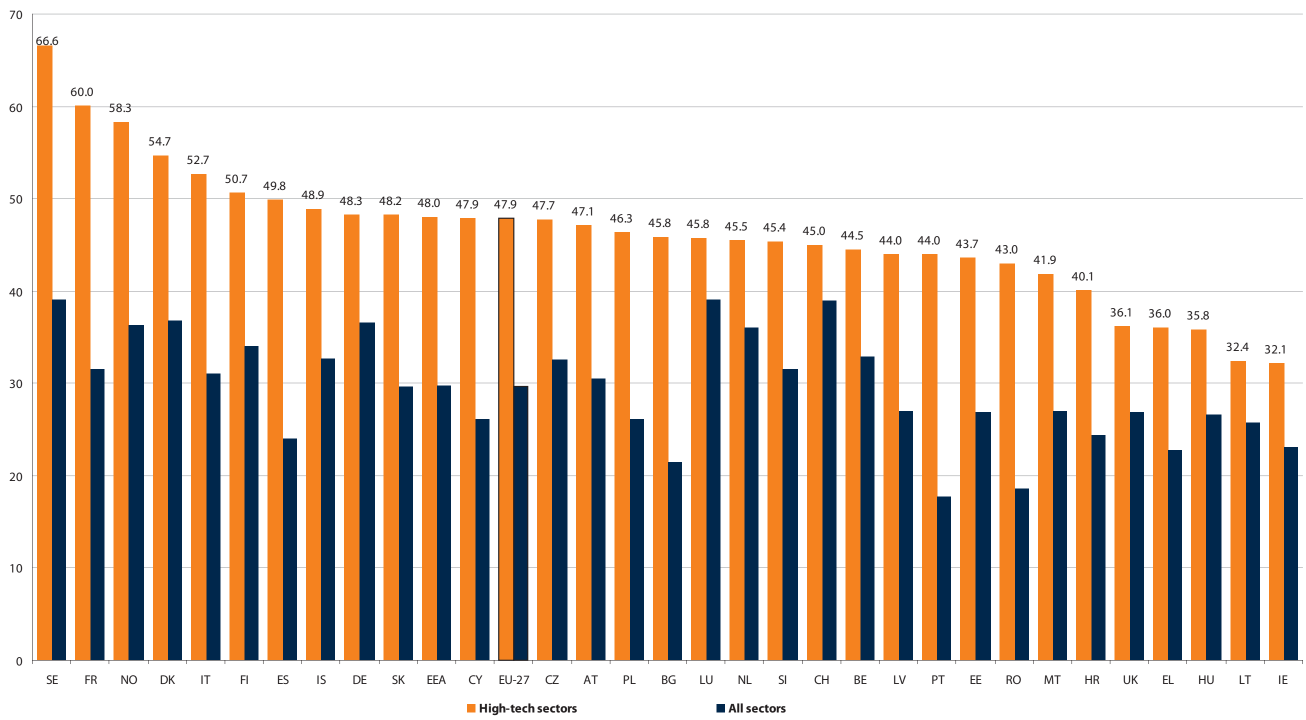
Technicians and professionals accounted for more than half of the workforce in high-tech sectors in five Member States and in Norway.

Technicians and professionals made up at least 60 % of the workforce in high-tech sectors in Sweden and France; the share in France was almost twice as high as the overall share of technicians and professionals in total employment. Spain, Iceland, Germany, Cyprus and Slovakia were also above the EU-27 average.

France, Sweden and Portugal recorded the largest discrepancies between the share of technicians and professionals employed in high-tech sectors and the share of those in total employment. These discrepancies were also visible in Spain and in the two newest Member States, Bulgaria and Romania, albeit to a slightly lesser extent.

The share of technicians and professionals working in high-tech sectors was below 40 % in the United Kingdom, Greece, Hungary, Lithuania and Ireland, but relatively close to the share for total employment, compared to other countries.

Figure 7.12: Share of technicians and professionals in all sectors and high-tech sectors[1], EU-27 and selected countries, 2006



(1) High-tech sectors include high-tech manufacturing and high-tech KIS sectors.
Data for high-tech sectors lack reliability due to small sample size in EE and LT.

Performance at regional level in Europe

Figure 7.13 presents the top 20 regions in terms of employment in high-tech sectors in 2006, as a share of total employment and the annual average growth rate from 2001 to 2006.

In 2006, the leading region was Berkshire, Buckinghamshire and Oxfordshire (UK), with high-tech sectors accounting for 11.5 % of total employment. This was followed by Île-de-France (FR) with 8.9 % and Oberbayern (DE) with 8.5 %.

Out of the 20 leading regions, seven were in Germany, three in Italy, two each in France, the UK and Spain, and one in Ireland, Finland, Hungary and Poland, the latter two countries being the sole representatives from the New Member States.

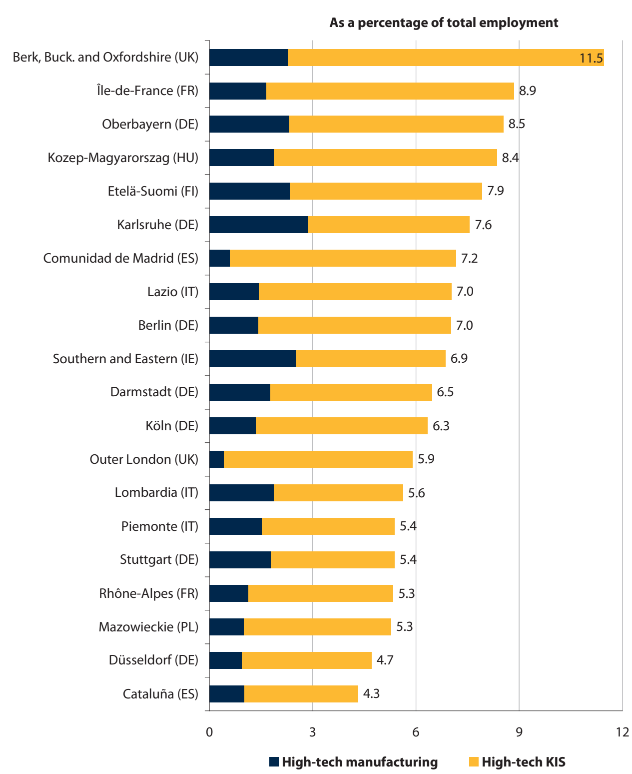
In terms of annual average growth rate, employment in high-tech sectors as a share of total employment rose in 13 of the 20 leading regions. Mazowieckie (PL) showed the highest growth rate (8.9 %), followed by Cataluña (ES), with an increase of 5.4 % on average per year.

By contrast, over the same period, the share of employment in high-tech sectors fell in Outer London (UK), Darmstadt (DE) and Stuttgart (DE) by an annual average of 4.8 %, 4.2 % and 4.0 % respectively. Employment in high-tech sectors also decreased in Berkshire, Buckinghamshire and Oxfordshire (UK), Île-de-France (FR), Karlsruhe (DE) and Southern & Eastern region (IE).

Most of the population employed in the high-tech sector were in high-tech knowledge-intensive services (high-tech KIS). Karlsruhe, in Germany, and the Southern and Eastern region, in Ireland, recorded the highest percentages of employment in high-tech manufacturing, while Outer London (UK) and Comunidad de Madrid (ES) remained firmly at the other end of the scale.

Considering the difference between the shares of people employed in high-tech manufacturing and of those employed in high-tech KIS, the largest discrepancies were found in Berkshire, Buckinghamshire and Oxfordshire (UK), Île-de-France (FR), Comunidad de Madrid (ES) and Outer London (UK).

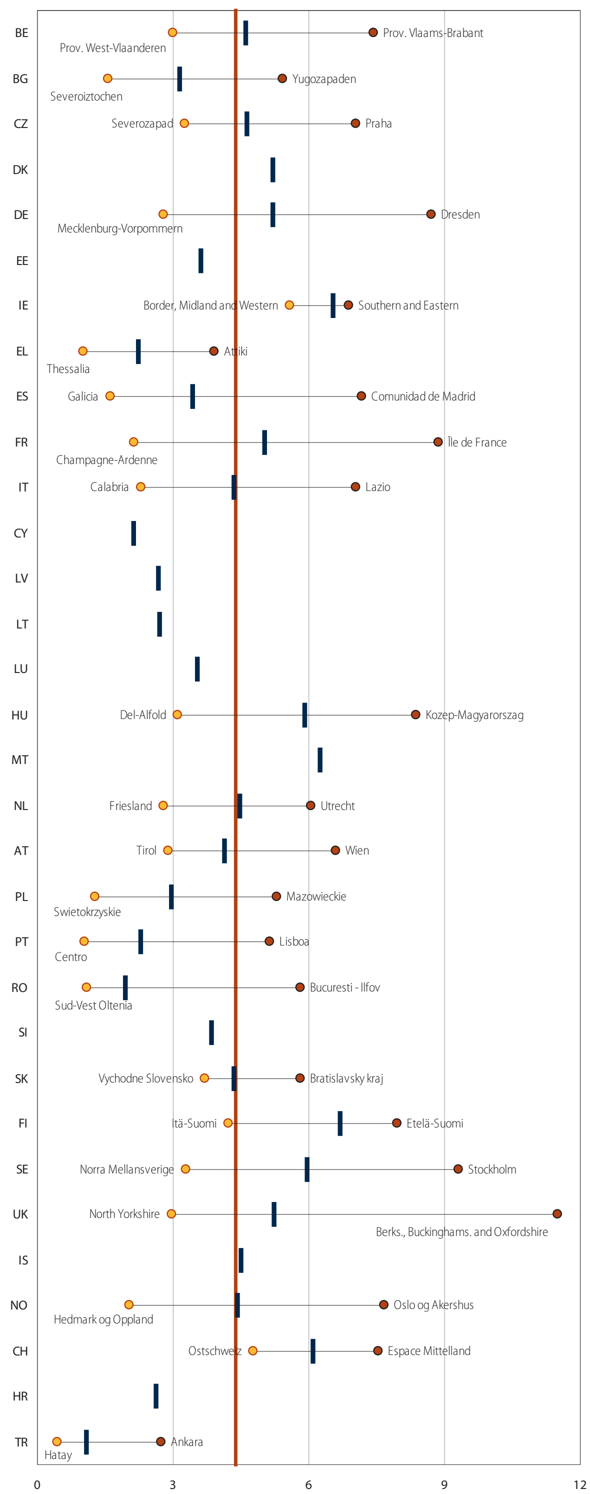
Figure 7.13: Top 20 leading regions (NUTS level 2) in terms of employment in high-tech sectors in 2006, as a share of total employment, in thousands and AAGR 2001-2006[(1)]



Total in 1000s	AAGR 2001-2006
132	-1.7
437	-1.6
182	2.8
104	3.2
102	0.7
100	-1.1
213	0.4
149	3.1
102	1.3
103	-0.3
116	-4.2
114	4.2
129	-4.8
240	4.3
100	1.7
103	-4.0
132	0.6
112	8.9
110	1.5
148	5.4

(1) Calculated on employment expressed in thousands
Exception to the reference period: 2004-2006: Mazowieckie (PL).

Figure 7.14: Regional disparities in employment in high-tech sectors as a share of total employment, NUTS level 2, 2006



Data lack reliability due to small sample size in region with the smallest share in BG, EL, NL, PL and NO.

Figure 7.14 shows the regional disparities in the share of employment accounted for in high-tech sectors by country. This figure plots the national average for each country as well as the regions with the lowest and highest shares of employment respectively in high-tech sectors.

In 2006, employment in high-tech sectors as a percentage of total employment ranged from 0.4 % in Hatay (TR) to 11.5 % in Berkshire, Buckinghamshire and Oxfordshire (UK). With the exception of Greece, all Member States not classified as a region at NUTS level 2 had at least one region where the rate of employment in high-tech sectors was higher than the EU-27 average (4.4 %).

Ireland was the only Member State (which is not classified as a region at NUTS level 2) where all regions registered shares above the EU average. This was also the case in Switzerland. For all countries apart from Belgium, the Netherlands, Germany and the United Kingdom, the leading national region was the capital region. Taking the national averages into account, the three main European economies – Germany, France and the United Kingdom – registered shares of employment in high-tech sectors that were higher than the European average. Generally this was also the case for northern European countries, which usually account for the biggest regional disparities in employment in high-tech sectors. By contrast, the national average was below the European average in many new Member States and in a majority of southern Member States.

In Ireland, Greece, Slovakia, Switzerland and Turkey, regional disparities in employment in high-tech sectors were only minor.

Map 7.15 provides an overview of the share of female workers in high-tech sectors in 2006 at NUTS 1 level, at which level many countries are counted as regions. As a rule, gender parity was not achieved in the EU high-tech sectors.

The highest shares of women employed in high-tech sectors were found mainly in Eastern European regions. This was especially the case in countries such as Lithuania, Bulgaria, Hungary, Slovakia, Latvia, Romania, the Czech Republic and Estonia, which recorded shares above 45 % in most regions. Only four other EU regions – three in France and one in Germany - recorded female employment rates in high-tech above 45 %.

By contrast, it should be noted that women were significantly under-represented (less than 25 %) in high-tech sectors in some regions of Germany, Greece, the Netherlands, Austria and the United Kingdom. The low percentages of women employed in high-tech sectors were even more apparent in Turkey, with female workers accounting for less than 15 % in several regions.

Map 7.15: Share of women among employment in high-tech sectors, EU-27 and selected countries at NUTS level 1, 2006

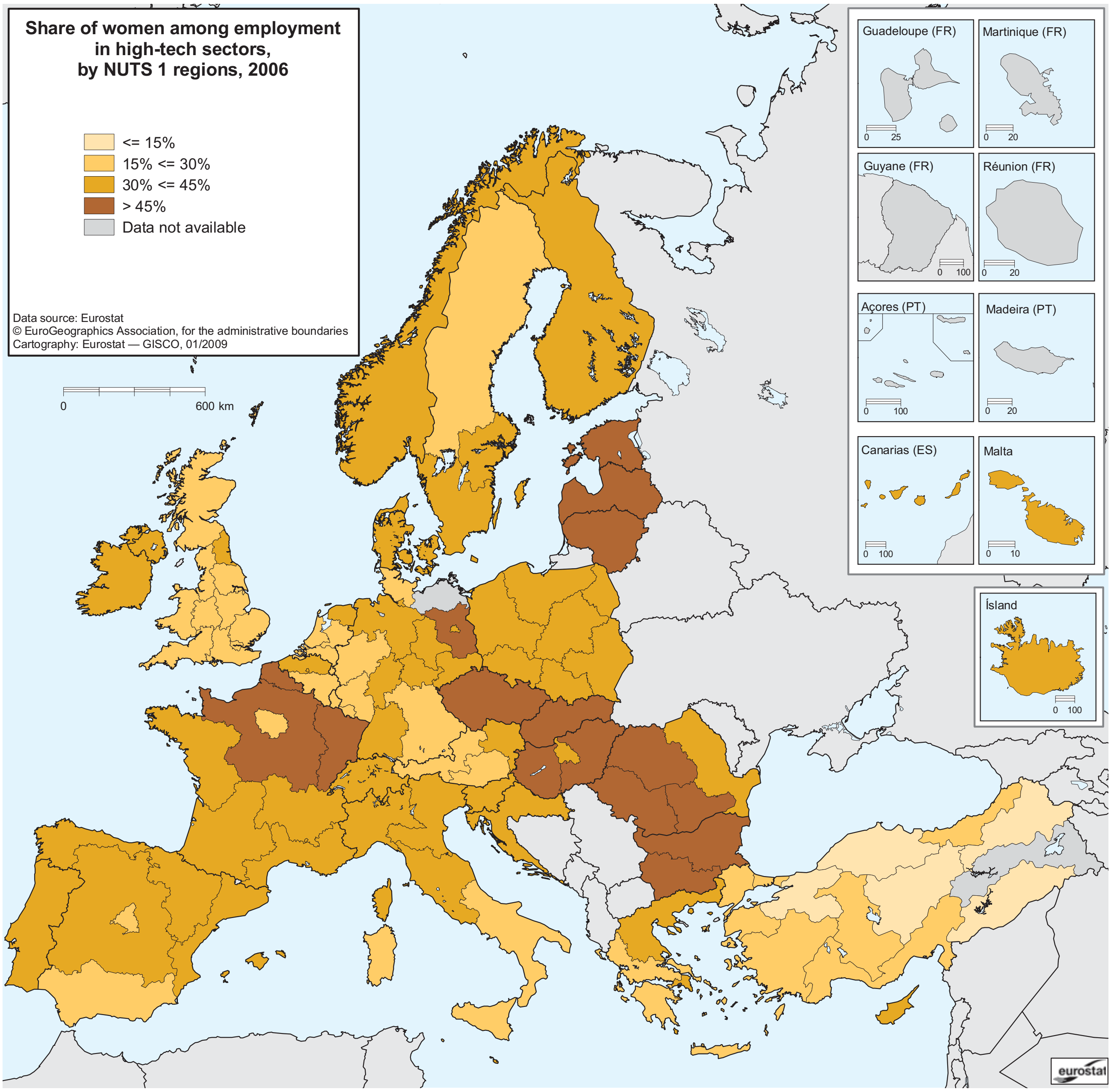
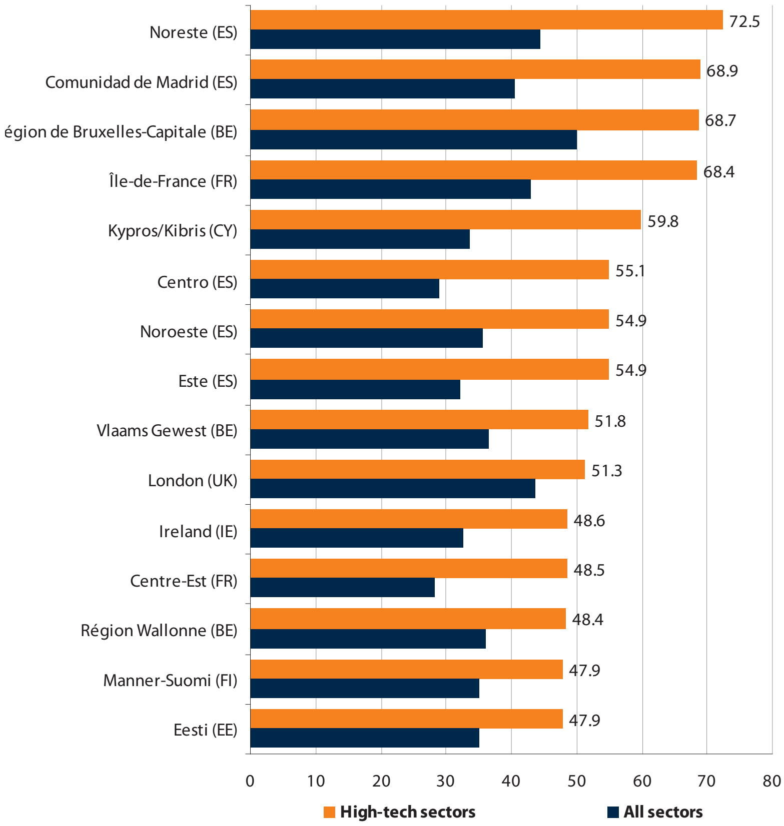


Figure 7.16: Top 15 regions (NUTS level 1) in terms of share of tertiary-educated persons employed in high-tech sectors, 2006



Data for high-tech sectors lack reliability due to small sample size in EE.

Figure 7.16 provides a ranking of the top 15 regions in terms of the share of tertiary-educated people employed in high-tech sectors in 2006, as compared to all sectors of activity. In all regions considered, the share of tertiary-educated people is significantly higher in high-tech sectors than in other sectors. Moreover, this was true not only for the top 15 regions, but also for all EU regions (at NUTS level 1) with the exception of Malta. Noreste (ES) accounted for the highest share of tertiary-educated persons in high-tech sectors (72.5 %), followed by three capital regions with shares of over 68 %: Communidad de Madrid (ES), Région de Bruxelles-Capital (BE) and Île-de-France (FR). All other regions recorded shares below 60 %. Two other capital regions were also among the top 15: London (UK) and Manner-Suomi (FI), as well as Cyprus, Ireland and Estonia, which are classified as regions at NUTS level 1.

There are five Spanish regions in the top eight regions (Noreste, Comunidad de Madrid, Centro, Noroeste and Este) and three Belgian regions (Région de Bruxelles-Capital, Vlaams Gewest and Région Wallonne) among the top 13. This is directly related to the large size of the tertiary-educated population in these two European countries.

Tertiary Education in Spain

'While the level of the population having attained secondary education is still below the OECD average, the proportion of population aged 25 to 34-years-old in Spain that has attained tertiary education is 7 percentage points higher than the OECD average (38 % in Spain compared to the OECD average of 31 %). Spain has made major investments in education since the mid-1990s and this may have spurred recent increases in tertiary attainment. Older people in Spain have not attained these levels of education. The proportion of 35-to-44-year-olds in Spain that have attained tertiary education is 10 percentage points lower than 25-to-34-year-olds, and for age cohorts above 44 years of age the levels of tertiary attainment are well below the OECD average.'

Source: OECD
http://www.oecd.org/dataoecd/51/21/37392840.pdf

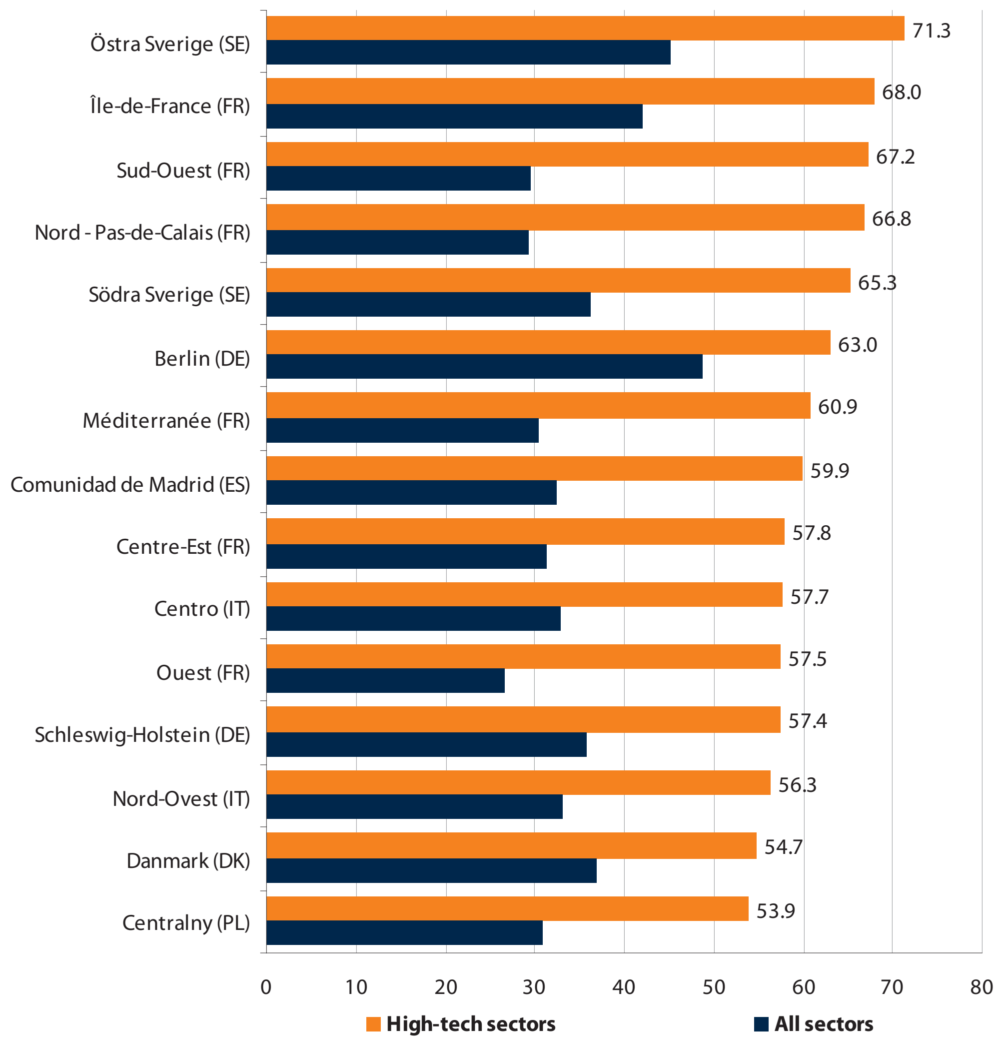
In terms of the percentage of professionals or technicians employed in high-tech sectors (Figure 7.17), six regions out of the top 15 were in France. Moreover, Île-de-France (FR), with 68.0 %, ranked second behind Östra Sverige (SE), which was followed by two more French regions: Sud-Ouest and Nord-Pas-de-Calais.

Once again, capital regions featured prominently among the top 15: Östra Sverige (SE), Île-de-France (FR), Berlin (DE), Comunidad de Madrid (ES), Centro (IT) and Centralny (PL), and Denmark.

For all regions in the top 15, the share of professionals or technicians was significantly higher in the high-tech sectors than in other sectors. However, the same was not true for all EU regions. For instance, this share was higher in the economy as a whole than in high-tech sectors in several regions of Germany and Portugal.

Considering both Figures 7.16 and 7.17, it appears that employment in high-tech sectors is mainly concentrated around capitals and other urban centres. There is also a significant concentration of knowledge and persons with tertiary education in the high-tech sectors of these regions.

Figure 7.17: Top 15 regions (NUTS level 1) in terms of share of persons employed as professionals and technicians in high-tech sectors, 2006



2007 EU industrial R&D investment scoreboard

8

8.1 Introduction

The European Union places strong emphasis on the need to invest more in R&D and human capital in the form of better education and skills. This is considered to be a key determinant of economic growth in a knowledge-based economy.

The 2007 EU Industrial R&D Investment Scoreboard ('the Scoreboard') provides information on the top 1 000 EU and non-EU companies in terms of investment in R&D. The Scoreboard includes not only R&D figures but also other economic and financial data from the last four financial years.

The data for the Scoreboard are taken from companies' publicly available audited accounts. In most cases, these accounts give no information on where the R&D is actually carried out. Therefore the approach taken in the Scoreboard is to attribute each company's total R&D investment to the country in which the company has its registered office .

The EU and non-EU groups include companies with different volumes of R&D investment. In 2007, the R&D investment thresholds for inclusion in the Scoreboard were EUR 3.3 millionfor the EU group and EUR 23 million for the non-EU group. In order to compare EU and non-EU companies on a similar footing, this analysis will consider only EU companies investing more than the non-EU threshold in R&D. This group of about 400 EU companies accounts for approximately 95 % of the total R&D investment by the EU group. Using the non-EU threshold yields a sample of the world's top 1 400 R&D investors that can be used for comparative purposes. However, Tables 8.1, 8.6 and 8.7 and Figure 8.2 are all based on 2 000 firms.

The branches of industry featured in the Scoreboard are based on the ICB (Industry Classification Benchmark) system. Data are generally disaggregated to three-digit level unless indicated otherwise.

In the Scoreboard, research and development investment means the investment funded by the companies themselves. It excludes R&D undertaken under contract for customers such as government departments or other companies. It also excludes the companies' participation in R&D investment in any associated company or joint venture. As R&D investment is included in the annual report and accounts, international accounting definitions of R&D apply. For example, the International Accounting Standard definition of 'intangible assets' (IAS 38) is based on the OECD Frascati Manual. 'Research' is defined as original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding. 'Expenditure on research' is recognised as an expense when it is incurred. 'Development' means application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use.

Development costs are capitalised when they meet certain criteria and when it can be demonstrated that the asset will generate probable future economic benefits. Where part or all of the R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

Data in the 2007 Scoreboard are neither collected nor monitored by Eurostat, but by the Commission's Industrial Research and Innovation initiative, 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 industrial sectors, the data in the 2007 Scoreboard cover only the business enterprise sector (BES).

For the sectoral breakdown of R&D statistics, however, Eurostat uses the Statistical Classification of Economic Activities in the European Community (NACE Rev. 1.1). This very detailed four-digit classification is subdivided into 17 sections, 31 sub-sections, 62 divisions, 224 groups and 514 classes. The tables in the 2007 Scoreboard show not only the ICB codes, but also the corresponding NACE codes. The industrial sectors mentioned in this chapter are, however, based on the ICB.

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.

Altogether, the 2 000 companies featured in the Scoreboard invested EUR 372 billion in R&D activities in 2006. One third of global R&D investment was made by European companies (EUR 121.1m).

(1) The EU Industrial R&D Investment Scoreboard is published annually by the European Commission (JRC-IPTS/DG RTD) as part of its Industrial Research Investment Monitoring (IRIM) activity. Company data were collected by Company Reporting Ltd.

(2) 'EU company' concerns companies whose ultimate parent has its registered office in a Member State of the EU. Likewise, 'non-EU company' applies when the ultimate parent company is located outside the EU (see also the glossary and definitions in Annex 1 as well as the handling of parent companies and subsidiaries).

(3) The registered office is the company address notified to the official company registry. It is normally the place where a company's books are kept.

(4) See: http://iri.jrc.ec.europa.eu/.

In 2006, the 1 000 EU companies in the Scoreboard increased their R&D investment by 7.4 %, compared with 5.3 % in the previous year. R&D investment growth in the 1 000 non-EU companies stood at 11.1 %, against 7.7 % in the previous year. This trend of accelerating R&D investment growth has now been visible for several years.

Between 2005 and 2006, net sales grew by 10.3 % in the EU. As a result, the downward trend in the R&D intensity of European companies continued. Only US companies reported higher growth in R&D investment than in sales.

Moreover, profitability figures stood at similar levels in EU (11.5 %) and non-EU (11.7 %) companies, thereby highlighting the increase in sales in the EU.

The EU also achieved the strongest growth in fixed capital investment over net sales (7 %), which plays an important part in total corporate investment and underpins investment in innovation.

Table 8.1: Overall performance by enterprise group in the Scoreboard, EU vs. non–EU enterprises, 2006

	EU	Non-EU
R&D investment (EUR billion)	121.1	250.5
Change over previous year (%)	7.4	11.1
Compound annual growth rate – 3 years (%)	4.6	8.7
Net sales (EUR billion)	5 156.1	6 474.3
Change over previous year (%)	10.3	9.7
Compound annual growth rate – 3 years (%)	8.1	10.7
R&D investment/Net sales (R&D intensity) (%)	2.3	3.9
Profitability (%)	11.5	11.7
Fixed capital investment/Net sales (%)	7.0	6.6

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

Methodological Caveats

When using the Scoreboard for comparative analyses, a number of factors potentially affecting interpretation of the figures should be borne in mind.

The following points should be noted:

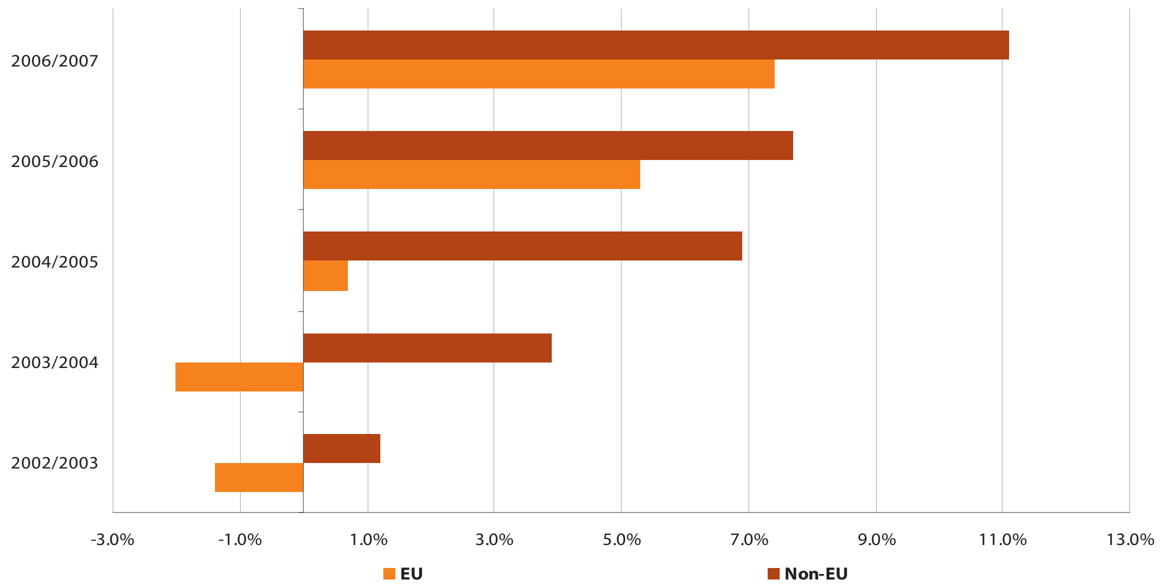
- Scoreboard figures are nominal and expressed in euros with all foreign currencies converted at the exchange rate prevailing on 31 December 2006. Financial indicators consolidated from companies' activities in different currency areas are influenced by fluctuations in exchange rates. This has an impact on firms' relative positions in the world rankings based on these indicators. Moreover, the ratios between indicators or the growth rate of an indicator may be under- or overestimated. For example, the euro appreciated significantly against the US dollar over the period concerned, rising from $1.18 to $1.32. This means that Scoreboard figures underestimate the R&D growth rate of EU companies with operations in the USA and overestimate the growth rate of US companies which also operate in the EU.
- The EU and non-EU groups include companies with different volumes of R&D investment. This year, the R&D investment thresholds are €3.3 million for the EU group and €23 million for the non-EU group. In order to compare EU and non-EU companies on a similar footing, it is preferable to consider only EU companies with R&D above the non-EU threshold. This group of about 400 EU companies accounts for approximately 95 % of the total R&D investment by the EU group. Using the non-EU threshold yields a sample of the world's top 1 400 R&D investors that can be used for comparative purposes.
- Other important influencing factors are the differences in the various countries' (or sectors') business cycles and the potential impact of mergers and acquisitions. The latter factor may explain sudden changes in growth rates and rankings of specific companies, while the former may have a significant impact on companies' investment decisions.

Source: 2007 EU Industrial R&D Investment Scoreboard

Figure 8.2 shows the growth in R&D investment by the enterprise groups in the Scoreboard for EU and non-EU countries.

It should be added that the enterprise groups included in the Scoreboard change more or less every year as only those with the highest R&D investment are taken into account.

Figure 8.2: Growth of R&D investment of the enterprise groups in the Scoreboard, EU and non-EU



Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.
Note: the years shown in the graph indicate the Scoreboard editions, e.g. the 2007 edition is based on 2006 data.

8.2 Key indicators

Readers should please note that the R&D in the Scoreboard is allocated to each company's registered office. This may, therefore, differ from the actual geographical distribution of R&D investment.

In absolute terms, German, French and UK enterprises were the biggest R&D investors in the EU, with a total of EUR 87.5 billion. In 2006, the Netherlands, Sweden and Finland invested more than EUR 5 billion each in 2006, closely followed by Italy. R&D expenditure in Portugal and Latvia totalled EUR 4 million and EUR 3 million respectively. The highest year on year increases in R&D expenditure were recorded in Latvia (this is the first time that a Latvian company has been included in the Scoreboard) and Luxembourg (55 %).

The data in Table 8.3 were compiled from enterprise group data and take into account only the enterprise groups with the highest R&D investment in 2006. In small countries with very few enterprise groups in the Scoreboard, high growth in R&D investment by just one company can lead to very high year on year increases in R&D expenditure.

Table 8.3: R&D key indicators, by EU Member State

	R&D investment			Employees			R&D per employee	
	2006	Change 06/05	CAGR 3yrs	2006	Change 06/05	CAGR 3yrs	2006	2005
	€m	%	%	€m	%	%	€K	€K
BE	2 166	21.2	13.2	539 964	5.0	4.0	4	3
	33	*33*	*25*	*33*	*33*	*29*	*33*	*33*
CZ	50	-3.8	29.5	50 161	3.4	9.9	1	1
	4	*4*	*3*	*4*	*4*	*4*	*4*	*4*
DK	2 438	15.9	10.6	256 674	3.8	3.5	9	9
	38	*38*	*32*	*38*	*38*	*36*	*38*	*38*
DE	40 757	5.3	2.3	5 216 804	3.5	1.5	8	8
	167	*166*	*138*	*167*	*167*	*157*	*167*	*166*
IE	455	0.6	3.4	63 755	-1.8	0.5	7	7
	12	*12*	*10*	*12*	*12*	*11*	*12*	*12*
EL	20	5.8	30.2	5 214	22.4	26.1	4	3
	3	*3*	*3*	*3*	*2*	*2*	*3*	*2*
ES	1 340	6.5	5.7	540 114	11.0	12.4	2	3
	23	*23*	*19*	*22*	*22*	*20*	*22*	*22*
FR	23 139	7.1	10.4	4 301 489	3.6	2.7	5	5
	114	*110*	*90*	*114*	*112*	*109*	*113*	*110*
IT	4 942	3.5	-8.8	889 162	10.9	-5.6	6	6
	48	*46*	*29*	*48*	*45*	*38*	*48*	*44*
LV	3	80.3	109.2	683	29.6	:	5	4
	1	*1*	*1*	*1*	*1*	*0*	*1*	*1*
LU	217	55.0	34.4	49 396	15.0	10.7	4	3
	5	*5*	*3*	*5*	*5*	*4*	*5*	*5*
HU	93	18.4	14.9	11 962	8.2	4.6	8	7
	3	*3*	*3*	*3*	*3*	*3*	*3*	*3*
NL	9 132	7.0	2.8	1 394 196	17.1	4.0	7	7
	50	*48*	*41*	*50*	*48*	*47*	*50*	*47*
AT	540	10.5	6.8	237 054	-0.1	10.3	2	2
	31	*27*	*25*	*31*	*30*	*27*	*31*	*28*
PL	29	-3.6	-3.5	38 068	0.4	-7.1	1	0
	2	*1*	*1*	*2*	*2*	*2*	*2*	*2*
PT	4	:	:	323	:	:	13	:
	1	*0*	*0*	*1*	*0*	*0*	*1*	*0*
SI	56	29.5	19.9	8 258	-0.3	15.9	7	5
	2	*2*	*1*	*2*	*2*	*2*	*2*	*2*
FI	5 043	3.4	-1.7	516 554	6.0	1.6	10	10
	67	*64*	*55*	*67*	*66*	*61*	*67*	*65*
SE	7 261	5.8	3.8	769 382	2.9	1.1	9	9
	75	*74*	*69*	*75*	*74*	*74*	*75*	*74*
UK	23 449	11.7	7.0	3 901 336	3.0	1.8	6	6
	321	*316*	*257*	*321*	*318*	*294*	*321*	*316*

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'
Note: figures in italics: number of enterprises used for the calculation.

The top three investors in R&D also employed the highest number of people in absolute terms, but increases in the relative shares of R&D expenditure between 2004 and 2006 were especially marked for companies in Greece (26.1 %), Slovenia (15.9 %) and Luxembourg (10.7 %).

Overall, the R&D investment figures per employee for 2006 were generally similar to or slightly above those for 2005, except in Spain, where the number of companies in the Scoreboard increased but R&D expenditure per employee dropped. Nordic countries such as Finland, Sweden and Denmark had the highest R&D investment rates per employee.

A general trend towards high net sales was observed in most EU companies. Net sales in Luxembourg grew by almost 50 % compared with the previous year, with Greek and Latvian companies reporting increases of around 30 %.

Most EU companies made operating profits ranging between 10 % and 20 %, with the exception of Dutch and Portuguese companies, which fell short of the 10 % mark.

Table 8.3 (continued): R&D key indicators, by EU Member State

	Net sales			R&D/Net sales ratio		Operating profit		Market capitalisation	
	2006	Change 06/05	CAGR 3yrs	2006	2005	2006	2005	2006	Change 06/05
	€m	%	%	%	%	% of net sales	% of net sales	€m	%
BE	143 141	9.0	7.0	1.5	1.4	15.0	13.8	188 278	18.3
	33	*33*	*28*	*33*	*33*	*33*	*33*	*32*	*31*
CZ	8 136	21.0	18.3	0.6	0.8	23.5	24.4	29 530	42.6
	4	*4*	*4*	*4*	*4*	*4*	*4*	*2*	*1*
DK	65 313	7.6	10.5	3.7	3.5	13.0	12.0	108 302	36.1
	38	*37*	*35*	*37*	*37*	*37*	*37*	*31*	*29*
DE	1 367 550	10.7	6.9	3.0	3.1	6.6	6.3	929 488	36.5
	167	*165*	*157*	*166*	*164*	*166*	*165*	*139*	*126*
IE	17 824	10.7	11.3	2.6	2.8	12.2	10.4	31 147	18.2
	12	*11*	*11*	*12*	*11*	*12*	*11*	*12*	*10*
EL	1 216	30.1	10.6	1.6	2.0	20.3	18.1	2 494	24.1
	3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
ES	168 636	17.0	14.6	0.8	0.9	15.1	15.6	235 623	34.8
	23	*23*	*22*	*23*	*23*	*23*	*23*	*20*	*16*
FR	1 001 575	9.1	7.2	2.3	2.4	10.9	11.2	1 143 728	25.0
	114	*112*	*109*	*114*	*110*	*114*	*112*	*110*	*96*
IT	309 620	12.8	2.6	1.6	1.7	17.2	17.5	423 464	29.8
	48	*47*	*39*	*48*	*46*	*48*	*47*	*42*	*32*
LV	60	30.4	30.5	5.8	4.2	20.0	17.4	11	-79.2
	1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
LU	20 952	49.9	19.2	1.0	1.0	17.3	15.9	26 903	34.9
	5	*5*	*4*	*5*	*5*	*5*	*5*	*3*	*3*
HU	1 304	20.2	12.2	7.1	7.2	20.6	18.8	3 473	-8.8
	3	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
NL	252 292	22.5	13.5	3.6	4.2	8.1	9.4	251 838	21.1
	50	*49*	*49*	*50*	*48*	*50*	*49*	*42*	*35*
AT	63 918	18.2	19.3	0.8	0.9	10.1	10.7	64 593	18.3
	31	*30*	*27*	*31*	*28*	*31*	*30*	*28*	*23*
PL	5 304	3.0	1.8	0.5	0.3	18.8	20.7	12 181	11.0
	2	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*
PT	104	:	:	3.9	:	3.8	:	0	:
	1	*0*	*0*	*1*	*0*	*1*	*0*	*0*	*0*
SI	837	4.9	9.9	6.7	5.4	20.8	17.7	5 274	93.2
	2	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*
FI	160 270	12.5	4.8	3.1	3.6	9.4	9.0	202 448	33.8
	67	*66*	*61*	*67*	*65*	*67*	*66*	*55*	*52*
SE	193 686	9.1	8.5	3.7	3.9	13.7	11.9	248 378	38.8
	75	*73*	*73*	*75*	*73*	*75*	*73*	*67*	*59*
UK	1 374 395	6.9	9.2	1.7	1.6	15.1	12.6	1 986 605	7.0
	321	*309*	*290*	*315*	*306*	*315*	*309*	*232*	*221*

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.
Note: figures in italics: number of enterprises used for the calculation.

Three quarters of total R&D investment in the EU can be ascribed to only three Member States

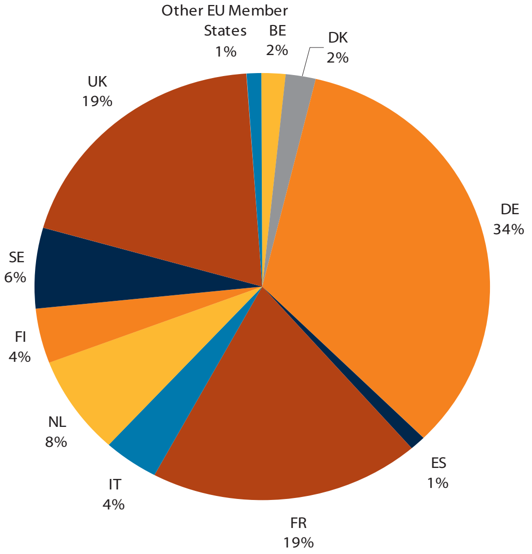
In 2006, as in previous years, German companies accounted for more than one third of total R&D investment in the EU. Together with France and the United Kingdom, these three countries generated three quarters of the total R&D investment. These figures were similar to those for the previous year (34 % for Germany and 19 % for both the United Kingdom and France).

R&D investment shares in the Netherlands, Sweden, Finland and Italy remained very close to those in the previous year, the Netherlands being the only country to achieve a slight increase. Belgian and Danish enterprises accounted for 2 % of total EU R&D investment, which confirms the sustained increase observed in these two countries since 2004.

The number of enterprises from the new Member States in the Scoreboard rose from 10 in 2005 to 11 in 2006. In 2007 the Scoreboard included four enterprises from the Czech Republic, two from both Poland and Slovenia, two from Hungary — one less than in 2005 — and one from Latvia. Slovakia was represented in the Scoreboard in 2006, but not in 2007.

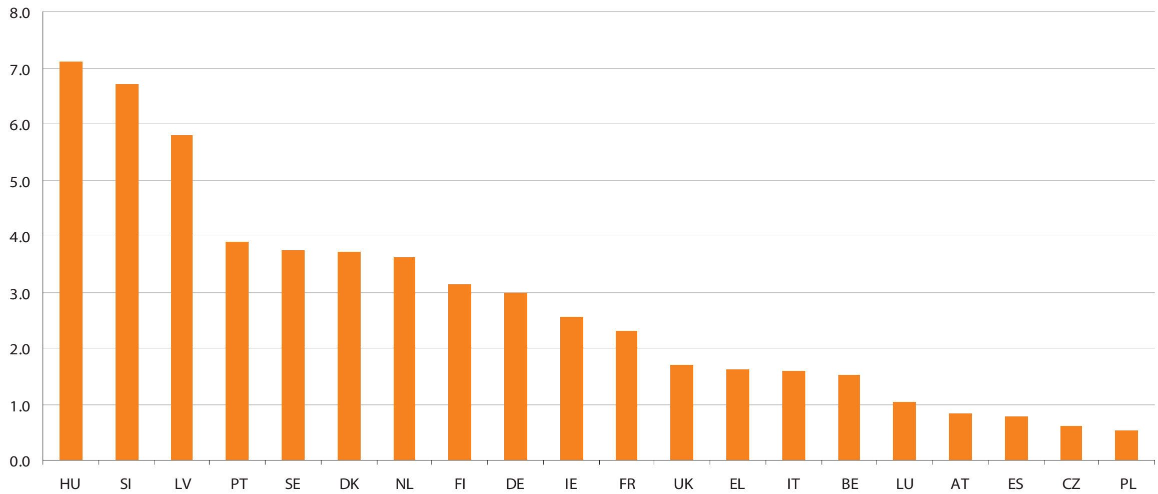
Currently, R&D investment in the EU tends to be concentrated in a small number of Member States.

Figure 8.4: Breakdown of R&D investment, by EU Member State, 2006



Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

Figure 8.5: Ranking of R&D intensity by EU Member State — 2006



Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

R&D intensity means the ratio between R&D investment and net sales of a given company or group of companies. The average R&D intensity of EU companies has continued to decrease slowly as net sales have been growing faster than R&D investment.

In 2006, Hungary recorded the highest R&D intensity in the EU, with 7 %. Two other Eastern European countries followed: Slovenia (6.7 %) and Latvia (5.8 %), confirming the commitment of enterprises in the new Member States to R&D. But it should be pointed out again that in this context R&D intensity is calculated as the ratio between R&D investment and net sales.

Portugal, Sweden, Denmark, the Netherlands and Finland reported R&D intensity of around 3 %, on a par with previous years.

Poland, the Czech Republic, Spain and Austria averaged R&D intensity of below 1 % in 2006.

Table 8.6: Ranking of industrial sectors in terms of R&D investment by enterprise group, EU countries, 2006

	R&D investment 2006 €m	Net sales 2006 €m	R&D/Net sales ratio (R&D intensity) %	Share in R&D investment %
1 Automobiles & parts	27 112	606 548	4.5	22.4
2 Pharmaceuticals & biotechnology	20 011	160 541	12.5	16.5
3 Technology hardware & equipment	13 086	109 122	12.0	10.8
4 Aerospace & defence	9 194	121 912	7.5	7.6
5 Electronic & electrical equipment	8 001	169 426	4.7	6.6
6 Chemicals	7 511	230 678	3.3	6.2
7 Industrial engineering	4 830	169 121	2.9	4.0
8 Software & computer services	4 474	55 714	8.0	3.7
9 Fixed line telecommunications	4 326	275 763	1.6	3.6
10 Banks	2 380	280 287	0.8	2.0
11 Leisure goods	2 136	34 202	6.2	1.8
12 Food producers	1 914	143 311	1.3	1.6
13 Oil & gas producers	1 898	762 202	0.2	1.6
14 Media	1 768	76 691	2.3	1.5
15 General industrials	1 658	73 017	2.3	1.4
Top 15 sectors	**110 299**	**3 268 535**	**3.4**	**91.1**
Other sectors	10 832	1 887 599	0.6	8.9
All sectors	**121 131**	**5 156 134**	**2.3**	**100.0**

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

Automobile & parts in pole position in R&D investment

In 2006, European companies spent a total of EUR 121 131 million on R&D activities.

'Automobiles and parts' remained the sector with the highest R&D investment in the EU. It took more than one fifth (22.4 %) of the total investment in R&D followed by 'pharmaceuticals and biotechnology' (16.5 %) and 'technology hardware and equipment' (10.8 %). These three sectors accounted for close to half of total R&D investment by EU companies.

'Aerospace and defence', together with 'electronic and electrical equipment' and 'chemicals' remained at their 2005 levels in terms of R&D investment, but 'fixed line telecommunications', still very profitable in terms of net sales, dropped two places and was overtaken by 'industrial engineering' and 'software and computer services'.

In terms of R&D intensity, 'pharmaceuticals and biotechnology' showed the highest share (12.5 %), closely followed by 'technology hardware and equipment' (12 %). 'Software and computer services' (8 %), 'aerospace and defence' (7.5 %) and 'leisure goods' (6.2 %) also ranked high in terms of R&D intensity, while high net sales led to low R&D intensity in the 'oil and gas production' sector (0.2 %).

Table 8.7: Ranking of industrial sectors in terms of R&D investment by enterprise group, non-EU countries, 2006

	R&D investment 2006 €m	Net sales 2006 €m	R&D/Net sales ratio (R&D intensity) %	Share in R&D investment %
1 Technology hardware & equipment	51 807	647 017	8.0	20.7
2 Pharmaceuticals & biotechnology	51 310	317 872	16.1	20.5
3 Automobiles & parts	33 856	899 888	3.8	13.5
4 Software & computer services	22 912	232 947	9.8	9.1
5 Electronic & electrical equipment	19 604	461 202	4.3	7.8
6 Leisure goods	12 104	184 336	6.6	4.8
7 Chemicals	9 914	345 366	2.9	4.0
8 General industrials	7 336	371 394	2.0	2.9
9 Aerospace & defence	6 891	213 534	3.2	2.8
10 Health care equipment & services	5 160	64 525	8.0	2.1
11 Industrial engineering	4 874	206 778	2.4	1.9
12 Oil & gas producers	3 062	980 560	0.3	1.2
13 Fixed line telecommunications	3 009	191 093	1.6	1.2
14 Household goods	2 878	128 675	2.2	1.1
15 Food producers	2 169	138 173	1.6	0.9
Top 15 sectors	**236 885**	**5 383 360**	**4.4**	**94.6**
Other sectors	13 570	1 090 886	1.2	5.4
All sectors	**250 455**	**6 474 246**	**3.9**	**100.0**

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

Non-EU companies outperformed their EU counterparts in terms of R&D investment

Amongst non-EU enterprises, 'technology hardware and equipment' and 'pharmaceuticals and biotechnology' were the biggest investors in R&D in 2006, accounting together for more than 40 % of total non EU R&D investment. 'Automobiles and parts' came third with 13.5 %, down by one place from the previous year.

'Health care equipment and services' and 'aerospace and defence' were in the top ten in 2006, but not in the previous year.

In 2006, the top 15 industrial sectors investing in R&D accounted for 83 % of net sales and 95 % of R&D investment in all sectors, highlighting the concentration of R&D activity in just a very few sectors.

The highest R&D intensity levels were observed in the 'pharmaceuticals' sector – as in the EU – followed by 'software and computer services' and 'health care equipment and services'.

Comparing Table 8.7 and Table 8.6, a number of differences emerge between the top 15 sectors in the EU and outside.

As a rule, in 2006 non-EU enterprises invested more in R&D activities: at sector level, R&D spending, net sales and R&D intensity were higher for non-EU enterprises than for their EU counterparts.

There were also discrepancies in the sectors represented: within the EU, 'media' and 'banks' tended to allocate more resources to R&D activities, while outside the EU 'health care equipment and services' and 'household goods' were among the top 15 investors in R&D.

Table 8.8: Top 20 EU and non-EU enterprises in terms of total R&D investment (EUR million), 2006

	EU			Non-EU		
1	DaimlerChrysler	DE	5 234	Pfizer	US	5 763
2	GlaxoSmithKline	UK	5 131	Ford Motor	US	5 460
3	Siemens	DE	5 024	Johnson & Johnson	US	5 403
4	Sanofi-Aventis	FR	4 404	Microsoft	US	5 400
5	Volkswagen	DE	4 240	Toyota Motor	JP	5 172
6	Nokia	FI	3 712	General Motors	US	5 005
7	Robert Bosch	DE	3 398	Samsung Electronics	KR	4 660
8	BMW	DE	3 208	Intel	US	4 454
9	Ericsson	SE	2 976	IBM	US	4 304
10	AstraZeneca	UK	2 959	Roche	CH	4 093
11	EADS	NL	2 869	Novartis	CH	4 068
12	Bayer	DE	2 457	Merck	US	3 627
13	Renault	FR	2 400	Matsushita Electric	JP	3 594
14	Peugeot (PSA)	FR	2 175	Sony	JP	3 385
15	Alcatel-Lucent	FR	1 988	Honda Motor	JP	3 248
16	Philips Electronics	NL	1 948	Motorola	US	3 114
17	Finmeccanica	IT	1 869	Cisco Systems	US	3 084
18	BAE Systems	UK	1 852	Nissan Motor	JP	2 849
19	BT	UK	1 661	Hewlett-Packard	US	2 723
20	Boehringer Ingelheim	DE	1 574	Hitachi	JP	2 578

Source: Eurostat, based on the '2007 EU Industrial R&D Investment Scoreboard'.

DaimlerChrysler, which invested EUR 5.2 billion in R&D in 2006, held on to the lead in R&D expenditure within the EU, although on the international scene it fell back one place to fifth in terms of total R&D investment. Globally, the four largest investors were US companies: Pfizer (5.7 billion), Ford Motor (5.5 billion), Johnson & Johnson (5.4 billion) and Microsoft (5.4 billion).

Generally speaking, European companies in the top 50 achieved lower average R&D intensity than their non-EU counterparts. Nonetheless, 18 of the top 50 R&D investors were European, which is in line with previous years.

Several pharmaceutical companies recorded strong increases in R&D investment, e.g. Merck (24.3 %), AstraZeneca (15.5 %), Novartis (10.7 %) and GlaxoSmithKline (10 %). This reflects the general increase in R&D investment observed in the pharmaceuticals sector.

Five EU companies achieved double-digit growth rates in R&D investment: Bayer (mainly as a result of the acquisition of Schering), Boehringer Ingelheim, Finmeccanica, BT and Alcatel Lucent.

8.3 Other key findings

Sectoral differences and persistently lower growth rates in R&D-intensive sectors have led to lower R&D growth rates in the EU

One reason for the slower R&D growth of EU companies is that growth rates in R&D-intensive sectors have been much higher in non-EU enterprises than in their EU counterparts. The share of R&D investment in these sectors was also higher in the non-EU group. Nevertheless, EU enterprises showed the highest growth in fixed capital investment, which plays an important part in total corporate investment and underpins investment in innovation.

Effervescence in the chemicals sector; slowdown in car manufacturing

R&D investment in the chemicals sector recovered strongly (up by 9.8 %) after the negative growth observed in the previous year. This was especially pronounced for EU companies (17 %), with large chemical enterprises reporting impressive R&D growth rates, e.g. Bayer (30.3 %), Solvay (20.3 %) and BASF (19.8 %). However, the financial results of several large chemical companies were strongly affected by merger and acquisition activities.

On the other hand, the pace of R&D investments in the automobiles and parts sector slackened significantly, with the two largest companies, Ford and DaimlerChrysler, cutting their R&D investment. However, other companies such as Toyota Motor and Volkswagen recorded high R&D growth rates (7.6 % and 4 % respectively). Among the top companies in this sector, R&D investment was strongest at Robert Bosch, with an average growth rate of 15.9 % from 2005 to 2006.

Scoreboard webpage

The electronic version of the 2007 EU Industrial R&D Investment Scoreboard is available on the Scoreboard webpage at:

http://iri.jrc.ec.europa.eu/research/scoreboard_2007.htm.

Most of the data are also available in Eurostat's NewCronos reference database.

Methodology

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
- 2007 EU industrial R&D investment scoreboard.

1 General information

1.1 Currency

Series in current euro have been calculated by using the annual average euro-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 1 January is the number of inhabitants of a given area on 1 January of the year in question (or, in some cases, on 31 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 Labour Force Survey (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 performed work during the reference week — 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 Average annual growth rate

Average annual growth rates (AAGR) in this publication are calculated according to the following formula:

$$\mathbf{AAGR}_{T,\ T-n} = [(X_T/X_{T-n})^{1/n} - 1] \times 100$$

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.

1.8 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	05
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
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 machinery and equipment n.e.c.	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.
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.

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.

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 to 97** Activities of households; **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, 2006 version. The NUTS was established by the Statistical Office of the European Communities (Eurostat), in cooperation 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 number of NUTS 1 regions, each of which is in turn subdivided into a 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 2006 version. The exceptions have been indicated in the tables or figures.

For six countries (Estonia, Cyprus, Latvia, Lithuania, Luxembourg and Malta) 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 eleven countries (Czech Republic, Denmark, Estonia, Ireland, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Slovenia and Slovakia) the national level coincides with the NUTS 1 level, which explains their potential presence amongst the regional rankings in this publication.

For Bulgaria, Romania and Croatia, the NUTS level 2 has been revised and no one-to-one correspondence is possible between the previous and the new NUTS level 2. This could explain the lack of data at NUTS level 2 for these countries in some figures in this Statistical Book.

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 for 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 — Main Science and Technology Indicators (MSTI).

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 Commission Regulation (EC) No 753/2004 regarding statistics on science and technology, (OJ L 118, 23.4.2004, p. 23).

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 utilisation 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 into data compiled according to the NABS classification (see Table 8.2 of the Frascati Manual).

Exceptions

No GBAORD data exist for Bulgaria and Luxembourg before 2000, and therefore EU aggregates exclude them before that year.
No GBAORD data exist for Cyprus and Malta before 2004, and therefore EU aggregates exclude Cyprus and Malta before that year.
No GBAORD data exist for Hungary before 2005, and therefore EU aggregates exclude Hungary before that year.

Time series

The analysis in this Statistical Book covers the period 1996 to 2006.

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 particularly 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 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 — Main Science and Technology Indicators (MSTI).

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 Commission Regulation (EC) No 753/2004 regarding statistics on science and technology, (OJ L 118, 23.4.2004, p. 23).

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 national level (EEA countries), GDP from national accounts is used as reference data. At regional level, GDP data are taken from the regional accounts. Both data series were extracted from NewCronos.

R&D personnel

Data on R&D personnel measure the resources going directly to R&D activities. The total R&D personnel is defined as follows:

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

Intramural 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 the 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 et seq. Since the amounts from the Higher Education and PNP sectors are small, they have been combined as 'other national sources'.

Field of science

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 economic activity

Data on R&D expenditure and personnel in the BES may be broken down by sector of economic activity on the basis of the NACE Rev. 1.1 (see General information).

Size class of enterprise

Data on R&D personnel in the BES may be broken down by size class of enterprises. The size classes of enterprises are:

– 0 employees
– 1 to 9 employees
– 10 to 49 employees
– 50 to 249 employees
– 250 to 499 employees
– 500 and more 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 (Frascati Manual, § 306).

– Other supporting staff: this includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects (Frascati Manual, § 309).

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 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-27 Member States, candidate countries, Iceland, Norway, Switzerland, China, Japan, Russia and the United States at the national level and for European countries at the regional level NUTS level 2 (see General information).

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 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 and EEA aggregates are estimated values.

– EEA: Liechtenstein is not included.

Time series

Data are presented for the period 2001–2006. 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 in Eurostat's reference database — NewCronos.

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*[(2)] , 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, which is based on a sample of the 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 (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).

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

Sub-categories of HRST	People belonging to HRST that have/are
HRSTO: Human Resources in Science and Technology — Occupation	• employed in an 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 (ISCED '97 version levels 5a, 5b or 6).
HRSTC: Human Resources in Science and Technology — Core	• successfully completed education at the third level (ISCED '97 version levels 5a, 5b or 6) **and**
	• employed in an S&T occupation (ISCO '88 COM codes 2 or 3).
SE: 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 (ISCED '97 version levels 5a, 5b or 6) **and** are unemployed.
NHRSTU: Unemployed non-HRST	• no education at the third level **and** are unemployed.

Note that according to the *Canberra Manual*, § 71, the seven broad fields of study in S&T are: natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, humanities and other fields.

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 then fulfil 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 user should note that European education systems differ between countries and that duplications of degrees might exist for some countries.

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 all 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 the definition of S&T occupations deviates to a certain extent from the recommendations laid down in the Canberra Manual. In addition to ISCO major groups 2 and 3, the Canberra Manual proposes also considering the following as HRST: production and operations managers, other specialist managers, managers of small enterprises (ISCO 122, 123 and 131) who may work in the S&T field. However, they are not included in the term HRST as used here (but they are included in HRSTE 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, the inclusion of 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 coursework only. They usually require 3–5 years of research and coursework, 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 an 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.

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 the General Information part.

Breakdown by nationality

HRST data by nationality are based on the citizenship of the person. This is defined as the particular legal bond between an individual and his/her state acquired by birth or naturalisation whether by declaration, option, marriage or other means in accordance with national legislation. The following aggregates are distinguished in this publication:

– Nationals: persons having citizenship of the country of residence.

– Non-nationals: persons having a citizenship different from the country of residence.

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.

Readers should note that, in mid-2007, HRST results were updated in Eurostat's reference database by using a slightly different methodology. This new methodology takes into account the changes in the EU LFS data collection process. In addition, the reference population is based on the age group 15–74 years old and not the entire population as was the case before.

Sources

Additional information on the methodology used may be found in 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/Human Resources in Science & Technology.

2.4 Innovation

Community Innovation Survey

At European level, the **Community Innovation Survey (CIS)** data are the main source of information for studying innovation drivers and company behaviour towards innovation.

The CIS is a survey on innovation activity in enterprises covering EU Member States, candidate countries, Iceland and Norway.

The data are collected on a two-yearly basis (from 2004 onwards). The latest survey (CIS 4) was carried out in 25 Member States, candidate countries, Iceland and Norway in 2005, based on the reference year 2004.

In order to ensure comparability across countries, Eurostat, in close cooperation with the EU Member States, developed standard core questionnaires for CIS 4, accompanied by a set of definitions and methodological recommendations.

CIS 4 is based on the Oslo Manual (2nd edition, 1997), which gives methodological guidelines and defines the concept of innovation, and on Commission Regulation (EC) No 1450/2004. As the questionnaires for the two surveys are not fully identical, the results are sometimes not fully comparable.

STATISTICAL UNITS

The main statistical unit for CIS 4 was the **enterprise**.

The target population for CIS 4 was the total population of enterprises (with 10 or more employees) engaged primarily in the following market activities: mining and quarrying (NACE 10–14), manufacturing (NACE 15–37), electricity, gas and water supply (NACE 40–41), wholesale trade (NACE 51), transport, storage and communication (NACE 60–64), financial intermediation (NACE 65–67), computer and related activities (NACE 72), architectural and engineering activities (NACE 74.2) and technical testing and analysis (NACE 74.3).

TYPE OF SURVEY

Most Member States and other countries carried out CIS 4 by means of a stratified sample survey, while a number used a census or a combination of the two.

The enterprise size classes referred to in this publication are:

- **small**: 10–49 employees
- **medium-sized**: 50–249 employees
- **large**: 250+ employees

The economic activities covered by this publication are based on the NACE Rev. 1.1 classification. The two sectors used are:

- **industry**, which includes mining and quarrying (NACE C), manufacturing (NACE D) and electricity, gas and water supply (NACE E); and
- **services**, which includes NACE I and J plus NACE divisions 51, 72, 74.2 and 74.3.

The CIS 4 data are organised in the Eurostat reference database following broadly the same structure as the questionnaire.

REFERENCE PERIOD

CIS 4 covered the observation period 2002–2004 inclusive, i.e. the three-year period from the beginning of 2002 to the end of 2004. The reference period for CIS 4 was 2004.

All the countries covered collected data for this observation period; only the Czech Republic took 2003–2005 as the observation period.

DEFINITION

OSLO MANUAL 1997

Innovation: a new or significantly improved product (good or service) introduced to the market or a new or significantly improved process introduced within an enterprise. Innovations are based on the results of new technological developments, new combinations of existing technology or utilisation of other knowledge acquired by the enterprise.

Enterprises engaged in innovation activity (propensity to innovate): enterprises that introduce new or significantly improved products (goods or services) to the market or enterprises that implement new or significantly improved processes. Innovations are based on the results of new technological developments, new combinations of existing technology or utilisation of other knowledge acquired by the enterprise. The term covers all types of innovator, i.e. product innovators, process innovators and enterprises with only ongoing and/or abandoned innovation activities.

Product innovation is introduction to the market of a new good or service or of a good or service with significantly improved capabilities, such as improved software, user-friendliness, components or sub-systems.

Process innovation is implementation of a new or significantly improved production process, distribution method or support activity for goods or services. Purely organisational innovations are excluded.

Organisational innovation is implementation of new or significant changes in a firm's structure or management methods that are intended to improve the firm's use of knowledge, the quality of its goods and services or the efficiency of its workflows.

Marketing innovation is implementation of new or significantly improved designs or sales methods to increase the appeal of goods and services or to enter new markets.

Intramural (in-house) R&D: creative work undertaken within the enterprise to increase the stock of knowledge and use it to devise new and improved products and processes (including software development).

Extramural R&D: same activities as above, but performed by other companies (including other enterprises within the same group) or by public or private research organisations and purchased by the enterprise.

Acquisition of machinery, equipment and software: acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved products and processes.

Acquisition of other external knowledge: purchase or licensing of patents and non-patented inventions, know-how and other types of knowledge from other enterprises or organisations.

European Innovation Scoreboard 2007

The 2007 version is the seventh edition of the European Innovation Scoreboard (EIS). The EIS is the instrument developed at the initiative of the European Commission, under the Lisbon Strategy, to provide a comparative assessment of the innovation performance of EU Member States. The 2007 EIS includes innovation indicators and trend analyses for the EU-27 Member States as well as for Croatia, Turkey, Iceland, Norway, Switzerland, Japan, the USA, Australia, Canada and Israel.

The methodology for the 2007 EIS remains largely the same as that used in 2006, although a more robust analysis of country groupings has been added. For the first time, Australia, Canada and Israel were included as these countries provide interesting comparisons with EU Member States. The thematic reports that accompany the 2007 Scoreboard are on innovation in services, wider factors influencing innovation performance and on innovation efficiency. In addition, the 2007 EIS reflects on seven years' experience in comparing countries' innovation performance and where the main future challenges lie.

This report was prepared by the **M**aastricht **E**conomic and Social **R**esearch and Training Centre on Innovation and Technology (UNU-MERIT) with the support of the European Commission's Joint Research Centre (Institute for the Protection and Security of the Citizen).

The Annex includes tables with definitions as well as comprehensive data sheets for every country. The EIS report and its annexes, accompanying thematic papers and the indicators' database are available at: http://www.proinno-europe.eu/

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 a 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 in order to be patented. On the basis of this assumption, Eurostat collects patent statistics to build up indicators of R&D output.

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

Since 2005 Eurostat has produced patent statistics using the priority year of the application and not, as previously, the year of filing. However, the data values are similar. These data are in general less extensive than the data released by Eurostat before 2005. This is because Eurostat takes into consideration all PCT applications filed with the EPO (i.e. applications made in accordance with the procedure under the Patent Cooperation Treaty), whereas the OECD data sets do so only in part. The data produced provide a better indication of the innovation and R&D performance of an economy.

Since 2004 the interinstitutional Patent Statistics Task Force has developed the concept of a worldwide patent statistics database (PATSTAT). PATSTAT has to be understood as a single patent statistics raw 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 fulfil the user needs of the various international organisations which will use this raw database for production. Designed to be sustainable over time, PATSTAT — which has been operational since 2006 — concentrates on raw data, leaving the 'production' of indicators mainly to PATSTAT users, such as the OECD, Eurostat and others.

At the end of 2007 the patent data will be updated in Eurostat's reference database, with data entirely based on PATSTAT but following a slightly different methodology compared to the data shown in this Statistical Book. This new methodology, which is also used by the OECD, includes only EPO patent applications to the EPO (EPO direct) and PCT patent applications designating the EPO as the receiving office that was involved in the regional phase. The PCT patent applications which are in the international phase are no longer taken into account at this stage. This is because they were already included in the calculations of the indicators in the previous years, and so the new figures are lower than the data shown before. For all further details, please see the Eurostat metadata on patent statistics posted on the webpage.

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. Owing to methodological differences in the manner of processing the data, no cross-comparisons are advisable between the EPO, USPTO and patent family data. Methodological issues specific to each type of data are explained below.

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 Cooperation Treaty (PCT) and designating the EPO (Euro-PCT) for protection. The regional (national) distribution of patent applications is based on 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 1993 to 2003; 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:

http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL under Science and Technology/Patent statistics/Patent applications to EPO by priority year.

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 from the EPO. Data in these two collections are therefore not comparable.
USPTO data are available from 1989 to 2000; 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:
http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL under Science and Technology/Patent statistics/Patents granted by the USPTO by priority year.

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 grouped together in 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 removed; the patents are more homogeneous in terms of their value).
Data on triadic patent families are presented by priority year, i.e. the year of the first international filing of a patent. This compounds the disadvantage of traditional patent counts as regards timeliness, and therefore the latest available data refer to 2000 only.
For further methodological notes please refer to: OECD triadic patent families, OECD, 2004.
Metadata are available in Eurostat's reference database NewCronos:
http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL under Science and Technology Patent statistics/Triadic patent families by earliest priority year.

Patent Cooperation Treaty

The Patent Cooperation Treaty (PCT) makes it possible 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 both of these 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 twelfth.

Costs — mainly translation costs — are one of the problems of patent applications to the EPO. 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 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 an example a patent with three inventors (one French resident, one German resident and one American resident) and two applicants (one German resident and one American resident). Combining the resident countries of inventors and applicants there are six partnerships, of which four are foreign, because they involve two different resident countries, 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

B 22 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: (http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136250,0_45572555&_dad=portal&_schema=PORTAL) under Science and Technology/Patent statistics.

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 6.6 in Chapter 6 of this publication shows patents by NACE sectors. The table below gives the correspondence between these NACE sectors and the divisions of the International Standard Industrial Classification (ISIC). ISIC codes are currently used at world-wide level, whereas the NACE codes are used at EU level.

NACE Rev. 1.1		ISIC Rev. 3.1	
DA	Manufacture of food products, beverages and tobacco	D 15 D 16	Manufacture of food products and beverages Manufacture of tobacco products
DB	Manufacture of textiles and textile products	D 17 D 18	Manufacture of textiles 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 D 22	Manufacture of paper and paper products 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 D 28	Manufacture of basic metals Manufacture of fabricated metal products, except machinery and equipment
DK	Manufacture of machinery and equipment n.e.c.	D 29	Manufacture of machinery and equipment n.e.c.
DL	Manufacture of electrical and optical equipment	D 30 D 31 D 32	Manufacture of office, accounting and computing machinery Manufacture of electrical machinery and apparatus n.e.c. Manufacture of radio, television and communication equipment and apparatus
DM	Manufacture of transport equipment	D 34 D 35	Manufacture of motor vehicles, trailers and semi-trailers Manufacture of other transport equipment
DN	Manufacturing n.e.c.	D 36 D 37	Manufacture of furniture; manufacturing n.e.c. 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 services

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-27 Member States, candidate countries, Norway and Switzerland at 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).

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 refers 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 in all tangible goods during the reference period. 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 buy-outs, 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 accordance with the European System of National and Regional Accounts in the Community (ESA 95).

The data cover EU-15, EU-27 Member States (except for Bulgaria, Estonia, Cyprus, Latvia, Lithuania, Luxembourg, Malta and Romania), 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 Rev. 3) using data from COMEXT and from COMTRADE databases.

These data are available for EU-27 Member States, candidate countries, Iceland, Norway, Switzerland, China, 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 Rev. 3 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

The EU totals reported include only extra-EU trade (i.e. they exclude intra-EU trade). This makes it possible to consider the EU as an entity and compare it with other countries. Nevertheless, figures for the individual EU Member States include intra-EU trade.

It should also be noted that these high-tech exports include re-exported imports. That means some countries might show large figures because a large number of goods pass through the country and are counted as both imports and exports.

The indicator 'exports/imports of high-tech products as a percentage of total' is calculated as share of exports/imports of high-technology products from a country (entity) in total exports/imports from such country (entity).

The world market share is a ratio in which the nominator is the sum of the total exports/imports of high-tech products from countries (entities). The denominator is calculated as the sum of high-tech exports from all countries/entities in the world. This means that the denominator for world market shares when counting the EU as an entity is lower as it excludes intra-EU trade. As data originate from two different sources with partly different methodologies, analysis should be done with caution.

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-27 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).

Employed people are defined as persons aged 15 years and over who performed work during the reference week, even for just one hour a 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 and training. In the present case and for data quality reasons, the population excludes anyone below the age of 15 or over the age of 74 from the figures.

2.7 The 2007 EU industrial R&D investment scoreboard

The 2007 EU industrial R&D investment scoreboard was 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 2 000 top companies. The Scoreboard was compiled from companies' annual reports and accounts with the reference date being 1st August of each year. In order to maximise completeness and avoid double counting, the consolidated group accounts of the ultimate parent company are used. Companies which are subsidiaries of another company are not listed separately. Where consolidated group accounts of the ultimate parent company are not available, however, subsidiaries are included.

Definitions of indicators

1. **Research and Development (R&D) investment** 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 any associated company or joint venture R&D investment. 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' and is based on the OECD *Frascati Manual*.

Research is defined as original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding. Expenditure on research is recognised as an expense when it is incurred.

Development is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use. Development costs are capitalised when they meet certain criteria and when it can be demonstrated that the asset will generate probable future economic benefits. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

2. **Sales** follow 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. **R&D intensity** is the ratio between R&D investment and net sales of a given company or group of companies. At the aggregate level, R&D intensity is calculated only by those companies for which data exist for both R&D and net sales in the specified year. The calculation of R&D intensity in the Scoreboard is different from that in official statistics, e.g. BERD, where R&D intensity is based on value added instead of net sales.

4. **Operating profit** is calculated as profit (or loss) before taxation, plus net interest cost (or minus net interest income) and government grants, less gains (or plus losses) arising from the sale/disposal of businesses or fixed assets.

5. **One-year growth** is simple growth over the previous year, expressed as a percentage: 1yr growth = 100*((C/B)-1); where C = current year amount, and B = previous year amount. 1yr growth is calculated only if data exist for both the current and previous year. At the aggregate level, 1yr growth is calculated by aggregating only those companies for which data exist for both the current and previous year.

6. **Three-year growth** is the compound annual growth over the previous three years, expressed as a percentage: 3yr growth = 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). 3yr growth is calculated only if data exist for the current and base years. At the aggregate level, 3yr growth is calculated by aggregating only those companies for which data exist for the current and base years.

7. **Capital expenditure (Capex)** is expenditure used by a company to acquire or upgrade physical assets such as equipment, property, industrial buildings. In accounts, capital expenditure is added to an asset account (i.e. capitalised), thus increasing the asset's base. It is disclosed in accounts as additions to tangible fixed assets.

8. Number of **employees** is the total consolidated average of employees or year-end employees if the average is not stated.

9. **R&D per employee** is the simple ratio of R&D investment over employees. At the aggregate level, R&D per employee and the other non-growth statistics are calculated by aggregating only those companies for which data exist for both the numerator and the denominator.

10. **R&D employees** is the number of employees engaged in R&D activities as stated in the annual report.

11. **Market capitalisation** is the share price multiplied by the number of shares issued at a given date. Market capitalisation data have been extracted from both the Financial Times London Share Service and Reuters. These reflect the market capitalisation of each company at the close of trading on 4 August 2006. 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.

12. **Market Spread** details sales by destination, distinguishing between Europe, North America (USA and Canada) and the Rest of the World. The definition of Europe is subject to the definitions adopted by the individual companies. In cases in which companies have defined a market spread area as EMEA (Europe, Middle East, Africa), this has been allocated to Europe. When a company has not clearly disclosed the turnover region North America but Americas, this has been allocated to North America.

13. **Industry sectors** are based on the ICB Industry Classification System. The level of disaggregation is generally the three-digit level unless indicated otherwise.

More information is available at http://iri.jrc.es/research/scoreboard_2007.htm .

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