KEY DATA ON SCIENCE, TECHNOLOGY AND INNOVATION BELGIUM 2010

Belgian Science Policy Office

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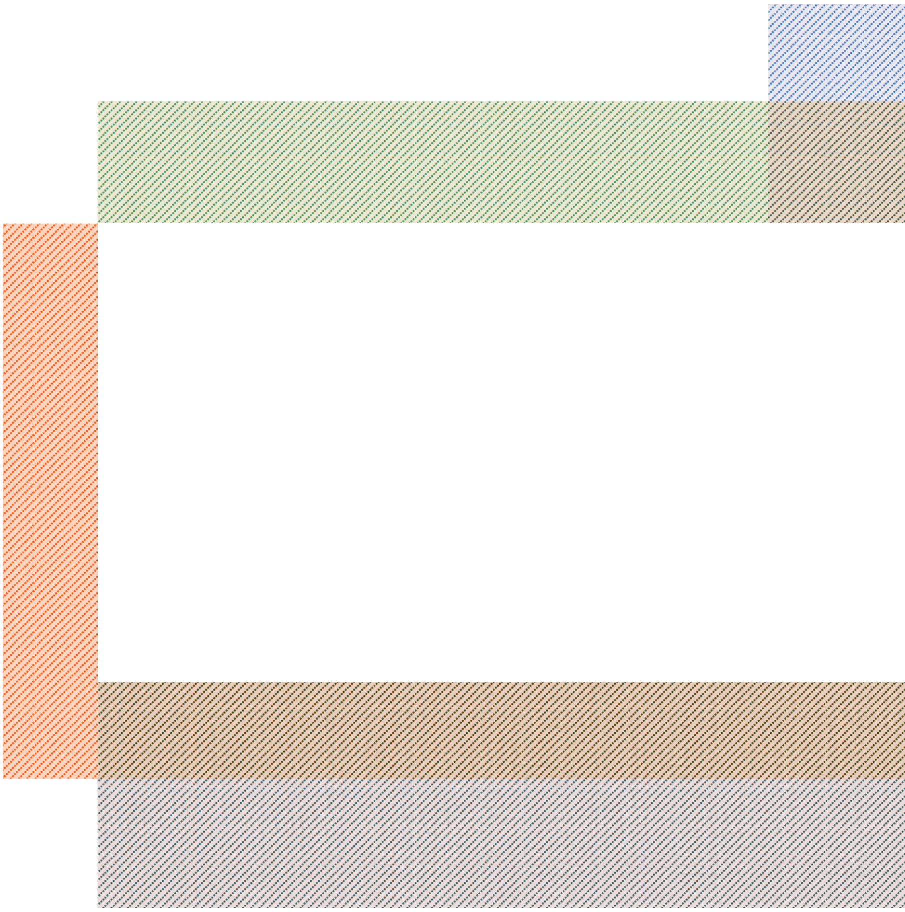

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With suggestions and comments of the representatives of the different authorities in the 'CFS/STAT commission on R&D statistics'.

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Foreword

Some ten years have passed since the last Belgian Presidency of the European Union. In the meantime, the Lisbon agenda and the Barcelona objective have influenced policy making[1] in Belgium and across Europe as whole. Hence, it is time to take stock of where Belgium stands regarding these objectives and its performances in the field of science, technology and innovation (STI) in general.

Therefore, the Belgian Science Policy Office (BELSPO) has taken the initiative to elaborate in co-operation with its partners from the other authorities in Belgium, a follow-up to the volume of the previous Belgian Report on Science, Technology and Innovation (BRISTI) dedicated to STI key figures.

Since 1992, the representatives of the authorities in Belgium concerned by STI statistics meet regularly in the 'CFS/STAT commission on R&D statistics'. The partnership composed of the BELSPO (Unit for production and analysis of R&D indicators), the EWI in Flanders, the DGO6 in Wallonia, the DGENORS of the French Community and the IRSIB of the Brussels-Capital Region co-operate to ensure an efficient and co-ordinated collection of data and its transmission to Eurostat, the OECD and other international statistical organisations. This key data brochure is the result of the collaboration of all these partners[2].

As for the first time, a trio of EU Member States has agreed to promote a joint programme over 18 months, beginning in January 2010, the data on Belgium is benchmarked with Spain and Hungary, where appropriate and available.

Furthermore, the Belgian data is benchmarked with available data for Belgium's main European trading partners (France, Germany, the Netherlands and the United Kingdom), the EU27, the United States and Japan.

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1. This is all explained in detail in another publication 'Belgian Report on Science, Technology and Innovation 2010' issued at the same time as this one.
2. This publication gives only a small selection of what you can find on the website of the Belgian Science Policy Office, specifically on the page *http://www.belspo.be/belspo/stat/index_nl.stm* (in Dutch) or *http://www.belspo.be/belspo/stat/index_fr.stm* (in French).

As far as possible, the main source used for international data is the ‘Main Science and Technology Indicators (MSTI)’-database of the OECD. When relevant or to complete missing data, other databases (mainly from Eurostat) were consulted and used.

Every indicator presented starts with an explanation of the indicator, illustrated with a figure and a table with data.

We hope that the publication will prove to be a valuable reference tool for those interested in understanding the comparative performance of Belgium and its contribution to the European research and innovation system. The R&D investment targets set in Lisbon ten years ago have been recently reaffirmed in the Europe 2020 strategy and the authorities in Belgium remain fully committed to monitoring progress towards this important goal.

Dr Philippe METTENS
Chairman of the Board of Directors,
Federal Science Policy Office (BELSPO)

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Acronyms and abbreviations

BERD	Business Enterprise Expenditure on R&D
CFS	Federal Cooperation Commission
CFS/STAT	Federal Cooperation Commission on Statistics
CIMPS/IMCWB	Interministry Conference for Science Policy
CIS	Commission of International Cooperation
CIUF	Conseil Interuniversitaire de la Communauté française de Belgique / Inter-University Council of the French Community
CRef	Conseil de Recteurs des Universités Francophones de Belgique / Council of Rectors of the French-speaking Universities of Belgium
DGENORS	Direction Générale de l’Enseignement non obligatoire et de la recherche scientifique (Communauté française) / Directorate General for non-obligatory Education and Scientific Research (French Community)
EPO	European Patent Office
EU	European Union
EWI	Departement Economie, Wetenschap en Innovatie (Vlaamse Gemeenschap) / Economy, Science and Innovation Department (Flemish Community)
FCSP	Federal Council for Science Policy
FRS-FNRS	Fonds National de la Recherche Scientifique / National Fund for Scientific Research (French-speaking part of Belgium)
FTE	Full-time equivalent

GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Expenditure on R&D
GUF	General University Funds
HERD	Higher Education Expenditure on R&D
ICT	Information and communication technologies
IPC	International Patent Classification
ISCED	The International Standard Classification of Education
ISRIB	Institute for the encouragement of Scientific Research and Innovation of Brussels
IWT	Agentschap voor Innovatie door Wetenschap en Technologie / Agency for Innovation by Science and Technology
FWO	Fonds Wetenschappelijk Onderzoek-Vlaanderen / Research Foundation-Flanders
MSTI	Main Science and Technology Indicators
OECD	Organisation for Economic Cooperation and Development
PNP	Private non-profit
R&D	Research and Development
SERV	Sociaal-Economische Raad van Vlaanderen / Flanders' Social and Economic Council
SPC	Science Policy Council of the Brussels-Capital Region / Conseil de la Politique Scientifique de la Région de Bruxelles-Capital / Raad voor het Wetenschapsbeleid van het Brussels Hoofdstedelijk Gewest
SPW-DGO6	Service public de Wallonie-Direction générale opérationnelle de l'Économie, de l'Emploi et de la Recherche / Operational Directorate General for Economy, Employment and Research
SRI–DOI	Service Recherche et Innovation – Dienst Onderzoek en Innovatie / Research and Innovation Office
STA	Scientific and technological activities
STI	Science, Technology and Innovation
TBP	Technology Balance of Payments
USPTO	United States Patent & Trademark Office
VLIR	Vlaamse Interuniversitaire Raad / Flemish Inter-University Council
VRWI	Vlaamse Raad voor Wetenschap en Innovatie / Flemish Council for Science and Innovation

Spotlights on Belgium

Statistics and indicators have become an industry unto themselves. Academic researchers, private consultants and public bureaus of statistics are producing enormous amounts of data on science, technology and innovation (STI). Monitoring through statistics and indicators has indeed become a crucial element in policy setting. The Lisbon strategy, aimed at converting the European Union (EU) into the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, as well as respect for the environment by 2010, makes use of statistical targets to monitor progress towards this goal. The Lisbon strategy also acknowledged innovation to be a key driver in the process.

The EU presidency of Belgium, once again, offers an opportunity to emphasise the pressing demands posed by the knowledge economy. The generation, diffusion and application of knowledge are crucial in safeguarding the social structures, ecological balances and cultural vitality of all countries. These issues have become even more urgent in light of the current downturn of the economies. Even though knowledge has evolved into a key production factor and become a major driver behind productivity growth and economic welfare, and public authorities widely acknowledge that it deserves to be stimulated, the world economies have found themselves struggling with a severe economic downturn. Nevertheless, knowledge remains a key element in all efforts aimed at stimulating economic recovery.

The Key Data on Science, Technology and Innovation are meant to highlight the most characteristic tendencies that affect the functioning of the knowledge economy. Two of them are especially relevant: internationalisation and open innovation. For a small open economy such as Belgium and its regions, these tendencies deserve to be met through adapted policy measures. The strength of Belgium's decentralised organisation is that each region is taking the measures that best suit their needs. In order to formulate adequate policies, a thorough appreciation of the relevant statistics and indicators, and the implications they bring in their wake, is instrumental for policy design.

Several related issues pass in review. First, the input indicators recount the fact that a sufficiently large pool of knowledge needs to be generated in order to fuel the system. Input indicators consist of R&D resources, budgetary resources and human resources. Next, the output indicators demonstrate the productivity of the system by looking at the results in terms of publications, patents and innovative activities. The international relations in terms of the technology balance of payments and high-tech exports demonstrate the degree of openness of modern day economies. Finally, science, technology and innovation do not operate in a vacuum, and therefore a selection of relevant structural indicators is included.

This brochure on Key Data on Science, Technology and Innovation uses many indicators to measure the elements in the innovation process. These indicators are grouped into several dimensions as presented in the following figure. Although these dimensions are organised from input to output in the innovation process, it is not to be understood as an assertion that the process is linear, because many feedback mechanisms and interactions exist.

FIGURE 1 **Dimensions of science, technology and innovation**

ENABLERS: DRIVERS OF SCIENCE, TECHNOLOGY AND INNOVATION

- R&D activities –investments and personnel efforts by enterprises, governments, higher education and private non-profit organisations.
- Human resources – education, skills and training.
- Government budgets for R&D – public financing revealing the policy emphasis.

FACILITATORS: LINKING BUSINESS TO THE OUTSIDE WORLD

- International linkages – technology balance of payments, high tech exports, foreign direct investments.
- Research productivity – intellectual property rights (patents), publications (bibliometrics).

RESULTS: PERFORMANCE OF THE KNOWLEDGE-BASED ECONOMY

- R&D activities in firms – process and product innovation, marketing and organisational innovation, cooperation on innovation, turnover due to new products.
- Entrepreneurship – venture capital, firm dynamics.
- Macroeconomic effects – real GDP growth, labour productivity, participation rate.

Obviously, key data only offer a snapshot of the complex processes behind science, technology and innovation. Therefore this short note intends to highlight the context in which these key data can be read for Belgium. This setting is characterised by two tendencies that permeate the entire socio-economic fabric of society: globalisation and the extraversion of economic activities.

The science, technology and innovation landscape has changed due to several tendencies which can be summarised as follows: (i) a distributed innovation process in which networking has become a vital issue; (ii) a need to complement outsourced R&D with in-house knowledge generation; (iii) an optimising strategy for raising the efficiency of R&D activities because of increased risk and cost issues; (iv) an internationalisation of R&D activities and concomitant spatial division of labour; and (v) a conversion towards R&D activities directed at the knowledge-intensive services sectors (Howells, 2008).

Investments in research and development

The aim of the European Union is to attain the status of a world leading competitive and dynamic knowledge-based economy by 2010. Building on the main assumption that research and development (R&D) is a key driver in this aim, one of the central objectives has been the 3% level of R&D intensity, i.e. R&D expenditure as a share of gross domestic product, to be reached by 2010. Both private and public sectors should contribute to this. Two-thirds of the R&D investments should be financed by the dominant private sector, and one-third should be financed by public authorities. Although these were European targets at first, many European countries and regions have followed suit. As time went by, the consciousness grew that these targets could not be reached.

R&D intensity of Belgium is well above the EU-27 level

1.90%

And, indeed, the indicator of the EU-27 clocked in at 1.77% in 2007. In view of the current economic downturn and tight budgets, it is hardly realistic to suppose that the remaining three years will show a remarkable acceleration towards reach the target.

When the government appropriations and outlays on R&D is compared to the government debts, the results show a strong negative correlation, suggesting that the state of government finances has an impact on the spending on R&D and innovation by governments. Since government debts have been increasing due to the economic downturn, it can be expected that political room for the stimulation of R&D and innovative activities has reduced concomitantly.

The difficult situation of the public budgets, as exemplified by the indicators on the government debt and government budget appropriations and outlays on R&D, does not support optimism that public authorities are in a financial position to take actions to stimulate R&D intensity.

Tightening government budgets should, however, not induce panic, since there is a policy shift away from direct subsidies towards tax relief measures. This shift recognises the opportunities of enterprises to pursue their choice of innovative projects instead of being offered a chance to get a certain type of project subsidised.

In times of open innovation, and with innovation becoming more complex, firms are increasingly looking elsewhere for additional sources for knowledge and technology. The extraversion of the economy with respect to

R&D is demonstrated by the evolution from the share of R&D outsourcing in total R&D investment. This share rose constantly from 16% in 1998 to 26.7% in 2007.

R&D outsourcing becomes a popular practice in Belgium

26.7%

Human resources for a knowledge-based economy

If the target of an R&D investment of 3% of GDP is to be reached, the provision of an adequate pool of human resources is vital. Human resources are the prime asset in knowledge-based economies. There is a variety of reasons for this. First, without enough human resources, there is a risk of running into bottlenecks when demand for R&D personnel is high. Moreover, if this demand is not met adequately or labour costs prove too high, it might induce companies to delocalise R&D facilities. Second, since most knowledge is tacit in nature and resides within human beings, there is a need for a high proportion of knowledge workers, which presupposes a pool of highly-skilled and well-educated people.

One of the dominant indicators on the supply of human resources is the educational system. This indicator points especially towards the future prospects both for individuals and for society as a whole.

In the European Union, Belgium has a high share of people with tertiary education

32.1%

The United States and Japan have by far the highest shares of population with tertiary education. And Belgium has one of the highest shares in the European Union. However, since the graduation rates at first stage and doctoral level are now lagging behind its main trading partners, there is the danger that Belgium will be surpassed in the future.

Along with the Netherlands, Belgium is relatively modest when it comes to stimulating the uptake of education in science and engineering in terms of graduates at the first stage of university. This type of training is deemed to play a decisive role in R&D and innovative activities. Once graduated, however, the share of doctorates in science and engineering is quite high (49.2% of all new degrees at the doctoral level), indicating that these graduates often pursue the highest academic degree. This opens up the question whether these doctorates find their way into the enterprise sector or remain active within universities.

The increase in the total number of new science and technology graduates (including the first and second stage of tertiary education) per 1000 of population aged 20-29 should be highlighted (from 10.5 in 2002 to 14 in 2007).

The share of graduates in science and engineering in Belgium is relatively weak at the first stage university level

21.8%

Knowledge, skills and competences are bestowed upon people through education and enable them to participate in and contribute to the economy. The number of students and graduates are, therefore, stock variables proxying human resources.

Internationalisation: development of global value chains in R&D and innovation

The tendency to globalisation of the economic landscape has an impact on science technology and innovation. Two counteracting forces are at play where R&D activities are concerned (OECD, 2008). First, centripetal forces pertaining to the stickiness of R&D activities are related to firm-specific aspects such as economies of scale and scope in R&D activities; dodging the danger of incurring involuntary spillovers of key technologies; and avoiding stepping up the already high costs of performing R&D through costs due to an enhanced need for coordination and control. On top of these firm-specific aspects, there is also some historical inertia and the fact that comparative advantages in home countries make R&D activities less footloose. On the other hand, there are also many centrifugal forces rendering R&D activities more prone to decentralisation. Demand conditions, such as the need to be in proximity to local customers in order to adapt innovative products to the requirements and wishes of local markets, make the need to offshore R&D activities more keenly felt. But supply conditions also entice the performance of R&D activities.

R&D investments by foreign affiliates is high in Belgium

59.4%

Here, the access to highly qualified personnel at relatively low cost; the potential spillovers from renowned universities and research centres; and the proximity to key actors such as suppliers and lead users are important drivers to decentralising R&D. Both counteracting forces are especially important for multinational firms.

On the other hand, this foreign involvement makes the innovation system in Belgium vulnerable to the decisions taken abroad. Moreover, the beneficial effects resulting from spillovers due to the location of multinationals are yet to be proven.

International technology transfers are measured by the flows of receipts and payments for ready-made technology. Well-known channels are licence fees; purchases and royalties; and research and technical assistance. The use made by these channels is, moreover, closely related to the instalment of a technology market. In times of open innovation and global networks these flows of technology transfer are increasing. In an international context they are captured by the information in the technological balance of payments. Overall these flows are increasing for Belgium, whose position evolved from a surplus in the early 2000s to a deficit in technological payments in 2007-2008, indicating a strong presence of foreign affiliates.

The augmentation of the capital flows due to foreign direct investment (FDI) reflects a growing specialisation of production.

An important mechanism for FDI can be found in activities involving mergers and acquisitions. FDI also reflects the presence of multi-location firms.

Belgium is integrated into the international economy through its FDI

22.1%

Research productivity

Patents and publications are well-established indicators of research productivity and have become critical instruments in public policy. Patent information aims at quantifying the research results of firms. Patents are intended to protect innovations or, in an open innovation context, are used to benefit from the innovations by licensing to other users.

Different propensities to patent exist between industries. Science-based sectors patent more, while other sectors use other strategic mechanisms, like lead time advantage, to protect their innovation and to capture profits from their innovations. Patents, moreover, are costly. The rise in patenting – especially in sectors like ICT and biotechnology – reflects the policy measure to stimulate technology transfer from universities to enterprises. As universities are increasingly starting to patent, the creation of entrepreneurial universities is a recent phenomenon and might be seen as a possible reaction to budget cuts.

Patents information is used to reveal the technological specialisation of countries in research domains. In the case of Belgium, the patent information shows that biotechnology is a strong sector in Belgium.

Patent applications in biotechnology is one of the highest in Europe

11.0%

Scientific productivity, mainly by the higher education sector, is measured by the number of publications. These are predominantly realised by universities. Relatively high scores on scientific publications and a relatively low performance of innovative activities demonstrate the so-called innovation paradox. Specifically when innovative activity is seen in terms of entrepreneurial activity.

Scientific publications in Belgium shows a high activity (per 10,000 inhabitants)

14.3%

This paradox states that the record on knowledge generation was insufficiently translated into commercial results. Indeed, data on turnover due to new products from the innovation survey demonstrate that enterprises in Belgium are average in this respect.

Converting the innovation process: open innovation

Although business sector R&D is at the heart of the innovation process, the commercialisation of innovations is a vital element in doing business. Product and process innovation can, therefore, be seen as another output indicator.

The technical innovation rate for enterprises in Belgium ranks as one of the highest

48.2%

Innovations can be technological or non-technological. In the case of technological innovations in the manufacturing sectors, enterprises in Belgium show a good performance.

Non-technological innovation refers to innovations in marketing and in organisation and is quite a popular type of innovation in Belgium. This type of innovation is often related to the services sectors and is a strong driver of performance within these sectors.

Firms increasingly look for knowledge and technology from beyond the firm's boundaries to use in their innovation activities. They also aim to commercialise their new products and processes through a variety of mechanisms such as licenses and spin-offs. These twin concepts – outside-in and inside-out – have changed the innovation process by making it more dependent on external knowledge sourcing such as increased R&D collaboration, reliance on R&D outsourcing, and the importance of appropriation mechanisms such as patents.

Because the 3% target on R&D intensity stipulates that two-thirds has to be financed by enterprises, indicators on entrepreneurship have become important. In a favourable business climate uncertainty is reduced, and investments reflect an optimistic belief in the future. But in times of economic downturn the business climate turns gloomy. The recent economic downturn is, first and foremost, a financial one. Therefore the willingness to lend money for the risky undertakings of R&D is reduced. But venture capital is a major source of funding for new technology-based firms, plays a crucial role in promoting breakthrough innovations and is one of the key determinants of entrepreneurship. At the present time, because of the current economic downturn, access to bank credit and stock market financing is tight and venture capital becomes sparse as venture capitalists become risk-averse during recessions.

Enhancing economic growth, creating jobs and providing income are envisaged targets to be reached through increased productivity and innovation. A main driver is the formation of new business that has become an explicit policy objective in most countries.

A principal measure of entrepreneurship is offered by the global entrepreneurship monitor. This is a measure of the share of people who are involved in setting up a business. This activity has been very weak in Belgium during the past few years.

Entrepreneurial activity is weak in Belgium

3.5%

Macroeconomic context

The past two years have been characterised by an economic downturn. The impact of these elements have not yet materialised in most statistical data and indicators. Key data are always lagging behind developments in the real economy. And 2009 proved to be a turbulent year for the world economy. Industrial production fell by 6.2% in the European Union (EU-27) during 2009; i.e. from November 2008 to November 2009 (Eurostat, Newsrelease, 12 February 2010). This proved to be the case for all European countries for which key data were provided. Belgium, with a fall of 4.0%, was only moderately hit, but as labour-intensive firms such as Opel are considering leaving Belgium, the worst is yet to come. However, as in the rest of the European Union, all authorities in Belgium are trying to absorb the shocks from the economic downturn.

A key measure of economic activity is the gross domestic product (GDP) of a country. The most common indicator of welfare is the GDP per capita. To correct for the size and the price effects, this is usually calculated per capital and in purchasing standards.

If the EU-27 stands at an index of 100; then Belgium has a GDP that is in line with its key trading partners. Only France scores slightly less (108); and the Netherlands score higher (134).

Belgium's gross domestic product is in line with its key trading partners

115.1%

Differences in GDP between countries reflect a combination of labour productivity and the use that is made of the labour force. The Lisbon target also discusses the performances on the participation rate and the employment rate of economies; both indicators are a reflection of the labour market. In this respect, the Belgian scores are relatively weak compared to its main trading partners.

Production in Belgium is capital intensive. This aspect is part of the explanation for the high labour productivity score in Belgium when compared to the other EU countries.

Labour productivity in Belgium is one of the highest in the EU

125.5%

A.
INPUT INDICATORS

A.1 Gross Domestic Expenditure on R&D (GERD)

Basic information

The standard measure is the gross domestic expenditure on R&D (GERD), which covers all R&D investment carried out on national territory in the year concerned. It thus includes domestically performed R&D which is financed from abroad but excludes R&D funds paid abroad, notably to international agencies. The pattern of financing and of performance of GERD is also presented.
The data on the GERD have been collected and presented in line with the standard OECD methodology for R&D statistics entitled "The Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys of Research and Expenditure – Frascati Manual 2002 (OECD)". Most R&D data, as in Belgium, are derived from retrospective and regular R&D surveys.

The basic measure is intramural expenditures which are all expenditures for R&D performed within a statistical unit or sector of the economy during a year, whatever the source of funds. They are composed of labour costs of R&D personnel, other current costs and capital expenditures. Another measure, 'Extramural expenditures', covers payments for R&D performed outside the statistical unit or sector of the economy. Data on the extramural R&D expenditures of statistical units are a useful supplement to the information collected on intramural expenditures.
Domestic R&D efforts are divided into four sectors of performance: Business Enterprise, Higher Education, Government and Private Non-Profit institutions (PNP). The intramural R&D expenditures are also subdivided into five sources of funds: Business Enterprise, Government, Higher Education, Private non-profit and Abroad.

Message

GERD covers all financial outlays private and public sectors made on behalf of R&D activities, and so this indicator is widely used to measure the knowledge intensity of a society as a whole. One particularly useful way of constructing such an indicator for international comparisons is to compare the expenditure on R&D with the gross domestic product (GDP). The GERD/GDP ratio, expressing the R&D intensity of a country, is regarded as the main indicator for learning about the state of innovation of an economy. Nowadays it is still widely used in the framework of the

Barcelona target (to invest 3% of the GDP in research by 2010); although it became obvious quite some time ago that this target could not be reached.

BARCELONA TARGET

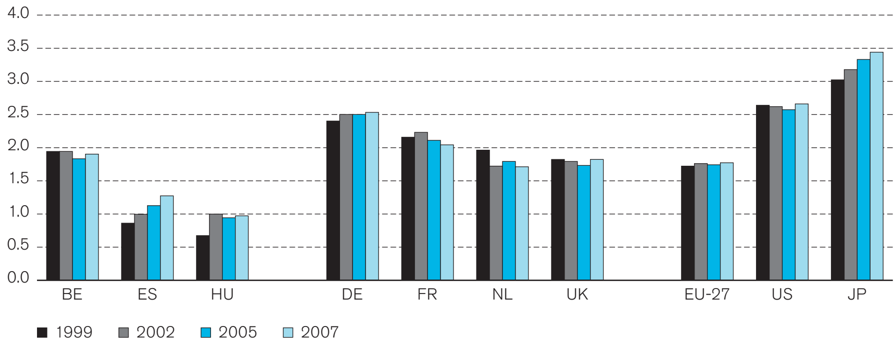
The Lisbon strategy for growth and jobs was launched in 2000 as a response to globalisation. One key area was 'more research, development and innovation'. In 2002 at the Barcelona Summit, the goal was set to invest 3% of the GDP in research by 2010 in Europe. The Barcelona target also specified the appropriate split of the financing of R&D between public and private sectors (1/3rd public vs 2/3rds private).
'The European Commission proposed in her Communication 'Europe 2020 – A strategy for smart, sustainable and inclusive growth' (3 March 2010) to keep the 3% target while developing an indicator which would reflect R&D and innovation intensity.
At the Spring European Council of 25/26 March 2010, the European Council adopted the proposal of the European Commission to improve the conditions for research and development, in particular with the aim of bringing combined public and private investment levels in this sector to 3% of the GDP; the Commission will elaborate an indicator reflecting R&D and innovation intensity.

Belgium's R&D intensity is a little better than the EU-27 average (Figure A.1.1). Japan and the United States perform a great deal better in this respect. Despite some progress on R&D investments, Belgium and other European countries have stagnated in terms of R&D intensity, which shows that growth in these European countries has not been driven by science and technology alone, but also by other factors. Another hypothesis is that research has been executed in a more efficient way, thanks to phenomena like 'open innovation', the merging of technologies, the concentration of research in fewer labs…
Figure A.1.2 illustrates the R&D activities in the different R&D performing sectors. The GERD in Belgium is highly influenced by the two main R&D performers, i.e. the business enterprise sector and the higher education sector. Their respective R&D intensity is 1.32% and 0.40% in 2007. Both sectors represent 69.5% and 21.1% respectively of the national total R&D expenditure. In 'research-intensive' countries such as the USA, Japan and Germany, more than two-thirds of R&D expenditures are performed in the business sector. In less 'research-intensive' countries such as Hungary and Spain, less than half of R&D expenditures is performed in the business sector.
Figure A.1.3 shows the financing side of the R&D activities. Government, business enterprise and abroad together finance more than 95% of R&D expenditures (this is the case in most countries). Are the 1% public and 2% private funding targets met? (see Figure A.1.4 for the situation in Belgium).
Despite an increase in public budgets for R&D since 2000, the 1% public funding target remains far out of reach in Belgium (0.54% in 2007) and this goes for the other European countries as well. The same comment can be made with regard to the 2% private funding target. The private funding in Belgium represents more than 2/3rds of the GERD funding.

Figure A.1.5 concentrates on the business sector and confirms what was said earlier (Figure A.1.2). In Belgium, big R&D-intensive multinationals (foreign-controlled affiliates and parent companies) play an important role.
Figure A.1.6 shows the share of industrial R&D realised under foreign control. In Belgium, the ratio is approximately 60% (70% in Hungary). The higher the ratio, the more a country's domestic market is internationalised and reflects its interdependence with other countries.
In spite of the increasing weight of services in the Belgian economy (75% of total Belgium value-added in 2007), the R&D expenditures incurred in the business sector in 2007 were essentially distributed 76.3% in the manufacturing industry and 20.4% in services (Figure A.1.7). The high-tech manufacturing and services sectors count for more than 50% of the BERD in Belgium.
The extramural R&D expenditure data are essential for providing statistics on R&D performed abroad but financed by domestic institutions. The focus of R&D data is necessarily on individual countries, and it is very difficult to track international flows of R&D funds. Figure A.1.8 presents the evolution of the intramural and extramural R&D expenditures in the Belgian business enterprise sector. The extramural R&D expenditure has increased much more strongly than the extramural R&D expenditure (in the period 1999-2007). Since 1999, extramural R&D expenditures have increased yearly by 8.7% in real terms. Over the same period, BERD grew yearly by 1.5% in real terms. In 2007, extramural R&D expenditure represented 36.5% of the total intramural R&D expenditure. The analysis of the data on intramural R&D in the Belgian business enterprise sector has also showed that there are industrial concentrations of research activities in high-tech industries. We also note that these industrial concentrations become even more accentuated when looking at the extramural expenditures, especially for pharmaceutical. The concentration is also observed in terms of the number of companies performing extramural R&D. Indeed, the top 10 and the top 100 of the business enterprise sector performed close to 75.0% and 90.0% of the total of extramural R&D expenditure in 2007. The total number of companies subcontracting their R&D are estimated to approximately 1310 in Belgium.
Foreign performers take two-thirds of extramural R&D expenditure of the business enterprise sector for their account. The national performers represent only one-third of the total extramural R&D expenditure of the business enterprise sector (Figure A.1.9).
Figure A.1.10 gives an overview of the R&D sectors of performance in the three regions in Belgium (2002 and 2007). The GERD of Belgium performed by the Flemish Region was 60.7% in 2007 (64.0% in 2002). In the Walloon Region and in the Brussels-Capital Region it is respectively 25.7% and 13.5% in 2007 (against 23.4% and 12.6% in 2002). The business enterprise sector is the most important R&D performer in each of the three regions. The higher education sector is the second most important R&D performer.

A.1.1
GERD as a percentage of GDP

GERD as a percentage of GDP, or R&D intensity, is the most commonly used indicator for international comparisons regarding the knowledge intensity of a country and as a proxy for evaluating the success of national science and technology policies. The European Union also set itself the goal of spending 3% of GDP on R&D by 2010 in the framework of the Lisbon Strategy. This indicator gives information about the progress in this respect and refers to the period 1999-2007.



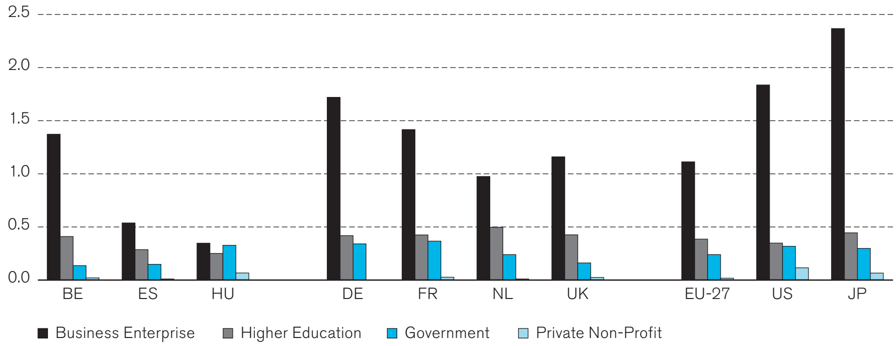
		1999	2002	2005	2007
Belgium	BE	1.94	1.94	1.83	1.90
Spain	ES	0.86	0.99	1.12	1.27
Hungary	HU	0.67	1.00	0.94	0.97
Germany	DE	2.40	2.49	2.49	2.53
France	FR	2.16	2.23	2.10	2.04
Netherlands	NL	1.96	1.72	1.79	1.71
United Kingdom	UK	1.82	1.79	1.73	1.82
EU-27	EU-27	1.72	1.76	1.74	1.77
United States	US	2.64	2.62	2.57	2.66
Japan	JP	3.02	3.17	3.32	3.44

Source: OECD, Main Science and Technology Indicators 2009-2.

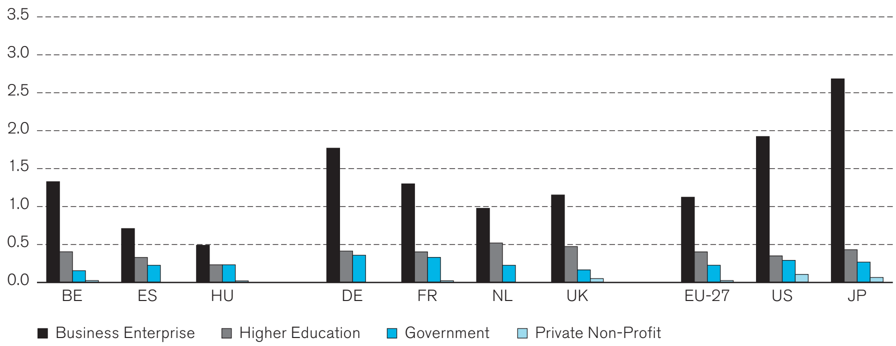
A.1.2
GERD according to sector of performance

Intramural R&D expenditure is broken down into the following four sectors of performance: business enterprise, government, higher education and the private non-profit institutions. 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. The **government** sector is composed of 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, as well as those that administer the state and the economic and social policy of the community. The **higher education sector** is composed of all universities, colleges of technology and other institutions 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 institutions. Finally, the **private non-profit institutions** include non-market, private non-profit institutions serving households (i.e. the general public), private individuals or households.
The figures show the differences in levels of R&D performing intensities between Belgium compared with Spain, Hungary, its four main European trading partners, the EU-27, the United States and Japan, broken down over these four sectors of performance for 2002 and 2007.

2002



2007



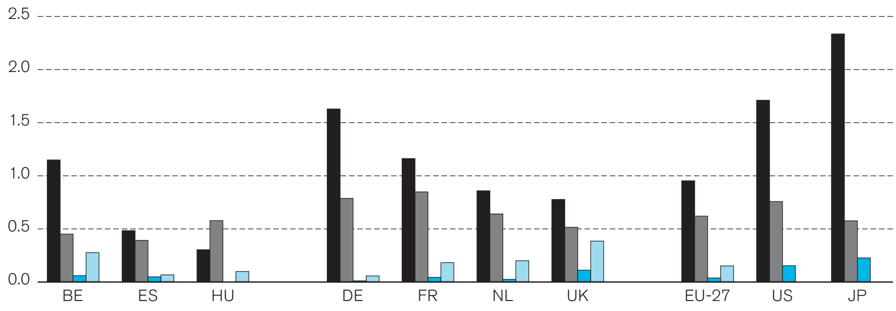
		2002				2007			
		BUSINESS ENTERPRISE	HIGHER EDUCATION	GOVERNMENT	PRIVATE NON-PROFIT	BUSINESS ENTERPRISE	HIGHER EDUCATION	GOVERNMENT	PRIVATE NON-PROFIT
Belgium	BE	1.37	0.41	0.14	0.02	1.32	0.40	0.15	0.02
Spain	ES	0.54	0.29	0.15	0.00	0.71	0.33	0.22	0.00
Hungary	HU	0.35	0.25	0.33	0.07	0.49	0.23	0.23	0.02
Germany	DE	1.72	0.42	0.34	0.00	1.77	0.41	0.35	0.00
France	FR	1.41	0.42	0.37	0.03	1.29	0.40	0.32	0.02
Netherlands	NL	0.97	0.50	0.24	0.01	0.97	0.52	0.22	0.00
United Kingdom	UK	1.16	0.43	0.16	0.03	1.15	0.47	0.16	0.04
EU-27	EU-27	1.11	0.39	0.24	0.02	1.12	0.40	0.23	0.02
United States	US	1.83	0.35	0.32	0.12	1.92	0.35	0.29	0.10
Japan	JP	2.36	0.44	0.30	0.07	2.68	0.43	0.27	0.06

Source: OECD, Main Science and Technology Indicators 2009-2.

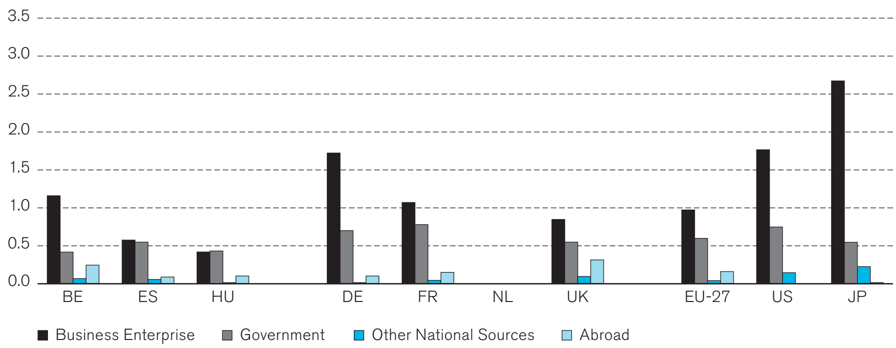
A.1.3
GERD by source of funds

GERD is also broken down into five sources of funds. GERD by source of funds complements the indicator on GERD by sector of performance. The sources of financing of GERD are the following: the sectors of performance themselves (business enterprise, government, higher education and the private non-profit institutions), but also abroad.
The source of funds 'abroad' consists of funds of all institutions and individuals located outside the political borders of a country, excepting vehicles, ships, aircraft and space satellites operated by domestic entities and testing grounds acquired by such entities. It also includes all international organisations (except business enterprises), including facilities and operations within the country's borders.
In this figure, R&D expenditure funded from the higher education sector and the private non-profit institutions have been re-grouped under 'other national sources'. Figures refer to GERD as a percentage of GDP by source of funds for 2002 and 2007.

2002



2007

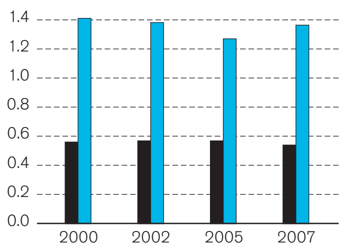


		2002				2007			
		BUSINESS ENTERPRISE	GOVERNMENT	OTHER NATIONAL SOURCES	ABROAD	BUSINESS ENTERPRISE	GOVERNMENT	OTHER NATIONAL SOURCES	ABROAD
Belgium	BE	1.15	0.45	0.06	0.28	1.16	0.42	0.07	0.25
Spain	ES	0.48	0.39	0.05	0.07	0.58	0.55	0.05	0.09
Hungary	HU	0.30	0.58	0.00	0.10	0.42	0.43	0.01	0.11
Germany	DE	1.63	0.79	0.01	0.06	1.72	0.70	0.01	0.10
France	FR	1.16	0.85	0.04	0.18	1.06	0.78	0.04	0.15
Netherlands	NL	0.86	0.64	0.02	0.20	..	..	..	..
United Kingdom	UK	0.78	0.52	0.11	0.39	0.85	0.55	0.10	0.32
EU-27	EU-27	0.95	0.62	0.04	0.15	0.97	0.60	0.04	0.16
United States	US	1.71	0.76	0.15	..	1.76	0.75	0.15	..
Japan	JP	2.34	0.58	0.23	0.01	2.67	0.54	0.22	0.01

Source: OECD, Main Science and Technology Indicators 2009-2.

A.1.4
GERD financed by public sector and private sector as a percentage of GDP

The indicator regroups all the sources of funds into two categories (public and private) in order to be able to evaluate to what degree the Barcelona target is met. In order to properly monitor public and private sources, the abroad source of funds is split into public and private sources, so that the private (public) part of the abroad source for R&D can be added to private (public) national sources of funds. These elements influence the type of science policies that are needed. However the public/private breakdown in the abroad source of funds is only available in a limited number of countries.
Thus we do this exercise only for Belgium in 2000-2007.



■ Public Sources ■ Private Sources

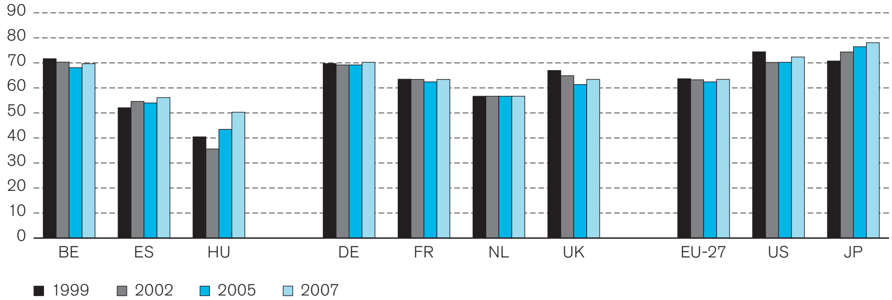
	2000	2002	2005	2007
Public sources	0.56	0.56	0.56	0.54
Private sources	1.41	1.38	1.27	1.36
GERD	1.97	1.94	1.83	1.90

Source: Federal Cooperation Commission, CFS/STAT.

A.1.5

Percentage of GERD performed by the business enterprise sector

Business enterprise expenditure on R&D (BERD) covers R&D activities carried out in the business sector by performing firms and institutes, regardless of the origin of funding. While the government and higher education sectors also carry out R&D, industrial R&D is most closely linked to the creation of new products and production techniques, as well as to a country's innovation efforts. The business enterprise sector has an important role to play in supporting and in performing R&D. It is essential to know its share in GERD and its evolution. This indicator gives information about the share of this sector in the national total intramural R&D expenditure and refers to the period 1999-2007.

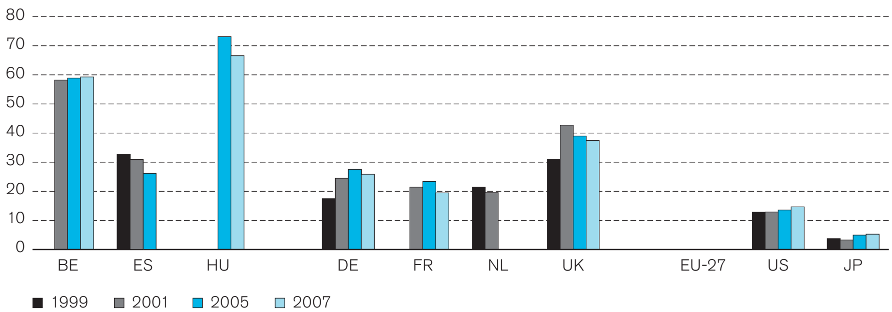


		1999	2002	2005	2007
Belgium	BE	71.6	70.4	68.0	69.5
Spain	ES	52.0	54.6	53.8	55.9
Hungary	HU	40.2	35.5	43.2	50.3
Germany	DE	69.8	69.2	69.3	70.0
France	FR	63.2	63.3	62.1	63.3
Netherlands	NL	56.4	56.7	56.4	56.5
United Kingdom	UK	66.8	64.9	61.4	63.4
EU-27	EU-27	63.6	63.2	62.4	63.3
United States	US	74.2	70.0	70.0	72.0
Japan	JP	70.7	74.4	76.5	77.9

Source: OECD, Main Science and Technology Indicators 2009-2.

A.1.6
R&D expenditure of foreign affiliates as a percentage of intramural R&D expenditures of enterprises

This indicator shows the share of industrial R&D which is under foreign control over the period 1999-2007. It is proposed for measuring the degree of internationalisation of technology. Industrial R&D is the main technological input that can be developed by a firm or parent company in a particular country, or else under the control of the latter it could be developed in various countries via a network of affiliates and R&D centres. This indicator is also used quite often as a proxy to measure the attractiveness of a country for R&D investments of foreign firms. The foreign affiliates are identified under the criterion of ultimate control. An investor (company or individual) is considered to be the investor of ultimate control of an investment if it is at the head of a chain of companies and directly or indirectly controls all the enterprises in the chain without itself being controlled by any other company or individual.



		1999	2001	2005	2007
Belgium	BE	..	58.2	59.0	59.4
Spain	ES	32.8	31.0	26.2	..
Hungary	HU	..	..	73.2	66.7
Germany	DE	17.8	24.8	27.8	26.2
France	FR	..	21.5	23.5	19.6
Netherlands	NL	21.5	19.6	..	..
United Kingdom	UK	31.2	42.8	39.1	37.5
EU-27	EU-27	..	..	..	..
United States	US	13.0	13.1	13.8	14.8
Japan	JP	3.9	3.4	5.1	5.4*

Sources: OECD, Main Science and Technology Indicators 2009-2; Federal Cooperation Commission, CFS/STAT.
*Note: *figure of 2006.*

A.1.7
Business enterprise intramural R&D expenditure (BERD) of Belgium per industry

This indicator yields information about the concentration of research in the main industrial sectors of the economy. The industrial specialisation of a country determines its general R&D intensity. A greater share of high-tech sectors in the economy is necessary in order to increase business R&D intensity. The manufacturing sectors are usually grouped into four types of industry according to R&D intensity: high-tech, medium high-tech, medium low-tech and low-tech industries, by decreasing order of R&D intensity. And the services sectors can also notably be grouped into knowledge-intensive high-tech, medium-tech and low-tech services. The classification per industry is according to product fields (ANBERD). Product field analysis focuses on the actual industrial orientation of the R&D carried out by units in the business enterprise sector. The data of different industrial sectors as a percentage of total of BERD refer to the period 1999-2007.

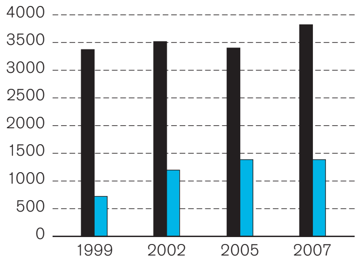
	1999	2002	2005	2007
MANUFACTURING INDUSTRIES	81.9	79.1	80.7	76.4
HIGH-TECH	36.5	39.7	40.6	42.4
→ Aircraft and spacecraft	1.4	1.6	1.7	1.9
→ Office, accounting and computing machinery	0.2	0.3	0.5	0.6
→ Radio, television and communication equipment and apparatus	15.9	16.2	10.7	9.0
→ Pharmaceuticals	17.8	19.1	24.5	28.3
→ Medical, precision, optical, watches and clocks instruments	1.2	2.5	3.2	2.6
MEDIUM HIGH-TECH	29.1	23.6	24.1	20.2
→ Motor vehicles, trailers and semi-trailers	3.8	2.1	2.6	2.8
→ Electrical machinery and apparatus n.e.c.	2.4	4.0	3.0	2.9
→ Chemicals and chemical products (less pharmaceuticals)	18.1	12.9	12.8	8.8
→ Machinery and equipment, n.e.c.	4.8	4.6	5.7	5.7
MEDIUM LOW-TECH	5.4	5.5	5.1	4.8
LOW-TECH	10.9	10.3	10.9	9.0
OTHER INDUSTRIES	3.2	3.9	2.4	3.2
SERVICES	14.9	17.0	16.9	20.4
HIGH-TECH	7.2	9.2	8.2	9.6
→ Computer and related activities	6.2	6.6	5.3	6.0
→ Research and development	0.3	0.0	0.0	0.0
→ Telecommunications	0.7	2.6	2.9	3.6
MEDIUM-TECH	6.0	6.4	6.4	8.3
LOW-TECH	1.7	1.4	2.3	2.5
TOTAL BERD	100.0	100.0	100.0	100.0

Source: Federal Cooperation Commission, CFS/STAT.

A.1.8

Business Enterprise sector in Belgium: intramural and extramural expenditures on R&D

A company may have expenditures on R&D either within the unit (intramural) or outside it (extramural). To a growing extent R&D is being bought (or sub-contracted). Extramural expenditures are the sums that a unit, organisation or sector reports having paid or committed themselves to pay to another unit, organisation or sector for the performance of R&D during a specific period. This includes acquisition of R&D performed by other units and grants given to others for performing R&D. Outsourcing of R&D is part of the phenomenon known as 'open innovation'; its importance can be assessed with this indicator. Data are presented in million constant EUR for the period 1999-2007.



■ Intramural expenditure on R&D ■ Extramural expenditure on R&D

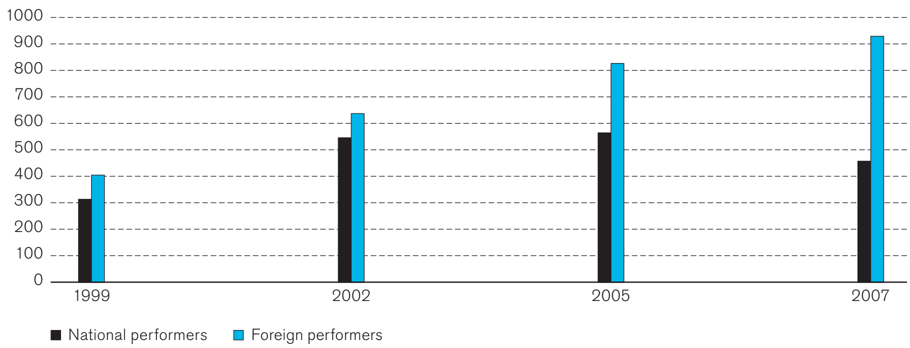
	1999	2002	2005	2007
Intramural expenditure on R&D	3372	3518	3402	3809
Extramural expenditure on R&D	711	1183	1391	1389

Source: Federal Cooperation Commission, CFS/STAT.

A.1.9

Business Enterprise sector in Belgium: extramural R&D expenditure per performer

In the context of the increasingly worldwide organisation of R&D and open innovation, greater use is made of analysis of extramural R&D according to national and foreign performers. This indicator includes R&D performed abroad but financed by the national business enterprise sector, and it also gives some supplementary information on R&D cooperation between the business enterprise sector and the different kinds of national or foreign performers. Data on the extramural R&D expenditures may also be helpful to those analysing the flows of funds reported by performers, particularly if there are gaps in survey coverage. Data are presented in million constant EUR for the period 1999-2007.

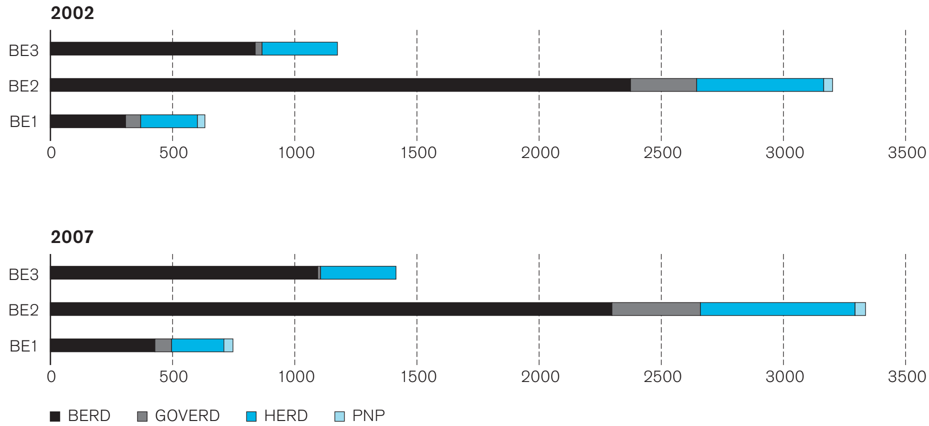


	1999	2002	2005	2007
NATIONAL PERFORMERS	310	547	564	461
BUSINESS ENTERPRISE SECTOR	197	329	350	282
→ Other enterprise in the same group	...	175	195	144
→ Other enterprise	...	154	155	138
HIGHER EDUCATION SECTOR	81	134	139	127
OTHER NATIONAL PERFORMERS	32	85	75	52
FOREIGN PERFORMERS	401	636	827	929
BUSINESS ENTERPRISE	373	559	751	848
→ Enterprise within the same group	...	361	546	498
→ Other enterprise	...	197	204	350
OTHER FOREIGN PERFORMERS	28	77	76	80
TOTAL	711	1183	1391	1389

Source: Federal Cooperation Commission, CFS/STAT.

A.1.10
Intramural R&D expenditures: regional data for all sectors

A regional distribution of R&D intramural expenditures is also recommended. For the EU member states, regional levels are given by the Nomenclature of Territorial Units for Statistics (NUTS) classification. The intramural R&D expenditures of Belgium are divided into three regional levels (NUTS1): the Brussels-Capital Region (BE1), the Flemish Region (BE2) and the Walloon Region (BE3).
The indicator informs us about two issues: the geographical concentration of research in Belgium over the three regions, on the one hand, and the importance of each of the four performing sectors in each region on the other. These data only deal with performance of R&D, not the funding. Regional data are presented in million constant EUR for 2002 and 2007.



	2002				2007			
	BRUSSELS-CAPITAL REGION	FLEMISH REGION	WALLOON REGION	BELGIUM	BRUSSELS-CAPITAL REGION	FLEMISH REGION	WALLOON REGION	BELGIUM
	BE1	BE2	BE3	BE	BE1	BE2	BE3	BE
BERD	304	2.375	839	3.518	424	2.294	1.091	3.809
GOVERD	63	270	26	358	69	361	12	442
HERD	232	519	305	1.057	214	638	305	1.158
PNP	28	35	0	63	34	35	0	69
GERD	627	3.199	1.170	4.996	742	3.328	1.409	5.478

Source: Federal Cooperation Commission, CFS/STAT.

A.2
R&D personnel

Basic information

Personnel data measure the human resources going directly to R&D activities. Resources devoted to R&D can be measured in real terms through all labour devoted to R&D, researchers as well as other R&D personnel. All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators and clerical staff.
The data on R&D personnel are also collected by means of retrospective and regular R&D surveys and presented in line with the standard OECD methodology for R&D statistics entitled 'Frascati Manual 2002 (OECD)'.
The data on R&D personnel are divided into four sectors of performance (like the GERD): business enterprise, higher education, government and private non-profit organisations (PNP).

Message

R&D investments are to a large extent a matter of investment in human resources. People who pursue R&D activities are the driver for knowledge creation in the field of technology. In 2007, the number of full-time equivalent researchers per thousand total employment was 6.4 in EU-27, compared to 11.0 in Japan and 9.7 in the United States (Figure A.2.1). With 8.3, Belgium scores well in terms of researchers compared with the EU-27 average.
Figure A.2.2 presents the total R&D personnel (FTE) per thousand total employment. The total R&D personnel consists not only of researchers, but also of technicians and other supporting staff. Per thousand total employment, 13.2 persons are counted as R&D personnel in Belgium (10.4 in EU-27) in 2007.
Figures A.2.1 and A.2.2 combined show that the researchers represent 62.6% of the total R&D personnel in Belgium (61.4% in EU-27).
The pool of researchers still remains much smaller in Belgium and in EU-27, especially in the business sector. Just under half of all researchers work in the business enterprise sector in Belgium and in EU-27, while in Japan and United States more researchers work in the private sector. In 2007, 49.7% of researchers are employed by the enterprises (Figure A.2.3). EU-27 has a lower share of business researchers (45.9%) than the United States (79.7%) and Japan (68.1%).
Not all member countries of the OECD or the EU provide R&D data on women. Figure A.2.4 shows that in Belgium 31.1% of the researchers (in terms of head-

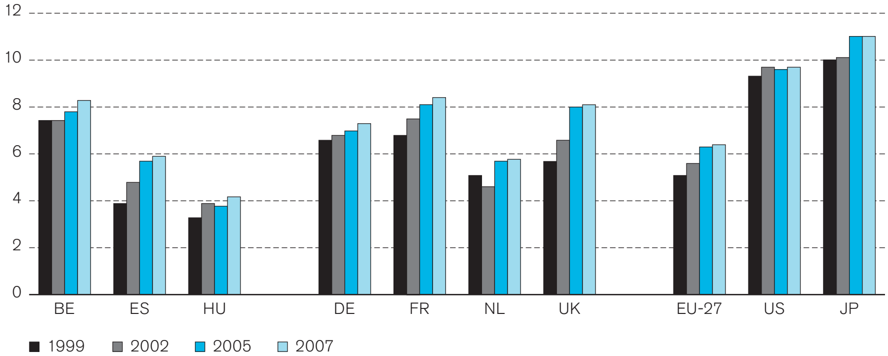
count) are women. In Spain, the UK and Hungary, the representation of women researchers is slightly more than one-third. The under-representation of women in R&D activities results from both exogenous and endogenous factors, such as the attractiveness of research careers, study and career choices, etc.

The annual growth of the number of researchers and of the total R&D personnel has been slightly higher than that of the GERD counterpart (Figure A.2.5), meaning that the intramural R&D expenditures per researcher decreased slightly over the past years.
As was the case when looking at the expenditure side of R&D, business enterprise sector and higher education sector are also the most important R&D employment sectors. In 2007, the respective shares were about 49.7% and 42.6% of the total number of researchers in Belgium. They represented respectively 58.7% and 33.7% of the national total R&D personnel. The annual growth of R&D human resources in the private sector has remained similar to that of the intramural R&D expenditures in this sector (period 1999-2007). The intramural R&D expenditures per researcher in business enterprise sector have therefore remained stable in recent years. Researchers in the business enterprise represent 53.1% of the total R&D personnel of the sector in 2007 (79.1% in the higher education sector).
The conception, creation and diffusion of new knowledge, new products, processes and services largely depends on the general level of education of the R&D human resources. In 2007, 38,919 FTE R&D personnel are university tertiary graduates (i.e. holders of a university degree at PhD level or of a basic university degree) and 32,913 FTE of them are researchers (Figure A.2.6). The university tertiary graduates represent 57.0% of the total R&D personnel in the business enterprise sector (and even 82.0% of the total number of researchers). For obvious reasons these proportions are higher in the higher education sector (respectively 83.9% and 99.6%). In Belgium, 16.1% of the total R&D personnel have a PhD; 25.6% of the total researchers have a PhD.

In 2007, about 61.3% of total R&D personnel and 61.7% of researchers were employed in the Flemish Region (see Figure A.2.7). These shares have been stable since 2002 and are quite similar to the corresponding GERD counterparts. These proportions are respectively 23.1% and 21.7% for the Walloon Region and 15.7% and 16.6% for the Brussels-Capital Region. As might be expected, the business enterprise is the most important sector in both the Flemish Region and the Walloon Region. By contrast, the higher education sector is the most important in the Brussels-Capital Region.

A.2.1
Total researchers (FTE) per thousand total employment

Researchers are considered to be professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned. One of the main indicators for the availability of research skills in the labour force of a country is the share of researchers in the total employment. The data for researchers are generally given in full time equivalent (FTE). One FTE may be thought of as one person-year. The FTE is a true measure of the volume of R&D and must be maintained for international and sector-based comparisons. This indicator refers to the period 1999-2007.



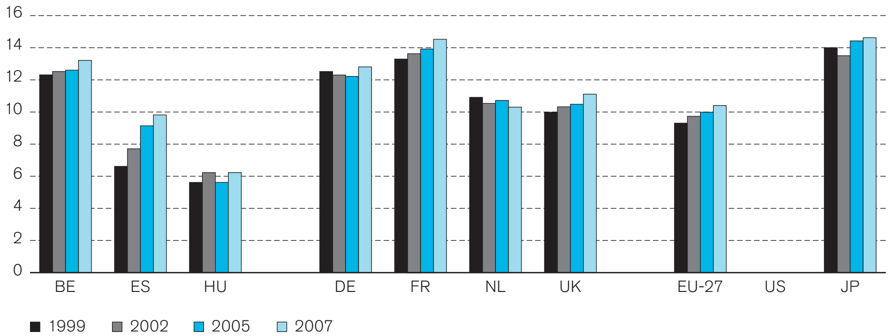
		1999	2002	2005	2007
Belgium	BE	7.4	7.4	7.8	8.3
Spain	ES	3.9	4.8	5.7	5.9
Hungary	HU	3.3	3.9	3.8	4.2
Germany	DE	6.6	6.8	7.0	7.3
France	FR	6.8	7.5	8.1	8.4
Netherlands	NL	5.1	4.6	5.7	5.8
United Kingdom	UK	5.7	6.6	8.0	8.1
EU-27	EU-27	5.1	5.6	6.3	6.4
United States	US	9.3	9.7	9.6	9.7*
Japan	JP	10.0	10.1	11.0	11.0

Source: OECD, Main Science and Technology Indicators 2009-2.
*Note: *figure of 2006.*

A.2.2

Total R&D personnel (FTE) per thousand total employment

Total R&D personnel, researchers and human resources in science and technology (HRST) are usually considered as the three broad statistical categories of human resources in science and technology. All scientific and technical persons employed directly on R&D are integral parts of R&D personnel, as well as those providing direct services such as R&D managers, administrators, and clerical staff. The indicator on R&D personnel complements the previous indicator on researchers by including the technical personnel and other supporting staff for R&D. Data on R&D personnel are also expressed in full-time equivalent (FTE) and physical persons (headcount). This indicator also refers to the period 1999-2007.

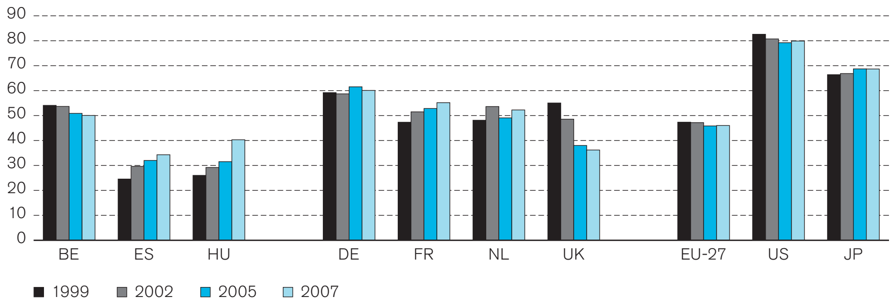


		1999	2002	2005	2007
Belgium	BE	12.3	12.5	12.6	13.2
Spain	ES	6.6	7.7	9.1	9.8
Hungary	HU	5.6	6.2	5.6	6.2
Germany	DE	12.5	12.3	12.2	12.8
France	FR	13.3	13.6	13.9	14.5
Netherlands	NL	10.9	10.5	10.7	10.3
United Kingdom	UK	9.9	10.3	10.5	11.1
EU-27	EU-27	9.3	9.7	10.0	10.4
United States	US	..	..	..	..
Japan	JP	14.0	13.5	14.4	14.6

Source: OECD, Main Science and Technology Indicators 2009-2.

A.2.3
Business enterprise researchers as a percentage of national total

The business enterprise sector has a major role to play in performing R&D which leads to the implementation of technologically new or improved products and processes. The number of researchers employed in the business sector therefore constitutes an indicator of a country's potential of human R&D capital. The number of researchers in the private sector influences not only knowledge production but also the capacity to absorb and exploit knowledge produced elsewhere. The more people are skilled to conduct industrial research activities, the more fully the business enterprise sector contributes to the expansion of a country's innovation system. The figures reported here relate to the period 1999-2007.



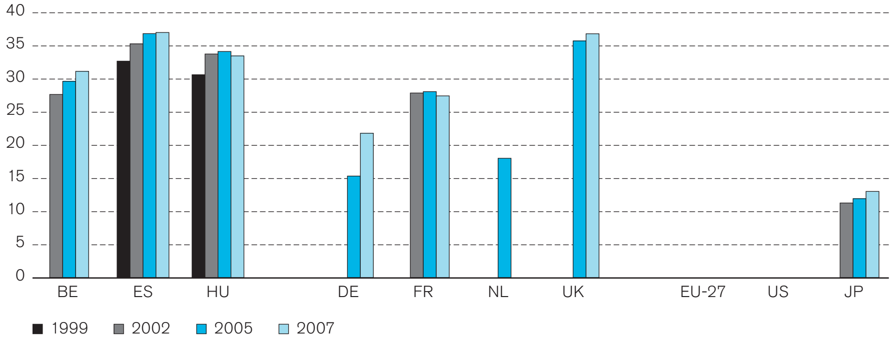
		1999	2002	2005	2007
Belgium	BE	53.8	53.4	50.6	49.7
Spain	ES	24.7	29.6	31.9	34.3
Hungary	HU	25.9	29.0	31.5	40.2
Germany	DE	59.0	58.5	61.3	59.9
France	FR	47.0	51.1	52.8	55.0
Netherlands	NL	47.9	53.5	49.0	52.2
United Kingdom	UK	55.0	48.3	37.7	36.0
EU-27	EU-27	47.2	47.1	45.7	45.9
United States	US	82.0	80.1	79.1	79.7*
Japan	JP	65.8	66.7	68.3	68.1

Source: OECD, Main Science and Technology Indicators 2009-2.
*Note: *figure of 2006.*

A.2.4

Women researchers as a percentage of total researchers (based on headcount)

This indicator provides information on the participation of women in R&D activities. A good representation of women among researchers is one of the factors influencing the stock of human resources for research. Headcount (physical persons) data are the most appropriate measure for collecting additional information about R&D personnel, such as age, gender or national origin. This indicator refers to the period 1999-2007.

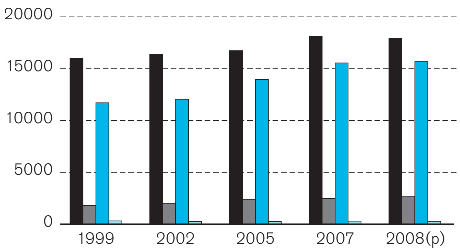


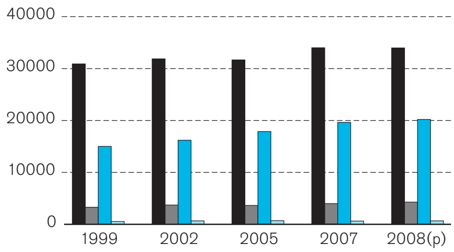
		1999	2002	2005	2007
Belgium	BE	..	27.7	29.6	31.1
Spain	ES	32.7	35.2	36.7	37.0
Hungary	HU	30.7	33.7	34.2	33.5
Germany	DE	..	..	21.4	23.2
France	FR	..	27.8	28.0	27.4*
Netherlands	NL	..	..	18.0	..
United Kingdom	UK	..	..	35.7	36.7
EU-27	EU-27	..	..	..	..
United States	US	..	..	..	..
Japan	JP	..	11.2	11.9	13.0

Source: OECD, Main Science and Technology Indicators 2009-2.
*Note: * figure of 2006.*

A.2.5
Total number of researchers and total R&D personnel (FTE) in Belgium according to performing sector

Researchers and total R&D personnel per performing sector, provide an opportunity to assess the investment in human resources for the R&D activities of the various R&D players of a country. In the business enterprise sector, R&D personnel and in particular, researchers are more focused on the creation of products and processes, while in the public sectors, higher education and government, researchers are involved in contributing to the development of basic and applied research. The figures reported here relate to the period 1999-2008 (p).





		1999	2002	2005	2007	2008 (p)
BUSINESS ENTERPRISE	Researchers	15996	16363	16769	18064	17838
	Total R&D personnel	30868	31686	31613	34011	33938
GOVERNMENT	Researchers	1738	1980	2274	2526	2652
	Total R&D personnel	3132	3687	3589	3844	4032
HIGHER EDUCATION	Researchers	11673	12066	13853	15461	15616
	Total R&D personnel	14957	16108	17767	19544	20166
PRIVATE NON-PROFIT	Researchers	324	259	250	267	277
	Total R&D personnel	509	574	548	564	598
NATIONAL TOTAL	Researchers	**29732**	**30668**	**33146**	**36318**	**36382**
	Total R&D personnel	**49466**	**52054**	**53517**	**57963**	**58733**

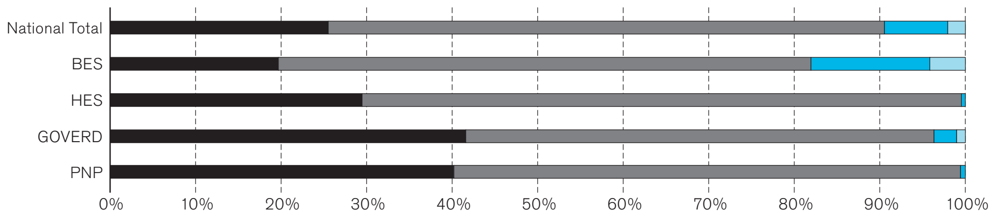
Source: Federal Cooperation Commission, CFS/STAT.
Note: Data of 2008 are provisional and compiled in line with the Eurostat data collection of preliminary 2008 data on R&D personnel and expenditure.

A.2.6

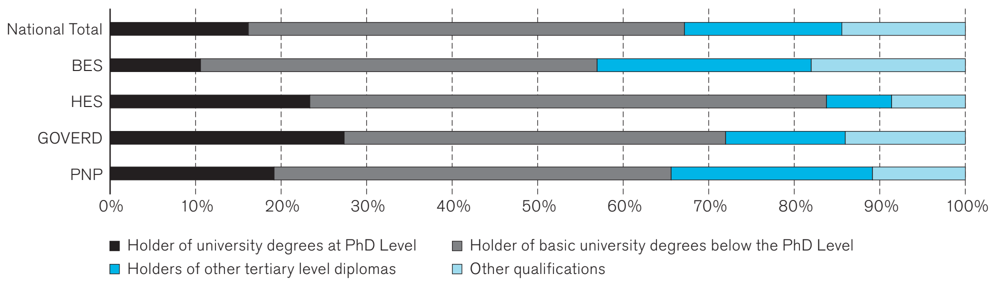
Total number of researchers and total R&D personnel in FTE per performing sector according to level of formal qualification

Two approaches may be used to classify R&D personnel: the most commonly used is by occupation, the other is by level of formal qualification. The classification by level of formal qualification provides the information on classes that define exclusively the level of education, regardless of the field in which personnel are qualified. The international classification of education developed by UNESCO (ISCED) provides the basis for classifying R&D personnel by formal qualification. The classification by level of formal qualification of human resource for R&D is important for broader analyses, for example for setting up total personnel databases and for forecasting needs and supplies of highly qualified S&T personnel. The reference date for the data is 2007.

Researchers (FTE)



Total R&D personnel (FTE)



	TOTAL NUMBER OF RESEARCHERS					TOTAL R&D PERSONNEL				
	BES	HES	GOVERD	PNP	TOTAL	BES	HES	GOVERD	PNP	TOTAL
Holders of university degrees at PhD level	3569	4575	1053	108	9305	3613	4575	1053	108	9349
Holders of basic university degrees below PhD level	11249	10819	1382	158	23608	15777	11818	1713	262	29570
Holders of other tertiary level diplomas	2539	62	66	1	2668	8494	1474	543	133	10643
Other qualifications	706	6	25	0	737	6126	1678	536	61	8401
TOTAL NUMBER OF RESEARCHERS	**18064**	**15461**	**2526**	**267**	**36318**	**34011**	**19544**	**3844**	**564**	**57963**

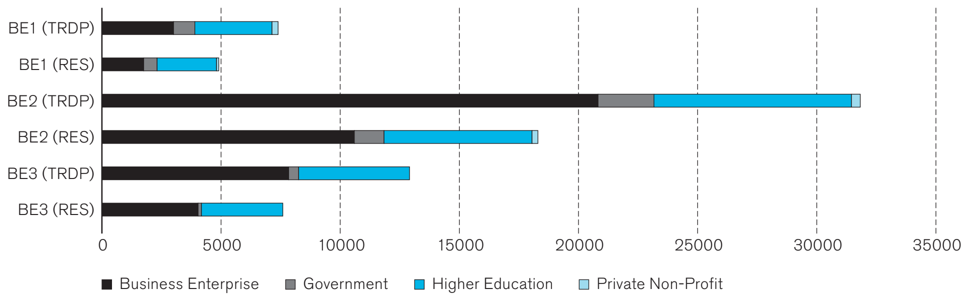
Source: Federal Cooperation Commission, CFS/STAT.

A.2.7

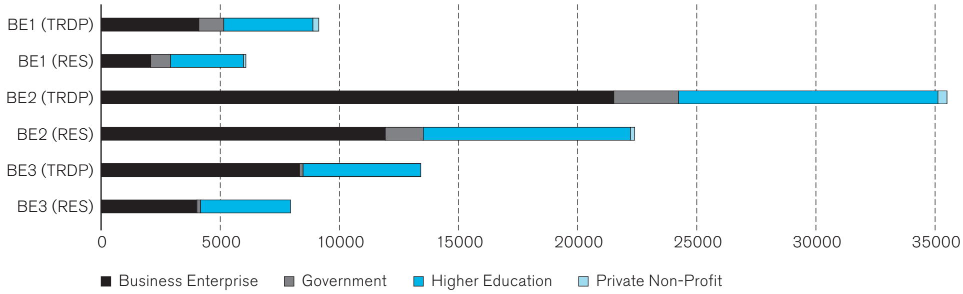
Total number of researchers (RES) and total R&D personnel (TRDP) in FTE per performing sector: regional data for all sectors

Belgium is divided into three regions (NUTS1): the Brussels-Capital Region (BE1), the Flemish Region (BE2) and the Walloon Region (BE3). In Belgium, the regional data are derived either directly, by classifying the statistical units, or by including a separate question on this breakdown in surveys, especially for the units which have R&D activities in several regions. The regional data for all sectors reported here relate to the years 2002 and 2007.

2002



2007



	BRUSSELS-CAPITAL REGION		FLEMISH REGION		WALLOON REGION		BELGIUM	
	2002							
	RES	TRDP	RES	TRDP	RES	TRDP	RES	TRDP
Business Enterprise	1757	3000	10580	20865	4026	7820	16363	31686
Government	547	891	1285	2351	148	445	1980	3687
Higher Education	2497	3219	6226	8279	3343	4610	12066	16108
Private Non-Profit	71	208	189	366	0	0	259	574
TOTAL	**4872**	**7317**	**18279**	**31862**	**7517**	**12875**	**30668**	**52054**
	2007							
Business Enterprise	2107	4128	11952	21577	4004	8306	18064	34011
Government	800	1008	1590	2674	137	162	2526	3844
Higher Education	3038	3734	8665	10894	3758	4916	15461	19544
Private Non-Profit	77	204	190	360	0	0	267	564
TOTAL	**6022**	**9074**	**22398**	**35505**	**7899**	**13384**	**36318**	**57963**

Source: Federal Cooperation Commission, CFS/STAT.

A.3 Human Resources in Science and Technology

Basic information

In knowledge-based economies, where ideas and knowledge are central factors in the innovation and growth process, countries must maintain their stock of human capital and educational level. Moreover, the availability of a skilled labour force is an essential condition for competitiveness. In order to achieve optimal use of human capital, there is a need to anticipate shortfalls in the supply of skilled persons and to provide training opportunities throughout a person's professional career.

Human resources in science and technology are so-called input variables: these people and their training are indispensable ingredients for fostering economic growth and enhancing competitiveness and the general future well-being of a nation.

The first and main source of human resources in science and technology (HRST) is, of course, the education system. Some professions are also regarded as belonging to the HRST category, more particularly researchers and engineers. The OECD has published a 'Manual on the measurement of human resources devoted to S&T' to harmonise the collection of these data ('Canberra Manual'). With regard to the economic performance of doctorate holders, at regular intervals (2005, 2009) the OECD conducts surveys to gauge their career paths and international mobility patterns.

The data used in this section differ from the R&D personnel data of section A.2. in as much as they are not collected by means of company surveys, but rather by means of education statistics.

Key message

Compared to the reference countries, Belgium invests most in education as a share of GDP, followed directly by France and the United States (A.3.1).

When paying attention to the graduation rates at the first stage university level, we notice that in Belgium 40% of the students succeed in attaining this level. This is the lowest figure of all the countries taken into consideration. The situation is more favourable when we take the graduation rates at the doctoral level into account, but even then Belgium remains below the EU average. If we focus our attention on the science and engineering degrees at the first stage university and doctoral level, Belgium performs much better. Belgium differs in no significant manner from the other countries with regard to the fact that the distribution between science and engineering degrees at the doctoral level is dominated by the former (A.3.4, A.3.5, A.3.6 and A.3.7).

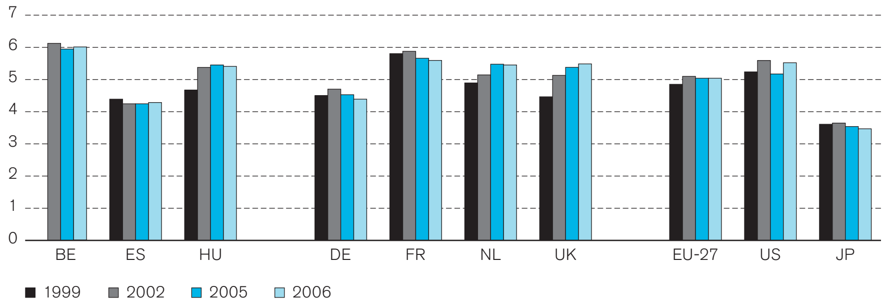
In a knowledge-based economy it is not only important to have a sufficiently large human capital stock of scientists and engineers, it is also important to create opportunities for people so they can constantly refine their skills to keep in touch with the latest developments in science and technology. A possible indicator for measuring this is the participation of a population in lifelong learning activities. Belgium and its neighbouring countries Germany and France show figures that indicate a rather low participation in lifelong learning. This conclusion is especially strong in comparison with countries like the Netherlands and the United Kingdom, where more than 15% of the people indicate they have received education or training in the four weeks preceding the survey (A.3.8).

The creation of knowledge has become an international activity. The community of knowledge workers no longer consists of individuals working independently of one another. Cooperation between researchers with different backgrounds is becoming more and more the prevailing standard. Also, the physical boundaries that hindered a smooth and efficient exchange of information are disappearing at an unrelentingly rate, thanks to new developments in information and communication technology. All of this is reflected by the fact that an increasing number of doctoral students stay for a certain period at a research institute abroad. The United Kingdom attracts the largest share of foreign students in the European Union. France and Belgium can also be considered among the leading countries (A.3.9).

A.3.1

Public expenditure on education as a percentage of GDP

Generally the public sector funds education either by directly bearing the current and capital expenses of educational institutions (direct expenditure for educational institutions) or by supporting students and their families with scholarships and public loans as well as by transferring public subsidies for educational activities to private firms or non-profit organisations (transfers to private households and firms). Both types of transaction together are reported as total public expenditure on education. The total public expenditure on education as a percentage of GDP is an indicator on spending on human resources.

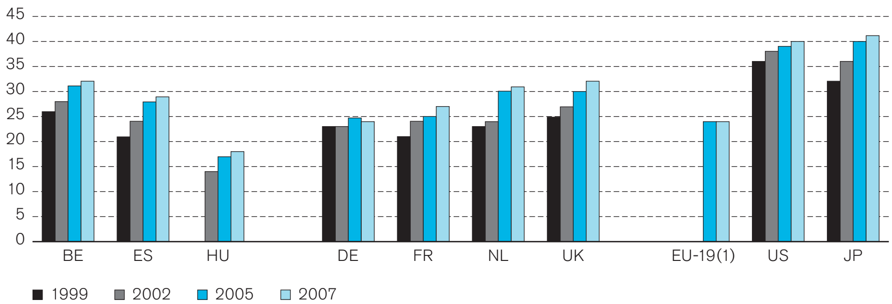


		1999	2002	2005	2006
Belgium	BE	..	6.11	5.95	6.00
Spain	ES	4.38	4.25	4.23	4.28
Hungary	HU	4.66	5.38	5.46	5.41
Germany	DE	4.51	4.70	4.53	4.40
France	FR	5.81	5.88	5.65	5.58
Netherlands	NL	4.90	5.15	5.48	5.46
United Kingdom	UK	4.47	5.11	5.37	5.48
EU-27	EU-27	4.86	5.10	5.04	5.04
United States	US	5.23	5.58	5.17	5.51
Japan	JP	3.60	3.65	3.52	3.47

Source: Eurostat, 2009.

A.3.2
Population with tertiary education

This is a general indicator of the supply of advanced skills. It is not limited to science and technical fields because the adoption of innovations in many areas, in particular in the service sectors, depends on a wide range of skills. Furthermore, it includes the entire working age population, because future economic growth could require drawing on the non-active fraction of the population. However, international comparisons of educational levels are difficult, due to the large discrepancies in educational systems, access, and the level of attainment that is required to receive a tertiary degree.
Tertiary-level graduates are defined as holders of degrees at the ISCED levels 5B, 5A and 6. University graduates only include graduates at ISCED levels 5A and 6. ISCED level 5A programmes are long-stream programmes which are theoretically-based or preparatory to research. The short streams (ISCED 5B) are more practically oriented. ISCED level 6 programmes are advanced research programmes.



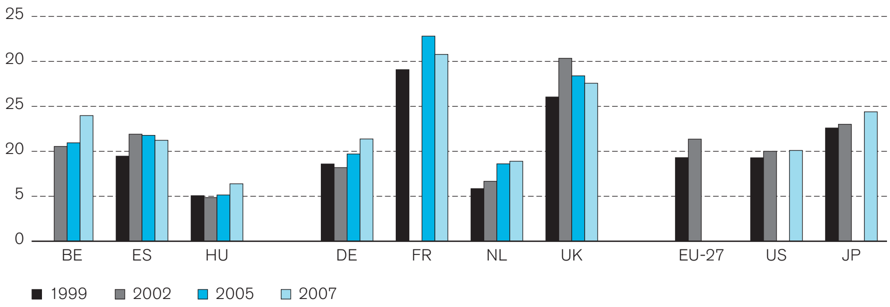
		1999	2002	2005	2007
Belgium	BE	26	28	31	32
Spain	ES	21	24	28	29
Hungary	HU	..	14	17	18
Germany	DE	23	23	25	24
France	FR	21	24	25	27
Netherlands	NL	23	24	30	31
United Kingdom	UK	25	27	30	32
EU-27	EU-19(1)	..	..	24	24
United States	US	36	38	39	40
Japan	JP	32	36	40	41

Source: OECD, Education at a Glance 2009.
Note: Data expressed as a percentage of the 25-64 age class —(1) data on the EU-27 are on EU-19.

A.3.3

Total tertiary graduates in science and technology

The science and technology graduates' indicator includes new tertiary graduates obtaining their degree or diploma during a calendar or academic year from both public and private institutions after completing tertiary level of education (graduate and post graduate studies) compared to an age group that corresponds to the typical graduation age in most countries and according to the national requirements for a successful completion.
Following the conclusions reached in Lisbon in 2000, the ministers of education have set a number of major objectives to be achieved by 2010 in education and training, among which is to improve the quality and effectiveness of EU education and training systems. An important sub-objective is to increase the recruitment for scientific and technical studies. Europe needs an adequate throughput of mathematics and science specialists in order to maintain its competitiveness.

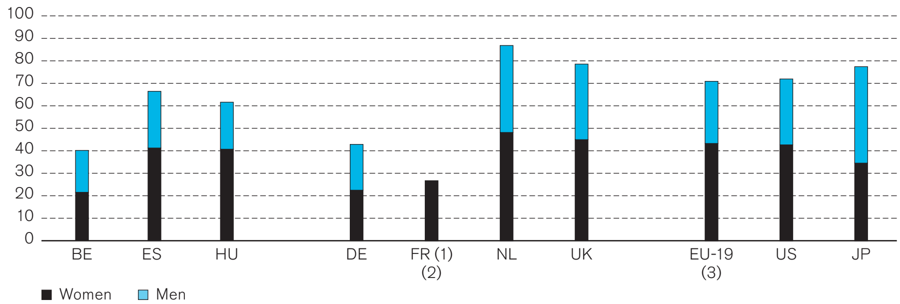


		1999	2002	2005	2007
Belgium	BE	..	10.5	10.9	14
Spain	ES	9.5	11.9	11.8	11.2
Hungary	HU	5.1	4.8	5.1	6.4
Germany	DE	8.6	8.1	9.7	11.4
France	FR	19	..	22.8	20.7
Netherlands	NL	5.8	6.6	8.6	8.9
United Kingdom	UK	16	20.3	18.4	17.5
EU-27	EU-27	9.2	11.3	..	..
United States	US	9.3	10	..	10.1
Japan	JP	12.6	13	..	14.4

Source: Eurostat.
Note: Data expressed per 1000 of population aged 20-29.

A.3.4
Graduation rates of men and women at first stage university level

University graduates obtain tertiary degrees at levels 5A and 6 of the 1997 International Standard Classification of Education (ISCED 1997). The first stage (ISCED 5A) of university education is composed of long-stream programmes which are largely theoretically-based or preparatory to research and which provide qualifications to enter advanced research programmes at level ISCED 6 or professions with high skill requirements. Graduation rates represent the share of persons receiving a degree in the population at the typical age of graduation. Figures refer to the net graduation rates of 2006, summing graduation rates by individual years of age.

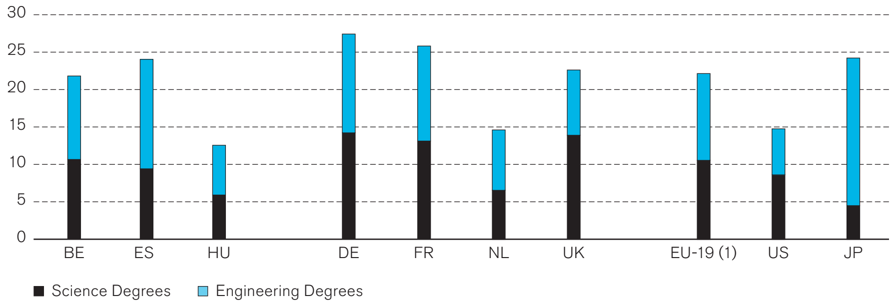


		FIRST STAGE UNIVERSITY GRADUATION RATES			PERCENTAGE OF FIRST STAGE UNIVERSITY DEGREES AWARDED TO WOMEN
		WOMEN	MEN	TOTAL	
Belgium	BE	21.22	18.43	39.64	53.5
Spain	ES	40.77	25.45	66.22	61.6
Hungary	HU	40.36	20.77	61.14	66.0
Germany	DE	22.24	20.24	42.48	52.4
France	FR (1) (2)	26.04	..	26.04	..
Netherlands	NL	48.07	38.13	86.20	55.8
United Kingdom	UK	44.77	33.39	78.17	57.3
EU-27	EU-19 (3)	43.23	27.49	70.71	61.1
United States	US	42.43	29.09	71.52	59.3
Japan	JP	34.21	42.85	77.05	44.4

Source: OECD, Education at a Glance, 2009.
Note: Data expressed as a percentage of the relevant age cohort
(1) A breakdown by gender is not available for France. The bar for women corresponds to graduation rates for both men and women. — (2) 2004 instead of 2006 — (3) data on the EU-27 are on EU-19.

A.3.5
Science and engineering degrees at first stage university level

Science degrees include: life sciences; physical sciences; mathematics and statistics; and computing. Engineering degrees comprise: engineering and engineering trades; manufacturing and processing; and architecture and building. The reference date for the data is 2006.

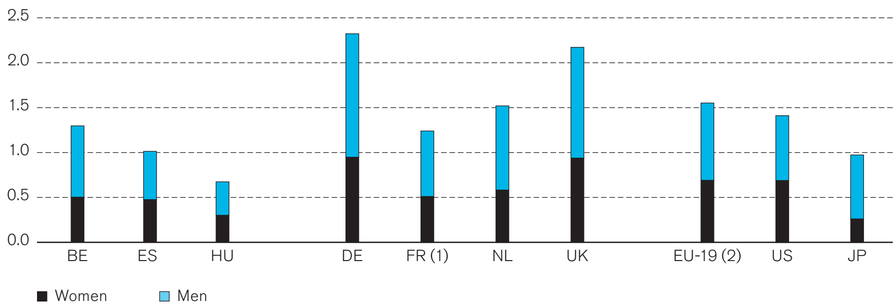


		SCIENCE DEGREES	ENGINEERING DEGREES	SCIENCE & ENGINEERING DEGREES
Belgium	BE	10.7	11.1	21.8
Spain	ES	9.4	14.6	24.0
Hungary	HU	5.9	6.5	12.4
Germany	DE	14.3	13.0	27.2
France	FR	13.1	12.6	25.7
Netherlands	NL	6.5	8.0	14.5
United Kingdom	UK	13.9	8.6	22.5
EU-27	EU-19 (1)	10.6	11.5	22.1
United States	US	8.7	6.0	14.7
Japan	JP	4.5	19.6	24.1

Source: OECD, Education at a Glance, 2008.
Note: Expressed as a percentage of all new degrees at first stage university level
(1) data on the EU-27 are on EU-19.

A.3.6
Graduation rates at doctoral level

Doctoral graduates have attained the second stage of university education and obtain a degree at ISCED level 6. They have successfully completed an advanced research programme and earned an advanced research qualification, e.g. Ph.D. They are qualified for faculty posts in institutions offering ISCED 5A programmes. In most countries the theoretical duration of a doctoral programme is three years full-time, although actual enrolment times are typically longer. The completion of an advanced research programme 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. The reference date for the data is 2006.

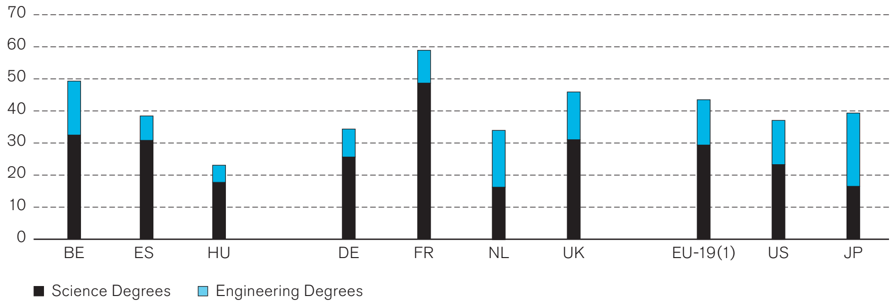


		DOCTORAL GRADUATION RATES			PERCENTAGE OF DOCTORAL DEGREES AWARDED TO WOMEN
		WOMEN	MEN	TOTAL	
Belgium	BE	0.49	0.80	1.29	38.2
Spain	ES	0.47	0.54	1.01	46.8
Hungary	HU	0.30	0.37	0.67	44.3
Germany	DE	0.95	1.37	2.32	40.9
France	FR (1)	0.51	0.72	1.23	41.4
Netherlands	NL	0.58	0.93	1.51	38.7
United Kingdom	UK	0.94	1.23	2.17	43.2
EU-27	EU-19 (2)	0.69	0.86	1.55	44.2
United States	US	0.69	0.72	1.41	48.9
Japan	JP	0.26	0.71	0.97	26.7

Source: OECD, Education at a Glance, 2009.
Note: Expressed as a percentage of the relevant age cohort
(1) 2005 instead of 2006
(2) data on the EU-27 are on EU-19.

A.3.7
Science and engineering degrees at doctoral level

Science degrees include: life sciences; physical sciences; mathematics and statistics; and computing. Engineering degrees comprise: engineering and engineering trades; manufacturing and processing; and architecture and building. The reference date for the data is 2006.



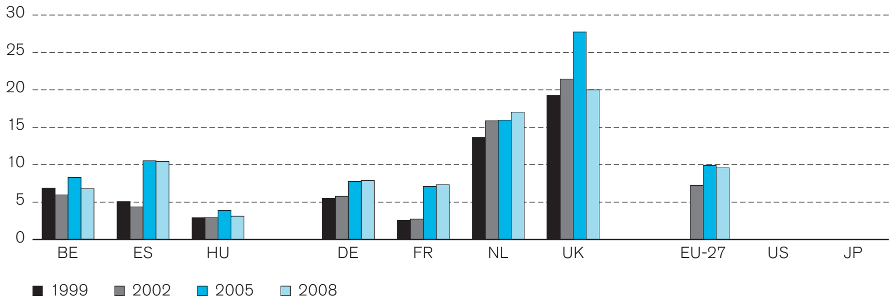
		SCIENCE DEGREES	ENGINEERING DEGREES	SCIENCE & ENGINEERING DEGREES
Belgium	BE	32.5	16.6	49.2
Spain	ES	30.8	7.4	38.2
Hungary	HU	17.9	5.1	23.0
Germany	DE	25.5	8.8	34.2
France	FR	48.8	10.4	59.2
Netherlands	NL	16.0	17.9	33.9
United Kingdom	UK	31.2	14.6	45.8
EU-27	EU-19 (1)	29.4	14.0	43.4
United States	US	23.1	13.7	36.8
Japan	JP	16.4	23.0	39.4

Source: OECD, Education database, 2009.
Note: Expressed as a percentage of all new degrees at doctoral level
(1) data on the EU-27 are on EU-19.

A.3.8

Participation in lifelong learning

Life-long learning refers to persons aged 25 to 64 who stated that they received education or training in the four weeks preceding the survey (numerator). The denominator consists of the total population of the same age group, excluding those who did not answer the question about 'participation in education and training'. Both the numerator and the denominator come from the EU Labour Force Survey. The information collected relates to all education or training whether or not relevant to the respondent's current or possible future job.

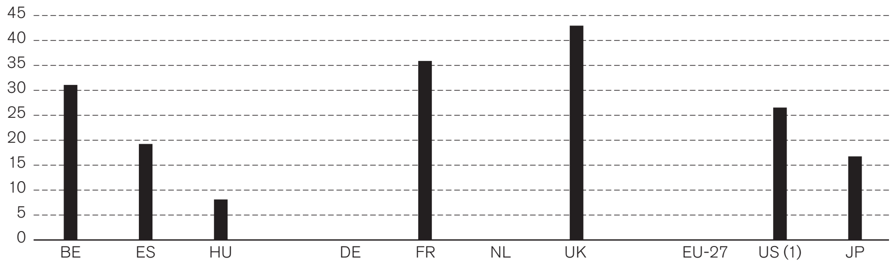


		1999	2002	2005	2008
Belgium	BE	6.9	6	8.3	6.8
Spain	ES	5	4.4	10.5	10.4
Hungary	HU	2.9	2.9	3.9	3.1
Germany	DE	5.5	5.8	7.7	7.9
France	FR	2.6	2.7	7.1	7.3
Netherlands	NL	13.6	15.8	15.9	17
United Kingdom	UK	19.2	21.3	27.6	19.9
EU-27	EU-27	..	7.2	9.8	9.5
United States	US	..	..	..	..
Japan	JP	..	..	..	..

Source: Eurostat, 2009.
Notes: Expressed as percentage of the 25-64 age class.

A.3.9
Share of foreign doctoral students

International mobility of doctoral students is an indicator of the internationalisation of both the higher education sector and the research system. Doctoral students are defined according to the International Classification of Education developed by UNESCO (ISCED 1997). ISCED level 6 corresponds to programmes that lead to an advanced research qualification, equivalent to a doctorate. The reference date for the data is 2006.



		FOREIGN DOCTORAL STUDENTS
Belgium	BE	31.0
Spain	ES	19.2
Hungary	HU	8.1
Germany	DE	..
France	FR	35.8
Netherlands	NL	..
United Kingdom	UK	42.7
EU-27	EU-27	..
United States	US (1)	26.3
Japan	JP	16.8

Source: OECD, Education database, 2009.
Note 1: As a percentage of total doctoral enrolment in host country
Note 2: Foreign doctoral students include foreign students from non-OECD countries.
(1) 2001 instead of 2006.

A.4 Government Budget Appropriations or Outlays on R&D (GBAORD)

Basic information

The GBAORD is based on the budget programmes of the various federal, regional and community authorities. Some of these are linked to scientific policy and others to budgets assigned to scientific and technological activities.
Only the R&D proportion of a budget item is to be taken into account in order to be part of the GBAORD.
In line with the related OECD and EU Directives, this indicator is not based on real expenditure on scientific and technological activities but on the budget allocations of the aforementioned authorities, and this irrespective of where the money is spent, thus whether or not within the public sector or within the national territory.

The GBAORD aggregate is different from and must not be confused with government-financed GERD[3].
There are two main differences:

- → Government-financed GERD is based on surveys by R&D performers, whereas GBAORD is based on government budgets;
- → Government-financed GERD covers R&D performed on national territory, whereas GBAORD also includes payments to foreign performers (including international organisations).

The GBAORD tells us something about the theoretical destination of the investment. It shows trends in the financial involvement and attitude of the public authorities over time towards investment in research and development.
The GBAORD is presented in relation to socio-economic objectives (according to the NABS classification[4]). Finally, this indicator is particularly valuable for the purposes of international comparison, as it is used by all of the OECD countries.
In Belgium, another classification 'CFS/STAT nomenclature' is also used. More explanation about this classification is given under A.4.4.

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3. See first subsection on input indicators, which deals with the Gross Domestic Expenditure on R&D (GERD).
4. Details on the NABS classification can be found on the website of EUROSTAT: *http://ec.europa.eu/eurostat/ramon/index.cfm?TargetUrl=DSP_PUB_WELC*; choose 'Classifications', search for 'NABS' and two nomenclatures are presented: the older 'NABS 1992' and the new 'NABS 2007' (applicable since 2007).

The observed period goes from 1999 till 2008 and the GBAORD data are based on final budgets. Data for 2009 are not used for the international comparison, because they are not available for most countries. And even if available, e.g. in the Belgian context, they are not used either, because those data are based on provisional budget data and are therefore less reliable.

Message

Belgium's GBAORD expressed as a percentage of the gross domestic product (GDP) lies below the EU-27 average and as such reveals an underinvestment in R&D by the authorities in Belgium.
One should however admit that this indicator does not take into account the efforts undertaken by the authorities to support research by means other than subsidies, e.g. the tax system. Belgium started gradually to develop this instrument since 2003. At the end of 2009, the OECD developed a questionnaire to collect information on countries' R&D tax incentives schemes. Further analysis on the national estimates is under way at the OECD.
When making international comparisons, it is also worth mentioning that the weight of the socio-economic objective 'defence' in the total GBAORD can be quite important in some countries (in 2008: USA: 56%; FR: 27%; UK: 21%).

The GBAORD indicator reveals three important messages :

→ The authorities in Belgium have not been the best public investors in R&D in Europe.
  There was no tendency for Belgium to genuinely catch up with the European average, despite efforts from the Flemish Community and the Walloon Region in particular. However, the year 2008 shows an important increase in the GBAORD of Belgium as a percentage of the GDP. The question is whether this is the beginning of a real catching up in budgetary credits or just a one-shot phenomenon.

→ The Federal authority's share in the GBAORD of the country has experienced a continuous decline over the last two decades. The share was 43% in 1989. In 2008 this was reduced to 25%. This eye-opening change is a good illustration of the growing impact of the regional authorities in the scientific decision-making of the country. But of course the recent tax credits change the numbers and the respective weight of each of the Belgian authorities in the total public effort regarding research funding.

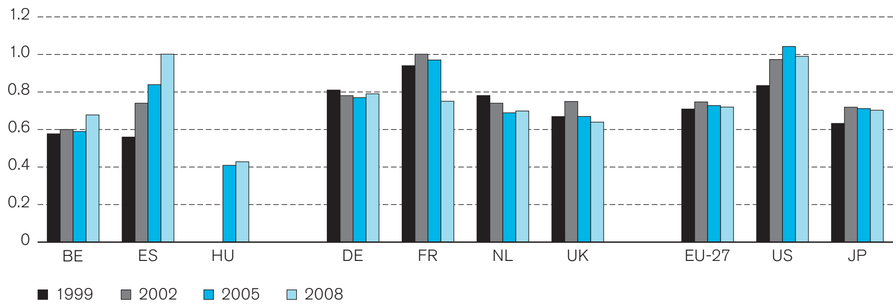
→ The public efforts in R&D in Belgium are highly oriented towards 'technological objectives'. Indeed, NABS 6 'Industrial production and technology' and NABS 13 'General advancement of knowledge: R&D financed from other sources than GUF (=General university funds)' combined represent a very high 57% of the total GBAORD in 2008.

WHAT ABOUT THE R&D TAX CREDITS IN ALL OF THIS?

- → R&D-tax credits are not integrated into the GBAORD as tax credits deal with revenues foregone for the government. As such they are less visible in STI statistics.
- → However, the recent tax credits change the numbers and the respective weight of each of the Belgian authorities in the total public effort regarding research funding. The ministry of finance estimates the foregone revenues for 2009 due to the main R&D tax credits at a total of 470 million €. This comes very close to the GBAORD for the Federal authorities, which is slightly above 500 million €. This means that the federal support of research funding as shown by the GBAORD data could nearly double.
- → The OECD is working on an indicator showing the indirect government support for research (through tax credits) in comparison with GBAORD for OECD countries. As a matter of fact countries differ widely in their preference for either direct support (subsidies which are visible through the GBAORD data) or indirect support (not shown in the GBAORD). However, many methodological issues remain to be solved in order to measure tax credits adequately.

A.4.1
GBAORD in % of GDP

The indicator provides an international comparison, expressing the GBAORD in % of the GDP. The advantage of this indicator is that it measures the R&D intensity and not the real value. In this way, the influence of the size of a country is limited. The indicator shows that Belgium continues to lag fairly far behind in Europe (in the observed period 1999-2008) in terms of budgetary credits.
However, the year 2008 shows an important increase. The question is whether this is the beginning of a real catching up in this regard or just a one-shot phenomenon. In any event, the 2009 GBAORD data (on the basis of provisional budget data) seem to confirm that budget efforts for R&D might be considered as being intensified.

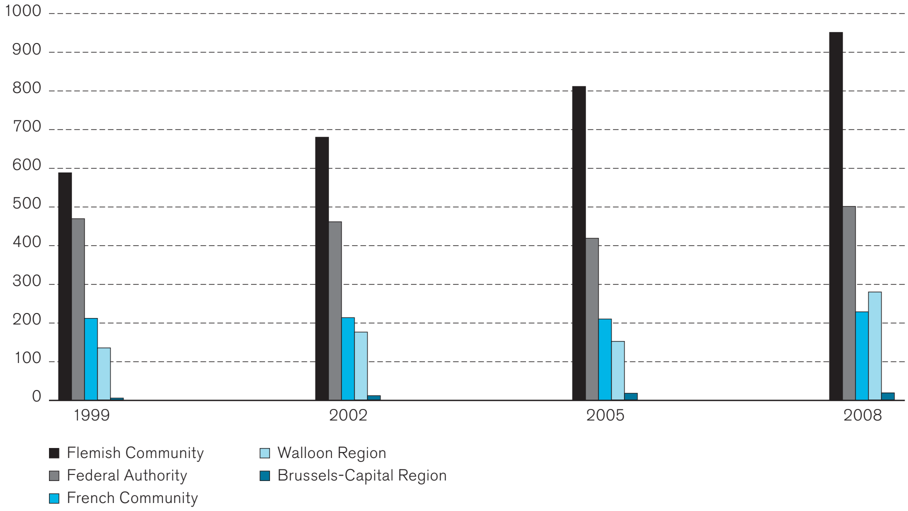


		1999	2002	2005	2008
Belgium	BE	0.58	0.60	0.59	0.68
Spain	ES	0.56	0.74	0.84	1.00p
Hungary	HU			0.41	0.43
Germany	DE	0.81	0.78	0.77	0.79
France	FR	0.94	1.00	0.97	0.75p
Netherlands	NL	0.78	0.74	0.69	0.70
United Kingdom	UK	0.67	0.75	0.67	0.64c
EU-27	EU-27	0.71	0.75	0.73	0.72
United States	US	0.83	0.97	1.04	0.99hip
Japan	JP	0.63	0.72	0.71	0.70h

Source: OECD, Main Science and Technology Indicators 2009-2; data of EU-27: Eurostat (Science, technology and innovation database.
Notes: c) National estimate or projection; h) Federal or central government only; i) Excludes data for the R&D content of general payment to the Higher Education sector for combined education and research (public GUF); p) Provisional.

A.4.2
Overview of the GBAORD of the different authorities in Belgium

The GBAORD data (in million constant EUR) of the different federal authorities in Belgium in the period 1999-2008 are overviewed. They are all trending upward, and this is especially noticeable in the Flemish Community[5] and the Walloon Region. The GBAORD of the federal Authority, however, remains more or less stagnant. An increase is measured in 2008, but the federal GBAORD 2009 (on the basis of provisional budget data) does not confirm this.



	1999	2002	2005	2008
Flemish Community	586.4	678.3	809.6	948.9
Federal Authority	467.6	460.0	416.7	501.9
French Community	211.5	213.7	211.5	230.8
Walloon Region	136.0	177.0	152.9	281.0
Brussels-Capital Region	7.7	13.5	19.9	21.1
TOTAL	1409.3	1542.5	1610.5	1983.7

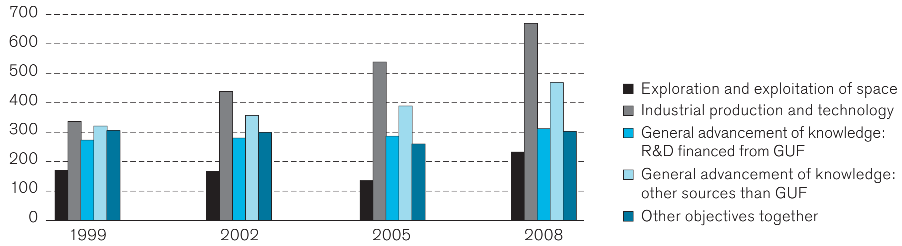
Source: Federal Cooperation Commission, CFS/STAT.
Note: Implicit GDP Price Indices (2000 = 1.00); OECD-Main Science and Technology Indicators 2009-2.

5. Soon after Belgium became a federal state, the politicians in the Dutch-speaking part of Belgium decided to institute a single authority: the 'Flemish Community', dealing with 'community' related issues and 'region' related issues. The politicians in the French-speaking part of Belgium chose to institute two different authorities: the French Community and the Walloon Region.

A.4.3

GBAORD by socio-economic objectives

The GBAORD data, of all authorities in Belgium combined, are presented (in million constant EUR) and they are classified according to the NABS nomenclature in the period 1999-2008.
The Figure gives an overview of the most important socio-economic objectives, which are presented in detail in the table (in a combination of the older 'NABS 1992' classification and the new 'NABS 2007' classification).
NABS 6 'Industrial production and technology' and NABS 13 'General advancement of knowledge: R&D financed from other sources than GUF (=General university funds)' combined represent a very high 57% of the total GBAORD in 2008.



SOCIO-ECONOMIC OBJECTIVES	1999	2002	2005	2008
1. Exploration and exploitation of the earth	14	11	10	19
2. Environment	37	41	37	41
3. Exploration and exploitation of space	171	167	136	234
4. Transport, telecommunication and other infrastructures	13	23	14	37
5. Energy	37	41	31	31
6. Industrial production and technology	337	439	538	669
7. Health	19	25	31	39
8. Agriculture	44	30	21	25
9. Education	61	73	65	5
10. Culture, recreation, religion and mass media	0	0	0	40
11. Political and social systems, structures and processes	0	0	0	61
12. General advancement of knowledge: R&D financed from General University Funds (GUF)	273	281	287	311
13. General advancement of knowledge: R&D financed from other sources than GUF	322	358	389	467
14. Defence	6	5	4	5
(Other civil research)	75	49	47	0
TOTAL APPROPRIATIONS	1409	1542	1611	1984

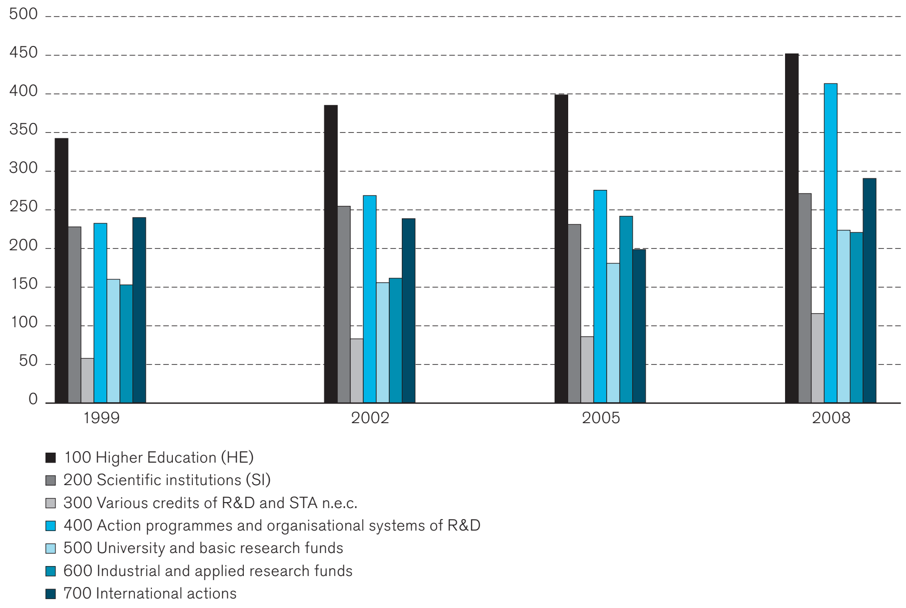
Source: Federal Cooperation Commission, CFS/STAT.
Note: Implicit GDP Price Indices (2000 = 1.00); OECD-Main Science and Technology Indicators 2009-2.

A.4.4
GBAORD by institutional and functional destination

The GBAORD data, of all authorities in Belgium combined, are presented (in million constant EUR) and they are classified according to the '*CFS/STAT nomenclature*'[6] in the period 1999-2008.

The category '100 Higher education' regroups all financial data related to the block funding of universities and institutions of higher education. The category '500 University and basic research funds' regroups all financial data related to the funding of academic research from sources other than block funding.

This classification (with seven categories) was elaborated after the country's institutional reform and has been applied since 1989. It offers a good insight into the institutional and functional destination of the R&D budget across the various governments in Belgium. The R&D budget classified in the category 'Action programmes and organisational systems of R&D' is growing by far the most rapidly (in constant terms) in the observed period. Its share in the total GBAORD is almost as high as the R&D budget classified in the category 'Higher education'.



6. Details on the CFS/STAT classification can be found on the website of the Federal Science Policy (specifically on page *http://www.belspo.be/belspo/stat/bokoo/inst_nl.stm* (in Dutch) or *http://www.belspo.be/belspo/stat/bokoo/inst_fr.stm* (in French).

INSTITUTIONAL AND FUNCTIONAL DESTINATION	1999	2002	2005	2008
Higher Education (HE)	341	384	398	452
Scientific Institutions (SI)	227	254	231	270
Various Credits of R&D and STA n.e.c.	57	82	86	115
Action programmes and organisational systems of R&D	233	268	276	413
University and basic research funds	160	155	180	223
Industrial and applied research funds	152	161	241	221
International actions	239	238	198	291
TOTAL	1409	1542	1611	1984

Source: Federal Cooperation Commission, CFS/STAT.
Note: Implicit GDP Price Indices (2000 = 1.00); OECD-Main Science and Technology Indicators 2009-2.

B. OUTPUT INDICATORS

B.1

Technology Balance of Payments

Basic Information

The Technology Balance of Payments (TBP) registers the commercial transactions related to international technology transfers. It consists of money paid or received for the acquisition and use of patents, licences, trademarks, designs, know-how and closely-related technical services (including technical assistance) and for industrial R&D carried out abroad, etc.

The TBP data are extracted from national sources (balance of payments as in Belgium or surveys results) with the aim of measuring the flow of technological know-how and services into and out of the country concerned. The OECD manual '***Proposed Standard Method of Compiling and Interpreting Technology Balance of Payments Data***', TBP Manual 1990, gives the methodology for the international standards for compiling such data. Another OECD publication, '***Handbook on Economic Globalisation Indicators***' (2005), also describes the indicators for measuring the degree of globalisation of technology, including the intangible trade in technology (technology balance of payments).

The importance of TBP indicators is frequently underestimated, for two main reasons. First, there are the problems involved in collecting data consistent with international definitions. Second, there are the difficulties of interpreting the indicators, the appraisal of which involves comparison with a number of other indicators and some at times rather complex analyses.

Message

The degree of internationalisation of the diffusion of a country's technology can be expressed by looking at the share of the national technology receipts and payments in the national GERD.
Figure B.1.1 shows that these shares are by far the highest in Belgium and Hungary. This confirms the relatively high presence of foreign-controlled affiliates in both countries, a typical situation for an open economy. A higher 'technology receipts/ R&D expenditure' ratio could also mean that the R&D effort is contributing to substantial technology-exporting capacity. And when the 'technology payments/ R&D expenditure' ratio is high, it implies a development strategy based on imports of foreign technology rather than the use of native technology.

The largest economies, such as the United States and Japan, have lower shares. Their domestic R&D effort, to a large extent, satisfies their country's technology requirements. Larger European economies such as Germany and United Kingdom have intermediate ratios.

Figure B.1.2 focuses on Belgium. Eye-catching is the appearance of a TBP deficit in 2008, after a long period of a favourable balance. The recent deficit of TBP Belgium mainly comes from capital accounts and some current accounts such as royalties and the technical services.

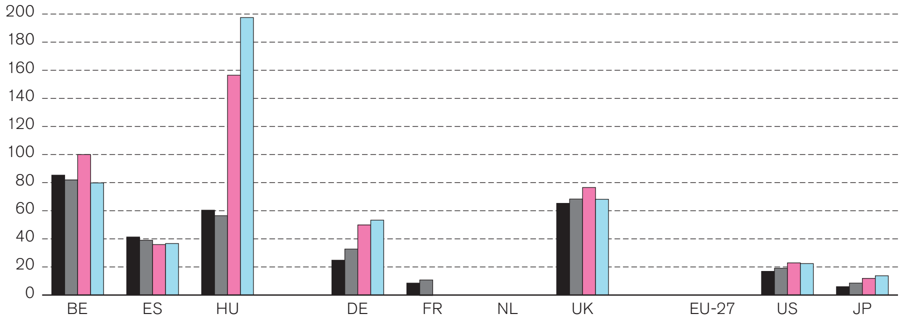
Presenting the data per sector makes it possible to identify the sectors contributing the most to this kind of transaction, and thus the areas in which Belgium is specialised when it comes to the trade of technology. The totals of the payments and the receipts of TBP by categories of TBP operations in the year 2008 are shown in Figure B.1.3. It is important to know that the receipts and the payments of the R&D services have increased considerably since 2002.

B.1.1

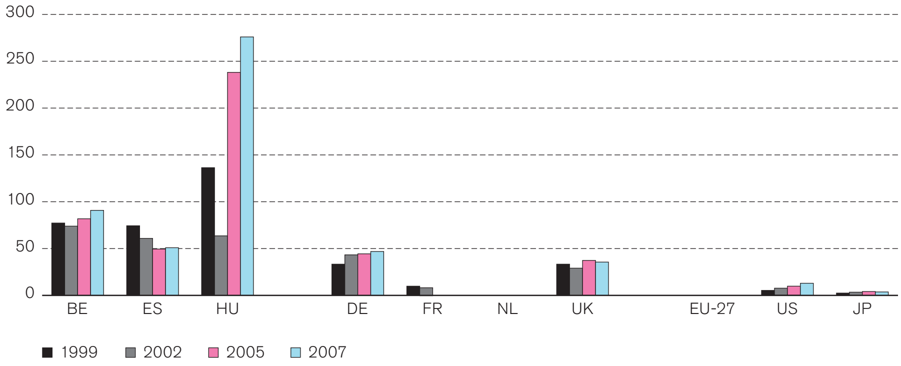
Technology balance of payments – Technology receipts and payments in % of GERD

Internationalisation of technology can be presented by looking at a country's technology receipts and payments. The two figures show the proportion of the technology receipts and the payments in the total intramural R&D expenditure of a country (GERD). The comparison between the trade in technology (non-embodied) and the R&D expenditure makes it, to some extent, possible to get a good idea whether trade in technology is substantial or not, and it shows the degree of internationalisation of the diffusion of technology in a country. The reference years are 1999-2007.

Technology receipts in % of GERD



Technology payments in % of GERD



		TECHNOLOGY RECEIPTS IN % OF GERD				TECHNOLOGY PAYMENTS IN % OF GERD			
		1999	2002	2005	2007	1999	2002	2005	2007
Belgium	BE	84.8	81.5	100.0	79.4	77.2	74.0	81.9	91.3
Spain	ES	40.1	38.9	35.0	36.3	74.2	60.8	49.9	50.6
Hungary	HU	60.2	56.4	156.2	196.9	136.7	64.1	237.9	276.0
Germany	DE	25.2	33.0	49.8	53.2	33.5	43.3	44.4	47.2
France	FR	8.8	11.1	..	..	10.1	8.6	..	..
Netherlands	NL	..	..	..	..	..	..	..	..
United Kingdom	UK	65.0	68.1	76.6	68.1	33.6	29.3	37.3	35.2
EU-27	EU-27	..	..	..	..	..	..	..	..
United States	US	16.2	19.0	23.2	22.2	5.3	8.1	9.9	13.1
Japan	JP	6.4	8.9	12.2	14.0	2.7	3.5	4.2	4.0

Source: OECD, Main Science and Technology Indicators 2009-2.

B.1.2
Technology balance of payments – receipts, payments and balance

The technology balance of payments expresses a country's position with regard to the technological transactions in a universal perspective. Technology receipts are usually dependent on a country's R&D effort and correspond to foreign sales of the marketable results of that effort. Technology payments, on the other hand, correspond to knowledge that is immediately useable by countries' productive systems. In contrast to receipts, payments constitute a technology input which can supplement or take the place of a country's own R&D effort. Data on technology receipts, payments and balance for Belgium are presented in million constant EUR over the period 1999-2008.

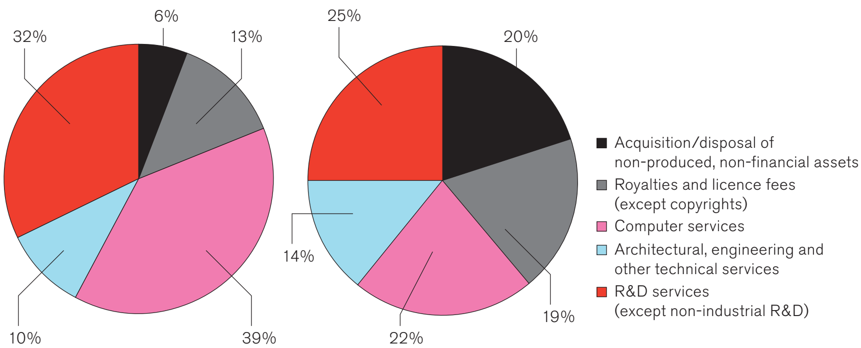
	1999	2002	2005	2008
Receipts	3993	4074	5004	5142
Payments	3634	3695	4095	6666
BALANCE	360	378	909	-1524

Source: OECD, Main Science and Technology Indicators 2009-2.

B.1.3
Technology receipts and payments according to sector

Trade in non-embodied technology in the form of patents, licences, know-how, technical studies or R&D usually represents the results of the industrial R&D that can be developed by a firm or parent company in a particular country. The TBP Manual distinguishes different types of transaction that are regrouped to sectors. There are the transfers of patents, unpatented inventions, licences (linked to know-how) and know-how; the transfers of designs (sales, licences, franchises), trademarks and patterns; the provision of technical and engineering studies and technical assistance and also the provision of industrial R&D (performed abroad or financed from abroad). We note that the R&D services cover flows to finance R&D performed outside the agent's country of residence. The work must be industrial and technological R&D. The reference date for the data is 2008.

Receipts 2008 **Payments 2008**



	ACQUISITION/ DISPOSAL OF NON-PRODUCED, NON-FINANCIAL ASSETS	ROYALTIES AND LICENCE FEES (EXCEPT COPYRIGHTS)	COMPUTER SERVICES	ARCHITECTURAL, ENGINEERING AND OTHER TECHNICAL SERVICES	R&D SERVICES (EXCEPT NON-INDUSTRIAL R&D)	TOTAL
Receipts	378	809	2308	638	1944	6077
Payments	1608	1459	1732	1116	1963	7878
BALANCE	-1230	-650	576	-478	-19	-1801

Source: National Bank of Belgium, Balance of Payments Department, 2009.

B.2 Bibliometrics

Basic information

Scientometric indicators have become a standard tool of evaluation and analysis in science policy and research management. These indicators are supposed to represent objective measures of productivity and impact, provided the underlying data sets form sufficiently large and statistically representative samples. Scientometric indicators have therefore long since become widely accepted measures of research performance at the national level.
Two types of indicators are used in this subsection. ***Publication-based indicators*** are supposed to measure important aspects of research activity and output. By contrast, ***citation-based indicators*** are considered to reflect the reception of published research results within the framework of documented scholarly communication. Contrary to what is often assumed, citations are not a primary measure of quality.

All data used for this compilation were extracted from the yearly updates of the Web of Science® database of Thomson Reuters[7].
→ Publication-based indicators: publication counts indicate the number of publications of a given country or supra-national region based on a full-counting scheme.
→ Citation-based indicators: the citation impact of publications is analysed on the basis of citation indicators[8].

Publications in social sciences are usually less covered in publication databases. This is due to the fact that social scientists tend to publish more in their national language in national publications.

Message

Indicator B.2.1 presents the average publication output per 10,000 inhabitants for the period 2004–2008. The UK, the Netherlands and Belgium represent the highest standard in the set. These countries lie distinctly above both the European and American standard.

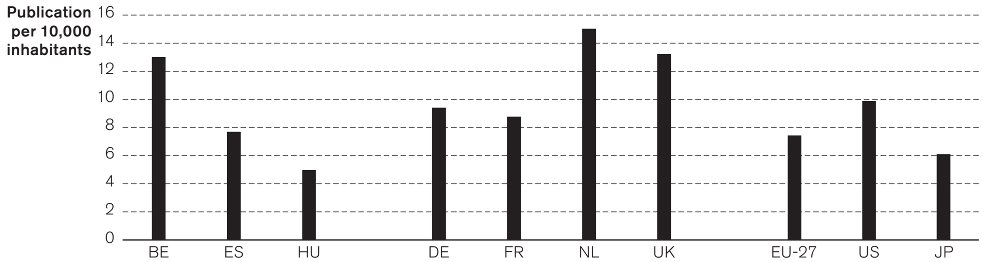
7. Only 'citable' publications published in journals and serials in the sciences and indexed in the 1999–2008 volumes were selected.
8. The indicators originate from the standard toolkit developed at ISSRU in Budapest (e.g., Braun et al, 1985) and at K.U. Leuven (e.g., Glänzel et al., 2009), including measures of 'citation visibility' and relative citation indicators to eliminate possible subject biases which might otherwise distort the interpretation of citation-impact indicators.

With regard to the share of publications in world's total publication output (B.2.2), within the set of medium-sized European countries, the share of Spain reflects an unambiguous growth. The Netherlands, Hungary and Belgium reflect rather stable patterns. The 'bigger' European countries (the UK, Germany and France) reflect a clear decline concerning their share in the world total. The same applies to the European Union (EU-27), the US and Japan.

B.2.1
The average publication output per 10,000 inhabitants

The term ‘size’, as used in the context of the next indicator B.2.2, rather expresses a country’s weight; size as such is not merely a question of economic, scientific or technological potential. The normalisation of publication output by inhabitants therefore reveals further aspects of a country’s research activity.

Indicator B.2.1 presents the average publication output per 10,000 inhabitants for the period 2004–2008. The UK, the Netherlands and Belgium represent the highest standard in the set. In these countries, more than 10 papers per 10,000 inhabitants have been published. These countries lie distinctly above both the European and American standard. The last two EU enlargements in 2004 and 2007 have somewhat lowered the publication ‘density’ with respect to the EU15. The data reflect a large variation of this indicator within the European Union; Hungary’s publication output per 10,000 inhabitants amounts to 1/3rd of the corresponding value of the Netherlands.

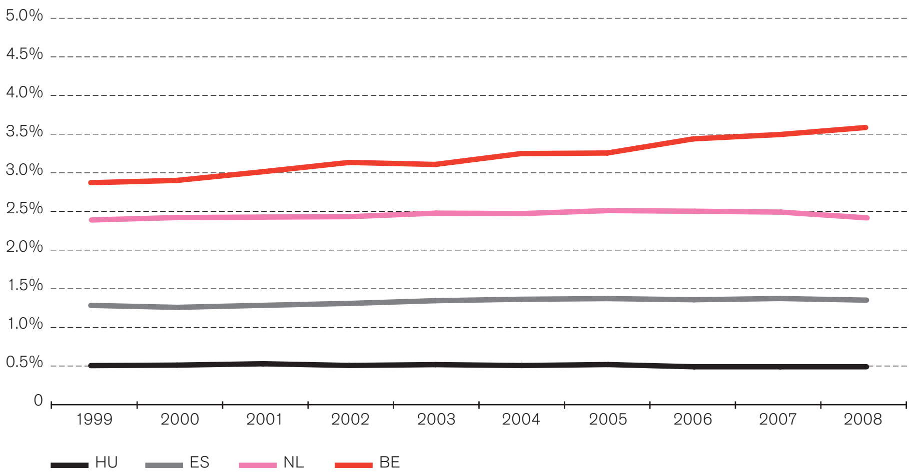


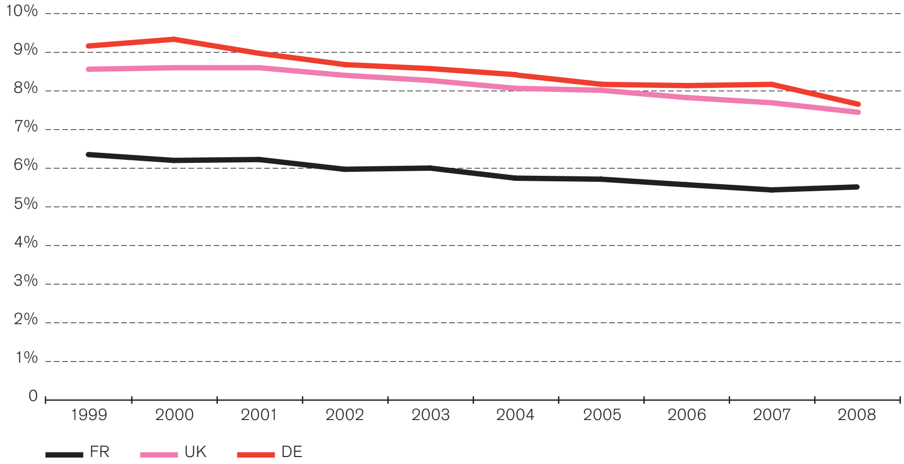
		AVERAGE PUBLICATION OUTPUT PER 10,000 INHABITANTS FOR THE PERIOD 2004-2008
Belgium	BE	13.0
Spain	ES	7.7
Hungary	HU	5.0
Germany	DE	9.4
France	FR	8.8
Netherlands	NL	15.0
United Kingdom	UK	13.2
European Union	EU-27	7.4
United States	US	9.9
Japan	JP	6.1

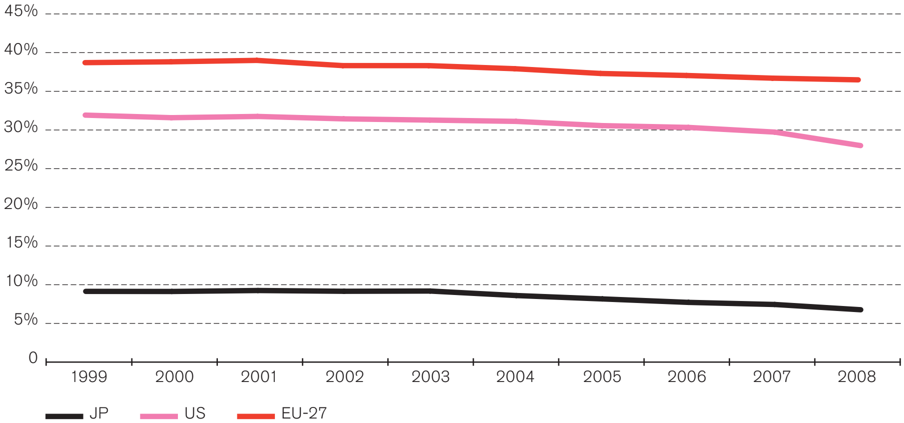
Source: Web of Science, EUROSTAT, US Census Bureau, Statistics Bureau, ECOOM.

B.2.2
The evolution of the share of publications in the world's total publication output

The indicator shows the evolution of the share of the publication output of medium-sized European countries, the bigger European countries and the 'Triad members' in the world total during the ten-year period 1999-2008.
Within the set of medium-sized European countries, the share of Spain reflects an unambiguous growth. The other three countries including Belgium, reflect rather stable patterns.
The 'bigger' European countries (the UK, Germany and France) reflect a clear decline concerning their share in the world total.
The same applies to the European Union (EU-27), the US and Japan. The relative decline of the publication output of the 'big' countries and the European Union is intimately connected with the powerful growth of the emerging economies.







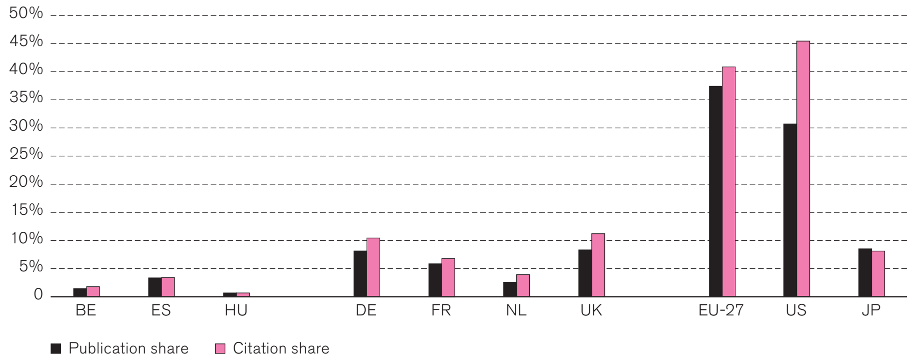
		1999	2002	2005	2008
Belgium	BE	1.30%	1.32%	1.39%	1.37%
Hungary	HU	0.52%	0.52%	0.53%	0.50%
Netherlands	NL	2.39%	2.44%	2.52%	2.42%
Spain	ES	2.88%	3.15%	3.27%	3.61%
France	FR	6.3%	6.0%	5.7%	5.5%
Germany	DE	8.6%	8.4%	8.1%	7.5%
United Kingdom	UK	9.2%	8.7%	8.2%	7.6%
Japan	JP	9.3%	9.2%	8.3%	7.0%
United States	US	31.8%	31.3%	30.5%	28.2%
European Union	EU-27	38.6%	38.1%	37.1%	36.3%

Source: Web of Science, ECOOM.

B.2.3

The relative citation impact of research: number of publications and citations and their share in the world total in two sub-periods

The share of publications in the world's total publication output can be supplemented by the corresponding share of citations. A possible deviation from the publication share reflects the relative impact of research with respect to the publication activity. In the selected European countries, except for Hungary and Spain, this efficiency balance is markedly positive. The indicator values of the USA express the highest 'efficiency', while Japan's indicators reflect a less favourable situation. The figure illustrates the deviation (publication share/citation share) in the period 2003-2006.



		1999-2002				2003-2006			
		PUBLICATION COUNT	CITATION COUNT	PUBLICATION SHARE	CITATION SHARE	PUBLICATION COUNT	CITATION COUNT	PUBLICATION SHARE	CITATION SHARE
Belgium	BE	41 552	210 545	1.3%	1.6%	50 983	315 503	1.4%	1.8%
Spain	ES	95 687	377 517	3.0%	2.9%	121 659	588 653	3.3%	3.4%
Hungary	HU	16 851	60 765	0.5%	0.5%	19 355	86 398	0.5%	0.5%
Germany	DE	273 224	1 376 278	8.5%	10.6%	299 412	1 779 712	8.1%	10.4%
France	FR	196 991	906 042	6.2%	7.0%	213 569	1 144 458	5.8%	6.7%
Netherlands	NL	77 467	450 054	2.4%	3.5%	92 581	640 806	2.5%	3.7%
United Kingdom	UK	289 239	1 505 944	9.0%	11.6%	308 407	1 906 159	8.3%	11.1%
European Union	EU-27	1 232 610	5 357 217	38.5%	41.2%	1 386 987	6 982 636	37.4%	40.8%
United States	US	1 009 421	6 213 837	31.6%	47.8%	1 137 582	7 766 023	30.7%	45.4%
Japan	JP	296 628	1 152 876	9.3%	8.9%	314 606	1 370 745	8.5%	8.0%

Source: Web of Science, ECOOM.

B.3 Patents

Basic information

A patent is an intellectual property right issued by authorised bodies. The owner has the legal right to prevent others from using, manufacturing, selling, importing, etc., in the country or countries concerned, for a period of up to 20 years from the filing date.

Raw data on patents are published; they can thus be transformed into statistics and indicators. Patents are regarded as an indicator for measuring the results of the research activity of firms (and public institutions). The more a firm or an institution is patenting, the more it is considered to be a highly productive generator of research results.

However, patents cover only part of reality, because patenting is not the sole way to protect an invention. This depends on the sector and the firm which might opt for a completely different strategy, like secrecy, quick appearance on the market, copyright, etc. Therefore, there does not exist a direct link between innovation and patenting. Some sectors or subsectors can be underestimated in terms of their innovative performance. Nevertheless, patents data allow for international comparisons at various levels of refinement.

The calculations in this publication are based on patent data published by the OECD (Main Science and Technology Indicators – Volume 2009/2) and are mainly derived from the European Patent Office (EPO) and based on data from the United States Patent & Trademark Office (USPTO).
The OECD classifies the patents according to the country of residence of the inventor(s), 'giving thus a measure of technological innovativeness of researchers and laboratories located in a country' (MSTI, p. 109).

Message

The number of patents by Belgian inventors at the EPO has fluctuated around 130 per million inhabitants since 1999; this is a little higher than the EU average.
The reason why Belgium lies above the EU average can be partially explained by the fact that the patent data, published by the OECD, are classified according to 'inventor country'.

As a matter of fact, the data look less positive when not classified by 'inventor country'. This shows that Belgian researchers and research labs create as many inventions as their European counterparts, but the companies located in Belgium patent less due to their patenting strategies. This can be attributed to their business strategies, to the fact that many important research-active companies are foreign owned or are at least multinational companies, and thus pursue an international strategy regarding where and how to patent.

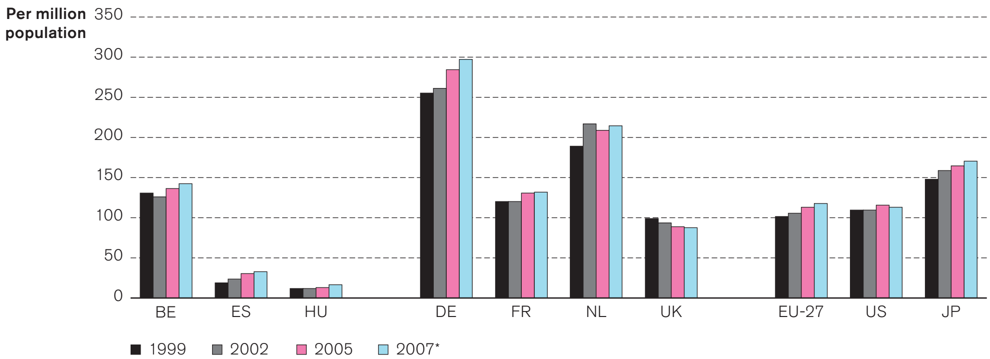
The increase in the number of patent applications to the EPO is positive in every country, except for the United Kingdom, and varies from 3% (US) to 79% (Spain). The growth percentage of Belgium is half that of the EU-27.

The increase in the number of patent applications to the USPTO varies from 22% (France) to 85% (Spain). The growth percentage of Belgium is little better than that of the EU-27.

The gap of Belgium vis-à-vis Germany or Netherlands remains important (and confirmed) in the selected period.
Benchmarking Belgium with the rest of Europe or the US regarding ICT or biotechnology patents, makes it clear that Belgium performs comparatively better when it comes to biotechnology.

B.3.1
Number of patent applications to the EPO (priority year) per million population

The following statistics are produced on the basis of data from the European Patent Office (EPO), reproduced in the MSTI (OECD database). One should keep in mind that there is a 'home advantage'. European countries patent more in the EU than in the US or Japan. That also explains why the US number in this table is much lower than in the tables based on the USPTO data. This is important when interpreting the figures.

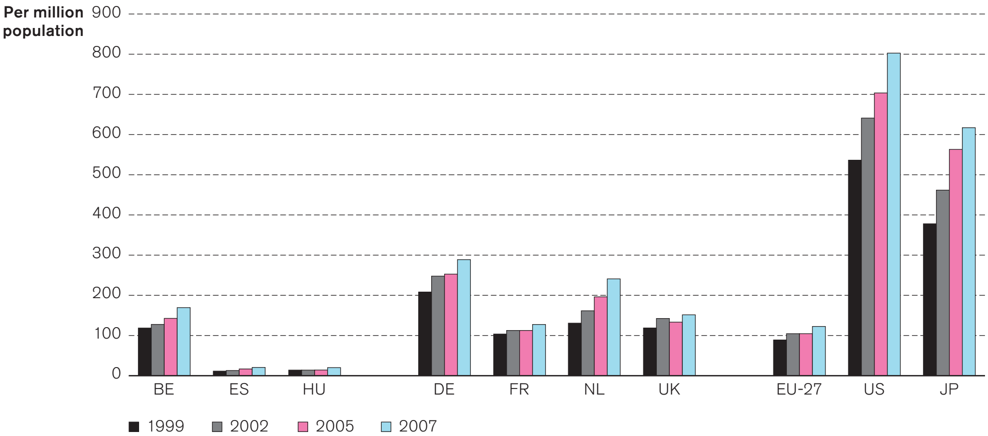


		1999	2002	2005	2007*
Belgium	BE	130.8	125.5	135.7	142.3
Spain	ES	18.4	22.7	30.8	32.9
Hungary	HU	11.3	11.9	13.3	16.8
Germany	DE	254.7	261.0	283.6	297.0
France	FR	119.4	119.4	130.2	131.3
Netherlands	NL	188.0	216.3	208.5	213.6
United Kingdom	UK	98.8	92.8	87.9	87.5
European Union	EU-27	101.7	104.3	112.2	117.0
United States	US	109.0	109.0	114.8	112.7
Japan	JP	148.1	158.7	164.5	169.3

Source: OECD, Main Science and Technology Indicators 2009-2.
**Number of applications: estimate by secretariat of the OECD or projection based on national sources.*

B.3.2
Number of patent applications to the USPTO (priority year) per million population

The data in this figure are based on the American USPTO data.
When interpreting these data, one should take account (once again) of the 'home advantage':
EU firms patent less in the US than they do in Europe.



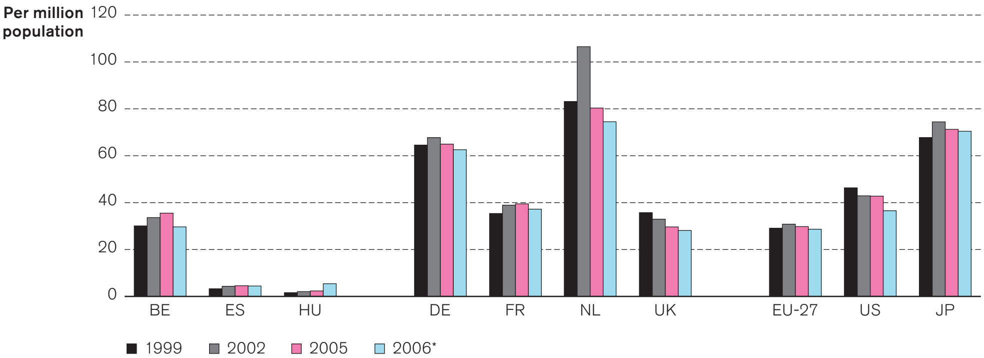
		1999	2002	2005	2007
Belgium	BE	117.8	125.2	139.4	166.3
Spain	ES	11.6	13.7	16.2	21.5
Hungary	HU	11.7	12.6	13.0	19.2
Germany	DE	206.8	247.5	250.6	287.0
France	FR	103.1	110.8	110.7	126.2
Netherlands	NL	130.2	161.1	195.4	241.0
United Kingdom	UK	118.4	141.4	132.2	150.3
European Union	EU-27	88.8	103.8	104.5	122.4
United States	US	536.4	639.6	702.2	799.9
Japan	JP	377.5	460.7	563.5	616.7

Source: OECD, Main Science and Technology Indicators 2009-2.

B.3.3

Number of patent applications to the EPO in the ICT sector (priority year) per million population

The patent data on information and communication technologies (ICT) are based on OECD statistics, published in MSTI, extracted from the OECD patent database. Patent data on ICT are shown because this sector in itself accounts for a large part of the difference in R&D intensity between Europe and the US.
In this case, the figure focuses on data from the EPO database. The same caveat as above applies: there is a probable overrepresentation of European firms compared to non-European firms.



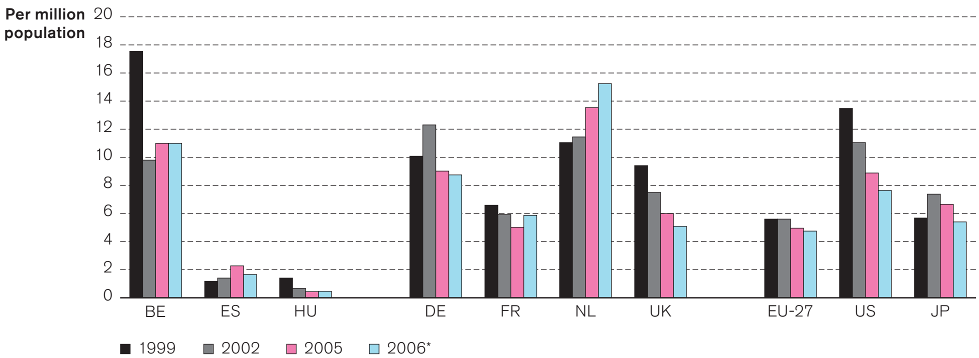
		1999	2002	2005	2006*
Belgium	BE	30.3	33.8	35.7	29.4
Spain	ES	3.5	4.6	4.8	4.7
Hungary	HU	1.9	2.4	2.5	5.7
Germany	DE	64.3	67.6	64.9	62.6
France	FR	35.5	39.0	39.6	37.0
Netherlands	NL	82.9	106.5	80.1	74.3
United Kingdom	UK	35.7	33.2	29.9	28.3
European Union	EU-27	29.3	31.0	30.0	28.8
United States	US	46.3	43.3	42.8	36.6
Japan	JP	67.7	74.5	71.1	70.3

Source: OECD, Main Science and Technology Indicators 2009-2.
**provisional*

B.3.4

Number of patent applications to the EPO in the biotechnology sector (priority year) per million population

These statistics are based on the OECD patent database and based on data coming from the EPO. Biotechnology is defined either on the basis of International Patent Classification system classes (IPC) or on list-based definitions of what biotechnology is supposed to include. Traditionally, Belgium (as do other European countries) performs better in this technology than in ICT.



		1999	2002	2005	2006*
Belgium	BE	17.6	9.8	11.0	11.0
Spain	ES	1.2	1.4	2.3	1.7
Hungary	HU	1.4	0.7	0.5	0.5
Germany	DE	10.1	12.3	9.0	8.8
France	FR	6.6	5.9	5.0	5.8
Netherlands	NL	11.1	11.5	13.5	15.3
United Kingdom	UK	9.4	7.5	6.0	5.1
European Union	EU-27	5.6	5.6	4.9	4.7
United States	US	13.5	11.0	8.9	7.7
Japan	JP	5.7	7.4	6.6	5.4

Source: OECD, Main Science and Technology Indicators 2009-2.
**provisional*

C. INNOVATION INDICATORS

C.1 Innovation

Basic Information

Innovation is a much broader concept than R&D. It is about the implementation, not only of new products and processes, but also of organisational and marketing novelties. R&D is merely one of several inputs into a whole, larger, system, called the ***innovation system***. In the same vein, patents or other IPRs are only some of the many outputs of this system. This systemic view considers innovation to be a complex process involving various actors in a dynamic of mutual interaction. 'Innovation' is to be seen both as a process and as the output of this process.

To monitor innovation, the ***European Community Innovation Survey*** (CIS) is the largest international innovation survey in the world. It is conducted on a recurrent basis and yields internationally comparable results. The figures presented hereafter are provided by the CIS-4 Survey wave (observation period 2002-2004), complemented by some results of an OECD exercise[9] intended both to obtain internationally comparable indicators for non-CIS countries and to compute new 'composite' indicators, performed over the same period (2002-2004).

Though more recent CIS data are available (2004-2006), we chose not to use them for either cross-country comparisons or dynamic assessment. There are several reasons for this. First of all, data are not exactly comparable over time. The 2004-2006 data come from a 'light' survey, in which some questions were omitted. We therefore cannot measure all of the variables of interest with this more recent survey. Second, the OECD exercise mentioned above allows one to use data for non-CIS countries (Japan, for example), and it allows one to compute 'composite' indicators, which are not directly available otherwise. Though the exercise was renewed for the 2004-2006 data, the results are not yet available at the time of writing. Therefore, as the 2002-2004 data involve both a wider set of indicators and a larger sample of countries, we prefer to stick to these somewhat older observations.

Message and indicators

We document here a number of trends that have been affecting the innovation landscape throughout the last decade. In a word, the main message conveyed here is that the innovation landscape has become far more complex than it used to be, and this requires new policy responses.

9. OECD (2009), 'Innovation in firms: a microeconomic perspective', OECD, Paris, 2009.

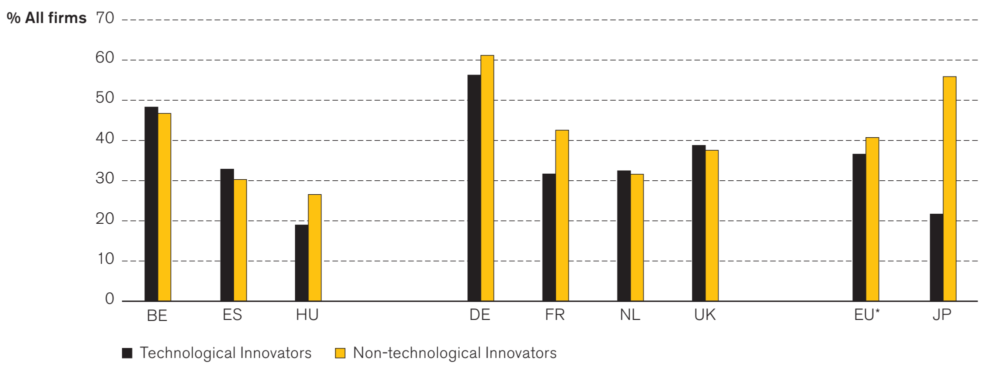
First, there has been a broadening of the very concept of innovation. Innovation is no longer to be regarded in its narrow 'technological' sense[10]. Nowadays, it also concerns making use of new organisational models for introducing innovative marketing methods. These two latter dimensions are jointly described as '***non-technological innovation***'. Non-technological innovation is in most countries almost as important as, if not more important than, technological innovation. Moreover, technological and non-technological innovation show up as natural complements, as the introduction of new products and processes often involves the introduction of new business models. This calls for policies aimed at targeting ***non-technological innovation*** as well.
Second, as far as technological innovation is concerned, it has been realised that R&D is not the only way to acquire knowledge. Knowledge can also be sourced in from outside the firm's boundaries. Conversely, internally-generated knowledge may be 'exported' to the outside world. Specifically, there is a significant proportion of such ***non-R&D technological innovators***. They represent 45% of technological innovators in Belgium, and 43% of them in Germany, for instance. It is also important to note that knowledge generation and transmission or acquisition of knowledge can be both complementary or substitutes. In the Netherlands, 46% of innovators claim to have both been inventive and collaborative, whereas in France, 35% of innovators developed their innovations through purely internal creativity, without resorting to external collaborations. All in all, this calls for wider public support to structures that enable not only the creation but also the diffusion of knowledge.
Third, there is increasing awareness of the importance of innovation, in both technological and non-technological dimensions, for the services sector as well. Firms in the services sector earn a non-negligible part of their turnover from their product innovations. This suggests paying wider policy attention to ***innovation in the services sector*** and to the services sector needs.
Fourth, paralleling the importance of non-R&D technological innovators and of well-functioning knowledge transmission mechanisms, we shed light on the emergence of the '***open innovation***' paradigm. Open innovation refers to the fact that firms increasingly tend to both use external knowledge for their innovation activities, and allow the outside world to access their internal knowledge. One way to access or transmit knowledge is through formal cooperation agreements. Such agreements are pervasive, both across countries and across sectors, especially in Belgium. Formal cooperations are in general somewhat more widespread in the manufacturing than in the services sector. The most commonly used cooperation partners are to be found within the business relations: suppliers and clients. By contrast, universities and public research institutes are not used so often as cooperation partners, so that greater efforts might be undertaken to increase their attractiveness. Finally, one should notice the importance of international cooperations, and

10. The definition of 'technological' innovation is given in subsection C.1.1

especially within Europe. This can be seen as a reflection of another widely-documented trend, namely the ***internationalisation of R&D***.
Another way to access or generate knowledge is through informal cooperations, i.e. accessing publicly-available knowledge. The most commonly encountered sources are, again, clients and suppliers. The quantitative importance of such informal collaborations confirms the relevance of the ***open innovation paradigm***.
Next, we document the main effects of innovation. The most important ones are market-oriented, concerning the product range, the market share, the entry on new markets, or the quality of products. On the other hand, it is worth noticing that meeting regulations or reducing environmental impacts show up as some of the less frequent effects.
Finally, we turn to the principal hampering factors. The costs of innovation, followed by a lack of internal finance to support these costs, show up as the most frequent hampering factors. Lack of competition (‘market dominated by established enterprises’), lack of qualified personnel, and risk aversion (‘uncertain demand for innovation’) also seem to be frequently-encountered important hampering factors. Interestingly enough, a wide range of instruments exist to counter or alleviate these effects.

C.1.1
Prevalence of technological and non-technological innovators

This indicator presents the ***innovation rate*** over the period 2002-2004, i.e. the proportion of firms having implemented various types of innovations. Formally speaking, an innovation is defined as the implementation of a new or significantly product (good or service), or process (production or delivery method), or a new marketing method, or a new organisational method in business practices, workplace organisation, or external relations[11]. The first two types of innovations, product and process innovations, define what is usually termed as 'technological' innovation, whereas the marketing and organisational innovations are usually called 'non-technological' innovations. The indicator below shows the proportion of all firms having introduced such technological and non-technological innovations.



		% FIRMS HAVING INTRODUCED A TECHNOLOGICAL/ NON-TECHNOLOGICAL INNOVATION (ALL FIRMS)	
		TECHNOLOGICAL INNOVATORS	NON-TECHNOLOGICAL INNOVATORS
Belgium	BE	48.2	46.6
Spain	ES	32.8	30.2
Hungary	HU	18.9	26.5
Germany	DE	56.2	61.1
France	FR	31.6	42.5
Netherlands	NL	32.4	31.5
United Kingdom	UK	38.7	37.5
European Union*	EU*	36.5	40.7
Japan	JP	21.6	55.8

Sources: Federal Cooperation Commission, CFS/STAT, CIS4; Eurostat (NewCronos database), and OECD (2009) 'Innovation in Firms: a Microeconomic Perspective'.
**Except Latvia, Slovenia, Finland, Sweden and the United Kingdom.*

11. OECD(2005), 'Oslo Manual', §146.

C.1.2
Classification of innovative firms according to creativity and diffusion

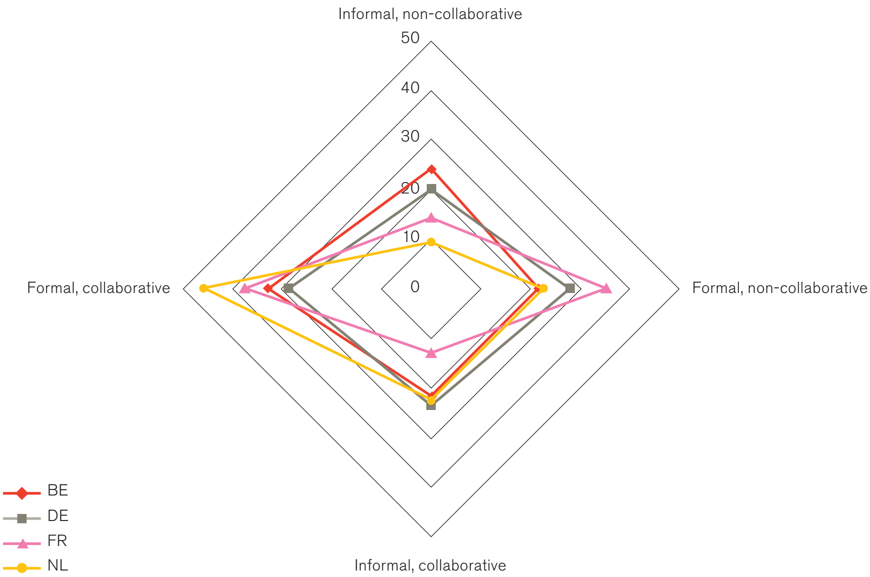
Simple indicators, such as the innovation rate (indicator C.1.1), provide useful information on the proportion of firms having introduced various types of innovation. However, they remain silent on some very important policy-relevant dimensions, such as ***how*** firms actually innovate. Concretely, knowing that, say, 50% of the firms have introduced innovations does not provide any information on whether these firms have developed these innovations through purely internal in-house research efforts or whether they have done so in cooperation with others, or even allow others to develop these innovations for them, or if they have combined these various strategies. To be innovative, firms can indeed either generate their own knowledge, be inventive and creative; or they can access external knowledge, through collaborations, for instance. Inventive firms can also 'export' their knowledge, so that other firms may benefit from it. Innovation policy is concerned with these two dimensions: knowledge generation, on the one hand; and knowledge transmission or absorption on the other. To tackle such issues, we present a 'composite' indicator, i.e. an indicator that combines several questions. This indicator shows how technological innovators actually proceeded to generate their innovations over the period 2002-2004. There are two main dimensions:

→ Formal innovators: these firms generate their knowledge internally; they have either carried out intramural R&D activities or applied for a patent;
→ Collaborative innovators: these firms source their knowledge from outside or diffuse their knowledge outside, they either engage in active cooperations or have their innovations primarily developed by others.

For the sake of clarity, the Figure only displays Belgium and its immediate neighbours (DE, FR, NL). Statistics for other countries are listed in the Table.

Two observations can be made about Belgium:

→ In absolute terms, a clear majority of Belgian innovators, as is the case in the other countries as well (except maybe Germany), adopt the 'formal-collaborative' type of strategy, that is they both generate knowledge internally and access external knowledge;
→ In relative terms, as compared to the other countries, Belgium is more biased towards the 'informal' kind of strategy, i.e. 'non-R&D innovators' is an important phenomenon in this country.



% Product or process innovators

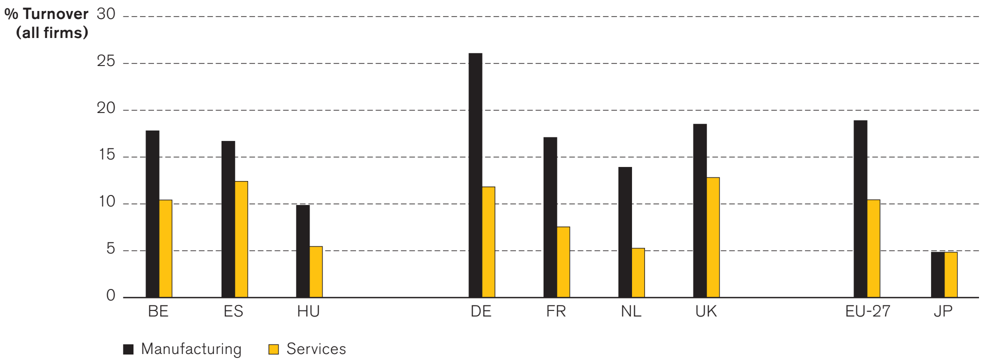
		% FIRMS WITH PRODUCT OR PROCESS INNOVATIONS			
		INFORMAL, NON-COLLABORATIVE	FORMAL, NON-COLLABORATIVE	INFORMAL, COLLABORATIVE	FORMAL, COLLABORATIVE
Belgium	BE	23.8	21.6	21.5	33.1
Spain	ES	..	..	..	..
Hungary	HU	..	..	..	..
Germany	DE	19.8	28	23.3	28.9
France	FR	14.1	35.3	12.9	37.7
Netherlands	NL	9.2	22.6	22.1	46.1
United Kingdom	UK	12.2	35.3	14.3	38.2
European Union	EU-27	..	..	..	..
Japan	JP	25.7	27.5	14.8	32.0

Sources: Federal Cooperation Commission, CFS/STAT, CIS4; OECD(2009) 'Innovation in Firms: a Microeconomic Perspective'.

C.1.3

Turnover due to new products

The indicator measures to what extent firms are reaping the returns from their product innovations. It shows the portion of the turnover that is due to product innovations. The figures reported here relate to the year 2004 only.

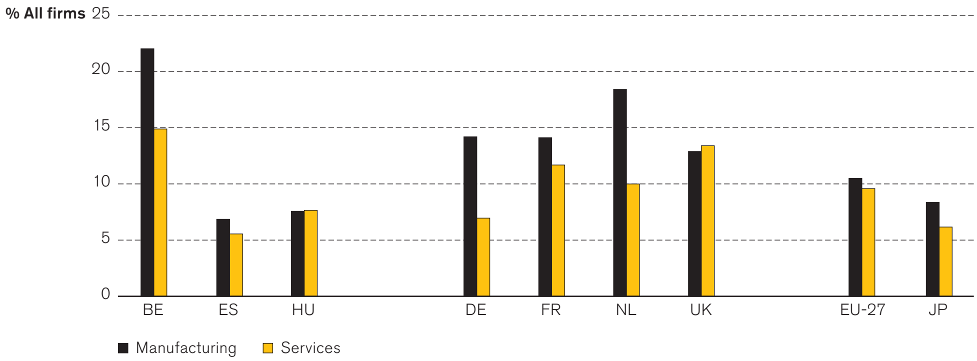


		SHARE OF TURNOVER FROM PRODUCT INNOVATIONS (% TOTAL TURNOVER IN 2004)	
		MANUFACTURING	SERVICES
Belgium	BE	17.8	10.4
Spain	ES	16.7	12.4
Hungary	HU	9.8	5.4
Germany	DE	26.1	11.8
France	FR	17.1	7.5
Netherlands	NL	13.9	5.2
United Kingdom	UK	18.5	12.8
European Union	EU-27	18.9	10.4
Japan	JP	4.8	4.8

Sources: Federal Cooperation Commission, CFS/STAT, CIS4; Eurostat (NewCronos database); OECD (2009) 'Innovation in Firms: a Microeconomic Perspective'.

C.1.4
Innovation collaborations

The indicator looks at the prevalence of formal cooperation agreements in view of developing innovations over the period 2002-2004. Formal cooperation agreements require active cooperations with other firms or institutions and may also include purchases of equipment or technology. The indicator presented here relates to the percentage of firms having entered into such kinds of agreement, notwithstanding the nature or the location of the partner.



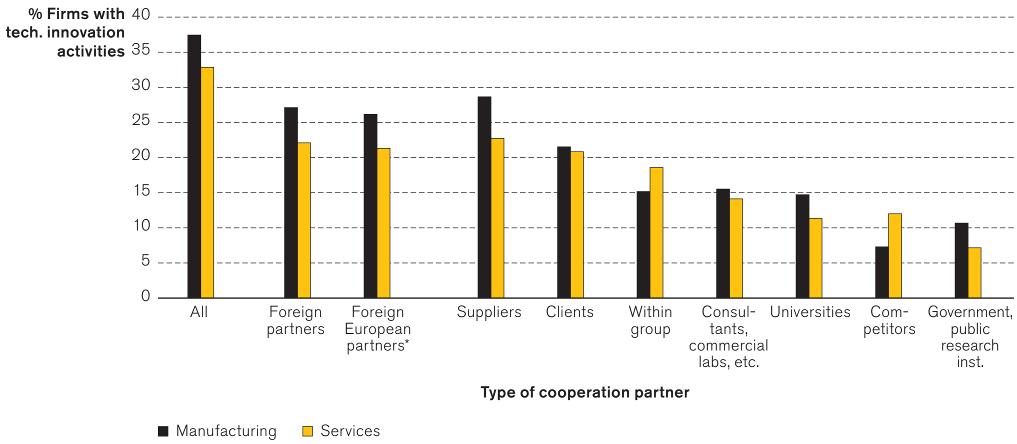
		FIRMS WITH FORMAL COOPERATION AGREEMENTS FOR THEIR INNOVATION ACTIVITIES (% ALL FIRMS)	
		MANUFACTURING	SERVICES
Belgium	BE	22	14.9
Spain	ES	6.9	5.6
Hungary	HU	7.6	7.7
Germany	DE	14.2	7
France	FR	14.1	11.7
Netherlands	NL	18.4	10
United Kingdom	UK	12.9	13.4
European Union	EU-27	10.5	9.6
Japan	JP	8.4	6.2

Sources: Federal Cooperation Commission, CFS/STAT, CIS4; Eurostat (NewCronos database); OECD(2009) 'Innovation in Firms: a Microeconomic Perspective'.

C.1.5

Innovation collaboration agreements for technological innovators in Belgium – by partner type and location

The indicator sheds light on the nature and location of cooperation partners for innovative firms in Belgium over the period 2002-2004. In the CIS Survey, firms are asked to specify the type and location of partners they have cooperated with. The indicator below shows the percentage of firms with technological innovation activities having collaborated with such partners.



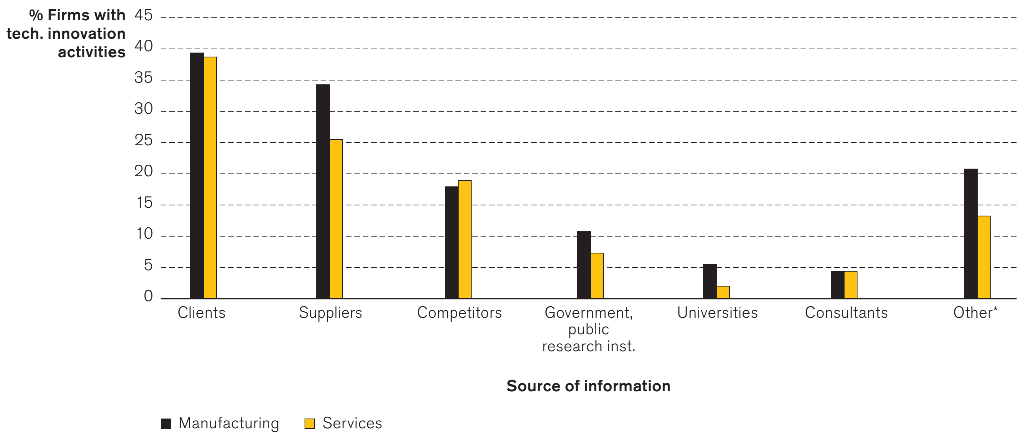
	FREQUENCY OF COOPERATION PARTNERS (% FIRMS WITH TECHNOLOGICAL INNOVATION ACTIVITIES)	
	MANUFACTURING	SERVICES
All partners	37.4	32.8
Foreign partners	27.1	22.1
Foreign European partners*	26.1	21.3
Suppliers of equipment, materials, components, or software	28.6	22.7
Clients or customers	21.5	20.8
Other enterprises within the enterprise group	15.2	18.6
Consultants, commercial labs, or private R&D institutes	15.5	14.1
Universities or other higher education institutions	14.7	11.3
Competitors or other enterprises in the sector	7.3	12
Government or public research institutes	10.7	7.2

Source: Federal Cooperation Commission, CFS/STAT, CIS4.
**Includes the following: EU-27 and Croatia, Iceland, Liechtenstein, Norway, Switzerland and Turkey.*

C.1.6

Important sources of information for technological innovators in Belgium

This indicator documents the existence of informal linkages over the period 2002-2004. Informal linkages refer to collecting 'openly available information that does not require the purchase of technology or intellectual property rights, or interaction with the source'[12]. Firms were asked to rank the various sources of information on a scale ranging between 0 (not used) and 3 (highly relevant). We report here the frequency of 'highly relevant' sources, among firms with technological innovation.



	% FIRMS WITH TECHNOLOGICAL INNOVATION ACTIVITIES RATING THE SELECTED SOURCE AS 'HIGHLY IMPORTANT'	
	MANUFACTURING	SERVICES
Clients or customers	39.3	38.6
Suppliers of equipment, materials, components, or software	34.2	25.4
Competitors or other enterprises in the sector	17.8	18.8
Consultants, commercial labs, or private R&D institutes	4.3	4.3
Universities or other higher education institutions	5.4	1.9
Government or public research institutes	10.7	7.2
Other*	20.7	13.2

Source: Federal Cooperation Commission, CFS/STAT, CIS4.

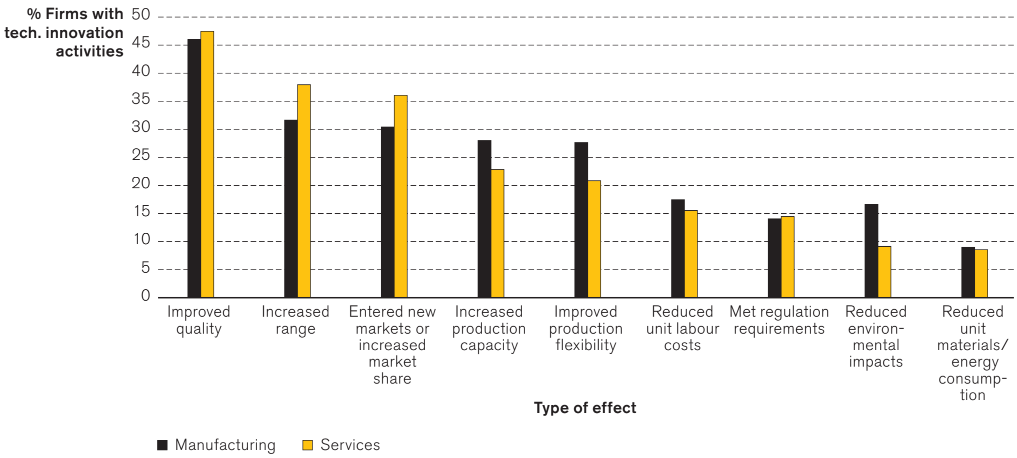
**Conferences, trade fairs, exhibitions, scientific journals and trade/technical publications, professional and industry associations.*

12. OECD(2005), 'Oslo Manual', §278.

C.1.7

Important effects of innovation for technological innovators in Belgium

The indicator investigates the important effects of innovation for firms in Belgium over the period 2002-2004. Firms were asked to rank the importance of various proposed effects on a scale ranging from 0 (not relevant) to 3 (highly important). We report here the frequency of 'highly important' effects, among firms with technological innovation.



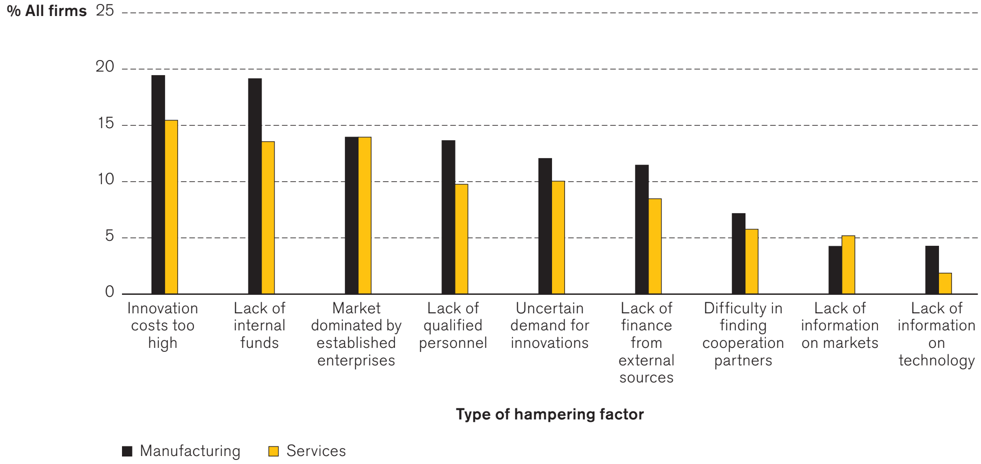
	% FIRMS WITH TECHNOLOGICAL INNOVATION ACTIVITIES RATING THE SELECTED EFFECT AS 'HIGHLY IMPORTANT'	
	MANUFACTURING	SERVICES
Improved quality of goods or services	46.1	47.5
Increased range of goods or services	31.7	38
Entered new markets or increased market share	30.5	36.1
Increased capacity of production or service provision	28.1	22.9
Improved flexibility of production or service provision	27.7	20.9
Reduced labour costs per unit output	17.5	15.6
Reduced environmental impacts or improved health and safety	16.7	9.2
Met regulatory requirements	14.1	14.5
Reduced materials and energy per unit output	9.0	8.6

Source: Federal Cooperation Commission, CFS/STAT, CIS4.

C.1.8

Important innovation-hampering factors for firms in Belgium

This indicator gathers information about the most important hampering factors for firms in Belgium over the period 2002-2004. Firms were asked to rank the importance of various proposed hampering factors on a scale ranging from 0 (not relevant) to 3 (highly important). We report here the frequency of 'highly important' hampering factors.



	% ALL FIRMS RATING THE SELECTED HAMPERING FACTOR AS 'HIGHLY IMPORTANT'	
	MANUFACTURING	SERVICES
Innovation costs too high	19.4	15.4
Lack of internal funds	19.1	13.5
Market dominated by established enterprises	13.9	13.9
Lack of qualified personnel	13.6	9.7
Uncertain demand for innovations	12	10
Lack of finance from external sources	11.4	8.4
Difficulty in finding cooperation partners	7.2	5.7
Lack of information on markets	4.2	5.2
Lack of information on technology	4.3	1.9

Source: Federal Cooperation Commission, CFS/STAT, CIS4.

C.2 Entrepreneurship

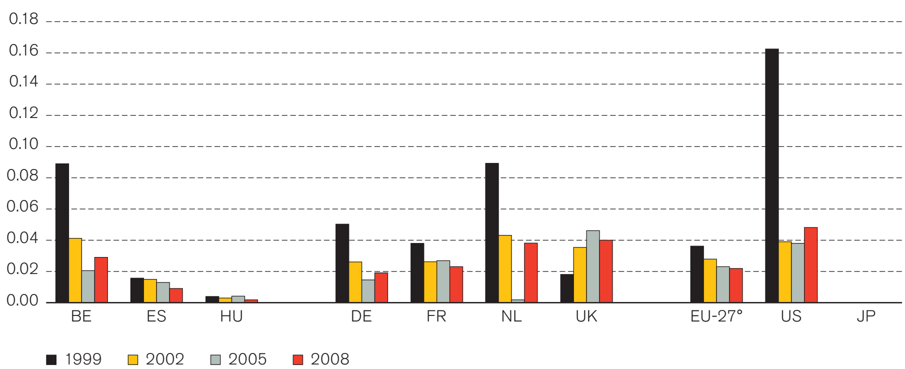
C.2.1 Venture capital investments as % of GDP

Venture capital investment is defined as private equity raised for investment in companies. It is provided by specialised financial firms acting as intermediaries between primary sources of finance (such as pension funds or banks) and firms (formal venture capital). It is also provided by so-called 'business angels' (usually wealthy individuals experienced in business and finance who invest directly in firms). Management buy-outs, management buy-ins and venture purchase of quoted shares are excluded.

In general, data on venture capital are broken down into two investment stages. First, the early stage consists of seed capital and start-up funding. Seed capital is provided to research, assess and develop an initial concept. Start-up financing is provided for product development and initial marketing. Second, expansion and replacement financing is provided for the growth and expansion of a company that is breaking even or trading profitably.

Venture capital investment is expressed as a percentage of gross domestic product (GDP) at market prices to account for the size of the economy.

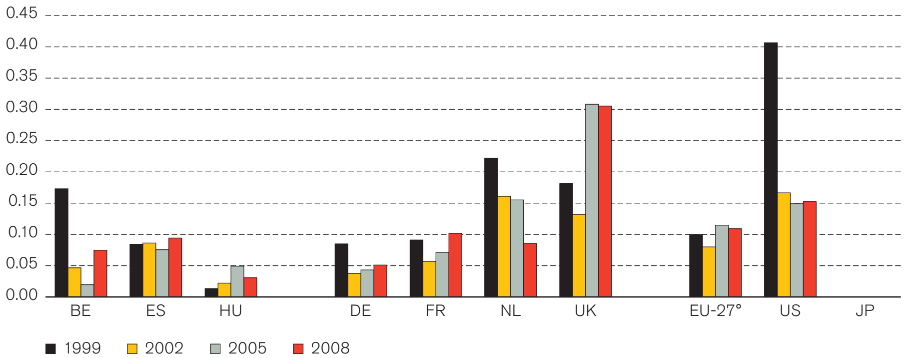
C.2.1a Early stage



GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	0.089	0.041	0.020	0.029
Spain	ES	0.016	0.015	0.013	0.009
Hungary	HU	0.004	0.003	0.004	0.002
Germany	DE	0.050	0.026	0.014	0.019
France	FR	0.038	0.026	0.027	0.023
Netherlands	NL	0.089	0.043	0.002	0.038
United Kingdom	UK	0.018	0.035	0.046	0.040
European Union	EU-27°	0.036	0.028	0.023	0.022
United States	US	0.162	0.039	0.038	0.048
Japan	JP	..	..	..	..

Source: Eurostat, Structural Indicators.
Note: °the data for the EU is for EU-15.

C.2.1b
Expansion and replacement

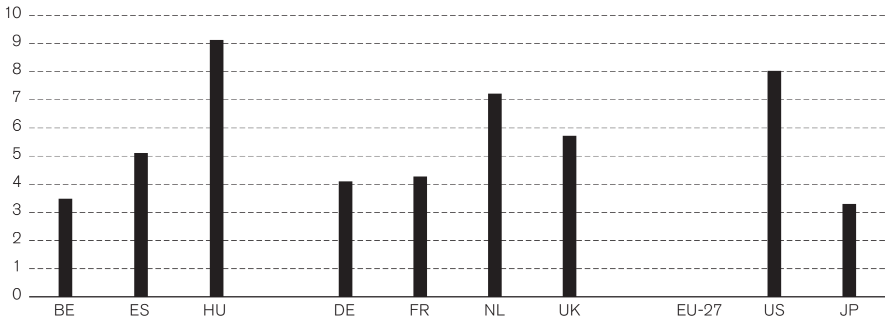


GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	0.173	0.046	0.019	0.075
Spain	ES	0.084	0.086	0.075	0.094
Hungary	HU	0.012	0.021	0.049	0.030
Germany	DE	0.084	0.037	0.043	0.050
France	FR	0.090	0.056	0.071	0.102
Netherlands	NL	0.222	0.159	0.154	0.084
United Kingdom	UK	0.180	0.132	0.308	0.304
European Union	EU-27°	0.100	0.079	0.114	0.109
United States	US	0.405	0.166	0.147	0.150
Japan	JP	..	..	..	..

Source: Eurostat, Structural Indicators.
Note: °the data for the EU is for EU-15.

C.2.2
Early-stage entrepreneurial activity (TEA)

The early-stage entrepreneurial activity (TEA) is one of the principal indicators of entrepreneurship. It focuses predominantly on the early stages of entrepreneurship as it looks at the percentage of the 18-64 population who are either nascent entrepreneurs or owner-managers of a new firm. This indicator is published in the Global Entrepreneurship Monitor (GEM), which is a worldwide research consortium. These indicators are based on over 180,000 interviews conducted in 54 countries during May and October of 2009. The relative focus on entrepreneurship in innovation-driven economies lies on dynamics – the creation of new firms and the replacement of less efficient ones – and on promoting new products and entering new markets.

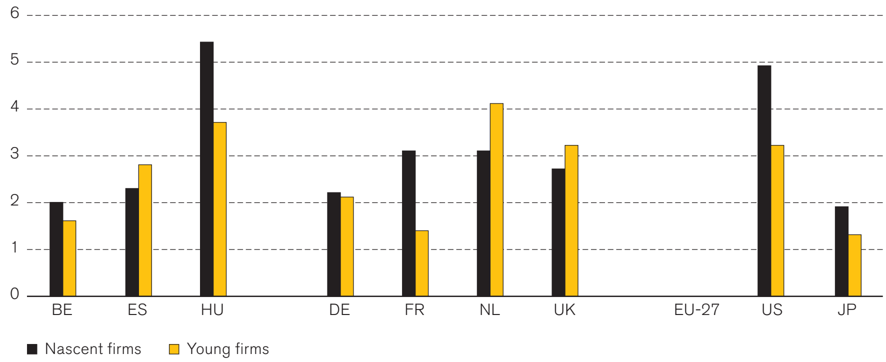


GEOGRAPHY		2009
Belgium	BE	3.5
Spain	ES	5.1
Hungary	HU	9.1
Germany	DE	4.1
France	FR	4.3
Netherlands	NL	7.2
United Kingdom	UK	5.7
European Union	EU-27	..
United States	US	8.0
Japan	JP	3.3

Source: Global Entrepreneurship Monitor, 2010.

C.2.3
Nascent entrepreneurship and young ownership rates

Nascent entrepreneurs are those actively involved in setting up a business they will own or co-own; this business has not paid salaries, wages, or any other payments to the owners for more than three months. The indicator is expressed as a percentage of the 18-64 population.
Young ownership rates point to those people who are currently an owner-manager of a new business. It refers to an ongoing business that has paid salaries, wages, or any other payments to the owners for more than three months, but not more than 42 months. The indicator is expressed as a percentage of the 18-64 population.
Nascent entrepreneurs and young ownership together add up to early stage entrepreneurial activity.

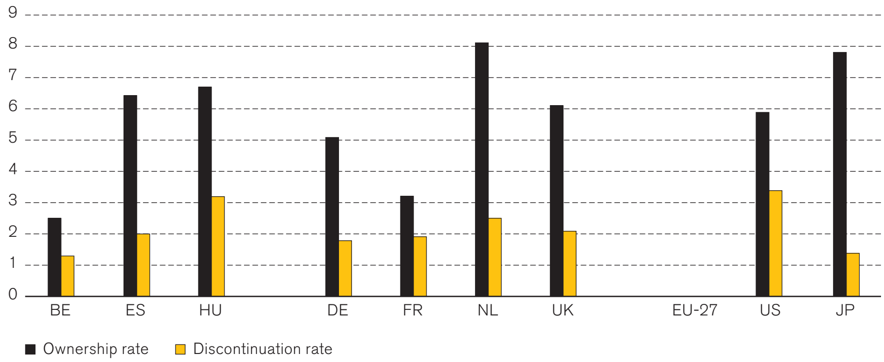


GEOGRAPHY		NASCENT FIRMS	YOUNG FIRMS
Belgium	BE	2.0	1.6
Spain	ES	2.3	2.8
Hungary	HU	5.4	3.7
Germany	DE	2.2	2.1
France	FR	3.1	1.4
Netherlands	NL	3.1	4.1
United Kingdom	UK	2.7	3.2
European Union	EU-27	..	..
United States	US	4.9	3.2
Japan	JP	1.9	1.3

Source: Global Entrepreneurship Monitor, 2010.

C.2.4
Established business ownership rate and discontinuation rate

The established business ownership rate refers to the percentage of the 18-64 population who are currently owner-managers of an established business. This refers to owning and managing an ongoing business that has paid salaries, wages, or any other payments to the owners for more than 42 months.
The business discontinuation rate points to the percentage of the 18-64 population who have, in the past 12 months, discontinued a business, either by selling, closing, or discontinuing an owner/management relationship with the business. This indicator is ***not*** to be equated with the business failure rates.

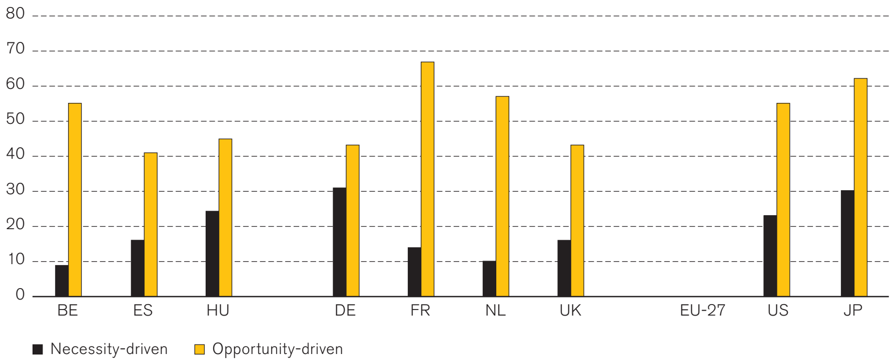


GEOGRAPHY		OWNERSHIP RATE	DISCONTINUATION RATE
Belgium	BE	2.5	1.3
Spain	ES	6.4	2.0
Hungary	HU	6.7	3.2
Germany	DE	5.1	1.8
France	FR	3.2	1.9
Netherlands	NL	8.1	2.5
United Kingdom	UK	6.1	2.1
European Union	EU-27	..	..
United States	US	5.9	3.4
Japan	JP	7.8	1.4

Source: Global Entrepreneurship Monitor, 2010.

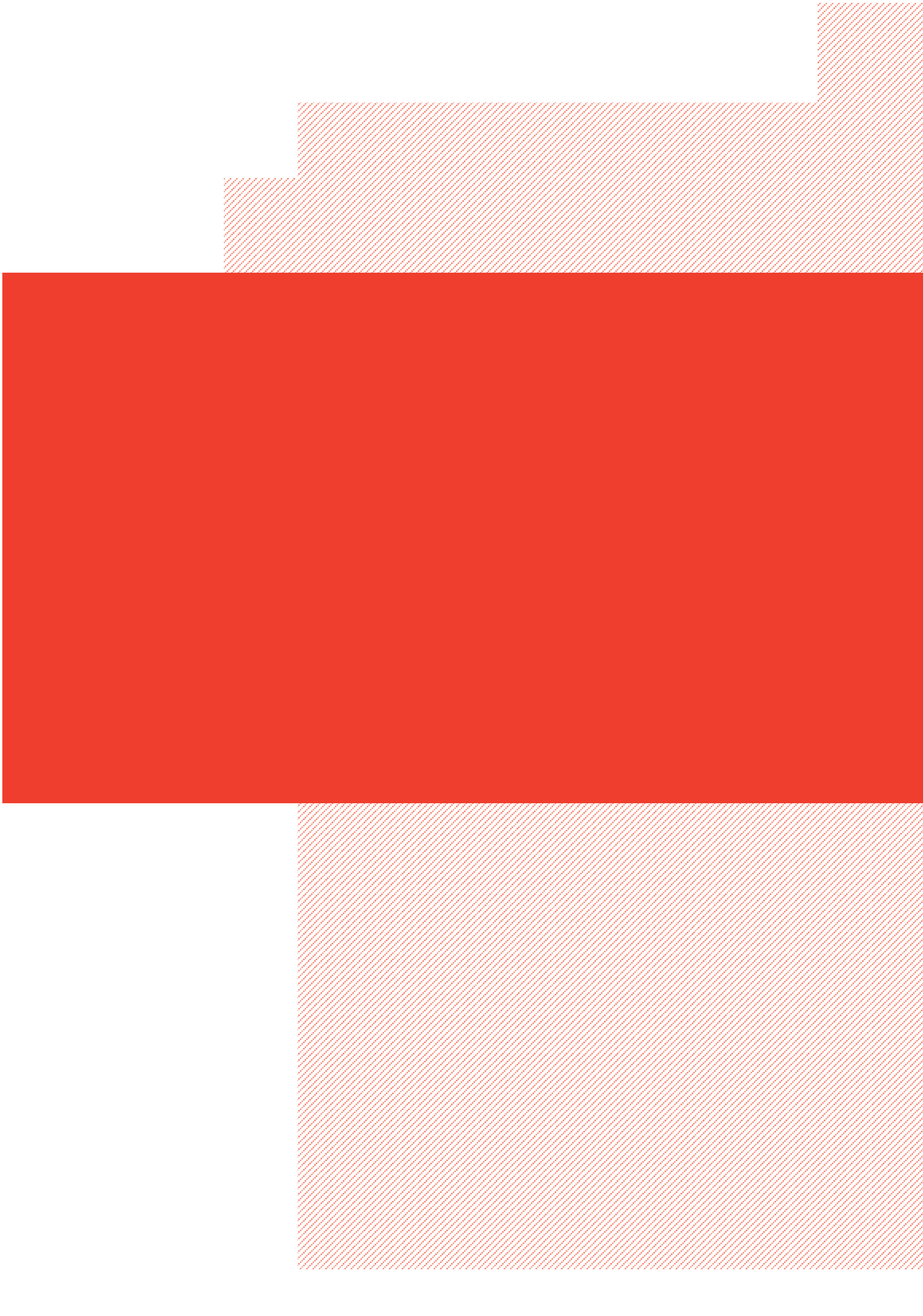
C.2.5
Necessity- and opportunity-driven entrepreneurial activity

Necessity-driven entrepreneurial activity considers those persons who engage in early-stage entrepreneurial activity mainly because they had no other option for alternative work. The indicator is presented as a share of TEA.
Improvement-driven opportunity relates to those persons who are involved in early-stage entrepreneurial activity who claim to be driven by opportunity as opposed to finding no other option for work; and who indicate that the main driver for being involved in this opportunity is being independent or increasing their income, rather than just maintaining their income. The indicator is presented as a share of TEA.



GEOGRAPHY		NECESSITY-DRIVEN	OPPORTUNITY-DRIVEN
Belgium	BE	9	55
Spain	ES	16	41
Hungary	HU	24	45
Germany	DE	31	43
France	FR	14	67
Netherlands	NL	10	57
United Kingdom	UK	16	43
European Union	EU-27	..	..
United States	US	23	55
Japan	JP	30	62

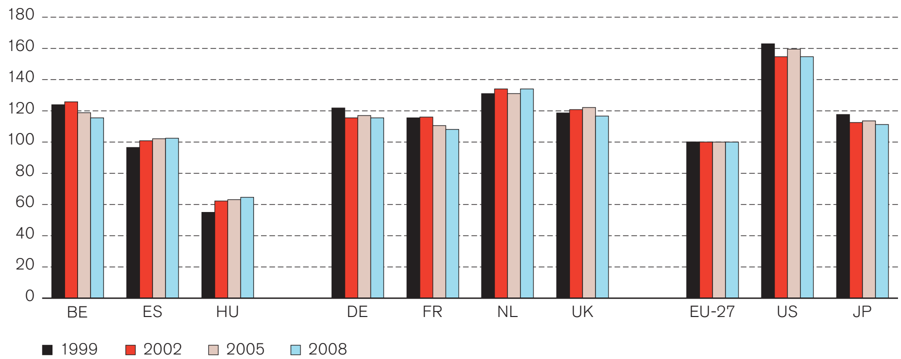
Source: Global Entrepreneurship Monitor, 2010.
Note: As a percentage of TEA.



D. ECONOMIC PERFORMANCE INDICATORS

D.1
GDP per capita in PPS

Gross domestic product (GDP) is often used as a measure of economic activity. It is defined as the value of all goods and services produced in a country or region less the value of any goods or services used in their creation. The volume index of GDP per capita in purchasing power standards (PPS) is expressed in relation to the European Union (EU-27) average set to equal 100. If the index of a country is higher than 100, this country's level of GDP per head is higher than the EU average and vice versa. Basic figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries allowing meaningful volume comparisons of GDP between countries. This index is intended for cross-country comparisons rather than for temporal comparisons.

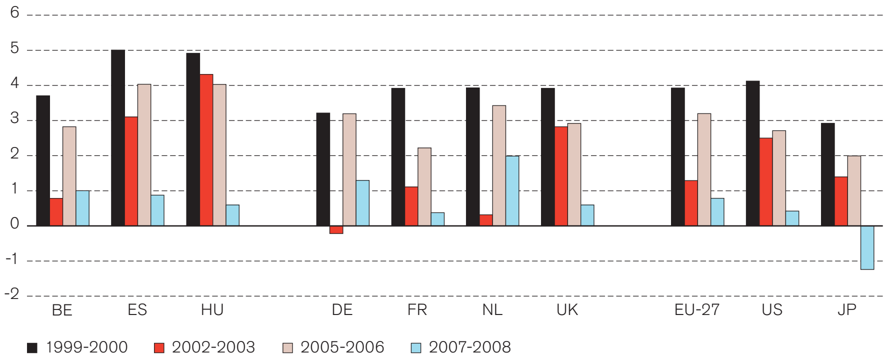


GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	123.0	125.3	119.8	115.1
Spain	ES	96.3	100.5	102.0	102.6
Hungary	HU	54.7	61.6	63.2	64.6
Germany	DE	122.1	115.2	116.9	115.6
France	FR	114.7	116.0	110.6	108.0
Netherlands	NL	130.8	133.3	130.8	134.0
United Kingdom	UK	117.8	120.6	121.9	116.2
European Union	EU-27	100.0	100.0	100.0	100.0
United States	US	162.6	154.2	159.0	154.7
Japan	JP	117.7	111.9	112.9	110.7

Source: Eurostat, Structural Indicators.
Note: EU-27 = 100.

D.2
Real GDP growth rate in %

The calculation of the annual growth rate of GDP volume is intended to allow comparisons of the dynamics of economic development both over time and between economies of different sizes. To measure the GDP growth rate in terms of volumes, the GDPs at current prices are valued in the prices of the previous year, and the thus-computed volume changes are related to the level of the reference year. Accordingly, price movements will not inflate the growth rate.



GEOGRAPHY		1999-2000	2002-2003	2005-2006	2007-2008
Belgium	BE	3.7	0.8	2.8	1.0
Spain	ES	5.0	3.1	4.0	0.9
Hungary	HU	4.9	4.3	4.0	0.6
Germany	DE	3.2	-0.2	3.2	1.3
France	FR	3.9	1.1	2.2	0.4
Netherlands	NL	3.9	0.3	3.4	2.0
United Kingdom	UK	3.9	2.8	2.9	0.6
European Union	EU-27	3.9	1.3	3.2	0.8
United States	US	4.1	2.5	2.7	0.4
Japan	JP	2.9	1.4	2.0	-1.2

Source: Eurostat, Structural Indicators.
Note: Annual average growth.

D.3
Labour productivity per person employed

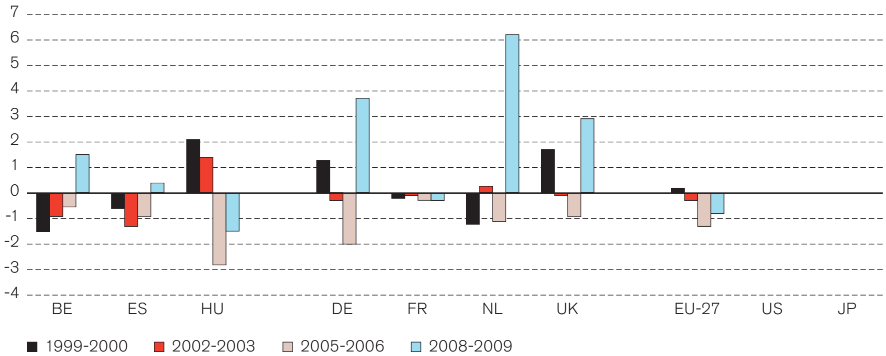
The labour productivity per person employed is calculated by looking at the GDP in purchasing power standards (PPS) per person employed relative to the EU-27. GDP per person employed is intended to give an overall impression of the productivity of national economies expressed in relation to the European Union (EU-27) average. If the index of a country is higher than 100, this country's level of GDP per person employed is higher than the EU average and vice versa. Basic figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries allowing meaningful volume comparisons of GDP between countries. Note that 'persons employed' does not distinguish between full-time and part-time employment.

GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	136.6	136.2	129.8	125.5
Spain	ES	103.7	104.8	101.3	103.6
Hungary	HU	63.8	71.0	67.3	71.1
Germany	DE	108.0	106.4	109.4	107.0
France	FR	125.1	125.5	122.2	121.6
Netherlands	NL	114.4	113.2	114.0	114.5
United Kingdom	UK	110.8	112.2	112.5	110.0
European Union	EU-27	100.0	100.0	100.0	100.0
United States	US	141.8	140.1	144.1	144.9
Japan	JP	98.8	98.0	99.5	99.7

Source: Eurostat, Structural Indicators.
Notes: EU-27=100; no data available before 2000; break in series in 2005.

D.4
Real unit labour cost growth

The real unit labour cost growth is a derived indicator that compares remuneration (compensation per employee) and productivity (gross domestic product per employment) to show how the remuneration of employees is related to the productivity of their labour. It is the relationship between how much each worker is paid and the value he/she produces by their work. Its growth rate is intended to give an impression of the dynamics of the participation of the production factor labour in output value created. Please note that the variables used in the numerator (compensation, employees) refer to employed labour only, while those in the denominator (GDP, employment) refer to all labour, including the self-employed.



GEOGRAPHY		1999-2000	2002-2003	2005-2006	2008-2009
Belgium	BE	-1.5	-0.9	-0.5	1.5
Spain	ES	-0.6	-1.3	-0.9	0.4
Hungary	HU	2.1	1.4	-2.8	-1.5
Germany	DE	1.3	-0.3	-2	3.7
France	FR	-0.2	-0.1	-0.3	-0.3
Netherlands	NL	-1.2	0.3	-1.1	6.2
United Kingdom	UK	1.7	-0.1	-0.9	2.9
European Union	EU-27	0.2	-0.3	-1.3	-0.8
United States	US	..	..	..	..
Japan	JP	..	..	..	..

Source: Eurostat, Structural Indicators.
Notes: Growth rate of the ratio: compensation per employee in current prices divided by GDP in current prices per total employment.

D.5
Employment rate

The employment rate is calculated by dividing the number of persons aged 15 to 64 in employment by the total population of the same age group. The indicator is based on the EU Labour Force Survey. The survey covers the entire population living in private households and excludes those in collective households such as boarding houses, halls of residence and hospitals. Employed population consists of those persons who during the reference week did any work for pay or profit for at least one hour, or were not working but had jobs from which they were temporarily absent.

GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	59.3	59.9	61.1	62.4
Spain	ES	53.8	58.5	63.3	64.3
Hungary	HU	55.6	56.2	56.9	56.7
Germany	DE	65.2	65.4	66.0	70.7
France	FR	60.9	63.0	63.7	64.9
Netherlands	NL	71.7	74.4	73.2	77.2
United Kingdom	UK	71.0	71.4	71.7	71.5
European Union	EU-27	61.8	62.4	63.5	65.9
United States	US	73.9	71.9	71.5	70.9
Japan	JP	68.9	68.2	69.3	70.7

Source: Eurostat, Community Labour Force Survey.
Note: In percent of the 15-64 age class.

D.6
Participation rate

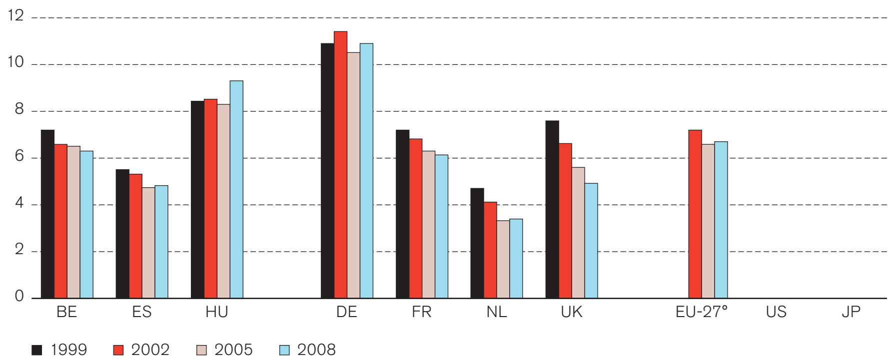
The participation rate is the sum of the employment rate and the unemployment rate. The employment rate is discussed in the previous Figure. Unemployment rates represent unemployed persons as a percentage of the labour force. The labour force is the total number of people employed and unemployed. Unemployed persons comprise persons aged 15 to 64 who were: without work during the reference week, currently available for work, 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.

GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	67.8	67.4	69.6	69.4
Spain	ES	66.3	69.6	72.5	75.6
Hungary	HU	62.5	62.0	64.1	64.5
Germany	DE	73.4	73.8	76.7	78.0
France	FR	71.3	71.6	73.0	72.7
Netherlands	NL	74.9	77.2	77.9	80.0
United Kingdom	UK	76.9	76.5	76.5	77.1
European Union	EU-27	..	71.3	72.4	72.9
United States	US	78.1	77.7	76.6	76.7
Japan	JP	73.6	73.6	73.7	74.7

Source: Eurostat, Community Labour Force Survey.
Notes: Participation rate: the share of employed and unemployed persons aged 15-64 in the total population of the same age; EU-27 had missing unemployment data for 1999.

D.7
Share of high and medium-high technology manufacturing sectors in total employment

The data shows the employment in high and medium-high technology manufacturing sectors as a share of total employment. Data source is the Community labour force survey (CLFS). The definition of high and medium-high technology manufacturing sectors is based on the OECD definition (itself based on the ratio of R&D expenditure to GDP).



GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	7.2	6.6	6.5	6.3
Spain	ES	5.5	5.3	4.7	4.8
Hungary	HU	8.4	8.5	8.3	9.3
Germany	DE	10.9	11.4	10.5	10.9
France	FR	7.2	6.8	6.3	6.1
Netherlands	NL	4.7	4.1	3.3	3.4
United Kingdom	UK	7.6	6.6	5.6	4.9
European Union	EU-27°	..	7.2	6.6	6.7
United States	US	..	..	..	..
Japan	JP	..	..	..	..

Source: Eurostat, Community Labour Force Survey.
Note: High and medium-high technology manufacturing: pharmaceuticals; computers; optics; electronics; chemicals; electrical equipment; machinery and equipment; motor vehicles, trailers and semi trailers; other transport equipment.
°data on EU-27 are from 2007.

D.8
Share of knowledge-intensive services in total employment

The data show the employment in knowledge-intensive service sectors as a share of total employment. The data source is the Community labour force survey (CLFS). The definition of knowledge-intensive services including high-technology services used by Eurostat is based on a selection of relevant items of NACE Rev. 1 on 2-digit level and is oriented on the ratio of highly-qualified working in these areas.

GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	36.0	37.8	38.4	38.5
Spain	ES	24.1	25.3	26.9	28.9
Hungary	HU	25.5	26.5	28.2	28.7
Germany	DE	29.9	31.8	33.8	35.3
France	FR	34.7	35.5	36.7	37.0
Netherlands	NL	39.1	38.8	42.0	42.7
United Kingdom	UK	39.5	40.9	42.3	42.7
European Union	EU-27°	..	31.4	32.5	33.0
United States	US	..	..	..	..
Japan	JP	..	..	..	..

Source: Eurostat, Community Labour Force Survey.
Note: °data on EU-27 are from 2007.

D.9

Business investment as a percentage of GDP

Business investment is defined as total gross fixed capital formation expressed as a percentage of GDP, for the private sector. Gross fixed capital formation consists of resident producers' acquisitions, less disposals, of fixed tangible or intangible assets, such as buildings, machinery and equipment, vehicles, or software. It also includes certain additions to the value of non-produced assets realised by productive activity, such as improvements to land. The ratio gives the share of GDP that is used by the private sector for investment (rather than being used for e.g. consumption).

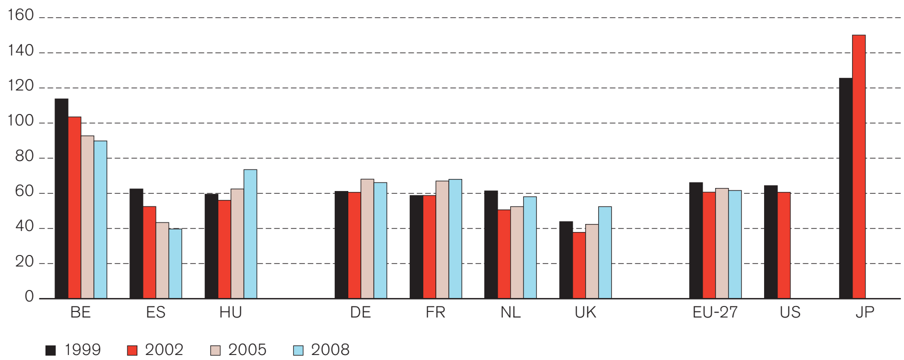
GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	18.8	17.4	18.9	21.0
Spain	ES	21.2	22.7	25.8	25.0
Hungary	HU	20.2	18.2	19.1	18.1
Germany	DE	19.4	16.7	16	27.5
France	FR	15.8	15.8	16.7	18.7
Netherlands	NL	19.9	16.4	15.6	16.9
United Kingdom	UK	16.1	15.3	16.1	14.5
European Union	EU-27	18.1	17.2	17.7	18.4
United States	US	..	..	..	..
Japan	JP	..	..	..	..

Source: Eurostat, Structural indicators.

D.10

General government debt as a percentage of GDP

The general government consolidated gross debt is expressed as a percentage of GDP. The EU definition provides that the general government sector comprises the subsectors of central government, state government, local government and social security funds. GDP used as a denominator is the gross domestic product at current market prices. Debt is valued at nominal (face) value, and foreign currency debt is converted into national currency using end-year market exchange rates (though special rules apply to contracts). The national data for the general government sector are consolidated between the sub-sectors. Basic data are expressed in national currency, converted into euro using end-year exchange rates for the euro provided by the European Central Bank.



GEOGRAPHY		1999	2002	2005	2008
Belgium	BE	113.7	103.5	92.1	89.8
Spain	ES	62.3	52.5	43.0	39.7
Hungary	HU	59.8	55.6	61.8	72.9
Germany	DE	60.9	60.4	68.0	65.4
France	FR	58.9	58.8	66.4	67.4
Netherlands	NL	61.1	50.5	51.8	58.2
United Kingdom	UK	43.7	37.5	42.4	52.0
European Union	EU-27	65.8	60.4	62.7	61.5
United States	US	64.1	60.2	..	..
Japan	JP	125.7	149.5	..	..

Source: Eurostat, Structural indicators.

D.11
High-tech exports

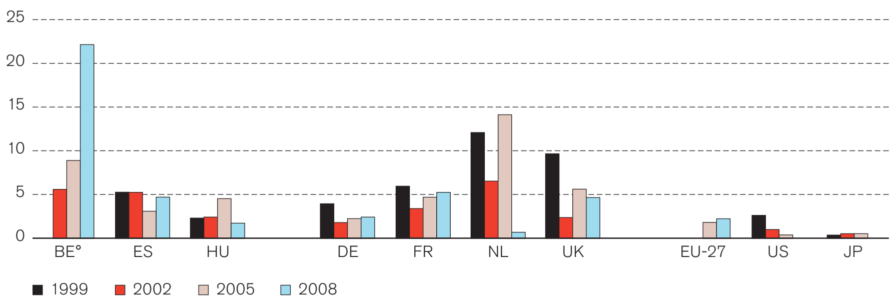
The exports of high-technology products as a share of total exports is calculated as the share of exports of all high-technology products of total exports. High-technology products are defined as the sum of the following products: Aerospace, computers, office machinery, electronics, instruments, pharmaceuticals, electrical machinery and armaments. The total exports for the EU do not include the intra-EU trade.

GEOGRAPHY		1999	2002	2005	2006
Belgium	BE	7.9	7.5	7.0	6.6
Spain	ES	5.9	5.7	5.6	4.9
Hungary	HU	19.4	21.5	19.7	20.3
Germany	DE	14.2	15.2	14.8	14.1
France	FR	24.0	21.9	19.1	17.9
Netherlands	NL	21.9	18.7	20.2	18.3
United Kingdom	UK	27.3	28.6	22.1	26.5
European Union	EU-27	20.4	18.9	18.7	16.6
United States	US	30.1	28.0	26.1	26.1
Japan	JP	25.1	23.1	21.1	20.0

Source: Eurostat, Structural indicators.

D.12
Foreign direct investment intensity

Foreign direct investment (FDI) intensity is an indicator of market integration. It is the average value of inward and outward FDI flows divided by GDP. The index measures the intensity of investment integration within the international economy. The direct investment refers to the international investment made by a resident entity (direct investor) to acquire a lasting interest in an entity operating in an economy other than that of the investor (direct investment enterprise). Direct investment involves both the initial transactions between the two entities and all subsequent capital transactions between them and among affiliated enterprises, both incorporated and unincorporated. Data are expressed as percentage of GDP to remove the effect of differences in the size of the economies of the reporting countries.



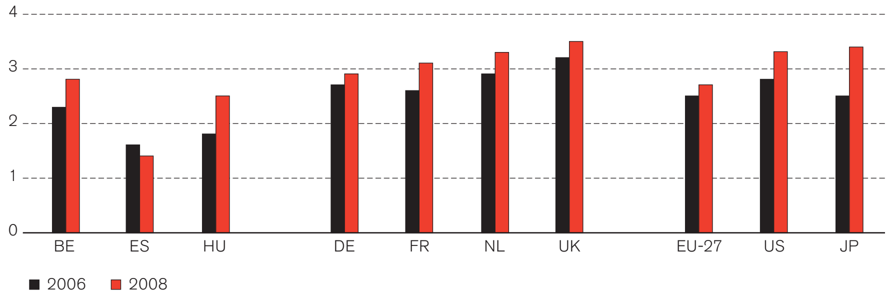
GEOGRAPHY		1999	2002	2005	2008
Belgium	BE°	..	5.6	8.9	22.1
Spain	ES	5.1	5.2	3.0	4.7
Hungary	HU	2.3	2.4	4.5	1.7
Germany	DE	3.8	1.8	2.2	2.4
France	FR	5.9	3.4	4.7	5.2
Netherlands	NL	12.0	6.5	14.1	0.7
United Kingdom	UK	9.6	2.3	5.6	4.7
European Union	EU-27	..	..	1.7	2.2
United States	US	2.6	1.0	0.3	..
Japan	JP	0.4	0.5	0.5	..

Source: Eurostat, Structural indicators.
Note: °missing data because 1999 was for the Belgo-Luxembourg Economic Union.

D.13

ICT expenditures as a percentage of GDP – Information technology

The ICT expenditure by type of product as a percentage of GDP is based on annual data on expenditure for IT and communication. IT includes: IT hardware, equipment, software and other services as a percentage of GDP. The expenditure is expressed as a percentage of GDP.

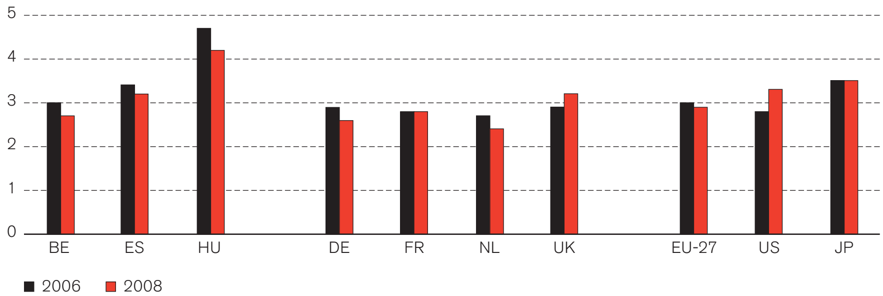


GEOGRAPHY		2006	2008
Belgium	BE	2.3	2.8
Spain	ES	1.6	1.4
Hungary	HU	1.8	2.5
Germany	DE	2.7	2.9
France	FR	2.6	3.1
Netherlands	NL	2.9	3.3
United Kingdom	UK	3.2	3.5
European Union	EU-27	2.5	2.7
United States	US	2.8	3.3
Japan	JP	2.5	3.4

Source: Eurostat; European Information Technology Observatory.

D.14
ICT expenditures as a percentage of GDP – Communication

The ICT expenditure by type of product as a percentage of GDP is based on annual data on expenditure for communication. Communication includes telecommunication hardware, equipment, software and other services. The expenditure is expressed as a percentage of GDP.



GEOGRAPHY		2006	2008
Belgium	BE	3.0	2.7
Spain	ES	3.4	3.2
Hungary	HU	4.7	4.2
Germany	DE	2.9	2.6
France	FR	2.8	2.8
Netherlands	NL	2.7	2.4
United Kingdom	UK	2.9	3.2
European Union	EU-27	3.0	2.9
United States	US	2.8	3.3
Japan	JP	3.5	3.5

Source: Eurostat; European Information Technology Observatory.

For more information

FEDERAL LEVEL AND GENERAL INFORMATION ON STI POLICY IN BELGIUM

- → The website of the federal agency in charge of STI policy (Belgian Science Policy): *www.belspo.be/stat/*
- → The website of the Federal Public Service Economy, SMEs, Self-employed and Energy: *http://economie.fgov.be/*
- → The website of the OECD (Organisation for Economic Cooperation and Development): *www.oecd.org*
- → The website of Eurostat, the statistical office of the European Union: *http://epp.eurostat.ec.europa.eu*

WALLOON REGION

- → The Regional Thematic Website on Research and Technologies: *http://recherche-technologie.wallonie.be*
- → The website of the advisory body for STI policy in the Region: *www.cesrw.be/activites/commission/cps*

FRENCH COMMUNITY

- → The website of the administration in charge of science policy in the Community: *www.cfwb.be/infosup* (gives access to the websites of all universities in the Community) and *www.agers.cfwb.be*
- → The website of the administration in charge of the promotion of external relations in the Community: *www.cfwb.be/cgri*
- → The website of the fund for support of fundamental research at universities in the French Community: *http://www2.frs-fnrs.be/*
- → The website of the Council of Rectors from universities in the Community: *www.cref.be* (gives access to the websites of all universities in the Community)

FLEMISH COMMUNITY

- → The website of the regional administration in charge of technology and innovation policy in the Region: *www.ewi-vlaanderen.be*
- → The website of the regional body with the mission of implementing the policy of the Region: *www.iwt.be*
- → The website of the advisory body for STI policy in the Region: *www.vrwi.be*
- → The website of the fund for fundamental research at universities in the Flemish Community: *www.fwo.be*
- → The website of the Council of Rectors from universities in the Community: *www.vlir.be* (gives access to the websites of all universities in the Community)
- → The website of the higher education establishments in the Community: *www.vlhora.be*

BRUSSELS-CAPITAL REGION

- → The website of the regional body with the mission of implementing the policy of the Region: *www.bruxelles.irisnet.be*
- → The website of the regional funding body for research, the I.S.R.I.B., the Institute for the encouragement for Scientific Research and Innovation of Brussels: *www.irsib.irisnet.be* or *www.iwoib.irisnet.be*
- → The website of R.I.B., the structure promoting scientific research and technical innovation of Brussels: *www.rib.irisnet.be*
- → The website of B.E.A., the regional non-profit organisation offering support to technology transfer and innovation in the Region: *www.abe.irisnet.be*
- → The website of S.D.R.B.: Regional Development Company for the Brussels-Capital Region: *www.sdrb.irisnet.be*
- → The website of ECOBRU: service in charge of delivering information and support to companies, starters and investors in the region: *www.investinbrussels.com*
- → The website of S.R.I.B./G.I.M.B., the Regional Investment Company: *www.srib.be*
- → The website of BRUCEFO, the Brussels Food Expertise Centre: *www.brucefo.be*
- → The website of BRUFOTEC/Brussels Food Technology: *www.brufotec.be*

Key Data on Science, Technology and Innovation Belgium 2010

This publication, issued by the Belgian Science Policy Office, aims to present the current state of science, technology and innovation (STI) through a set of key data.

STI-indicators are presented for Belgium, and benchmarked with Spain and Hungary (the actual EU-presidency trio) as well as with the most important trade partners of Belgium.

Another publication 'Belgian Report on Science, Technology and Innovation 2010' presents the institutional setting in which science, technology and innovation policies take place in Belgium.

Available online.
Interested readers can find up-to-date data and analyses on the following website: **www.belspo.be**

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