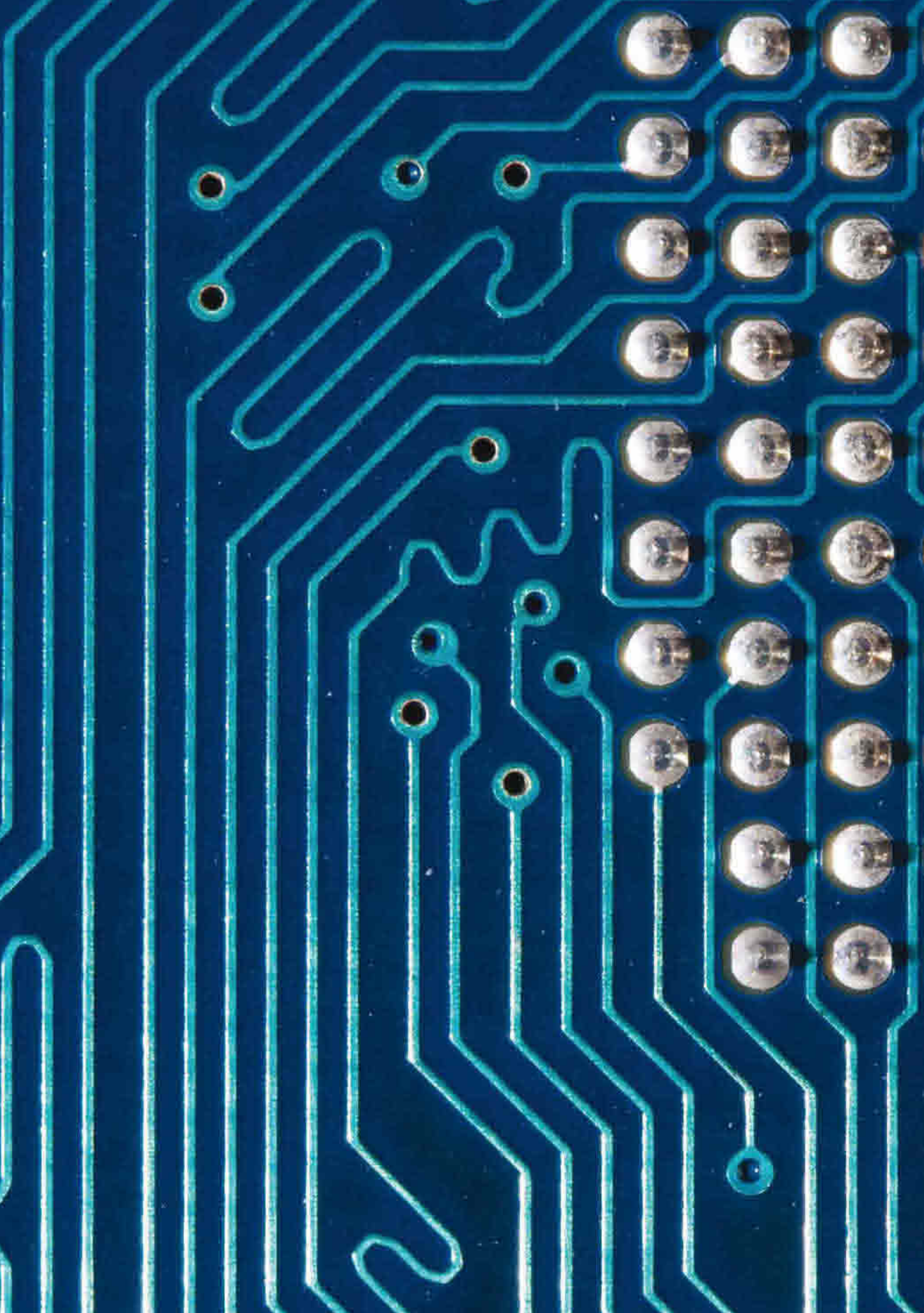


Science and technology 13

Science is part of almost every aspect of our lives: at the flick of a switch, we have light; when we are ill, medicines help us get better; when we want to talk to a friend we just pick up the telephone or send a text message or e-mail. Europe has a long tradition of excellence in research and innovation, having been the birthplace of the industrial revolution. Today, the European Union (EU) is a world leader in a range of cutting-edge industrial sectors – for example, biotechnology, pharmaceuticals, telecommunications or aerospace.

Research and development (R & D) is often considered as one of the driving forces behind growth and job creation. However, its influence extends well beyond the economic sphere, as it can potentially resolve environmental or international security threats, ensure safer food, or lead to the development of new medicines to fight illness and disease.

Since their launch in 1984, the EU's framework programmes for research have played a leading role in multidisciplinary research activities. The seventh framework programme for research and technological development (FP7) is the EU's main instrument for funding research in Europe; it runs from 2007 to 2013 and has a total budget of EUR 50 521 million, with an additional EUR 2 751 for 2007-2011 for nuclear research and training activities to be carried out under the Euratom treaty. This money is generally intended to finance grants to research actors all over Europe, usually through co-financing research, technological development and demonstration projects. FP7 is made up of four broad programmes – cooperation (collaborative research), ideas (the European Research Council), people (human potential) and capacities (research capacity). Through these programmes, FP7 aims to create European 'poles of excellence' across a wide array of scientific themes, such as information technologies, energy and climate change, health, food, and social sciences. FP7 also foresees direct research at the European Commission‘s own research institute (the Joint Research Centre (JRC)), whose activities are divided into 17 policy agendas, with an emphasis on understanding the relationship between the environment and health, internal and external security, and support for Europe’s 2020 economic strategy.

The European Research Area (ERA) was launched at the Lisbon European Council in March 2000. ERA aims to ensure open and transparent trade in scientific and technical skills, ideas and know-how. Europe’s research efforts are often described as being fragmented along national and institutional lines. Indeed, entire Member States may find it difficult to play a leading role in important areas of scientific and technological advance as research is increasingly complex, interdisciplinary and expensive.

ERA was given new impetus in April 2007 with the European Commission’s Green paper on the European research area: new perspectives. In May 2008 the ERA was re-launched as part of what has become known as the Ljubljana process, including specific initiatives for five different areas: researchers’ careers and mobility; research infrastructures; knowledge sharing; research programmes; and international science and technology cooperation. As a result, in the years through to 2020 the ERA will aim to establish a single European labour market for researchers, as well as single markets for knowledge and for innovative goods and services. Furthermore, the ERA should: encourage trust and dialogue between society and the scientific and technological community; benefit from a strong publicly-supported research and technology base and world-class research infrastructures and capacities across Europe; provide for the joint design of research, education and innovation policies; address major challenges through strategic partnerships; and enable Europe to speak with one voice to its main international partners.

International cooperation forms an integral part of the EU’s scientific policy, which includes programmes to enhance Europe’s access to worldwide scientific expertise, attract top scientists to work in Europe, contribute to international responses to shared problems, and put research at the service of EU external and development policies. In December 2008, the competitiveness Council adopted a 2020 vision for the ERA, which foresees the introduction of a ‘fifth freedom’ for the EU’s internal market – namely, the free circulation of researchers, knowledge and technology.

In October 2010, the European Commission launched a Europe 2020 flagship initiative, titled ‘innovation union’ (COM(2010) 546 final) which sets out a strategic approach to a range of challenges like climate change, energy and food security, health and an ageing population. The proposals seek to use public sector intervention to stimulate the private sector and to remove bottlenecks which stop ideas reaching the market (such as access to finance, fragmented research systems and markets, under-use of public procurement for innovation, and speedingup harmonised standards and technical specifications).

Official European statistics on science and technology provide a leading example of cooperation activities between international statistical organisations. In the domain of R & D statistics a joint survey produced by the OECD and Eurostat has been introduced, which is based on the collection of information following guidelines laid out in the Frascati manual. As regards human capital, the OECD, UNESCO and Eurostat are working towards developing internationally comparable indicators on the careers and mobility of doctorate (PhD) holders. Within the domain of innovation statistics, Eurostat conducts a Community innovation survey, which is based on the guidelines laid out within the Oslo manual (jointly produced with other European Commission services and the OECD). Together with the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the OECD, Eurostat has worked towards the improvement of PATSTAT, a harmonised database covering EPO patent applications and USPTO patents granted.

13.1 R & D expenditure

Most European research is funded at the national level, by private and/or public sources. This subchapter presents data on R & D spending within the European Union (EU), according to the sector performing the research and according to the source of funds.

Framework programmes are the main instrument for funding R & D within the EU. The 7th framework programme (FP7) started in 2007 and is due to continue for a total of seven years. The European Research Area (ERA) is composed of all research and development activities, programmes and policies in Europe which involve a transnational perspective. In December 2008, the Competitiveness Council adopted a 2020 vision for the ERA, which foresees the introduction of a 'fifth freedom' – namely, the free circulation of researchers, knowledge and technology.

Main statistical findings

Gross domestic expenditure on R & D (GERD) stood at EUR 237 001 million in the EU-27 in 2008, which marked a 3.5 % increase on the level of GERD in 2007. The level of expenditure on R & D in the EU-27 was 87.6 % of that recorded by the United States, although slightly more than double the level of expenditure in Japan (in 2007) and considerably above R & D expenditre levels in the emerging economies – for example, EU-27 expenditure was 6.4 times as high as in China in 2007.

In order to make figures more comparable, GERD is often expressed relative to gross domestic product (GDP) – see Figure 13.1 – or in relation to population. The ratio of GERD to GDP increased marginally in the EU-27 during the period up to 2002 reaching a high of 1.87 %, before gradually declining through to 2005 (1.82 %), and climbing again to 1.90 % by 2008. Nevertheless, the EU-27's R & D expenditure relative to GDP remains well below the corresponding shares recorded in Japan (3.44 % in 2007) and the United States (2.76 % in 2008); this pattern has existed for a lengthy period. There was a far higher increase in the relative importance of GERD in the Japanese economy, as its share of GDP rose by 0.44 percentage points during the period 1998 to 2007; note however that Japanese economic growth was also subdued during this period.

One of the key objectives of the EU during the last decade has been to encourage increasing levels of investment, in order to provide a stimulus to the EU's competitiveness. At the Barcelona Council in 2002, the EU agreed to a target of spending at least 3 % of gross domestic product (GDP) on research by 2010, of which two thirds was to be financed by the business sector; most of the EU Member States specified their own targets in national reform programmes. Using this measure, the highest R & D intensity was recorded in Sweden (3.75 % in 2008) and Finland (3.73 %) – see Table 13.1. While none of the other Member States reported GERD rising above 3 % of GDP at a national level, R & D intensity also rose to relatively high levels in a number of regions clustered in southern Germany (motor vehicles), through Switzerland into France (chemicals and pharmaceuticals) and on towards the Pyrenees (aerospace); regions containing capital cities also tended to report relatively high levels of R & D intensity. In contrast, there were nine Member States that reported R & D expenditure accounting for less than 1 % of their GDP in 2008 (Greece, data for 2007), with Bulgaria, Cyprus and Slovakia below 0.5 %. The regions with the lowest R & D intensity were generally those found in southern and eastern Europe.

The differences in the relative importance of R & D expenditure between countries are often explained by referring to levels of expenditure within the business enterprise sector. Table 13.2 shows that the share of R & D conducted within the business enterprise sector was equivalent to 1.21 % of the EU-27's GDP in 2008, compared with 2.68 % in Japan (2007) and 2.00 % in the United States, while the relative importance of R & D expenditure in the government and higher education sector was broadly similar across all three members of the Triad. An evaluation of the data for the Member States also confirms that those countries – namely, Sweden, Finland, Denmark, Austria and Germany – with relatively high shares of business enterprise R & D also reported relatively high levels of total GERD. These countries also tended to feature near the top-end of the rankings of expenditure by government and higher education sectors, where they were joined by the Czech Republic and France, as well as Slovenia for expenditure within the government sector.

A breakdown of R & D expenditure by source of funds shows that more than half (55.0 %) of the total expenditure in 2008 within the EU-27 came from business enterprises, while just over one third (33.5 %) was from government, and a further 8.9 % from abroad; business-funded R & D accounted for 77.7 % of total R & D expenditure in Japan (2007) and 67.3 % in the United States (2007). Table 13.3 confirms the relatively important role played by the business enterprise sector as a source of R & D funding in Luxembourg, Finland, Germany, Denmark and Sweden. In contrast, a majority of the gross expenditure on R & D made in 2008 in Romania, Cyprus (2007), Poland, Bulgaria (2007), Lithuania, Slovakia and Estonia was funded by the government sector. There were also considerable differences in the source of R & D funding from abroad, with relatively high shares (in excess of 15 % of total GERD) reported in the Baltic Member States, Ireland, Malta, Austria and the United Kingdom.

Data sources and availability

Statistics on science, technology and innovation (STI statistics) are based on Decision 1608/2003/ECconcerning the production and development of Community statistics on science and technology. In close cooperation with the Member States, this Decision was implemented by Eurostat in the form of legislative measures and through additional work. Regulation 753/2004 was adopted in 2004 implementing Decision 1608/2003/EC.

Eurostat's statistics on R & D expenditure are compiled using guidelines laid out in the Frascati manual, published in 2002 by the OECD. R & D expenditure is a basic measure that covers intramural expenditure, in other words, all expenditures for R & D that are performed within a statistical unit or sector of the economy.

The main breakdown of R & D statistics is by four institutional sectors of performance. These four sectors are the business enterprise sector, the government sector, the higher education sector, and the private non-profit sector (the latter is not shown in this subchapter). Gross domestic expenditure on R & D (GERD) is composed of expenditure from each of these four sectors. Expenditure data considers the research spend on the national territory, regardless of the source of funds; data are usually expressed in relation to GDP, otherwise known as R & D intensity. Additional breakdowns of R & D expenditure are available by: source of funds; field of science; type of costs; economic activity (NACE); enterprise size class; type of R & D; socio-economic objectives; and regions (NUTS).

The European Commission develops three levels of indicators to support research and innovation policymaking. These indicators are generally grouped together as: headline indicators; core indicators; and comprehensive indicators. Within the headline indicators – also referred to as Europe 2020 strategy indicators – is the measure of research intensity (with a 3 % target for investment in research across the EU). The core indicators are designed to monitor research and innovation for the Competitiveness Council, while the comprehensive indicators are for analytical purposes and Commission services to produce a science, technology and competitiveness report.

Context

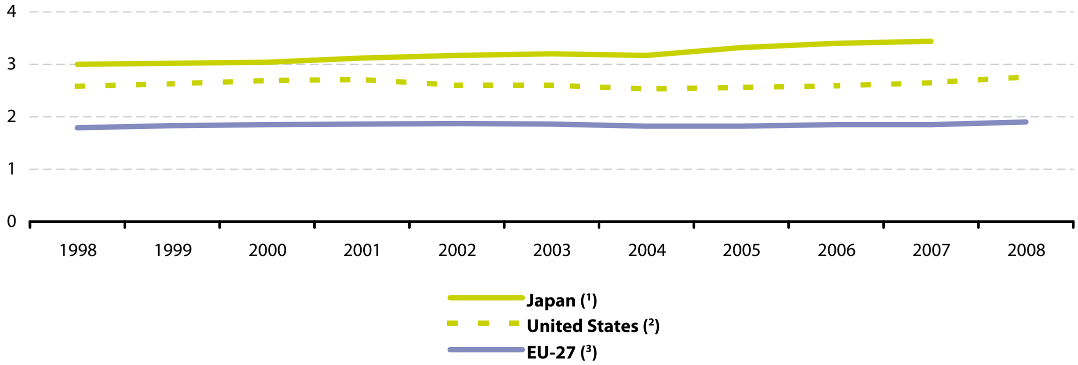
The European Commission has through its Europe 2020 flagship initiative, titled 'innovation union', placed renewed emphasis on the conversion of Europe's scientific expertise into marketable products and services, through seeking to use public sector intervention to stimulate the private sector and to remove bottlenecks which stop such ideas reaching the market. Furthermore, the latest revision of the integrated economic and employment guidelines (revised as part of the Europe 2020 strategy for smart, sustainable and inclusive growth) includes a guideline to optimise support for R & D and innovation, strengthening the knowledge triangle and unleashing the potential of the digital economy. Additional information about the Europe 2020 strategy can be found on the Europe 2020 website.

One area that has received considerable attention in recent years is the structural difference in R & D funding between Europe and its main competitors. Policymakers in Europe have tried to increase R & D business expenditure so that it is more in line with relative contributions observed in Japan or the United States. The European Research Area (ERA) is designed to overcome some of these barriers that are thought to have hampered European research efforts, for example, by addressing geographical, institutional, disciplinary and sectoral boundaries.

One specific area where studies have already been conducted in respect to business enterprises' investment is a November 2009 report, titled the EU's industrial R & D investment scoreboard. This presents information on the top 1 000 research investors whose registered offices are in the EU and the top 1 000 investors registered elsewhere. The report shows that R & D investment by these EU investors grew by 8.1 % in 2008 despite the economic crisis that took hold in the second half of the year. This rate of growth was faster than that recorded for investors from either Japan or the United States, although higher R & D investment growth was registered by investors based in the emerging economies of China and India. Volkswagen and Nokia were among the global top ten, which was led by Toyota Motors (Japan) and Microsoft (the United States).

In December 2008, the Competitiveness Council adopted a 2020 vision for the ERA. According to the opening statement of this vision, all players should benefit from: the 'fifth freedom', introducing the free circulation of researchers, knowledge and technology across the ERA; attractive conditions for carrying out research and investing in R & D intensive sectors; Europe-wide scientific competition, together with the appropriate level of cooperation and coordination. The 2020 vision for the ERA is part of the wider picture of Europe's 2020 strategy for smart, sustainable and inclusive growth. As part of the Europe 2020 strategy, the European Commission announced in July 2010 nearly EUR 6 400 million of investment in research and innovation, with the aim of providing an economic stimulus expected to create more than 165 000 jobs.

Figure 13.1: Gross domestic expenditure on R&D in the Triad
(% share of GDP)



(1) Not available, 2008.
(2) Excludes most or all capital expenditure.
(3) Estimates.

Source: Eurostat (tsc00001), OECD

Table 13.1: Gross domestic expenditure on R&D
(% share of GDP)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
EU-27	*1.79*	*1.83*	*1.85*	*1.86*	*1.87*	*1.86*	*1.82*	*1.82*	*1.85*	*1.85*	*1.90*
Euro area (EA-16)	:	*1.82*	*1.84*	*1.85*	*1.87*	*1.86*	*1.84*	*1.84*	*1.86*	*1.87*	*1.91*
Belgium	1.86	1.94	1.97	2.07	1.94	1.88	1.86	1.83	1.86	1.90	*1.92*
Bulgaria (1)	0.57	0.57	0.52	0.47	0.49	0.50	0.50	0.49	0.48	0.48	*0.49*
Czech Republic	1.15	1.14	1.21	1.20	1.20	1.25	1.25	1.41	1.55	1.54	1.47
Denmark (2)	2.04	2.18	2.24	2.39	2.51	2.58	2.48	2.46	2.48	2.55	*2.72*
Germany	2.27	2.40	2.45	2.46	2.49	2.52	2.49	2.49	2.53	2.53	*2.63*
Estonia	0.57	0.68	0.60	0.70	0.72	0.77	0.85	0.93	1.14	1.11	*1.29*
Ireland	1.24	*1.18*	1.12	1.10	1.10	1.17	1.23	1.25	1.25	*1.28*	*1.43*
Greece	:	0.60	:	0.58	:	0.57	*0.55*	0.59	*0.58*	*0.58*	:
Spain	0.87	0.86	0.91	0.91	0.99	1.05	1.06	1.12	1.20	1.27	1.35
France (3)	2.14	2.16	2.15	2.20	2.23	2.17	2.15	2.10	2.10	*2.04*	*2.02*
Italy	1.05	1.02	1.05	1.09	1.13	1.11	1.10	1.09	1.13	1.18	*1.18*
Cyprus	0.22	0.23	0.24	0.25	0.30	0.35	0.37	0.40	0.43	0.44	*0.46*
Latvia	0.40	0.36	0.44	0.41	0.42	0.38	0.42	0.56	0.70	0.59	0.61
Lithuania	0.54	0.50	0.59	0.67	0.66	0.67	0.75	0.75	0.79	0.81	0.80
Luxembourg	:	:	1.65	:	:	1.65	1.63	1.56	1.65	1.58	*1.62*
Hungary (4)	0.66	0.67	0.79	0.92	1.00	0.93	0.87	0.94	1.00	0.97	1.00
Malta (4)	:	:	:	:	0.26	0.26	0.53	0.57	0.61	*0.58*	*0.54*
Netherlands (1)	1.90	1.96	1.82	1.80	1.72	1.76	1.81	*1.79*	*1.78*	*1.71*	*1.63*
Austria	1.78	*1.90*	*1.94*	*2.07*	2.14	*2.26*	2.26	*2.45*	2.47	2.54	*2.67*
Poland	0.67	0.69	0.64	0.62	0.56	0.54	0.56	0.57	0.56	0.57	*0.61*
Portugal	0.65	0.71	*0.76*	0.80	*0.76*	0.74	*0.77*	0.81	*1.02*	1.21	*1.51*
Romania	0.49	0.40	0.37	0.39	0.38	0.39	0.39	0.41	0.45	0.52	0.58
Slovenia	1.34	1.37	1.39	1.50	1.47	1.27	1.40	1.44	1.56	1.45	1.66
Slovakia	0.78	0.66	0.65	0.63	0.57	0.57	0.51	0.51	0.49	0.46	0.47
Finland	2.88	3.17	3.35	3.32	3.37	3.44	3.45	3.48	3.48	3.48	3.73
Sweden (5)	:	3.61	:	4.17	:	3.85	3.62	3.60	3.74	3.61	*3.75*
United Kingdom	1.76	1.82	1.81	1.79	1.79	1.75	1.68	1.73	1.75	1.82	*1.88*
Iceland	2.00	2.30	*2.67*	2.95	*2.95*	2.82	:	2.77	2.99	2.70	2.65
Norway	:	1.64	:	1.59	1.66	1.71	1.59	1.52	1.52	1.65	*1.62*
Switzerland	:	:	2.53	:	:	:	2.90	:	:	:	:
Croatia	:	:	:	:	0.96	0.97	1.05	0.87	0.76	0.81	0.90
Turkey	0.37	0.47	0.48	0.54	0.53	0.48	0.52	0.59	0.58	0.72	:
Japan	3.00	3.02	3.04	3.12	3.17	3.20	3.17	3.32	3.40	3.44	:
United States	2.58	2.63	2.69	2.71	2.60	2.60	2.53	2.56	2.59	2.65	*2.76*

(1) Break in series, 1999.
(2) Break in series, 2007.
(3) Break in series, 2000 and 2004.
(4) Break in series, 2004.
(5) Break in series, 2005.

Source: Eurostat (tsiir020), OECD

Table 13.2: Gross domestic expenditure on R&D by sector
(% share of GDP)

	Business enterprise sector		Government sector		Higher education sector	
	2003	2008	2003	2008	2003	2008
EU-27	*1.19*	*1.21*	*0.24*	*0.24*	*0.41*	*0.43*
Euro area (EA-16)	*1.18*	*1.22*	*0.26*	*0.26*	*0.40*	*0.41*
Belgium	1.31	*1.32*	0.13	*0.17*	0.42	*0.41*
Bulgaria	0.10	*0.15*	0.35	*0.28*	0.05	*0.05*
Czech Republic	0.76	0.91	0.29	0.31	0.19	0.25
Denmark (1)	1.78	*1.91*	0.18	*0.09*	0.60	*0.71*
Germany	1.76	*1.84*	0.34	*0.36*	0.43	*0.43*
Estonia	0.26	*0.56*	0.12	0.15	0.36	0.56
Ireland	0.79	*0.93*	0.09	*0.11*	0.29	*0.39*
Greece	0.18	:	0.12	:	0.26	:
Spain	0.57	0.74	0.16	0.25	0.32	0.36
France (2)(3)	1.36	*1.27*	0.36	*0.32*	0.42	*0.40*
Italy (4)	0.52	*0.60*	0.19	0.16	0.37	0.39
Cyprus	0.07	*0.10*	0.13	*0.10*	0.11	*0.21*
Latvia	0.13	0.15	0.09	0.17	0.16	0.29
Lithuania	0.14	0.19	0.18	0.19	0.35	0.43
Luxembourg	1.47	*1.32*	0.17	*0.25*	*0.01*	*0.05*
Hungary (5)	0.34	*0.53*	0.29	0.23	0.25	0.22
Malta (6)	0.08	*0.35*	0.02	*0.01*	0.16	*0.17*
Netherlands (3)	1.01	*0.89*	0.26	*0.21*	0.49	*0.52*
Austria	:	*1.88*	:	*0.14*	:	*0.64*
Poland	0.15	*0.19*	0.22	*0.21*	0.17	*0.20*
Portugal	0.24	*0.76*	0.12	*0.12*	0.28	*0.51*
Romania	0.22	0.17	0.12	0.24	0.04	0.17
Slovenia	0.81	1.07	0.28	0.36	0.17	0.22
Slovakia	0.32	0.20	0.18	0.15	0.08	0.11
Finland	2.43	2.77	0.33	0.30	0.66	0.64
Sweden (7)	2.86	*2.78*	0.13	*0.17*	0.84	*0.80*
United Kingdom	1.11	*1.21*	0.18	*0.16*	0.42	*0.47*
Iceland	1.46	1.45	0.70	0.47	0.60	*0.67*
Norway (8)	0.98	*0.87*	0.26	*0.24*	0.47	*0.51*
Switzerland	:	:	:	0.02	:	:
Croatia	0.38	0.40	0.21	0.23	0.38	0.27
Turkey	0.11	:	0.05	:	0.32	:
Japan	2.40	:	0.30	:	0.44	:
United States	1.80	2.00	0.32	*0.29*	0.36	*0.35*

(1) Break in series, 2007.
(2) Break in series, business enterprise sector, 2006.
(3) Break in series, higher education sector, 2004.
(4) Break in series, higher education sector, 2005.
(5) Break in series, government sector, 2004.
(6) Break in series, business enterprise sector, 2004.
(7) Break in series, business enterprise sector and government sector, 2005.
(8) Break in series, government sector and higher education sector, 2007.

Source: Eurostat (tsc00001), OECD

Table 13.3: Gross domestic expenditure on R&D by source of funds
(% of total gross expenditure on R&D)

	Business enterprises		Government		Abroad	
	2003	2008	2003	2008	2003	2008
EU-27	*54.1*	*55.0*	*35.1*	*33.5*	*8.6*	*8.9*
Euro area (EA-16)	*55.9*	*56.3*	*36.4*	*34.7*	*6.3*	*7.2*
Belgium (1)	60.3	61.4	23.5	22.2	12.9	13.0
Bulgaria (1)	26.8	34.2	66.9	56.7	5.8	7.6
Czech Republic	51.4	52.2	41.8	41.3	4.6	5.3
Denmark (2)	59.9	*61.1*	27.1	*25.3*	10.3	*9.7*
Germany (1)	66.3	67.9	31.2	27.7	2.3	4.0
Estonia	32.9	*33.6*	48.6	*50.0*	15.2	*15.5*
Ireland	60.3	*49.6*	29.8	*32.2*	8.3	*15.9*
Greece	28.2	:	46.4	:	21.6	:
Spain (1)	48.4	45.5	40.1	43.7	5.7	7.0
France (3)	50.8	50.5	39.0	39.4	8.4	8.0
Italy (1)(4)	39.7	42.0	50.7	44.3	8.0	9.5
Cyprus (1)	19.9	16.4	60.1	64.6	13.9	14.5
Latvia	33.2	27.0	46.4	47.3	20.4	23.1
Lithuania	16.7	21.4	64.6	55.6	13.8	15.5
Luxembourg (1)	80.4	76.0	11.2	18.2	8.3	5.7
Hungary	30.7	48.3	58.0	41.8	10.7	9.3
Malta (5)	21.6	*50.8*	59.8	*28.1*	18.6	*21.0*
Netherlands	51.1	:	36.2	:	11.3	:
Austria	*45.1*	*46.3*	*34.4*	*37.2*	*20.0*	*16.1*
Poland	30.3	*30.5*	62.7	*59.8*	4.6	*5.4*
Portugal (1)	31.7	47.0	60.1	44.6	5.0	5.4
Romania	45.4	23.3	47.6	70.1	5.5	4.0
Slovenia	52.2	62.8	37.5	31.3	9.9	5.6
Slovakia	45.1	34.7	50.8	52.3	3.3	12.3
Finland (6)	70.0	70.3	25.7	21.8	3.1	6.6
Sweden (1)(6)	65.1	64.0	24.3	22.2	7.3	9.3
United Kingdom	42.2	*47.2*	31.7	*29.5*	20.3	*17.6*
Iceland	43.9	50.4	40.1	38.8	14.5	10.0
Norway (1)	49.2	45.3	41.9	44.9	7.4	8.3
Croatia	42.0	40.8	55.9	49.3	2.2	7.9
Turkey (1)	36.2	48.4	57.0	47.1	1.6	0.5
Japan (1)	74.6	77.7	18.0	15.6	0.3	0.3
United States	64.3	*67.3*	30.0	*27.0*	:	:

(1) 2007 instead of 2008.
(2) Break in series, 2007.
(3) Break in series, 2004.
(4) 2005 instead of 2003.
(5) 2002 instead of 2003.
(6) Break in series, 2005.

Source: Eurostat (tsiir030), OECD

13.2 R & D personnel

This subchapter analyses data on research and development (R & D) personnel and human resources in science and technology in the European Union (EU). Statistics on human resources in science and technology are a key indicator for measuring the knowledge-based economy and how it is developing. They show the supply of, and demand for highly qualified science and technology specialists.

Main statistical findings

R & D personnel

The number of researchers in the EU-27 has increased in recent years. There were 1.5 million researchers (full-time equivalents (FTE)) employed in the EU-27 in 2008 (see Table 13.4), which marked an increase of almost 386 000 (or 34.5 %) when compared with 2000.

A breakdown of R & D personnel in the EU-27 by institutional sector in 2008 shows that close to half (46 %) were concentrated in the business enterprise sector, while two fifths (40 %) were in the higher education sector and 13 % in the government sector. The relative importance of the different institutional sectors varied considerably across the Member States, with business enterprises accounting for more two thirds of all researchers in Sweden and Luxembourg. Bulgaria was the only country to report a majority (56 %) of its researchers employed within the government sector, while more than three fifths of all researchers working in Latvia, Lithuania, Poland and Slovakia were employed within the higher education sector.

R & D personnel from all sectors together made up more than 2 % of the labour force in Luxembourg and Finland in 2008. Aside from these two Member States, this share ranged from less than 0.5 % in Romania, Cyprus, Poland and Bulgaria to just over 1.5 % in Denmark and Sweden, with the EU-27 average estimated around 1.0 %. A gender breakdown shows that men accounted for 71 % of the EU-27's workforce of researchers in 2007; there was almost no change in the relative balance between male and female researchers during the period 2000-2007.

Human resources in science and technology

Human resources in science and technology (HRST) provide a broad measure of the supply of, and demand for, people highly qualified in science and technology. Some 65.1 million people were employed in the EU-27 within science and technology occupations in 2007; this amounted to 29.8 % of total employment. Between 2005 and 2007 there was a modest increase in the relative importance of HRST within the EU-27 workforce, as their share rose by 0.6 percentage points. The HRST 'core' – made up of people within science and technology occupations with a tertiary level education (for example, university graduates) – amounted to 37.4 million persons in 2007 (or 17.1 % of the total number of persons employed).

Persons in HRST occupations accounted for just over 40 % of the workforce in Luxembourg in 2008 and close to this share in Denmark and Sweden (2007). The lowest shares were recorded in Portugal and Romania which were below half this level; in other words persons in HRST occupations accounted for less than one fifth of total employment. Concerning core HRST, in other words persons simultaneously in HRST occupations and having completed a tertiary level of education, the range between countries was greater still: in Portugal some 11.5 % of total employment was core HRST in 2008, while at the other end of the scale the share rose to 27.9 % in Luxembourg (see Table 13.5).

Within the EU-27 there were 13.9 graduates in mathematics, science and technology fields of education per 1 000 persons aged 20 to 29 years in 2008, with particularly high ratios in Finland, Portugal, France and Ireland. This ratio should be interpreted with care as some graduates may be foreigners who return home following their studies and so push up the ratio in the country where they studied and pull down the ratio in their country of origin; this may explain to a large extent the very low ratios recorded in the three smallest Member States.

A similar but more specific measure of a country's potential research capability is provided by the number of doctoral students. There were 525 800 doctoral students in the EU-27 in 2007, compared with levels of 460 800 in the United States and 75 000 in Japan (both 2008 data). In relative terms, the broad subject group of science, mathematics, computing, engineering, manufacturing and construction-related studies accounted for more than one third (36.4 %) of the doctoral students in the EU-27 in 2007, a proportion that was somewhat higher than in Japan (32.2 %) but lower than in the United States (38.2 %).

Women accounted for 47.8 % of doctoral students in the EU-27 in 2007 (see Table 13.7), a share that was not too dissimilar from that recorded in the United States, where women were in a slight majority (50.1 %) in 2008; in contrast, men accounted for a much higher share of doctoral students in Japan (69.2 %) in 2008. The gender split of doctoral students across the Member States was typically quite balanced in 2008: women accounted for more than half of all the doctoral students in the Baltic Member States, Portugal, Italy, Finland, Spain, Poland and Bulgaria, and at least 40 % of all doctoral students in the remaining Member States for which data are available, with the exception of Luxembourg and Malta.

Data sources and availability

Statistics on science, technology and innovation (STI statistics) are based on Decision 1608/2003/EC concerning the production and development of Community statistics on science and technology. In close cooperation with the Member States, this Decision was implemented by Eurostat in the form of legislative measures and through additional work. Regulation 753/2004 was adopted in 2004 implementing Decision 1608/2003/EC.

Statistics on R & D personnel are compiled using guidelines laid out in the Frascati manual, published in 2002 by the OECD. R & D personnel include all persons employed directly on R & D, as well as persons supplying direct services to R & D, such as managers, administrative staff and clerical staff. For statistical purposes, indicators on R & D personnel who are mainly or partly employed on R & D are compiled as head counts (HC) and as full-time equivalents (FTEs). Researchers are a sub-category of R & D personnel and are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

Statistics on HRST are compiled using guidelines laid out in the Canberra manual, prepared in cooperation between the OECD, European Commission, UNESCO and the International Labour Organization, and published in 1995. Human resources in science and technology (HRST) are defined on the basis of education and/or occupation. HRST based on education are persons having successfully completed tertiary education in one or more of seven broad fields: natural sciences, engineering and technology, medical sciences, agricultural sciences, social sciences, humanities, and other fields. HRST based on occupation are persons who are employed in science and technology occupations as professionals or technicians. Persons who fulfil both education and occupation criteria are classified as the HRST 'core'. Tertiary education is defined as levels 5a, 5b or 6 of the 1997 version of the International standard classification of education (ISCED). Science and technology occupations are covered by major groups 2 and 3 of the International standard classification of occupations (ISCO-88). HRST data can be broken down by gender, age, region, sector of activity, occupation, educational attainment and fields of education (although it should be noted that not all combinations are possible). Data relating to stocks of HRST provide information on the characteristics of the current labour force.

Information on HRST flows from education are obtained from a UNESCO/OECD/Eurostat questionnaire on education and this can be used to provide a measure of the current and future supply of HRST from the education system, in terms of actual inflows (graduates from the reference period) and potential inflows (students participating in higher education during the reference period). Science and technology graduates are defined as the number of new graduates from all public and private institutions completing science and technology-related graduate and post-graduate studies in the reference year; it is expressed relative to the total number of persons aged 20-29 years.

Indicators based on the number of doctoral students give an idea of the extent to which countries will have researchers at the highest level of education in the future. The data relate to the number of students in the reference year not to the number of new graduates nor to the total number (stock) of graduates in the labour market that year. The number of doctoral students is measured as students enrolled in ISCED level 6: this level concerns tertiary programmes which lead to the award of an advanced research degree, for example, a doctorate in economics. These programmes should be devoted to advanced study and original research and are not based on course-work alone; studies at the doctoral level usually require 3-5 years.

Context

The European Research Area (ERA) is composed of all research and development activities, programmes and policies in Europe which involve a transnational perspective. In May 2008, the European Commission adopted a Communication to launch an initiative titled, 'better careers and more mobility: a European partnership for researchers'. The goal of this initiative is to improve the mobility of researchers and to enhance the diffusion of knowledge throughout Europe, by: balancing demand and supply for researchers at a European level; helping create centres of excellence; and improving the skills of researchers in Europe.

In December 2008, the competitiveness Council adopted a 2020 vision for the ERA. According to the opening statement of the vision, all players should benefit from: the 'fifth freedom', introducing the free circulation of researchers, knowledge and technology across the ERA; attractive conditions for carrying out research and investing in R & D intensive sectors; Europe-wide scientific competition, together with the appropriate level of cooperation and coordination. The 2020 vision for the ERA is part of the wider picture of Europe's 2020 strategy for smart, sustainable and inclusive growth. As part of the Europe 2020 strategy, the European Commission announced in July 2010 nearly EUR 6 400 million of investment in research and innovation, with the aim of providing an economic stimulus expected to create more than 165 000 jobs.

In the seventh framework programme for research and technological development (FP7) the Marie Curie actions have been regrouped and reinforced within the specific programme titled people. Entirely dedicated to human resources in research, this programme has an overall budget of more than EUR 4 700 million over a seven-year period until 2013. Within this programme, efforts will also be made to increase participation by women researchers, by encouraging equal opportunities in all Marie Curie actions, by designing the actions to ensure that researchers can achieve an appropriate work/life balance and by facilitating resuming a research career after a break. A number of groups are actively promoting greater gender equality. Among others these include the European association for women in science, engineering and technology (WiTEC), and the European platform of women scientists (EPWS).

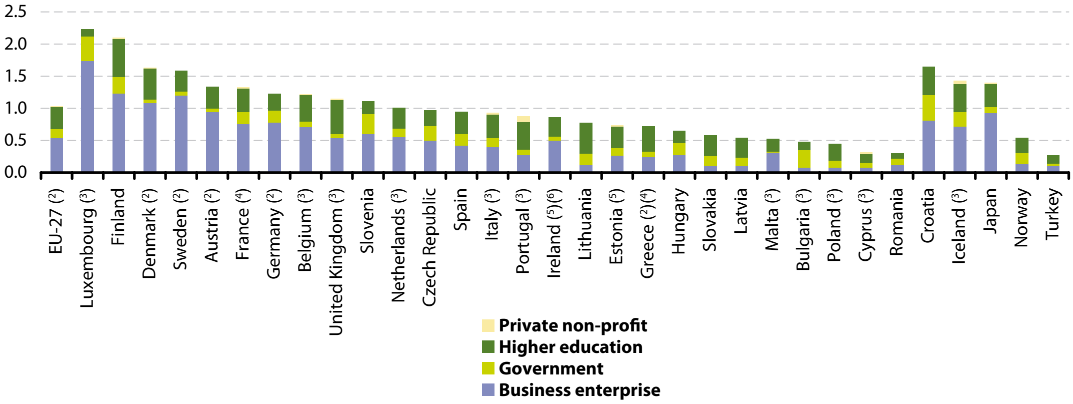
Table 13.4: Researchers, by institutional sector, 2008 (1)

	Total - all sectors	Business enterprise sector		Government sector		Higher education sector	
	(1 000 FTE)	(1 000 FTE)	(% of total)	(1 000 FTE)	(% of total)	(1 000 FTE)	(% of total)
EU-27	*1 504.6*	*689.9*	*46*	*188.4*	*13*	*608.6*	*40*
Euro area (EA-16)	*1 006.3*	*501.8*	*50*	*137.2*	*14*	*354.4*	*35*
Belgium	*36.4*	*17.8*	*49*	*2.7*	*7*	*15.6*	*43*
Bulgaria	*11.4*	*1.5*	*13*	*6.0*	*53*	*3.8*	*33*
Czech Republic	29.8	13.3	44	7.1	24	9.4	31
Denmark	*30.9*	*19.6*	*63*	*1.2*	*4*	*9.9*	*32*
Germany	*299.0*	*178.0*	*60*	*44.0*	*15*	*77.0*	*26*
Estonia	*4.0*	*1.2*	*31*	0.5	13	2.1	53
Ireland	13.7	*7.4*	*54*	0.6	5	*5.7*	*41*
Greece (2)	*20.8*	*6.1*	*29*	*2.2*	*11*	*12.4*	*59*
Spain	131.0	46.4	35	22.6	17	61.7	47
France (2)	215.8	118.6	55	26.5	12	67.4	31
Italy	*96.3*	*36.1*	*37*	*16.3*	*17*	39.8	41
Cyprus	*0.9*	*0.2*	*23*	*0.1*	*11*	*0.5*	*59*
Latvia	4.4	0.5	11	0.9	19	3.0	69
Lithuania	8.5	1.2	14	1.7	20	5.6	66
Luxembourg	*2.3*	*1.5*	*67*	*0.6*	*24*	*0.2*	*8*
Hungary	18.5	7.9	43	4.7	26	5.9	32
Malta	*0.5*	*0.2*	*48*	*0.0*	*4*	*0.3*	*49*
Netherlands	*51.1*	*26.6*	*52*	6.9	14	*17.5*	*34*
Austria	*34.4*	*21.8*	*63*	*1.5*	*4*	*11.0*	*32*
Poland	*61.8*	*8.9*	*14*	*12.9*	*21*	*39.9*	*65*
Portugal	*40.6*	*10.6*	*26*	*3.3*	*8*	*22.5*	*56*
Romania	19.4	6.3	33	6.2	32	6.8	35
Slovenia	7.0	3.1	43	2.2	31	1.8	26
Slovakia	12.6	1.6	13	2.9	23	8.1	64
Finland	40.9	24.1	59	4.5	11	11.8	29
Sweden	*48.2*	*33.4*	*69*	*1.8*	*4*	*12.9*	*27*
United Kingdom	*261.4*	*94.3*	*36*	*8.2*	*3*	*154.9*	*59*
Iceland	2.3	1.1	48	0.5	21	0.6	28
Norway (2)	24.8	12.4	50	3.9	16	8.5	34
Switzerland	:	:	:	0.5	:	:	:
Croatia	6.7	1.1	16	1.9	28	3.7	55
Turkey (2)	49.7	15.3	31	4.8	10	29.5	59
Japan (2)	710.0	483.7	68	32.7	5	185.2	26
United States (3)	*1 430.0*	1 140.0	80	:	:	:	:

(1) Shares do not sum to 100 % due to estimates, the exclusion of private non-profit sector data from the table and the conversion of data to a count in terms of FTE.
(2) 2007.
(3) 2006.

Source: Eurostat (tsc00004), OECD

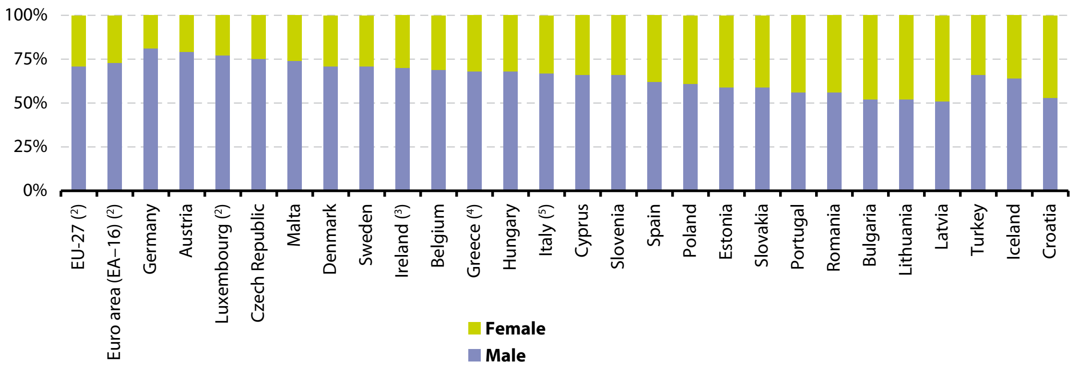
Figure 13.2: Proportion of research and development personnel by sector, 2008 (1)
(% of labour force)



(1) Germany, Ireland, Latvia, Lithuania, Luxembourg, Hungary, the Netherlands, Norway and Turkey, higher education, not available.
(2) Estimates.
(3) Provisional.
(4) 2007.
(5) Business enterprises, provisional.
(6) Higher education, estimate.

Source: Eurostat (tsc00002)

Figure 13.3: Gender breakdown of researchers in all institutional sectors, 2007 (1)
(% of total researchers, based on FTEs)



(1) France, the Netherlands, Finland and the United Kingdom, not available.
(2) Estimates.
(3) Provisional.
(4) 2005.
(5) 2006.

Source: Eurostat (tsc00006)

Table 13.5: Human resources in science and technology (1)

	People working in an S&T occupation					People who have a tertiary education and work in an S&T occupation				
	(1 000)	(% of total employment)				(1 000)	(% of total employment)			
	2008	2005	2006	2007	2008	2008	2005	2006	2007	2008
EU-27 (2)	65 120	29.2	29.7	29.8	:	37 378	16.6	17.0	17.1	:
Belgium	1 441	32.7	32.9	33.0	32.5	1 018	22.6	23.1	23.6	22.9
Bulgaria (2)	710	23.2	21.5	21.9	:	531	16.8	16.2	16.3	:
Czech Republic	1 687	32.6	32.6	33.3	33.8	591	11.3	11.6	11.5	11.8
Denmark (3)	1 117	36.6	36.8	36.0	39.1	699	24.2	24.6	21.9	24.5
Germany	14 181	36.1	36.5	36.3	36.5	7 130	17.9	17.7	17.9	18.4
Estonia	175	27.4	26.9	27.2	26.7	117	18.3	18.3	18.0	17.9
Ireland	494	23.2	22.4	23.3	23.5	384	17.1	17.0	17.7	18.3
Greece	1 061	21.9	22.8	23.1	23.3	829	16.7	17.5	17.9	18.2
Spain	5 119	23.8	23.9	24.2	25.3	3 966	18.2	18.8	18.7	19.6
France	8 338	31.2	31.8	31.8	32.0	5 225	19.0	19.7	19.6	20.1
Italy	7 347	29.5	31.1	31.9	31.5	3 050	11.4	11.9	12.5	13.1
Cyprus	104	25.7	26.1	27.0	27.2	83	19.1	19.9	21.3	21.8
Latvia	350	24.5	27.0	29.7	31.1	194	13.9	14.8	15.7	17.2
Lithuania	443	26.1	25.7	26.9	29.2	311	17.7	17.8	19.0	20.5
Luxembourg	84	38.4	39.0	39.5	41.5	56	25.5	23.9	26.3	27.9
Hungary	1 078	26.1	26.6	26.5	27.8	634	14.8	15.1	15.4	16.3
Malta	45	25.6	26.7	27.3	28.2	23	11.9	13.1	13.6	14.5
Netherlands	3 187	37.1	36.0	37.2	37.4	1 895	21.8	21.1	21.8	22.3
Austria	1 218	30.6	30.5	29.7	29.9	480	12.0	11.7	11.5	11.8
Poland (2)	3 988	25.9	26.2	26.2	:	2 429	15.3	15.8	16.0	:
Portugal	943	17.4	17.7	17.6	18.5	588	10.4	10.8	10.9	11.5
Romania	1 813	17.8	18.6	18.6	19.3	1 094	9.7	10.4	10.8	11.7
Slovenia (2)	300	30.7	31.6	30.6	:	172	16.3	17.4	17.6	:
Slovakia	707	29.5	29.7	29.3	29.0	298	12.0	12.5	12.1	12.2
Finland	882	33.5	34.1	34.5	34.8	621	22.4	22.8	23.1	24.5
Sweden (2)	1 780	39.2	39.1	39.2	:	1 083	23.2	23.5	23.9	:
United Kingdom	7 847	26.1	26.9	26.8	26.8	5 281	17.5	18.0	18.0	18.0
Iceland	64	31.2	32.7	33.4	36.2	36	17.9	13.8	18.9	20.5
Norway	940	36.2	36.4	36.9	37.4	661	24.6	25.2	25.9	26.3
Switzerland	1 704	38.3	38.9	39.4	40.5	909	19.1	19.5	20.3	21.6
Croatia (3)	406	23.8	24.4	24.0	24.9	248	14.5	14.7	14.6	15.3
FYR of Macedonia (2)	122	:	21.1	20.7	:	77	:	13.0	13.1	:
Turkey	2 748	:	12.5	12.5	12.8	1 768	:	7.4	7.7	8.2

(1) Break in series, 2006, with the exception of Belgium and Luxembourg.
(2) 2007 instead of 2008 for the number of people.
(3) Break in series, 2007.

Source: Eurostat (hrst_st_nocc)

Table 13.6: Science and technology graduates
(tertiary graduates in science and technology per 1 000 persons aged 20-29 years)

	Total		Male		Female	
	2003	2008	2003	2008	2003	2008
EU-27	*12.3*	13.9	*16.5*	18.4	*7.9*	9.2
Belgium	11.0	11.6	16.4	17.1	5.6	6.0
Bulgaria	8.3	9.1	9.4	11.2	7.2	6.9
Czech Republic	6.4	15.0	8.8	20.3	3.8	9.3
Denmark	12.5	15.5	17.3	19.5	7.6	11.4
Germany	8.4	12.5	12.7	17.0	4.0	7.9
Estonia	8.8	11.4	10.0	13.1	7.6	9.8
Ireland	24.2	19.5	31.5	27.1	16.8	11.8
Greece (1)	8.0	11.2	9.2	12.5	6.8	9.8
Spain	12.6	11.6	17.1	15.8	7.8	7.2
France	22.0	20.1	30.4	28.9	13.4	11.4
Italy (2)	9.1	12.1	11.6	14.8	6.6	9.4
Cyprus	3.6	4.0	4.2	5.1	3.0	3.0
Latvia	8.6	8.8	10.5	11.7	6.6	5.7
Lithuania	16.3	17.8	20.8	23.2	11.8	12.1
Luxembourg	:	1.8	:	1.8	:	1.7
Hungary	4.8	6.1	6.9	8.8	2.6	3.2
Malta	3.6	6.0	4.8	8.3	2.3	3.5
Netherlands	7.3	8.8	11.7	14.2	2.7	3.4
Austria	8.2	11.8	12.8	17.7	3.5	5.8
Poland	9.0	14.1	11.8	16.6	6.1	11.5
Portugal	8.2	20.7	9.5	26.8	6.9	14.3
Romania	9.4	15.2	11.1	16.9	7.5	13.4
Slovenia	8.7	10.7	12.5	15.3	4.6	5.9
Slovakia	8.3	15.0	10.7	18.6	5.8	11.3
Finland	17.4	24.3	24.0	31.8	10.4	16.5
Sweden	13.9	13.2	17.9	17.2	9.7	9.0
United Kingdom	21.0	17.6	27.5	23.7	14.5	11.2
Iceland	9.5	10.4	12.0	13.0	6.9	7.5
Liechtenstein	5.6	7.0	7.2	10.3	4.1	3.7
Norway	9.3	9.2	13.4	12.8	5.1	5.5
Switzerland	14.1	17.4	24.0	28.0	4.1	6.8
Croatia	5.6	10.1	6.4	13.3	3.5	6.8
FYR of Macedonia	3.3	6.1	3.8	6.7	2.8	5.3
Turkey	5.2	7.6	7.0	10.4	3.3	4.8
Japan	13.2	14.3	22.1	23.9	3.9	4.1
United States	10.9	10.1	14.6	13.5	7.1	6.4

(1) 2004 instead of 2003.
(2) 2007 instead of 2008.

Source: Eurostat (tsiir050)

Table 13.7: PhD students (ISCED level 6), 2008
(% of total PhD students)

	Total number of PhD students (1 000)	Male	Female	Social science, business & law	Teacher training & educ.; humanities & arts	Science maths & comput.; engin. manuf. & construc.	Agriculture & veterinary	Health & welfare; services	Others (¹)
EU-27 (²)	*525.8*	*52.2*	*47.8*	*21.8*	*21.0*	*36.4*	*2.9*	*14.5*	*2.0*
Belgium	9.8	56.3	43.7	19.5	12.9	:	6.5	:	:
Bulgaria	4.4	49.9	50.1	23.3	20.3	39.9	2.9	13.6	0.0
Czech Republic	24.3	60.4	39.6	17.0	16.3	49.8	4.1	12.7	0.0
Denmark	6.1	53.5	46.5	14.4	14.1	38.5	5.8	27.2	0.0
Germany	:	:	:	:	:	:	:	:	:
Estonia	2.4	44.4	55.6	21.8	22.5	:	4.6	:	:
Ireland	6.1	51.6	48.4	15.7	22.8	47.1	2.6	11.5	0.3
Greece	21.6	56.2	43.8	22.6	20.4	33.1	2.6	21.3	0.0
Spain	67.0	47.7	52.3	22.1	22.1	21.4	2.2	19.9	12.2
France	70.0	53.5	46.5	28.5	24.7	44.0	0.1	2.7	0.0
Italy	39.3	47.4	52.6	:	:	:	:	:	100.0
Cyprus	0.4	53.0	47.0	15.9	30.5	:	0.5	:	:
Latvia	2.0	40.2	59.8	35.0	21.6	30.3	2.0	11.2	0.0
Lithuania	2.9	41.5	58.5	31.2	:	39.7	4.8	:	:
Luxembourg	0.2	60.8	39.2	:	:	:	:	:	100.0
Hungary	7.2	51.3	48.7	22.5	27.1	30.6	5.7	14.1	0.0
Malta	0.1	67.2	32.8	20.9	35.8	29.9	0.0	13.4	0.0
Netherlands	7.4	57.6	42.4	:	:	:	:	:	100.0
Austria	17.3	54.2	45.8	33.8	21.2	:	3.3	:	3.1
Poland	31.8	48.9	51.1	20.8	32.9	31.1	5.3	9.9	0.0
Portugal	16.0	43.3	56.7	25.8	22.7	33.2	2.0	16.3	0.0
Romania	28.6	54.0	46.0	16.0	:	41.1	6.9	19.2	:
Slovenia	1.6	50.6	49.4	13.5	15.7	41.1	3.0	26.7	0.0
Slovakia	10.7	54.0	46.0	20.0	18.9	36.7	3.6	20.9	0.0
Finland	21.6	47.4	52.6	22.3	24.5	39.7	2.1	11.4	0.0
Sweden	20.1	50.8	49.2	11.8	11.7	41.5	2.0	33.0	0.0
United Kingdom	80.9	53.6	46.4	21.2	21.3	39.8	1.1	16.6	0.1
Iceland	0.3	43.2	56.8	14.8	24.2	37.9	0.0	23.1	0.0
Liechtenstein	0.1	71.7	28.3	22.6	15.1	0.0	0.0	62.3	0.0
Norway	6.2	51.6	48.4	20.5	10.8	40.4	2.2	26.1	0.0
Switzerland	18.2	57.6	42.4	26.4	16.3	38.7	2.4	15.8	0.4
Croatia	3.1	49.2	50.8	12.5	23.9	41.3	3.7	18.7	0.0
FYR of Macedonia	0.2	46.5	53.5	28.9	22.0	36.5	0.0	12.6	0.0
Turkey	35.1	57.1	42.9	23.4	23.5	33.6	7.9	11.7	0.0
Japan	75.0	69.2	30.8	13.0	13.9	32.2	5.7	32.3	2.8
United States	460.8	49.9	50.1	20.8	24.9	38.2	0.6	15.6	0.0

(¹) Unknown or not specified.
(²) 2007.

Source: Eurostat (educ_enrl5)

13.3 Innovation

Europe has a long-standing tradition of producing inventions. However, commentators often focus on an entrepreneurial gap in order to explain why some ideas for new products or services do not become a success in the marketplace, or why other ideas relating to new processes do not get implemented, thereby surrendering the opportunity to make efficiency gains on production lines or within industrial organisations. This subchapter looks at the state of innovation in the European Union (EU) by presenting data on where innovation takes place and how many enterprises are involved.

Main statistical findings

Among the EU Member States the highest propensity to innovate in 2008 (see Figure 13.4) was recorded in Germany (79.9 %), followed by Luxembourg (64.7 %) – these were the only Member States where more than 60 % of all enterprises were innovative - the EU-27 average (excluding Greece) was 51.6 %. The lowest propensity to innovate was recorded in Latvia (24.3 %), Poland (27.9 %) and Hungary (28.9 %) - the only Member States where the proportion of innovative enterprises was below 30 %. Estonia, Cyprus and the Czech Republic were the only Member States that joined the EU in 2004 to report a propensity to innovate above the EU average. Note that large enterprises tend to innovate more than small and medium-sized enterprises (SMEs) and as such these figures for the Member States may, at least to some degree, reflect the enterprise structure of each domestic economy.

New or significantly improved products contributed a relatively small proportion of total turnover among innovative enterprises in 2008, some 6.4 % for the EU-27 (excluding Greece) in 2008, with 19 of the 26 Member States for which data are available reporting single-digit shares (see Figure 13.5). These products did however account for a higher proportion of sales in Malta (23.4 %), Hungary (14.8 %), Bulgaria (13.9 %) and the Czech Republic (13.1 %).

Large enterprises (with 250 or more employees) were more likely to have brought product innovations to market in 2008 than either medium-sized enterprises (50 to 249 employees) or small enterprises (10 to 49 employees); this pattern held for all of the Member States for which data are available – as shown in Table 13.8. Lithuania was the only Member State where the proportion of small enterprises with process innovations was above the overall proportion for all enterprises.

A similar size class breakdown for process innovations that are developed within the enterprise also showed that large innovative enterprises were more likely to introduce processes innovations: the main exception to this was Cyprus where such process innovations were much less likely to have been introduced in large enterprises than in small or medium-sized enterprises.

Data sources and availability

The Community innovation survey (CIS) collects information about product and process innovation, as well as organisational and marketing innovations. The legal basis for the collection of these statistics is Regulation 1450/2004 of 13 August 2004 implementing Decision 1608/2003/EC concerning the production and development of Community statistics on innovation.

Innovations are based on the results of new technological developments, new combinations of existing technology, or the use of other knowledge acquired (by the enterprise). For the purpose of the Community innovation survey an innovation is defined as a new or significantly improved product (good or service) introduced to the market, or the introduction within an enterprise of a new or significantly improved process, as well as organisational and marketing innovations, including new logistics or distribution methods. Such innovations may be developed by the innovating enterprise or by another enterprise. However, purely selling innovations wholly produced and developed by other enterprises is not included as an innovation activity, nor is introducing products with purely aesthetic changes. Innovations should therefore be new to the enterprise concerned: for product innovations they do not necessarily have to be new to the market, and for process innovations the enterprise does not necessarily have to be the first one to have introduced the process.

Enterprises with innovation activity include all types of innovator, namely product and process innovators, as well as enterprises with only on-going and/or abandoned innovation activities. Enterprises may cooperate with other parties (for example suppliers, competitors, customers, educational/research establishments) when engaging in an innovative activity. The proportion of enterprises with innovation activity is also referred to as the propensity to innovate.

Context

While Europe is good at producing initial ideas (inventions), it is regarded by some as not being so good at bringing them to market; as such, EU policy in this field increasingly aims to provide more focus to industry-driven, applied research and development (R & D).

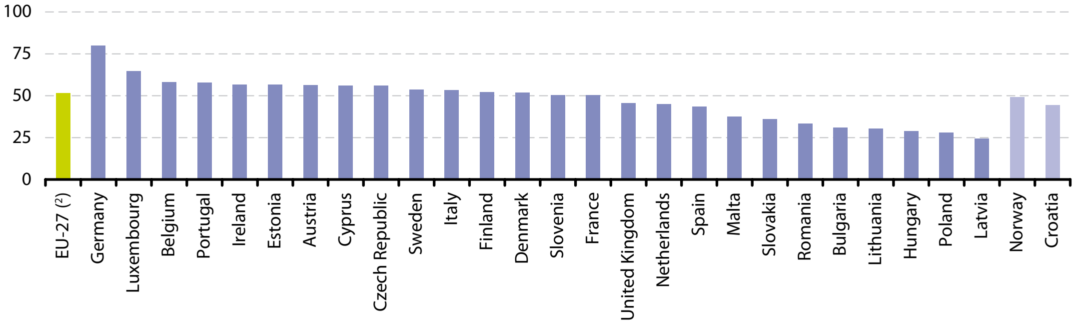
Education is another area seen as key to developing an innovation-orientated society, through the acquisition of entrepreneurial, managerial, scientific, mathematical and foreign-language skills, as well as digital literacy. Policymakers express concern at the numbers of science and technology graduates who directly apply their education once they move into the labour market, while a lack of job mobility between universities and business may potentially hinder the transfer of ideas, thereby reducing the EU's innovation performance (see Subchapter 13.2 on R & D personnel).

In October 2006, the European Parliament and the Council adopted a Decision 1639/2006/EC establishing a competitiveness and innovation framework programme (CIP) for the period 2007-2013. With SMEs as its main target, the competitiveness and innovation framework programme aims to support innovation activities (including eco-innovation), provide better access to finance and deliver business support services in the regions. It encourages the take-up and use of information and communication technologies and aims to help to develop the information society. Furthermore, it also promotes the increased use of renewable energies and energy efficiency.

The European Council called for a plan on innovation in December 2008, which provided the basis for a period of public consultation and business debate on the EU's future innovation policy. In September 2009, the European Commission adopted a Communication ((2009) 442) 'reviewing Community innovation policy in a changing world'. In October 2010, as one of the seven flagship initiatives of the Europe 2020: a strategy for smart, sustainable and inclusive growth, the European Commission adopted a Communication ((2010) 546) on an innovation union. This sets outs a comprehensive innovation strategy for Europe, focusing on major areas of concern for citizens such as climate change, energy efficiency and healthy living. It pursues a broad concept of innovation, not only technological, but also in business models, design, branding and services that add value for users. It includes public sector and social innovation as well as commercial innovation. It aims to involve all actors and all regions in the innovation cycle. The policies in the innovation union aim to do three things:

- make Europe into a world-class science performer;
- revolutionise the way public and private sectors work together, notably through innovation partnerships;
- remove bottlenecks like expensive patenting, market fragmentation, slow standard setting and skill shortages, that currently prevent ideas getting quickly to market.

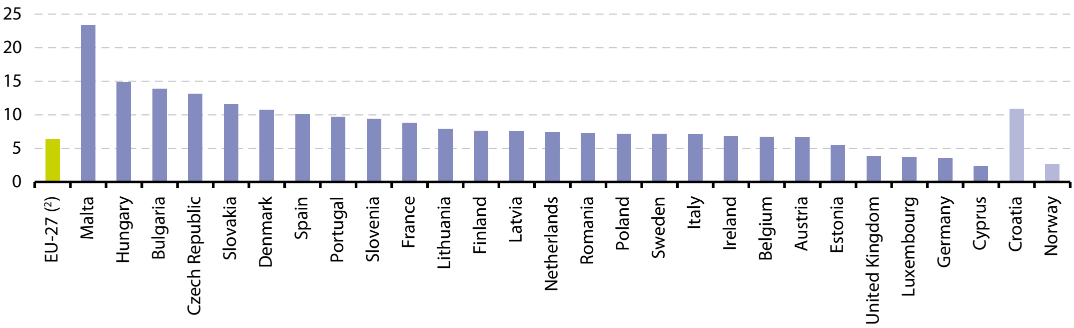
Figure 13.4: Proportion of innovative enterprises, 2008 ([1])
(% of all enterprises)



([1]) Greece, not available.
([2]) Excluding Greece.

Source: Eurostat (inn_cis6_type)

Figure 13.5: Turnover from new or significantly improved products new to the market, 2008 ([1])
(% of total turnover of innovative enterprises)



([1]) Greece, not available.
([2]) Excluding Greece.

Source: Eurostat (inn_cis6_prod)

Table 13.8: Proportion of innovative enterprises which introduced products new to the market or own-developed process innovations, 2008
(% of enterprises within size class or total)

	Process innovations: developed by the enterprise or group				Product innovations: new to market			
	Total	With 10 to 49 employees	With 50 to 249 employees	With ≥ 250 employees	Total	With 10 to 49 employees	With 50 to 249 employees	With ≥ 250 employees
Belgium	42.2	42.7	39.3	47.5	47.5	47.1	45.5	59.3
Bulgaria	41.3	40.7	43.8	38.1	25.9	23.3	30.8	30.8
Czech Republic	39.0	40.1	35.4	41.2	39.1	34.0	47.0	54.1
Denmark	:	:	:	:	44.4	44.1	42.3	54.1
Germany	30.1	27.1	35.6	42.0	26.0	23.2	29.5	43.7
Estonia	40.5	37.9	44.3	56.0	25.8	24.2	28.0	36.1
Ireland	:	:	:	:	:	:	:	:
Greece	:	:	:	:	:	:	:	:
Spain	50.7	50.6	49.4	57.4	21.5	18.0	28.1	43.6
France	50.8	50.8	49.1	55.0	43.2	39.9	46.3	60.0
Italy	44.9	44.0	48.7	47.9	47.7	45.5	55.5	61.4
Cyprus	50.9	53.5	47.3	22.7	26.8	24.0	33.6	40.9
Latvia	33.9	31.3	36.1	50.6	23.4	22.7	21.5	35.6
Lithuania	51.8	55.0	47.3	46.4	37.2	40.2	28.8	47.1
Luxembourg	51.7	48.0	53.2	69.7	40.6	35.3	47.6	55.8
Hungary	24.8	25.0	21.0	32.6	33.1	31.2	32.0	45.2
Malta	47.7	46.9	46.9	55.0	39.1	38.3	32.7	60.0
Netherlands	23.4	22.0	25.7	29.4	49.2	48.1	51.3	53.6
Austria	37.6	34.9	41.7	45.8	49.5	46.3	52.1	66.4
Poland	43.7	45.8	40.7	42.7	41.5	40.1	41.6	47.5
Portugal	52.0	52.4	50.7	52.2	35.6	33.1	41.7	53.7
Romania	66.0	67.0	64.4	63.7	24.8	23.0	26.8	31.4
Slovenia	37.2	36.2	38.8	38.7	51.3	51.3	48.1	59.5
Slovakia	34.2	34.6	31.3	39.7	35.7	34.2	33.4	48.0
Finland	39.2	40.4	35.1	40.0	37.3	35.5	35.9	57.7
Sweden	33.5	33.1	33.0	39.5	50.4	48.3	53.6	62.8
United Kingdom	:	:	:	:	:	:	:	:
Norway	27.4	28.0	25.1	29.0	34.5	36.8	28.5	34.6
Croatia	37.4	36.9	39.3	36.0	37.4	36.7	38.5	39.1

Source: Eurostat (inn_cis6_prod)

13.4 Patents

Intellectual property rights and in particular patents provide a link between innovation, inventions and the marketplace. Applying for a patent makes an invention public, but at the same time gives it protection. A count of patents is one measure of a country's inventive activity and also shows its 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 and innovative performance of a country. This subchapter provides information on patent applications in the European Union (EU).

Main statistical findings

With the exception of the years 2000 to 2002, the number of EU-27 patent applications filed with the European Patent Office (EPO) increased at a relatively fast pace from 1997 to the latest period for which data are available (2007), with annual growth averaging 8.2 % per annum between 1997 and 2000, and 2.7 % between 2002 and 2007; over the whole period under consideration, the number of patents increased from 40 576 to 57 725. Among the Member States, Germany had by far the highest number of patent applications to the EPO, some 23 929 in 2007 (41.5 % of the EU-27 total). In relative terms, Sweden reported the highest number of patent applications per million inhabitants (298.4), followed by Germany (290.7), Finland (250.8) and Luxembourg (230.2).

EU-27 high-technology patent applications to the EPO represented an increasing share of total patent applications up until 2001 when they accounted for 23.1 % of all applications. Their relative importance declined somewhat after this, as did their absolute number – from 11 763 high-tech patent applications in 2001, there was a relatively slow reduction through to 2006 (including growth in 2004). This was followed by a collapse in the number of high-tech applications in 2007, with the total falling to 5 684. This pattern of a sharp fall between 2001 and 2007 was observed across the majority of the Member States and particularly for the larger countries or those countries with traditionally the highest propensity to make patent applications.

Finland and Sweden registered the highest number of high-technology patent applications per million inhabitants in 2007, the figures for both countries being over 35, while Belgium, Denmark, Germany France, the Netherlands and Austria were the only other Member States to record double-digit ratios. The considerable reduction in high-technology patent applications filed with the EPO may reflect the length of patent procedures. Given the increasing speed of technological change and the rapid pace at which imitators are able to bring new technologies to market, it is perhaps not surprising that many enterprises increasingly choose to invest in continued innovation rather than spend time and resources to protect goods or services that may soon become copied or obsolete.

Data sources and availability

From 2007 onwards, Eurostat's production of European Patent Office (EPO) data has been based almost exclusively on the EPO's worldwide statistical patent database (PATSTAT). The EPO grants European patents for the contracting states to the European Patent Convention (EPC), of which there are currently 32 – the EU Member States, Iceland, Liechtenstein, Switzerland, Monaco and Turkey.

European patent applications refer to applications filed directly under the EPC or to applications filed under the Patent Co-operation Treaty (PCT) and designated to the EPO (Euro-PCT). Patent applications are counted according to the year in which they are filed and are assigned to a country according to the inventor's place of residence, using fractional counting if there are multiple inventors.

In contrast, the United States Patent and Trademark Office (USPTO) data refer to patents granted; data are recorded by year of publication as opposed to the year of filing. This methodological difference implies that any comparison between EPO and USPTO patent data should be interpreted with caution.

High-technology patents are counted following criteria established by the trilateral statistical report (drafted by the EPO, USPTO and the Japan Patent Office (JPO)), where the following technical fields are defined as high-technology groups in accordance with the international patent classification (IPC): computer and automated business equipment; micro-organism and genetic engineering; aviation; communication technology; semiconductors; and lasers.

Context

Intellectual property law establishes protection over intangibles – for example, when a manufactured product is sold, the product itself becomes the property of the purchaser, however, intellectual property rights allow intangible elements to remain in the ownership of the creator; these intangibles include (among others) the idea itself, or the name or sign/logo used to distinguish the product from others.

Patents and trademarks are common ways to protect industrial property. Patents are a limited term exclusive right granted to an inventor, maintained through the payment of fees. While patents are generally used to protect research and development (R & D) results, they are also a source of technical information, which can potentially prevent re-inventing and re-developing ideas. A count of patents shows a country's capacity to exploit knowledge and translate it into potential economic gains; in this context, patent statistics are widely used to assess the inventive and innovative performance of countries. Most studies show that innovative enterprises tend to make more use of intellectual property protection than enterprises that do not innovate. Enterprise size and the economic sector in which an enterprise operates are also likely to play an important role in determining whether an enterprise chooses to protect its intellectual property.

The use of patents is relatively restricted within the EU – this may be due to a range of influences: their relative cost; the overlap between national and European procedures; or the need for translation into foreign languages. Furthermore, the increasing number and complexity of patent applications worldwide has resulted in a backlog of pending applications, while the constant expansion of the human knowledge base makes it increasingly difficult for patent offices to keep abreast of technological developments.

The European Council held in Lisbon in March 2000 called for the creation of a Community patent system to address shortcomings in the legal protection of inventions, while providing an incentive for investments in R & D. In July of the same year the European Commission made a first proposal for the creation of a Community patent: this was discussed at various levels and despite a number of proposals and amendments for a Council Regulation during 2003 and 2004 no legal basis was forthcoming. In April 2007 the European Commission released a Communication (COM(2007) 165) titled 'Enhancing the patent system in Europe', stating that European patent systems were more expensive, uncertain and unattractive than those in non-member countries.

In July 2008 the European Commission adopted a Communication (COM(2008) 465) titled 'An industrial property rights strategy for Europe' foreseeing the development of legislation, arguing that the harmonisation of patent law could make it easier for European enterprises to patent their inventions both within and outside the EU.

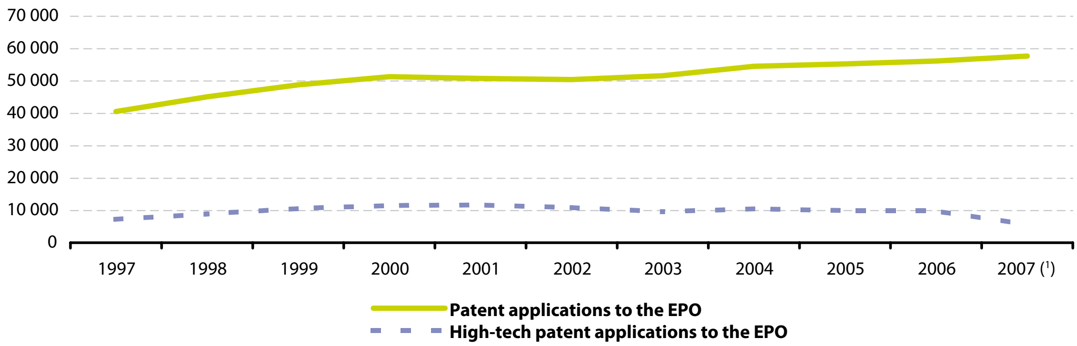
On 4 December 2009, the European Council unanimously adopted conclusions on an enhanced patent system in the EU. The package agreed covers two main areas: firstly, agreement on the approach to be adopted in order to move towards an EU patent regulation; secondly, an agreement on establishing a new patent court in the EU. It is hoped that these measures will together make it less costly for businesses to protect innovative technology and make litigation more accessible and predictable. However, the creation of the EU patent depends on a solution being found for translation arrangements which were the subject of European Commission proposal (COM(2010) 350) for a 'Council Regulation on the translation arrangements for the European Union patent' in July 2010.

Table 13.9: Patent applications to the EPO and patents granted by the USPTO

	Patent applications to the EPO			High technology patent applications to the EPO			Patents granted by the US Patent & Trademark Office		
	(number of patent applications)		(per million inhab.)	(number of patent applications)		(per million inhab.)	(number of patents granted)		(per million inhab.)
	2002	2007	2007	2002	2007	2007	1999	2004	2004
EU-27	50 462	*57 725*	*116.5*	10 964	*5 684*	*11.5*	31 172	*15 775*	*32.3*
Belgium	1 287	*1 472*	*139.0*	333	*231*	*21.8*	794	*395*	*38.0*
Bulgaria	15	*29*	*3.8*	2	:	:	10	*48*	*6.2*
Czech Republic	88	*162*	*15.8*	6	*9*	*0.9*	37	*49*	*4.8*
Denmark	935	*1 057*	*194.1*	230	*110*	*20.2*	564	*246*	*45.5*
Germany	21 503	*23 929*	*290.7*	3 823	*2 098*	*25.5*	12 799	*6 874*	*83.3*
Estonia	6	*23*	*17.4*	1	*7*	*5.2*	5	*4*	*2.8*
Ireland	224	*288*	*66.8*	65	*38*	*8.8*	214	*156*	*38.8*
Greece	74	*109*	*9.8*	18	*6*	*0.6*	18	*20*	*1.8*
Spain	938	*1 451*	*32.6*	148	*96*	*2.2*	381	*210*	*5.0*
France	7 321	*8 421*	*132.4*	1 821	*1 128*	*17.7*	4 616	*2 344*	*37.6*
Italy	4 168	*5 107*	*86.4*	489	*253*	*4.3*	1 938	*1 049*	*18.1*
Cyprus	7	*9*	*11.5*	2	*5*	*6.0*	4	*1*	*1.6*
Latvia	6	*19*	*8.4*	2	*2*	*1.0*	2	*2*	*0.9*
Lithuania	3	*8*	*2.4*	0	*2*	*0.7*	7	*19*	*5.5*
Luxembourg	61	*110*	*230.2*	4	*5*	*9.9*	39	*38*	*83.5*
Hungary	120	*173*	*17.2*	17	*19*	*1.9*	76	*39*	*3.9*
Malta	4	*8*	*20.5*	1	:	:	3	:	:
Netherlands	3 442	*3 656*	*223.5*	1 160	*348*	*21.3*	1 535	*938*	*57.7*
Austria	1 269	*1 797*	*217.0*	216	*149*	*18.0*	640	*366*	*44.9*
Poland	81	*146*	*3.8*	12	*24*	*0.6*	31	*40*	*1.0*
Portugal	41	*121*	*11.4*	5	*29*	*2.7*	15	*14*	*1.4*
Romania	11	*21*	*1.0*	3	*7*	*0.3*	8	*13*	*0.6*
Slovenia	76	*103*	*51.5*	12	*14*	*7.0*	15	*8*	*4.2*
Slovakia	24	*42*	*7.8*	7	*4*	*0.7*	7	*6*	*1.1*
Finland	1 257	*1 323*	*250.8*	598	*209*	*39.7*	1 169	*544*	*104.3*
Sweden	2 002	*2 719*	*298.4*	463	*331*	*36.4*	1 796	*509*	*56.8*
United Kingdom	5 500	*5 422*	*89.2*	1 527	*558*	*9.2*	4 451	*1 936*	*32.4*
Iceland	35	*28*	*90.6*	10	*3*	*9.8*	33	*25*	*85.2*
Liechtenstein	26	*31*	*895.4*	2	*1*	*28.4*	15	*13*	*377.2*
Norway	377	*515*	*110.0*	81	*16*	*3.5*	300	*149*	*32.7*
Switzerland	2 641	*3 224*	*429.3*	404	*222*	*29.6*	1 520	*762*	*103.5*
Croatia	37	*32*	*7.2*	4	*2*	*0.5*	9	*10*	*2.3*
Turkey	60	*220*	*3.2*	:	:	:	16	*9*	*0.1*
Japan	20 218	*20 657*	*161.7*	7 111	*3 615*	*28.3*	39 467	*29 149*	*228.1*
United States	31 171	*31 908*	*105.8*	10 919	*3 686*	*12.2*	103 966	*80 322*	*273.8*

Source: Eurostat (tsc00009, tsiir060, pat_ep_ntec, tsc00010, pat_us_ntot and tsiir070)

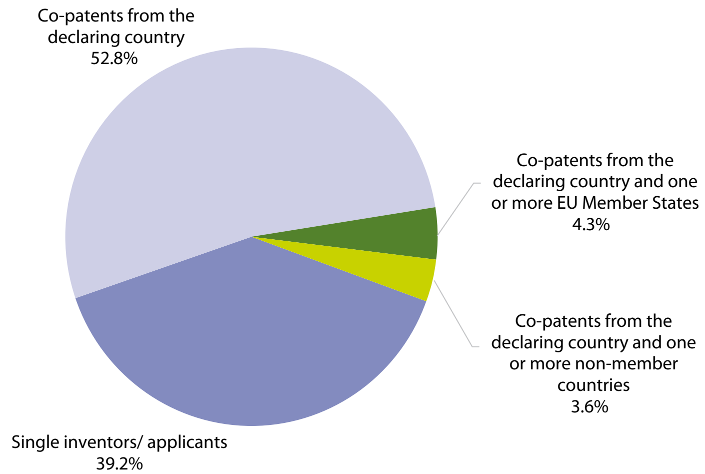
Figure 13.6: Patent applications to the EPO, EU-27
(number of applications)



(1) Estimate for total patent applications; provisional for high-tech patent applications.

Source: Euostat (pat_ep_ntot and pat_ep_ntec)

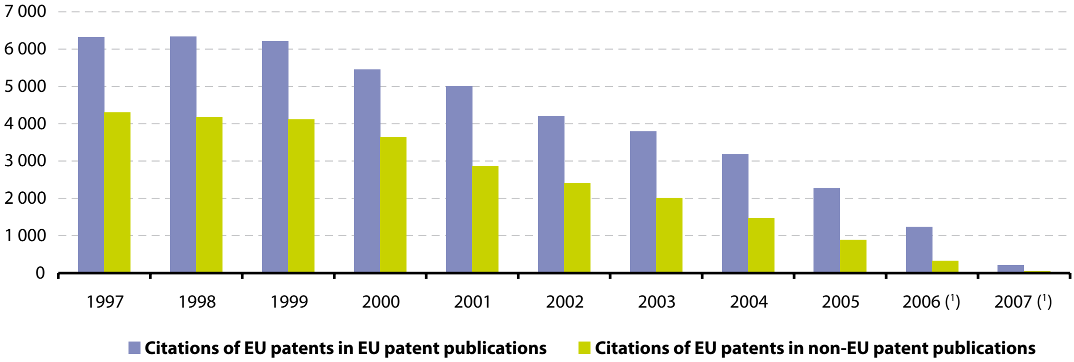
Figure 13.7: Co-patenting at the EPO according to inventors' country of residence, 2007 (1)
(% of total)



(1) Figures do not sum to 100 % due to rounding.

Source: Eurostat (pat_ep_cpi)

Figure 13.8: EU patent citations (EPO) according to inventors' country of residence (number)



(1) Provisional.

Source: Eurostat (pat_ep_cti)