OECD Science, Technology and Industry Scoreboard

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OECD Science, Technology and Industry Scoreboard

2003 EDITION

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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– to contribute to sound economic expansion in member as well as non-member countries in the process of economic development; and

– to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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Publié en français sous le titre :

Science, technologie et industrie

TABLEAU DE BORD DE L'OCDE 2003

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FOREWORD

The *Science, Technology and Industry Scoreboard* 2003 brings together the latest internationally comparable data on the knowledge-based economy. It draws mainly on OECD databases, indicators and methodology developed by the Directorate for Science, Technology and Industry (DSTI) and focuses on:

- *The growth in the knowledge base of* OECD *economies*: investment in knowledge, human resources and international mobility of scientists, research and development, innovation measured by patents and the importance of emerging areas such as biotechnology and nanotechnology.
- *The information economy*: resources and infrastructure for the information economy, the diffusion and use of Internet technologies and electronic business, the contribution of the ICT sector to economic activity and international trade.
- *The global integration of economic activity*: key channels of economic integration and technology diffusion, such as direct and portfolio investment, the role of foreign-owned affiliates, cross-border ownership of inventions and international co-operation in science and innovation, as well as analysis of trade competitiveness in industries by technology intensity.
- *Productivity and economic structure*: comparison of OECD economies in terms of income, productivity and industrial performance, the growing importance of technology and knowledge-intensive industries, the interaction of manufacturing and services, and the role of firm turnover.

The STI *Scoreboard* 2003 is the sixth in a biennial series that started a decade ago. Particular attention was given to offering new or improved official measures for international comparisons in emerging areas of policy interest. The STI *Scoreboard* 2003 is also available on line and provides easy access to individual sections, a more elaborate data appendix and links to the databases used. The electronic version also gives users "clickable" access to the Excel spreadsheets containing the data used in charts and figures.

This volume was prepared by the Economic Analysis and Statistics (EAS) Division of the Directorate for Science, Technology and Industry (DSTI). Dirk Pilat served as general editor of the publication, Sandrine Kergroach-Connan provided statistical co-ordination and Julie Branco-Marinho, Beatrice Jeffries and Paula Venditti secretarial support. Nadim Ahmad, Elena Anton-Zabalza, Laudeline Auriol, Elena Bernaldo, Hélène Dernis, Isabelle Desnoyers-James, Andrew Devlin, Emmanuel Hassan, Anders Hintze, Mosahid Khan, Vladimir Lopez-Bassols, Pierre Montagnier, Laurent Moussiegt, Martin Schaaper, Sharon Standish, Colin Webb and Alison Young all contributed to the publication. Dominique Guellec, Thomas Hatzichronoglou and Andrew Wyckoff offered guidance and commented on the draft. Joseph Loux supervised the publication process.

This volume is published on the responsibility of the Secretary-General of the OECD.

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HIGHLIGHTS

The rising knowledge intensity of OECD economies…

This issue of the *Science, Technology and Industry Scoreboard* reveals that the knowledge intensity of OECD economies has continued to increase in recent years, despite the economic slowdown and talk of the death of the "new economy". Investment in research and development (R&D) rose in 2001 and into 2002, as did investment in software in several countries. Information and communication technology (ICT) continued to diffuse to households and businesses and electronic commerce continued to gain in importance, despite the slowdown in parts of the ICT sector.

… is reflected in trade patterns and in stronger productivity growth in some OECD countries.

The growing role of knowledge is reflected in economic performance. Trade in high-technology goods, such as aircraft, computers, pharmaceuticals and scientific instruments, accounted for over 25% of total trade in 2000 and 2001, up from less than 20% in the early 1990s. Some OECD economies have performed better than others. In Australia, Canada, Finland, Ireland and the United States, the overall efficiency of capital and labour – multi-factor productivity (MFP) – increased considerably over the 1990s, partly thanks to rapid technological progress and the effective use of ICT. Services sectors accounted for some of the acceleration, particularly in Australia and the United States. In some countries that have historically lagged behind, technology diffused very rapidly in recent years. For example, 86% of all enterprises in the Czech Republic with more than ten employees had Internet access in 2002, close to the levels of Australia and Canada.

It is accompanied by closer integration of OECD and non-OECD economies.

The globalisation of OECD economies continues. The trade-to-GDP ratio increased by about 2 percentage points over the 1990s in the United States and the European Union, although it remained stable in Japan. Over the 1990s, manufacturing, particularly high-technology industries, was increasingly exposed to international competition. Services have been characterised by large flows of foreign direct investment and the growing role of foreign affiliates in turnover and employment. Moreover, globalisation has been accompanied by greater international mobility, notably of highly skilled workers. A range of new indicators for non-OECD economies shows that they play a greater role in this process.

The composition of R&D expenditure is changing

Investment in knowledge is highest in the United States, Sweden and Finland.

In the United States, investment in knowledge – the sum of investment in R&D, software and higher education – amounted to almost 7% of GDP in 2000, well above the share for the European Union or Japan. The OECD average was about 4.8% of GDP, of which almost

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half for R&D. In most OECD countries, investment in knowledge has grown more rapidly than investment in fixed assets; the United States, Canada and Australia are the major exceptions.

R&D expenditure has risen steadily…

In 2001, OECD countries allocated about USD 645 billion (current purchasing power parity) to R&D. The United States accounted for approximately 44% of the OECD total, the European Union for 28% and Japan for 17%. R&D expenditure in the OECD area rose annually by 4.7% over 1995-2001. R&D expenditure has risen faster in the United States (5.4% a year) than in the European Union (3.7%) and Japan (2.8%). In 2001, the R&D intensity of the European Union reached 1.9% of GDP, its highest level since 1991, still well below the Lisbon target of 3% in 2010. In 2001, Sweden, Finland, Japan and Iceland were the only OECD countries in which the R&D-to-GDP ratio exceeded 3%. In 2002, the R&D intensity of the United States remained stable at 2.8% of GDP.

… mainly owing to greater business investment in the United States and Japan.

Most of the rise in R&D expenditure is due to higher business investment. During the second half of the 1990s, the share of business funding of R&D increased significantly in the United States, moderately in Japan and only slightly in the European Union. R&D expenditure by the higher education sector increased in the first half of the 1990s and then stabilised. R&D by the government sector has declined in recent years, partly owing to the reduction in defence R&D and the transfer of some public agencies to the private sector.

The services sector and high-technology industries account for much of the increase in R&D spending.

In 2000, services accounted for about 23% of total business sector R&D in the OECD area, an increase of 8 percentage points from 1991. More than 30% of all R&D is carried out in the services sector in Norway, Denmark, Australia, Spain and the United States but less than 10% in Germany and Japan. High-technology industries accounted for more than 52% of total manufacturing R&D in 2000, ranging from over 60% in the United States to 47% and 44% in the European Union and Japan, respectively. Finland allocated more than 1% of GDP to ICT-related manufacturing R&D in 2000.

New technologies attract a considerable share of both public- and private-sector R&D funding.

Certain new technologies and socio-economic objectives account for a growing part of R&D spending. Nanotechnology, for example, is among the most rapidly growing targets of R&D funding, but it still accounts for only a small share of total R&D. Between 1997 and 2000, government R&D funding for nanotechnology trebled to 293 million in the United States, doubled to USD 210 million in the European Union and doubled to USD 190 million in Japan.

Government R&D priorities differ.

Direct government support for health R&D accounts for over 0.2% of GDP in the United States, substantially above the levels for the European Union and Japan. Canada, Denmark and New Zealand devote a large share of government funding to biotechnology R&D. In the United States, Spain and France, defence accounts for a large share of overall government R&D spending (over 54% in the United States in 2003), although defence R&D declined in most OECD countries over 1995-2003. US defence R&D accounts for more than 75% of total OECD spending on defence R&D. Government-funded R&D on space is particularly important in the United States, France and Belgium.

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Patenting is on the rise

Patenting, which is a measure of innovation, is increasing…

OECD data on patent families (a set of patents filed in various countries to protect a single invention) show the existence of more than 40 000 patent families in 1998 in the OECD area, a 32% increase from 1991. The United States accounted for around 36%, followed by the European Union (33%) and Japan (25%). Biotechnology and ICT have been among the main growth areas. On average, biotechnology patents filed at the European Patent Office (EPO) increased about 9.9% a year compared to 6.7% for total patents. ICT-related patent applications grew by 8.9% a year over the same period.

… but more quickly in certain countries.

Over the 1990s the European Union's share of patent families converged towards that of the United States, while that of Japan declined by 4 percentage points. Korea had the highest annual growth in patent families at more than 20%. When population is taken into account, Switzerland and Sweden had the highest propensity to patent among OECD countries.

The human resource base is expanding and becoming more mobile

More and more young people enter university…

In the OECD area, a quarter of the population aged 25-64 has completed tertiary-level education. The share is much higher in the United States (37%) and Japan (34%) than in the European Union (21%). The share of women exceeds that of men in half of all OECD countries. The educational level of the population continues to rise, as 45% of young people now enter university. However, entry rates vary from over to 60% in Finland, Sweden, Hungary and Poland to around or below 25% in Mexico, the Czech Republic and Turkey.

… but study in different disciplines in different regions.

While the United States and the European Union award approximately the same shares of total OECD university degrees, the European Union awards 36% of science and engineering (S&E) degrees while the United States only awards 24%. The gap is even larger for PhD degrees. Ireland, France and the United Kingdom have the largest share of science degrees; Finland, Japan, Korea and Sweden award the largest shares of engineering degrees. Women only account for 30% of university degrees in S&E and 27% of PhDs. In Japan, these shares are only around 10%.

Higher levels of education are reflected in the employment of tertiary-level graduates…

Large investments in education over the past decades have led to a general rise in the educational attainment of the employed population. On average, 28.2% of employed persons in OECD countries have a tertiary-level degree. The United States (36.8%) and Japan (36.5%) rank far ahead of the European Union (24.0%), which also has large cross-country disparities. Employment growth of tertiary-level graduates ranged between 2% and 6% a year over 1997-2001, substantially faster than aggregate employment growth. Unemployment rates are generally much lower for university graduates than for the overall population, although they are higher for women than for men.

… and the large share of professional and technical occupations.

Professional and technical workers represent between 20% and 35% of total employment in most OECD countries, and over 35% in Sweden, Switzerland, Australia and Denmark. The share of women in

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these professions stands at more than 60% in Hungary and Poland. Professional and technical occupations have grown at a much faster rate than overall employment over 1995-2002. Growth has been particularly rapid among highly skilled ICT workers, with annual average growth of 5% in the United States and over 10% in the European Union.

The human resource base is increasingly likely to cross national borders…

In the United States, the largest number of foreign-born scientists and engineers with S&E doctorates born in the OECD area come from the United Kingdom and Canada. However, the United States has three times as many foreign-born scientists from China and twice as many from India as from the United Kingdom. In the European Union countries, the relative share of non-national human resources in science and technology (HRST) is between 3% and 3.5%, with Belgium, Luxembourg, Austria and the United Kingdom having high shares. Women seem somewhat less internationally mobile than men; the share of women employed as non-national HRST is lower than the share of all women in HRST occupations in all OECD countries except the Netherlands.

… partly owing to the mobility of PhD students.

Foreign students represent more than a third of PhD enrolments in Switzerland, Belgium and the United Kingdom, 27% in the United States, 21% in Australia, 18% in Denmark and 17% in Canada. In absolute numbers, the United States has far more foreign PhD students than other OECD countries, with around 79 000. The United Kingdom follows with some 25 000. Language plays a role in the choice of destination, notably for English-speaking countries, but also for Spain, which receives many students from Central and South America.

Non-OECD economies make a growing contribution to the global knowledge base

Non-OECD economies account for a growing share of the world's R&D…

The major non-OECD economies currently account for 17% of global R&D expenditure. In 2001, Israel allocated 4.8% of GDP to R&D (excluding R&D for defence), a higher ratio than Sweden. R&D expenditure in China grew rapidly over the past decade and in 2001 reached almost USD 60 billion. This is behind the United States (USD 282 billion) and Japan (USD 104 billion), but ahead of Germany (USD 54 billion). India spent about USD 19 billion on R&D in 2000-2001, which puts it among the top ten countries worldwide. R&D spending by Brazil, the Russian Federation and Chinese Taipei is comparable to that of the G7 countries and Korea.

… but only a small share of innovation.

Non-OECD economies still make only a minor contribution to global patenting. OECD countries accounted for 97.6% of patent applications to the EPO in 1999 and over 95% of patents granted by the US Patent and Trademark Office (USPTO) in 1998. In 1999, Israel – at 122 patent applications per million population – was the only non-member economy whose patent applications at the EPO exceeded the OECD average of 88. In 1998, Chinese Taipei had 223 patents granted per million population at the USPTO. Of a world total of around 41 000 patent families in 1998, non-OECD economies accounted for only 1.5%, up from 1% in 1991.

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Several non-OECD economies have highly educated human resources.

In 2001, China had the second highest number of researchers in the world (743 000), behind the United States (1.3 million), but ahead of Japan (648 000) and Russia (505 000). China delivered 739 000 university degrees in 2000, equivalent to 13% of the OECD total in that year (5.6 million). India (687 000) and Russia (611 000) also contributed substantially to the world total. Non-OECD economies also contribute significantly to advanced research. In 2000, Russia granted 26 000 new degrees in advanced research programmes (equivalent to PhDs), and Brazil and Thailand had around 20 000 each. In comparison, the OECD awarded 147 000 new advanced research degrees in 2000.

ICT continues to diffuse and is used more effectively

Investment in ICT grew rapidly over the 1990s, but slowed in recent years.

The share of ICT in total non-residential investment doubled and in some cases quadrupled between 1980 and 2000. In 2001, it was particularly high in the United States, the United Kingdom and Sweden. In many countries, the share of software in non-residential investment multiplied several times between 1980 and 2000. Available data for 2001 indicate that ICT's share in total investment declined from 2000 to 2001.

Despite the slowdown, ICT technologies have diffused widely…

In OECD countries, access to telecommunications networks has increased in recent years by more than 10% a year, especially in countries with lower penetration rates, such as Poland, Mexico and Hungary. Wireless access has grown particularly fast. The Internet also continues to diffuse rapidly. Germany had 84.7 Web sites per 1 000 population in 2002, followed by Denmark (71.7) and Norway (66.4). Mexico, Turkey, Greece and Japan all had less than three Web sites per 1 000 population.

… and increasingly adopt broadband technologies.

Broadband has diffused most widely in Korea, Canada, Sweden, Denmark, Belgium and the United States. In Denmark and Sweden, one out of five enterprises accesses the Internet through a connection faster than 2Mbps. In Italy and Greece, relatively few firms have such a rapid Internet connection. In Canada, Ireland, Spain and Sweden, however, more than 40% of enterprises still connect to the Internet via dial-up.

Computers are more present in homes…

In Denmark, Germany, Sweden and Switzerland, some two-thirds of households had access to a home computer in 2002. In many other OECD countries, the share is less than 50%. Data on Internet access by household size show that Internet access is more frequent in households with children than in households without.

… and the Internet is increasingly used…

At the end of 2001, there were 77.5 million Internet subscribers to fixed networks in the United States, approximately 24 million in Japan, more than 23 million in Korea, almost 15 million in Germany and 13.6 million in the United Kingdom. A ranking in terms of Internet subscribers per capita places Iceland, Korea, Denmark, Sweden and Switzerland at the top of the list. The number of secure servers per capita increased significantly between July 1998 and July 2002, a sign of the growing importance of security for Internet applications. Iceland has the highest number of secure servers per capita, followed by the United States, Australia, Canada and New Zealand.

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… by individuals for various purposes.

Men use the Internet more than women in all countries for which data are available. More than eight out of ten people in Switzerland, Austria, the United States, Denmark and Sweden use the Internet for e-mail. It is also commonly used to find information about goods and services, particularly in Sweden, Denmark and Finland. In the United States, almost 40% of Internet users buy on line, as do many users in Denmark, Sweden and Finland. In Portugal and Sweden, about half of all Internet users play games on line and/or download games and music. In Sweden and Denmark, more than half of all Internet users utilise e-banking.

In many OECD countries, enterprise access to the Internet is almost universal for enterprises with more than ten employees.

In many countries almost all enterprises with ten or more employees use the Internet. In Finland, Denmark, Canada, Sweden and Ireland, two-thirds or more of such enterprises have Web sites. The Internet is less used by smaller than by larger enterprises, and differences among countries are more striking when small enterprises are compared. Internet penetration in enterprises with ten or more employees also varies considerably across sectors. In the financial sector, almost all firms use the Internet. The retail sector seems to lag behind, particularly in countries with low overall Internet use by enterprises.

Electronic commerce is growing, but remains small in most countries.

Internet sales range between 0.3% and 3.8% of total sales. Electronic sales, *i.e.* sales over any kind of computer-mediated network, reach 10% or more of sales in Austria, Sweden, Finland and Ireland. In the US retail sector, the share of electronic sales in total sales grew by 70% between the fourth quarter of 2000 and the fourth quarter of 2002. Large firms use the Internet more frequently than small ones to sell goods and services. It is also more common to purchase than to sell over the Internet. As many as two-thirds or more of enterprises with 250 or more employees in Australia, Canada, Denmark and Finland buy goods or services via the Internet.

The ICT sector makes an important contribution to value added and employment.

The ICT sector grew strongly in OECD economies over the 1990s, particularly in Finland, Sweden and Norway. In Finland, the ICT sector's share of value added doubled over 1995-2001 and now represents over 16.4% of total business sector value added. In most OECD countries, ICT services have increased their relative share of the ICT sector, owing to the increasing importance of telecommunication services and software. In 2000, the ICT sector accounted for about 6.6% of total business employment in the 21 OECD countries for which estimates are available. Over 1995-2000, OECD-area employment in the ICT sector grew by more than 3 million, *i.e.* an average annual growth rate of over 4.3% a year, more than three times that of overall business sector employment. ICT services were the main driver of employment growth.

OECD economies continue to integrate

The rise in international trade and investment implies the growing integration of OECD economies.

Financial transactions (direct investment, investment income, portfolio investment) constitute the fastest-growing and the most volatile segment of international transactions. The share of trade in international transactions has grown slowly and averaged just under 18% of OECD GDP for 1999-2001. The share of international trade in

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services remains substantially lower, at around 4% of GDP. Trade in services has increased slightly over time as services such as software, financial services and accounting have become more internationally tradable. The international trade-to-GDP ratio is over 50% for Ireland, Belgium, the Netherlands and certain eastern European countries. In contrast, it is only around 10% for the United States and Japan as well as the European Union when intra-EU trade flows are excluded.

High-technology industries are particularly closely integrated at world level.

Export ratios and import penetration rates for the United States, Japan and the European Union (excluding intra-EU trade) show that computers, aircraft, scientific instruments and radio and television communication equipment have high exposure to international competition, whereas exposure is low for paper, printing, metal products and food, drink and tobacco. Owing to international sourcing and intra-industry trade, strongly export-oriented industries can also have a high import penetration rate. This is the case for computers and electrical machinery in the United States and for scientific instruments and aircraft in Japan and the European Union.

A considerable share of trade takes place within firms or involves imports in order to export.

The share of intra-firm exports in total exports of manufacturing affiliates under foreign control ranges between 35% and 60% in the OECD countries for which data are available. Data for intra-firm exports and imports between US parent companies and their foreign affiliates show that such trade amounts to 25% of aggregate exports and 15% of aggregate imports. For imports, the ratio of intra-firm trade of US parent companies is highest with Singapore, accounting for 66% of total imports. In some countries, exports depend strongly on imports. In the Netherlands, for example, the import content of exports exceeds 40%. Japan and the United States are the least dependent on imports for exports. Between 1980 and 1997, dependency on imports for subsequent exports increased in Canada, Germany, Australia and the United States. It decreased in France, Japan, Denmark and the Netherlands.

Affiliates under foreign control make a large contribution to economic activity in some countries and a very small one in others.

The share of turnover under foreign control in the manufacturing sector ranges from about 70% in Hungary and Ireland to under 3% in Japan. For 1995-2000, however, the shares of foreign affiliates in manufacturing turnover rose in nearly all countries for which data are available. The shares of foreign affiliates in manufacturing employment range from around 50% in Ireland, Luxembourg and Hungary to 4% in Germany. The available data also indicate high export and import ratios for foreign affiliates in manufacturing. The share of turnover under foreign control is lower in services than in manufacturing, at over 20% for Hungary, Belgium, Ireland and Italy. In terms of employment, the share of foreign affiliates in services ranges from 19% in Belgium and around 14% in Hungary and Ireland to less than 1% in Japan.

The economic globalisation of OECD countries is also reflected in the internationalisation of technology…

Foreign affiliates also account for a growing share of R&D, ranging from less than 5% in Japan to over 70% in Hungary and Ireland. At over 30%, the share of R&D conducted by foreign affiliates is also high in Spain, Sweden, Canada, the Slovak Republic, the Netherlands, the United Kingdom, Australia and Portugal. In Hungary and Ireland, foreign affiliates carry out relatively more R&D than national firms. In

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most other OECD countries, the opposite is true. As firms relocate research facilities abroad, an increasing share of technology is owned by firms of another country than the inventor's country of residence. In both the mid- and late 1990s, an average of 14% of all inventions in any OECD country were owned or co-owned by a foreign resident. Foreign ownership of domestic inventions is high in many small economies, as well as in Canada and the United Kingdom, where a large share of inventions is owned by US companies. Japan and Korea are much less internationalised in this respect.

... and in international co-operation in science and technology.

Scientific collaboration is generally much more widespread with large OECD countries than with smaller ones. The United States plays the leading role in international scientific collaboration, followed by the United Kingdom, France and Germany. By the late 1990s, about 6% of patents were the result of international collaborative research. Internationalisation is highest in small European countries. However, when intra-EU co-operation is factored out, researchers in the European Union have a lower propensity than US researchers to collaborate with foreign researchers. In Japan, there is very little international co-operation in science and technology.

Rapid productivity growth in the services sector contributes to growth in some countries

The United States remains the OECD leader in GDP per capita.

In 2002, GDP per capita in the OECD area ranged from over USD 35 000 in Luxembourg, Norway and the United States to less than one-third of that amount in Mexico, Korea and eastern Europe. For most OECD countries, income levels are 70-85% of US income levels. Relative to the United States, most OECD countries have higher levels of GDP per hour worked than GDP per capita owing to lower levels of labour utilisation. The difference between income and productivity levels is largest in European countries. Income levels in most countries have not caught up with the United States in recent years; Ireland and Korea are the most notable exceptions.

Rapid growth in some OECD countries over the 1990s has several sources.

Stronger growth in some OECD countries over the 1990s is due to several factors, including higher labour utilisation, capital deepening, notably in ICT, and more rapid multi-factor productivity growth. Investment in ICT accounted for between 0.35 and 0.8 percentage points of growth in GDP over 1995-2001. The United States, Canada, the Netherlands and Australia received the largest boost; Japan and the United Kingdom a more modest one; and Germany, France and Italy a much smaller one. Investment in software accounted for up to one-third of the contribution of ICT capital. In countries such as Australia and Japan, the rising contribution of ICT was accompanied by a decline in that of non-ICT capital. Over the second half of the 1990s, MFP growth also accounted for a considerable part of overall growth of GDP, particularly in Finland, Greece, Ireland and Portugal.

The services sector has grown strongly in several OECD countries,...

By 2000, services accounted for 70% of OECD GDP; manufactures accounted for about 18%. The share of services has been growing steadily for many years, and in many OECD countries, business services currently account for the bulk of labour productivity growth.

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This is linked to increased use of technology, notably ICT, greater exposure to international competition, and a growing role in R&D. A large share of labour productivity growth in the non-agricultural business sector is attributable to knowledge-intensive activities, notably ICT services and high-technology and medium-high-technology manufacturing. In the United States, wholesale and retail trade also contributed significantly to aggregate productivity growth.

… owing in part to greater interaction between services and manufacturing…

Part of the increase in the services sector's contribution to value added reflects the manufacturing sector's greater demand for services, some of which is due to the outsourcing of services previously produced in house. Estimates of the amount of services embodied in one unit of final demand for manufactured goods show that it was significantly higher in the mid-1990s than in the early 1970s. In the Netherlands, it nearly doubled. The amount of services embodied in manufacturing also grew strongly in Japan, particularly between the mid-1980s and the early 1990s.

… although strong performance in some services sectors also reflects high enterprise turnover.

New indicators for nine European countries show that each year between 7% and 11% of all active enterprises enter the market, while about 8% exit. Entry rates are substantially higher in dynamic services sectors, such as business services or ICT-related industries, than in more mature industries such as manufacturing. While many new firms do not survive for long, those that do generally grow over time. In Spain, employment in new firms in 1998 increased from an initial average of 2.1 persons to 3.2 persons in 2000.

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A.1. Investment in knowledge

- Investment in knowledge is defined as the sum of R&D expenditure, expenditure for higher education (public and private) and investment in software. In 2000 investment in knowledge amounted to 4.8% of GDP in the OECD area and would be around 10% if expenditure for all levels of education were included in the definition.
- The ratio of investment in knowledge to GDP is 2.8 percentage points higher in the United States than in the European Union. In Sweden (7.2%), the United States (6.8%) and Finland (6.2%) investment in knowledge exceeds 6% of GDP. In contrast, it is less than 2.5% of GDP in southern and central European countries and in Mexico.
- Most OECD countries are increasing investment in their knowledge base. During the 1990s, it increased by more than 7.5% annually in Ireland, Sweden, Finland and Denmark, far above the increase in gross fixed capital formation. The amount of investment in knowledge was still low in Greece, Ireland and Portugal, although growth of GDP was similar to that of the most knowledge-based economies (such as Sweden and Finland). In the United States, Australia and Canada, gross fixed capital formation grew more rapidly than investment in knowledge.
- For most countries, increases in software expenditure were the major source of increased investment in knowledge. Notable exceptions are Finland (where R&D was the main source of increase) and Sweden (where all three components grew).
- Gross fixed capital formation also covers investment in structures and machinery and equipment, which is a channel for diffusing new technology, especially to manufacturing industries. Gross fixed capital formation accounts for around 21.3% of OECD-wide GDP, of which machinery and equipment accounts for around 8.4%. The ratio of investment in machinery and equipment to GDP varies from 6% (Finland) to 14.6% (Czech Republic).

Measuring investment in knowledge

Investment in knowledge is defined and calculated as the sum of expenditure on R&D, on total higher education from both public and private sources and on software. Simple summation of the three components would lead to overestimation of the investment in knowledge owing to overlaps (R&D and software, R&D and education, software and education). Therefore, before calculating total investment in knowledge, the data must be reworked to derive figures that meet the definition.

- The R&D component of higher education, which overlaps R&D expenditure, was estimated and subtracted from total expenditure on higher education (both public and private sources).
- Not all expenditure on software can be considered investment. Some should be considered as intermediate consumption. Purchases of packaged software by households and operational services in firms were estimated.
- The software component of R&D, which overlaps R&D expenditure, was estimated using information from national studies and subtracted from software expenditure.
- Owing to a lack of information, it was not possible to separate the overlap between expenditure on education and on software; however, the available information indicates that this overlap is quite small.

A more complete picture of investment in knowledge would also include parts of expenditure on innovation (expenditure on the design of new goods), expenditure by enterprises on job-related training programmes, investment in organisation (spending on organisational change, etc.), among others. However, owing to the lack of available data, such elements could not be included.

The OECD is the source of the data on R&D and education. Because software investment data are only available for some OECD countries (see B.1), this component was estimated using data from a private source. Data for a few countries are available from national sources; however, methods for compiling data vary, thereby limiting cross-country comparisons. An OECD task force has developed a harmonised method for estimating software. For details, see N. Ahmad (2003), "Measuring Investment in Software", STI *Working Paper* 2003/6, OECD, Paris. Available at: *www.oecd.org/sti/working-papers*

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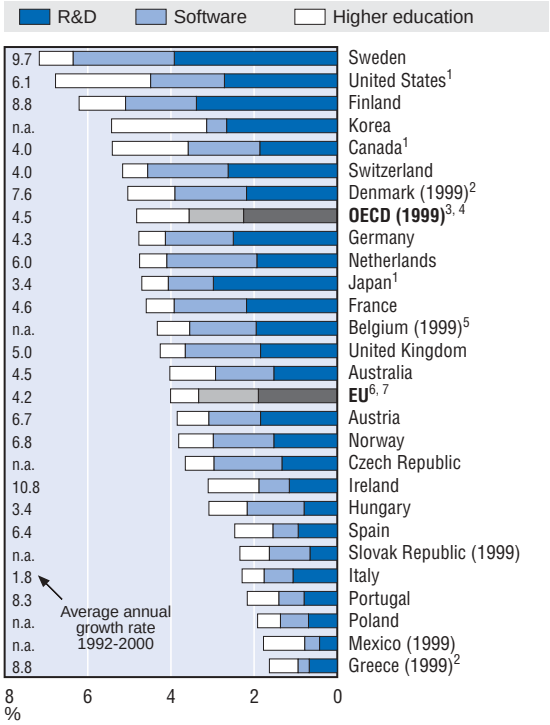
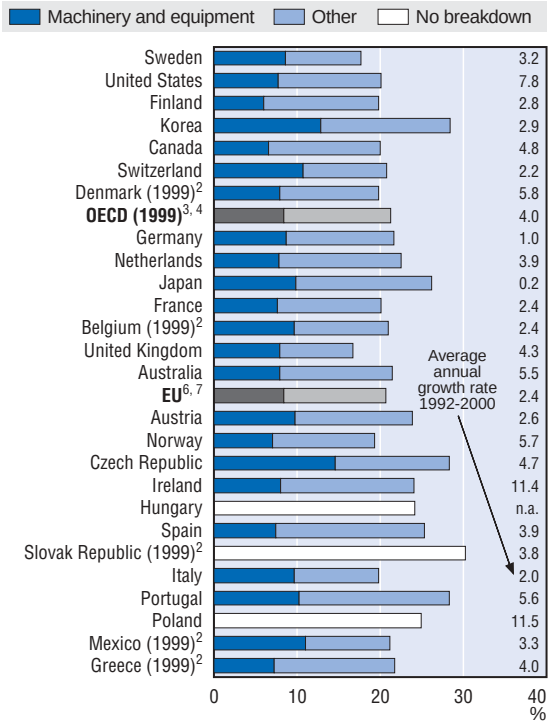
A.1. Investment in knowledge

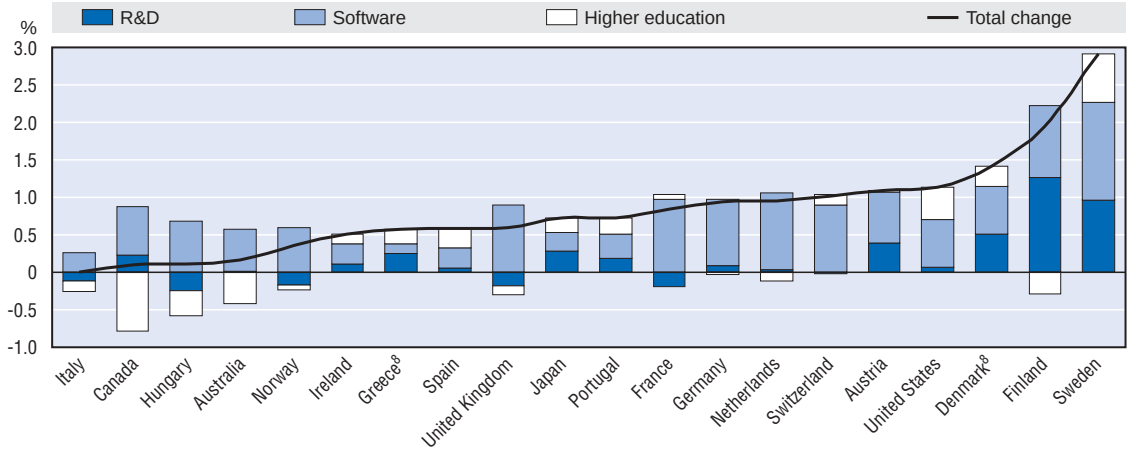
Investment in knowledge
As a percentage of GDP, 2000



Gross fixed capital formation
As a percentage of GDP, 2000



Source of change in investment in knowledge, as a percentage of GDP, 1992-2000



1. Post-secondary non-tertiary education is included in data for higher education.
2. Average annual growth rate refers to 1992-99.
3. Excludes Hungary, Poland and the Slovak Republic.
4. Average annual growth rate refers to 1992-99 and excludes Belgium, the Czech Republic, Hungary, Korea, Mexico, Poland and the Slovak Republic.
5. Data for higher education only include direct public expenditure.
6. Excludes Belgium, Denmark and Greece.
7. Average annual growth rate refers to 1992-99 and excludes Belgium.
8. Change between 1992 and 1999.

Source: OECD, Annual National Accounts of OECD countries, *OECD Economic Outlook*, MSTI database, Education database, and International Data Corporation, June 2003.

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A.2. Trends in domestic R&D expenditure

- In 2001, OECD countries allocated about USD 645 billion (current PPP) to R&D or about 2.3% of overall GDP.
- OECD-area R&D expenditure (in constant USD PPP) has continued to increase steadily in recent years, rising by 4.7% annually between 1995 and 2001. Since 1995, growth in the United States (5.4% a year) has outpaced growth in the European Union (3.7%) and Japan (2.8%). In 2001, R&D expenditure in the United States accounted for approximately 44% of the OECD total, close to the combined total of the European Union (28%) and Japan (17%).
- Below-average growth in R&D expenditure in the European Union is mainly due to slow and declining growth in the major European countries. Compared to average growth in the OECD area over 1995-2001 (4.7%), R&D expenditure increased by only 3.2% a year in Germany and by less than 3% in France, Italy and the United Kingdom. Only in the Slovak Republic did R&D expenditure decline during the second half of the 1990s.
- In the three main OECD regions, R&D expenditure relative to GDP (R&D intensity) has continued to increase steadily over the past three years. In Japan, this was due more to the stagnation in GDP since 1997 than to a significant increase in R&D expenditure. In the United States, however, the rise was mainly due to significant increases in R&D expenditure, as GDP also grew rapidly. In 2001, R&D intensity in the European Union exceeded 1.9% for the first time in a decade.
- In 2001, Sweden, Finland, Japan and Iceland were the only four OECD countries in which the R&D-to-GDP ratio exceeded 3%, well above the OECD average of 2.3%. During the second half of the 1990s R&D expenditure grew fastest in Iceland, Turkey, Mexico, and Greece, all of which had average annual growth rates above 12%.

Resources allocated to gross domestic expenditure on R&D (GERD)

Resources allocated to a country's R&D efforts are measured using two indicators, R&D expenditure and personnel. For R&D expenditure, the main aggregate used for international comparisons is gross domestic expenditure on R&D (GERD), which represents a country's domestic R&D-related expenditure for a given year. The R&D data are compiled on the basis of the methodology of the *Frascati Manual* 2002 (OECD, Paris, 2002).

The magnitude of estimated resources allocated to R&D is affected by several national characteristics, principally:

- *Improvements in national surveys on* R&D. This includes wider coverage of firms, particularly in the services sector (United States, 1992; Norway, 1987 and 1995; the Netherlands, 1994; Japan, 1995); and improved estimates of resources allocated to R&D by the higher education sector (Finland, 1991; Greece, 1995; Japan, 1996; the Netherlands, 1990; Spain, 1992).
- *Improved international comparability.* In Japan, R&D personnel data are expressed in full-time equivalent (FTE) as of 1996 (previously, these data were overestimated by about 30%) and R&D expenditure has been adjusted accordingly; in Italy, extramural R&D expenditures were excluded as of 1991 (previously, GERD was overestimated by 6-10%); in Sweden, R&D in social sciences and the humanities (SSH) in the business enterprise, government and private non-profit institutions (PNP) sectors was included as of 1993.
- *Other breaks in series.* For Germany, data as of 1991 relate to unified Germany; for the United States, capital expenditure is not covered; for Sweden, capital expenditure is not covered in the higher education sector from 1995.

For more details, see Annex Tables A.2.1 *and* A.2.2.

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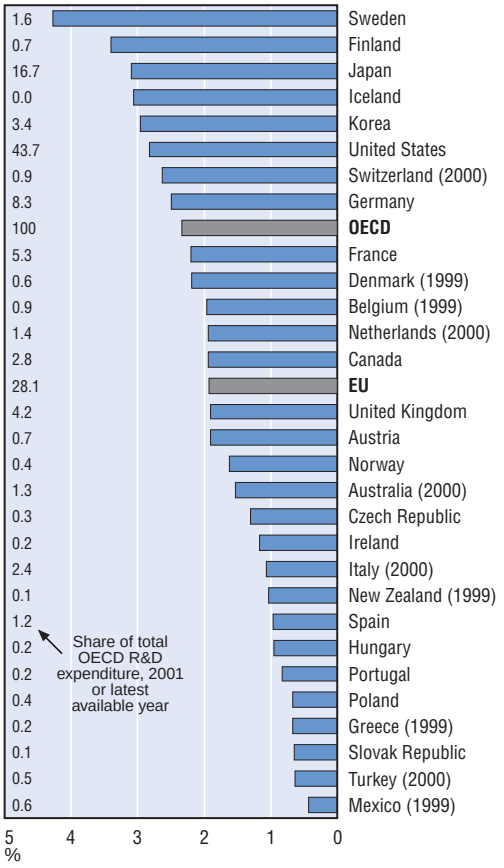
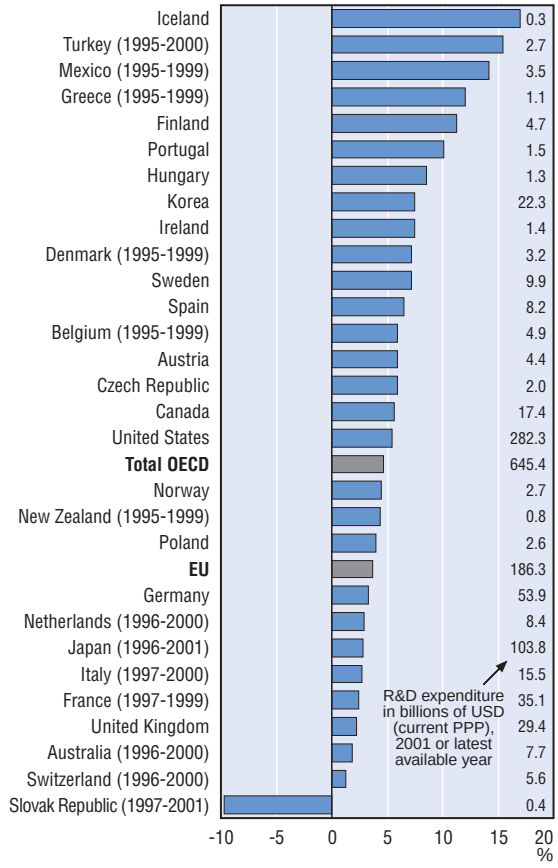
A.2. Trends in domestic R&D expenditure

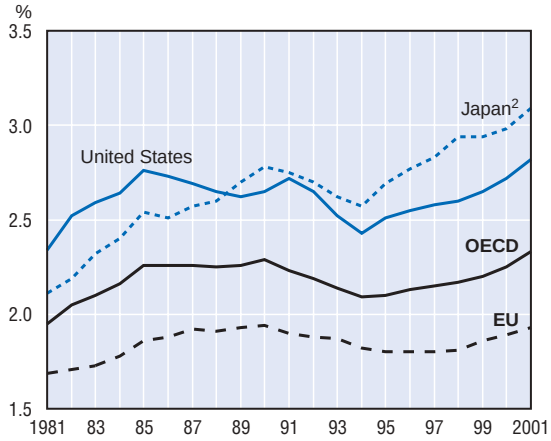
R&D intensity[1]
2001 or latest available year



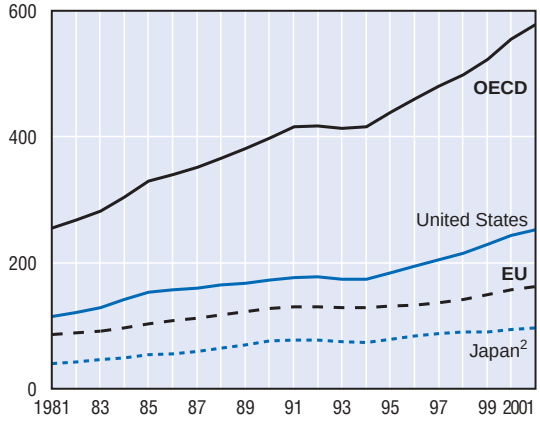
Evolution of gross domestic expenditure on R&D
Average annual growth rate, 1995-2001



Trends in R&D intensity[1] by area, 1981-2001
Percentage of GDP



Gross domestic expenditure on R&D by area
Billions of 1995 PPP dollars



1. Gross domestic expenditure on R&D as a percentage of GDP.
2. Data are adjusted up to 1995.

Source: OECD, MSTI database, May 2003.

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A.3. R&D financing and performance

- The business sector is the major source of financing of domestic R&D and accounted for more than 63% of funding in OECD countries in 2001.
- The role of the business sector in funding R&D differs sharply across the three main OECD regions. The business sector funds 73% of R&D in Japan and 68% in the United States, but only 56% in the European Union. During the second half of the 1990s, the share of business funding of R&D increased significantly in the United States, moderately in Japan and only slightly in the European Union.
- During the same period, the business sector's share of the funding of R&D declined markedly in the Czech Republic, Ireland, Poland and Austria. In most other countries, its share rose significantly, particularly in Denmark, Portugal, Iceland, Finland and Turkey.
- Also, government funding of R&D retreated in all countries except the Czech Republic, Korea, Poland and the Slovak Republic. However, government is still the major source of R&D funding in a third of OECD countries.
- Foreign funding of R&D has increased in recent years. Canada, the United Kingdom, Iceland and Austria receive more than 15% of their R&D funding from abroad and Greece receives almost one-quarter.
- The business sector also performs most R&D. Its contribution to the overall R&D effort has increased since the mid-1990s and, according to the latest available data, accounts for about 70% of total R&D expenditure.
- The higher education and government sectors perform 31% of all R&D funded in the OECD area. Their combined share is more than double the OECD average in Mexico, Greece, New Zealand, Turkey and Poland.

Sectors of R&D performance and funding

The R&D effort (expenditure and personnel) is usually broken down among four sectors of performance: business enterprise, higher education, government and private non-profit institutions serving households (PNP). This breakdown is largely based on the System of National Accounts, but higher education is viewed as a special sector, owing to the important role played by universities and similar institutions in the performance of R&D.

R&D has various sources of financing. Five are generally considered: the four R&D-performing sectors mentioned above and funds from "abroad". Flows of funds are measured using performance-based reporting on the funds received by one unit, organisation or sector from another unit, organisation or sector for the performance of intramural R&D. What is therefore measured are direct transfers of resources used to carry out R&D; other government provisions to encourage R&D, such as tax concessions, the payment of bonuses for R&D, exemption from taxes and tariffs on R&D equipment, etc., are excluded. For purposes of international comparisons, public general university funds (GUF) are included in the sub-total for government funds. These are the funds allocated by higher education establishments to R&D from the general grant in support of their overall research and teaching activities which they receive from the Ministry of Education or the corresponding provincial or local authorities.

When assessing the contributions of the different sectors to R&D performance and sources of finance and the changes in contributions over time, it is important to take account of changes in methods and breaks in series (see Box A.2). The role of the government sector in Sweden and the government and the higher education sectors in the United States is underestimated. In addition, the transfer of public-sector organisations to the private sector in 1992 in France and in 1986 in the United Kingdom (see Box A.5) reduced the government sector's contribution and increased that of the business sector.

For more details, see Annex Tables A.3.1, A.3.2 *and* A.3.3.

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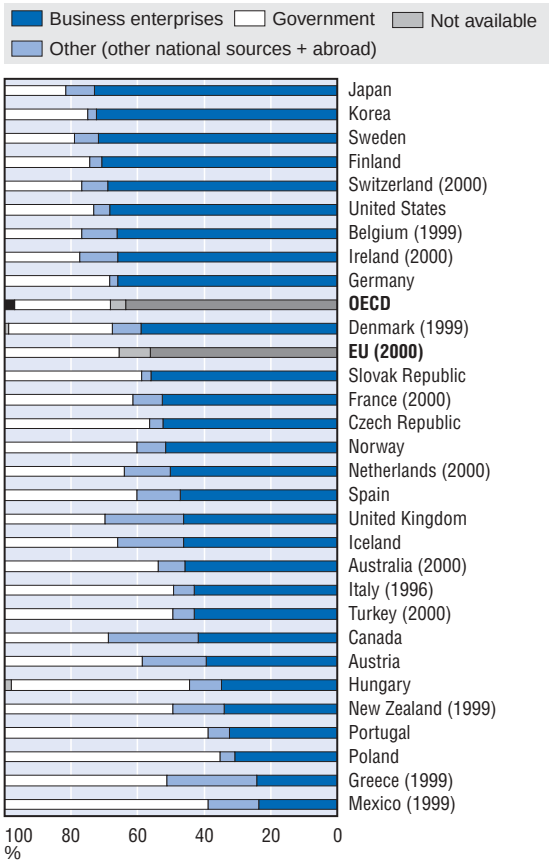
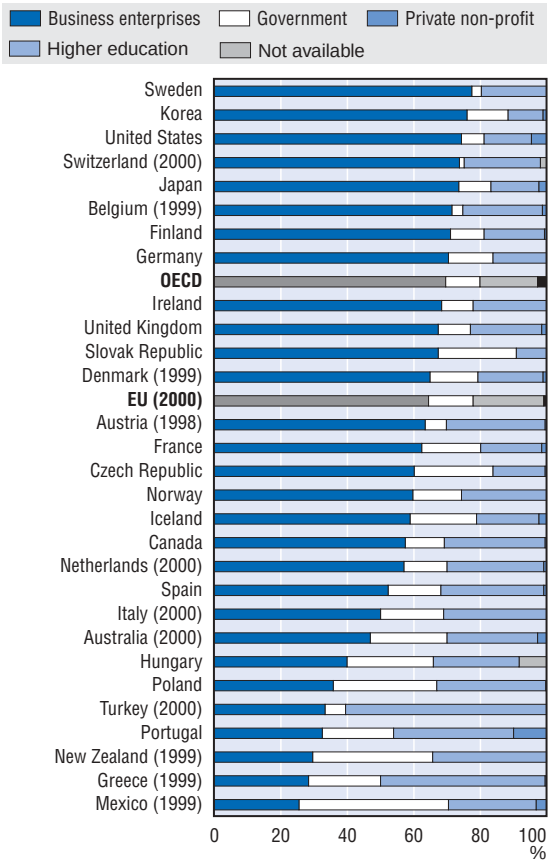
A.3. R&D financing and performance

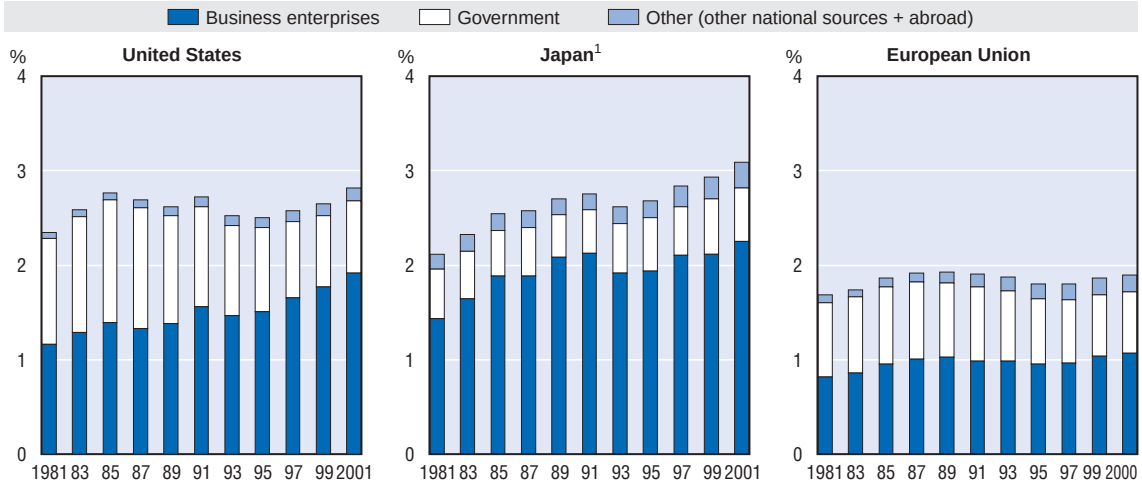
R&D expenditures by source of financing
Percentage share in national total, 2001



R&D expenditures by performing sector
Percentage share in national total, 2001



R&D expenditures as a percentage of GDP by source of financing, 1981-2001



1. Data are adjusted up to 1995.
Source: OECD, MSTI database, May 2003.

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A.4.1. Business R&D

- Business enterprise R&D accounts for the bulk of R&D activity in OECD countries in terms of both performance and funding (see A.3). In 2001, R&D performed by the business sector reached almost USD 450 billion (current PPP), or close to 70% of total R&D.
- In the OECD area, R&D performed by the business sector (in 1995 USD PPP) has increased steadily over the past two decades. However, the pace of growth has picked up since the mid-1990s, mostly owing to business R&D in the United States, which increased by 6.1% a year between 1995 and 2001 (the fastest growth among the G7 countries), compared to 4.4% in the European Union.
- Between 1995 and 2001, OECD-area business enterprise expenditure on R&D grew by USD 107 billion (1995 PPP). The United States accounted for more than half and the EU for less than a quarter.
- In the second half of the 1990s, annual average growth rates for business enterprise R&D were highest in Turkey, Mexico and Portugal. Only the Slovak Republic experienced a significant decline in business R&D spending during the period.
- In the three main OECD regions, business R&D intensity (expenditure relative to value added in industry) has continued to increase since the mid-1990s. In Japan it reached 3.3% in 2001.
- R&D intensity is well above the OECD average (2.3%) in all Nordic countries except Norway, and particularly in Sweden (5.2%) and Finland (3.5%). Iceland has enjoyed a large increase in R&D intensity since 1995 (2 percentage points).

Business enterprise R&D expenditure (BERD)

Business enterprise 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 includes:

- All firms, organisations and institutions whose primary activity is production of goods and services for sale to the general public at an economically significant price.
- The private and non-profit institutes mainly serving them.

When assessing changes in BERD over time, it is necessary to take account of changes in methods and series breaks, notably concerning the extension of survey coverage, particularly in the services sector (see Box A.4.2) and the privatisation of publicly owned firms (see Box A.5).

For more details, see Annex Tables A.4.1.1 *and* A.4.1.2.

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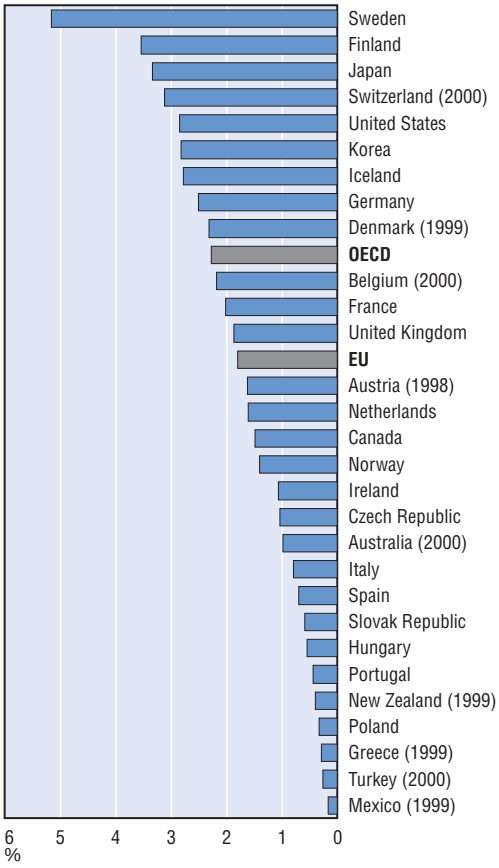
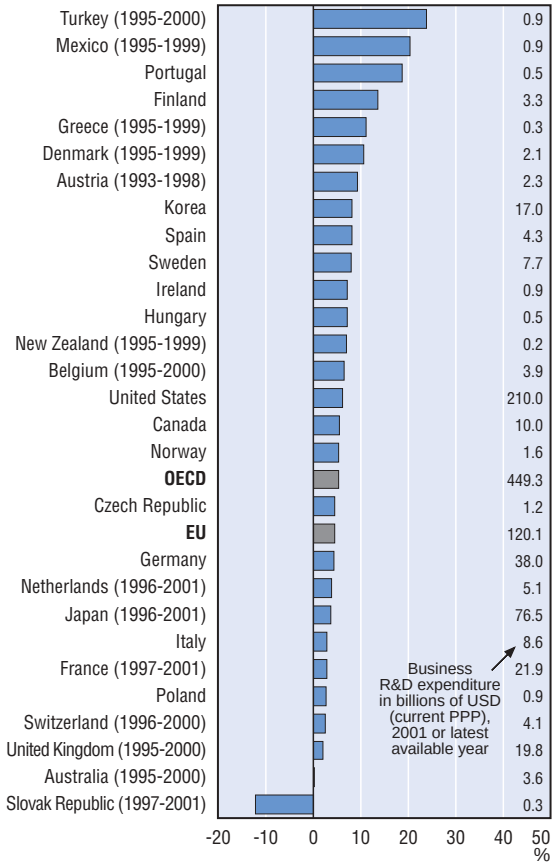
A.4.1. Business R&D

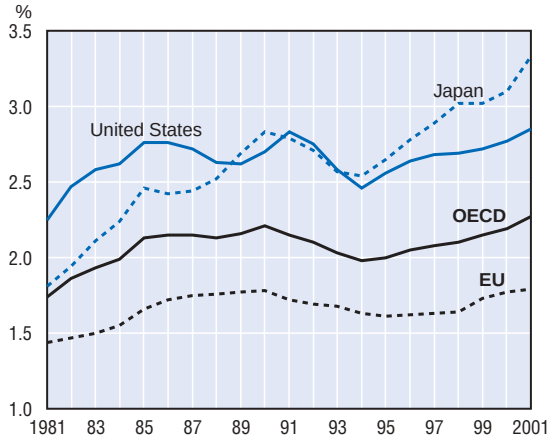
Business R&D intensity[1]
2001 or latest available year



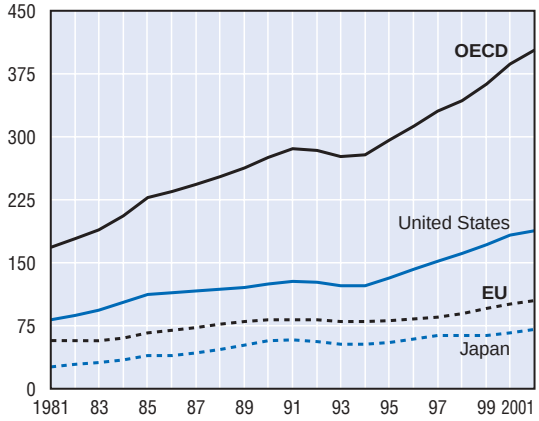
Business R&D, 1995 PPP[2] dollars
Average annual growth rate, 1995-2001



Evolution of business R&D intensity,[1] 1981-2001



Evolution of business R&D, 1981-2001
Billions of 1995 USD PPP[2]



1. Business enterprise sector R&D expenditure as a percentage of value added in industry.
2. 1995 USD using purchasing power parities (PPP).

Source: OECD, MSTI database, May 2003.

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A.4.2. Business R&D by industry

- While the economic structure of OECD countries has moved towards services (see D.7), services still represent a much smaller share of R&D than of GDP. In 2000, they accounted for about 22% of total business sector R&D in the OECD area, an increase of 8 percentage points from 1991. Given the measurement difficulties associated with services, this is a lower bound. The share is often higher in countries that have undertaken special measurement efforts in this area.
- In Norway, almost half (48%) of total business R&D is carried out in the services sector. Australia (40%), Spain (38%), Denmark (35%) and the United States (34%) are the only other countries where services sector R&D represents more than 30%. The share of services R&D in these countries increased significantly over the 1990s.
- Although the share of services R&D increased over the 1990s in Germany and Japan, these countries still have the lowest shares of services R&D (under 10%). This may partly be due to limited coverage of the services industries in their R&D surveys.
- Over the 1990s, average annual growth rates for R&D were higher in services than in manufacturing for all countries except Canada and the Czech Republic. The Netherlands and Ireland had the most notable difference in R&D growth rates for the two sectors. Between 1991 and 2000, Dutch R&D increased by about 18.5% a year in services, but only by 3.3% in manufacturing. Between 1993 and 1999, Irish R&D in services increased by 26% in services and by 6% in manufacturing.
- Manufacturing industries are grouped in four categories according to their R&D intensity: high, medium-high, medium-low and low technology (see D.6). Within the OECD area, high-technology industries account for more than 52% of total manufacturing R&D. The share of R&D in high-technology industries varies significantly between the United States, on the one hand, and the European Union and Japan on the other. In 2000, high-technology industries accounted for over 60% of total manufacturing R&D in the United States, compared to 47% and 44% in the European Union and Japan, respectively.
- Manufacturing R&D expenditure is skewed towards high-technology industries in Canada, Ireland and Finland. Medium-high-technology industries account for 50% or more in the Czech Republic, Poland and Germany.

Business R&D by industry

National statistical authorities recognise the need for improved R&D data for services, and R&D surveys are being extended to improve the measurement of expenditure in the services sector. In the process, however, certain methodological issues have emerged and need to be resolved. If data are to be comparable internationally as well as across time, practices concerning the allocation of activities formerly included in manufacturing but reclassified in services need to be standardised.

The ANBERD database was constructed to create a consistent data set that overcomes problems of international comparability and the temporal discontinuities associated with the official business enterprise expenditure on R&D (BERD) data provided to the OECD by member countries. The current ANBERD database covers 19 OECD member countries and 58 sectors and has greater coverage of services. The data are based on ISIC, Rev. 3 as from 1987. The ANBERD data are estimated by the OECD from official data supplied by national statistical authorities. Although the OECD has attempted to resolve comparability issues as they arise, it is still important to exercise caution when analysing these data.

For further information, see OECD, *Research and Development Expenditure in Industry* 1987-2000, Paris, 2002.

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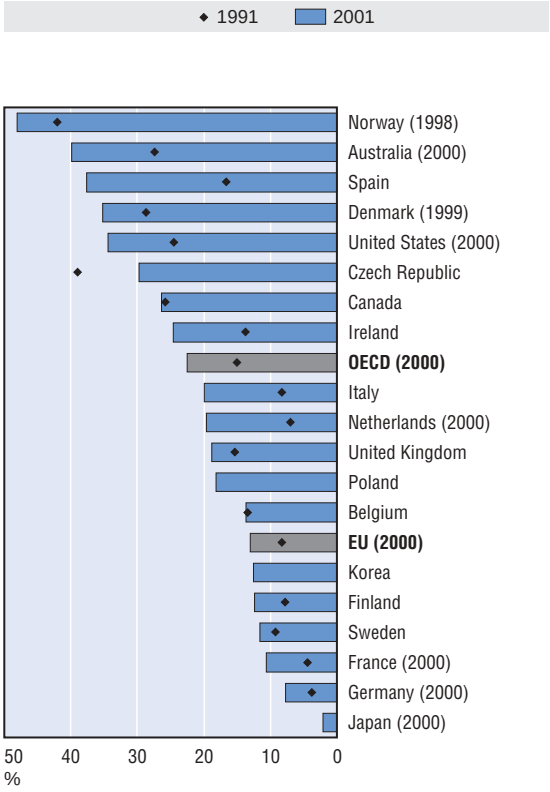
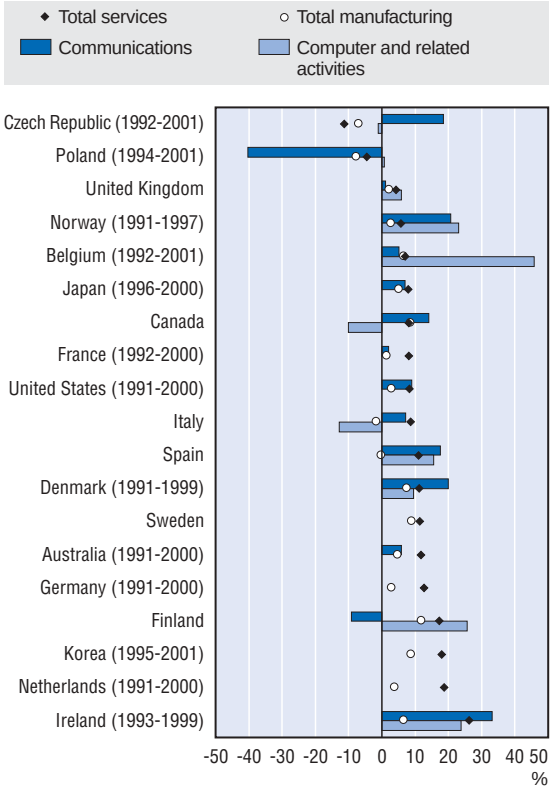
A.4.2. Business R&D by industry

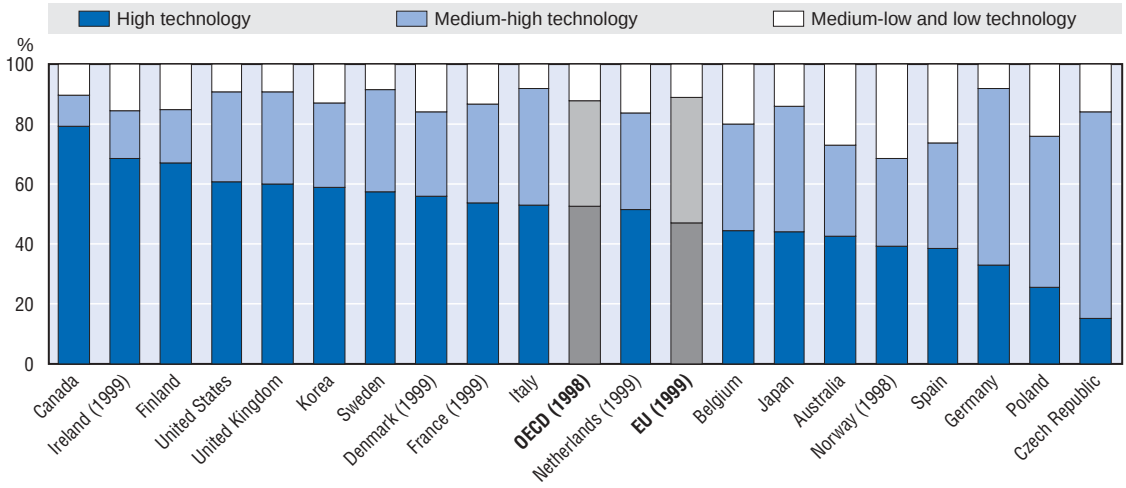
Share of services in business R&D,[1] 2000



R&D in selected services industries and manufacturing sector
Average annual growth rate 1991-2000



Share of business R&D in the manufacturing sector by technology intensity, 2000



1. Share of services in total services and manufacturing industries.
Source: OECD, ANBERD database, May 2003.

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A.4.3. R&D in selected ICT industries and ICT patents

- The ICT sector invests heavily in R&D and is highly innovative. In 2000, ICT manufacturing industries accounted for more than a quarter of total manufacturing business R&D expenditure in most OECD countries, and more than half in Finland, Korea and Ireland.
- In the 1990s, in countries with data for both manufacturing and services industries, ICT-related expenditure on R&D generally expanded much more rapidly in the ICT-related service industries. Average annual growth rates for ICT-related manufacturing R&D expenditure were about 6%, while for ICT-related services they were about 14%.
- For ICT industries, the ratio of R&D expenditure to GDP or to total business enterprise R&D can indicate the R&D specialisation of ICT industries. Finland, Korea and Sweden are relatively more specialised than large countries in both ICT manufacturing and services. Finland allocated more than 1% of GDP to ICT-related manufacturing R&D in 2000.
- ICT-related patent applications at the European Patent Office (EPO) by OECD countries have grown much more rapidly than overall patent applications. During the 1990s, they increased by 8.9% a year, while total patent applications only grew by 6.7%.
- According to the broad definition adopted here (see box), around one-third of all OECD patent applications are ICT-related. In 1997, two-fifths of all ICT-related patents originated from the European Union and one-third from the United States.
- To measure a country's level of specialisation in ICT patents, country shares are expressed in terms of a specialisation index (see box). By this measure, Japan and the United States are specialised in ICT, while the European Union is not. At country level, Finland is the most specialised OECD country in terms of ICT-related patents, followed by Iceland, Korea and the Netherlands (which also have high ICT-related expenditure). In contrast, the Czech Republic, Luxembourg and Mexico are not specialised in ICT.

Measuring R&D expenditure in selected ICT industries

The OECD definition of the ICT sector is largely based on the four-digit level of ISIC Rev. 3 (see B.6.1); however, data on R&D expenditure at the four-digit level are often lacking. Therefore, the ICT R&D indicators reported here are calculated at the two-digit level for selected ICT industries and include the following ISIC Rev. 3 divisions:

- Manufacturing industries: 30 (Office, accounting and computing machinery); 32 (Manufacture of radio, television and communication equipment apparatus); and 33 (Manufacture of medical, precision and optical instruments, watches and clocks).
- Services industries: 64 (Post and communications); and 72 (Computer and related activities). Data on R&D in services suffer from two major weaknesses. In certain countries, the R&D surveys cover the services industries only partially. Also, the definition of R&D is better suited to manufacturing industries than to services industries.

Data for R&D expenditure for selected ICT industries are from OECD's Analytical Business Enterprise R&D Expenditure (ANBERD) database, whose basis is more closely related to product field than to enterprise level. ANBERD data are estimated by the OECD on the basis of official business enterprise R&D data (OFFBERD) and may differ significantly from official data. For further information, see *Research and Development Expenditure in Industry*, OECD, Paris, 2002.

The provisional definition of ICT-related patents used here to calculate ICT-related patents is very broad and covers a wide range of classes of the International Patent Classification (IPC). For further information and the definition of ICT-related patents see: *www.wipo.int/classifications/*; and S. Schmoch, "Definition of Patent Search Strategies for Selected Technology Areas", STI Working Paper, forthcoming. *www.oecd.org/sti/working-papers*

The specialisation index (SI) is calculated as the share of country A (in the OECD total) in a specific technology area divided by the share of country A (in the OECD total) in all technology areas. By definition, the value of the SI for the OECD area is 1. When the SI value of a specific technology area is greater than 1, the country has higher share of this technology area relative to its share in all technology areas. Conversely, when the SI value is below 1, the country has a smaller share of the specific technology than its share in all technology areas.

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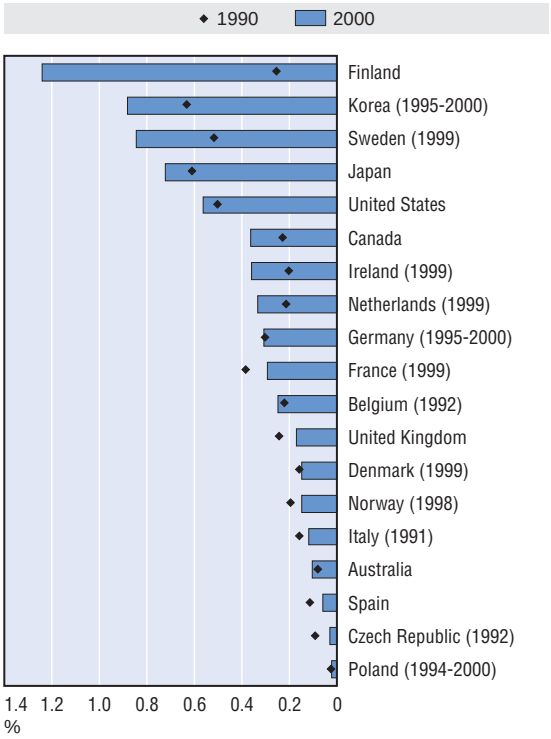
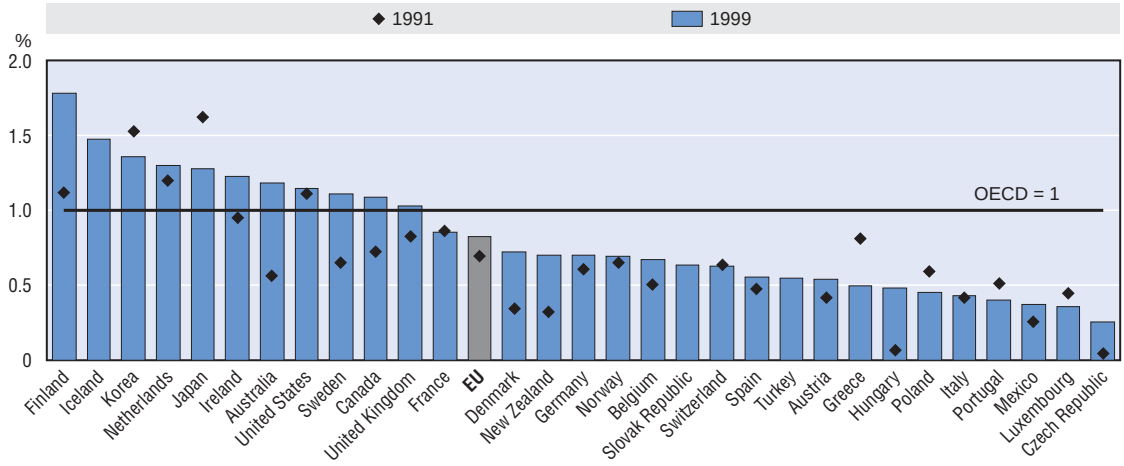
A.4.3. R&D in selected ICT industries and ICT patents

Business R&D expenditure by selected ICT manufacturing industries, 1990-2000[1]
As a percentage of GDP



Business R&D expenditure by selected ICT services industries, 1992-2000[1, 2]
As a percentage of GDP

ICT-related patent applications to the European Patent Office
Specialisation index, by priority year



1. 2000 or latest available year. Data are for 1990 or closest year for manufacturing, and 1992 or closest year for services industries.
2. Owing to unavailability of R&D data for class 642 (Telecommunications), division 64 (Post and telecommunications) is used as a proxy. Available information shows that in the United States, class 642 accounts for 97-98% of division 64 total R&D.

Source: OECD, ANBERD database, May 2003; OECD, Patent Database, May 2003.

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A.4.4. Business R&D by size classes of firms

- Both small and large firms play an important role in countries' innovative performance, but their relative importance for business R&D varies. In OECD countries, the share of R&D performed by small and medium-sized enterprises (SMEs) (defined here as firms with fewer than 250 employees) is generally greater in smaller economies than in larger ones. Sweden is an exception.
- Firms with fewer than 250 employees account for a high share of business R&D in Italy (65%), Greece and Ireland (50%), and Norway (48%). In the EU, their share is about one-quarter, while in the United States it is less than 15%. Japan has the lowest share among OECD countries, with only 7% compared to the OECD average of 17%.
- Firms with fewer than 50 employees account for a significant share of business R&D (around one-fifth) in New Zealand, Norway, Greece, Australia and Ireland.
- OECD countries differ greatly in terms of government financing of business R&D by size class. In Australia, Portugal, Switzerland, Hungary and Italy, SMEs receive two-thirds or more of government-financed R&D. In Australia, more than half of government-financed R&D goes to firms with fewer than 50 employees). In France, the United States, Germany and the United Kingdom, as well as in some smaller countries such as Turkey, government-financed business R&D is mainly directed to large firms.

R&D data by size class of firms

Small firms play an important role in innovation. They are a constant source of renewal of technology, of technological breakthroughs and of competitive pressures for large firms, which are compelled to innovate to maintain their technological edge. The so-called "new technology-based firms", most of which are small, play a crucial role in radical innovation and the creation of new markets. However, SMEs face specific problems for innovating and for adopting new technologies (access to funds, markets and skilled labour). Moreover, it is often argued that public policies are biased against SMEs and that this might justify corrective action in their favour.

On the other hand, the role of large firms should not be ignored: they play a leading role in structuring markets, carrying out large-scale innovations and even in co-ordinating smaller firms. The respective and complementary roles of small and large firms may vary across industries and across countries. The relevance of various types of policy tools may vary with the size profile of the target population of firms.

Data in this section are based on a mini-questionnaire launched in 1997. The data were subsequently updated in June 1999, May 2001 and May 2003 (for this publication). To conform to the size classification adopted by the European Commission for SMEs – and as recommended in the 2002 *Frascati Manual* (para. 183) – the data were aggregated using the size groups "fewer than 50" and "50 to 249 employees".

These data also make it possible to discern whether government support is biased towards larger firms. This appears to be particularly the case in countries with large defence budgets.

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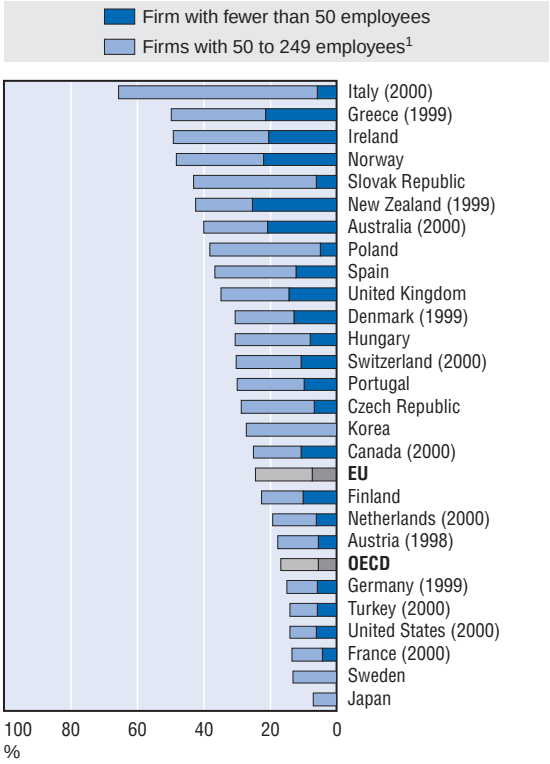
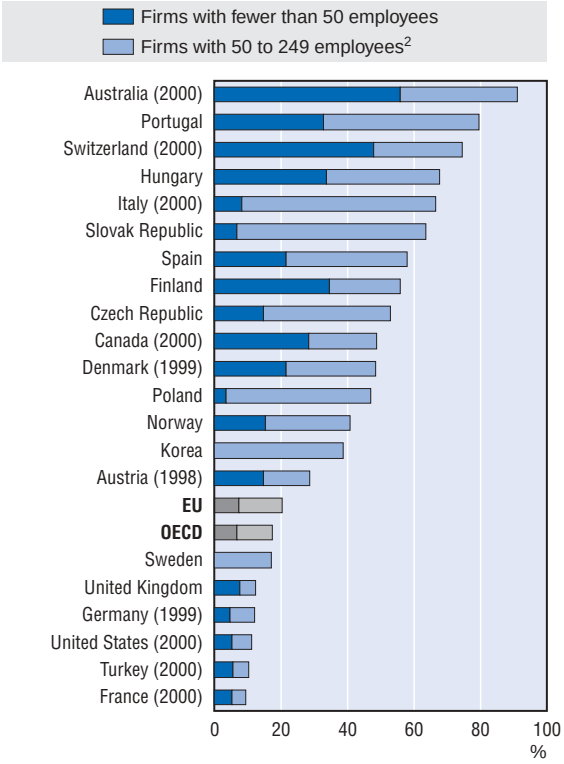
A.4.4. Business R&D by size classes of firms

Share of business R&D by size class of firms, 2001



Share of government-financed business R&D, by size class, 2001



1. For the Netherlands and Norway, 50 to 199 employees instead of 50 to 249 employees. For New Zealand, 50 to 99 employees instead of 50 to 249 employees. For Japan and Korea, fewer than 299 employees.
2. For Norway, 50 to 199 employees instead of 50 to 249 employees. For Korea, fewer than 299 employees.

Source: OECD, STI/EAS Division, June 2003.

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A.5. R&D performed by the higher education and government sectors

- The higher education sector performs about 17% of total domestic R&D in the OECD area (see A.3). This represents about 0.4% of GDP. Sweden, Switzerland and Finland had the highest shares of GDP for R&D by this sector at more than 0.6%. The corresponding shares for the Slovak Republic and Mexico were 0.1% or less.
- In 1999, this sector employed more than 26% of the research workforce, or more than 16 researchers per 10 000 labour force. These shares are probably affected by underestimates for the United States (see box).
- In the OECD area, R&D performed by the higher education sector increased steadily over the 1990s (in constant prices), with a slowdown in the mid-1990s. Since then, it has increased slightly relative to GDP in the European Union and the United States and has increased significantly in Japan (where GDP has grown little).
- Government performance of R&D declined until 1997 when it reached 0.24% of GDP, compared to 0.31% in 1985. It dropped in France, Italy, the United Kingdom and the United States, owing to a decrease in defence spending (see Box A.6.4) and transfers from public agencies to the private sector (see box). Japan is the only large OECD country where R&D performed by the government sector increased between 1991 and 2001, from 0.22% to 0.29% of GDP.
- The government sector accounts for one-tenth of total R&D performed in the OECD area. However, it conducts more than one-quarter in Mexico, New Zealand, Poland and Hungary. In the Slovak Republic, Mexico, the Czech Republic, Korea, New Zealand, Iceland and Hungary, the government sector performs more R&D than the higher education sector.

Measuring R&D performance in the government and higher education sectors

When measuring R&D performance in the higher education sector and its evolution, it should be remembered that many of the figures are estimates by national authorities and that evaluation methods are periodically revised (see boxes in A.2, A.3 and A.9.2). Furthermore, certain national characteristics may strongly influence R&D performance by the government and higher education sectors:

- Figures for these sectors in the United States are underestimated. Public-sector R&D only covers federal government activities, not those of individual states and local government; and since 1985 figures for researchers exclude military personnel in the government sector. In the higher education sector, R&D in the humanities is not included, and since 1991 capital expenditures have been excluded. In Sweden, too, the government sector, which includes only the central administrative units, is seriously underestimated; inclusion of county and local units might double the figures. Finally, in Korea, the higher education sector is probably greatly underestimated owing to the exclusion of R&D in the social sciences and humanities (SSH).
- In Japan, figures for R&D personnel in the higher education sector before 1996 are overestimated by international standards, as researchers were counted according to the number of persons employed in R&D instead of full-time equivalent (FTE) staff. According to studies conducted by some Japanese authorities, the number of FTE researchers is about 40% lower in the higher education sector and 30% lower in the national total. Because the number of researchers is overestimated, figures for R&D personnel costs are also overestimated prior to 1996, particularly for the higher education sector; the OECD has therefore computed an "adjusted" series for the years to 1995.
- Certain transfers of public agencies to private enterprise, as in the case of France Telecom in France (1992) and the Atomic Energy Authority in the United Kingdom (privatised in 1986), have had the effect of reducing R&D performance in the government sector and increasing it in the business enterprise sector.
- Finally, it is necessary to bear in mind remarks (Boxes A.2 and A.9.2) concerning the figures for unified Germany as of 1991 and complete coverage of SSH in Sweden as of 1993.

For more details, see Annex Tables A.5.1 *and* A.5.2.

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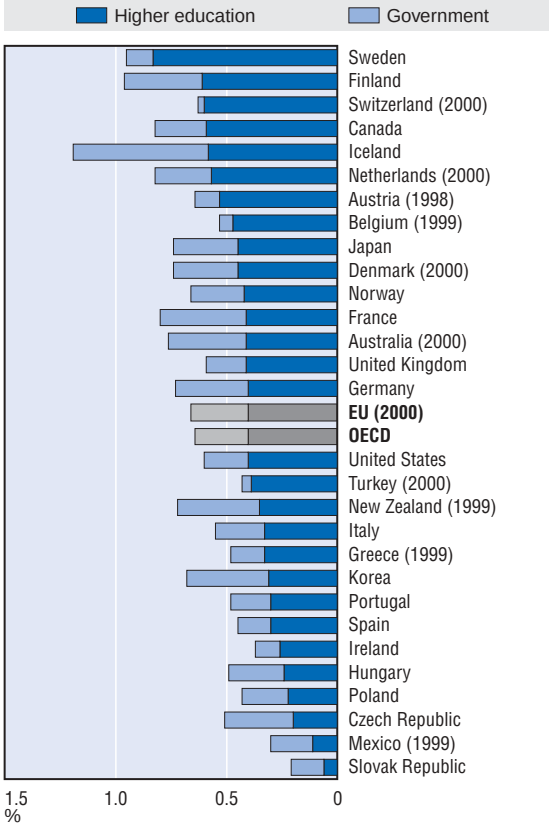
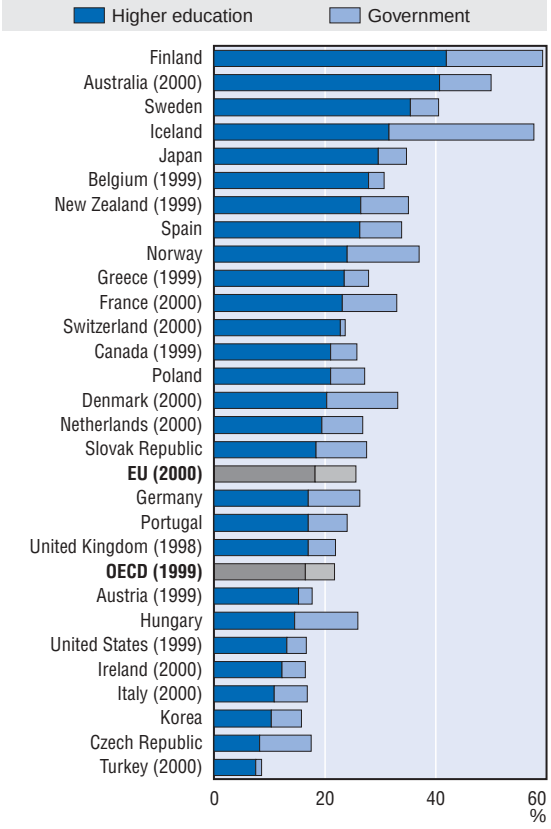
A.5. R&D performed by the higher education and government sectors

R&D expenditure as a percentage of GDP
2001

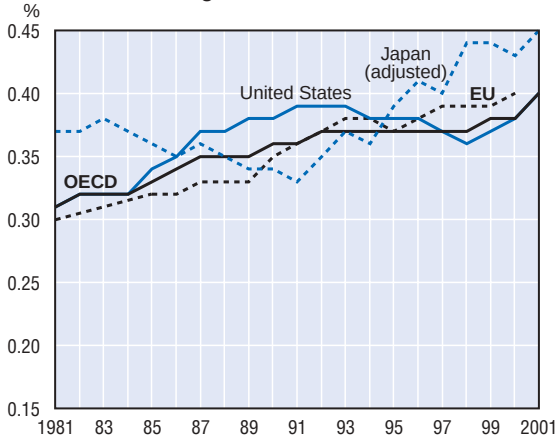


Researchers per 10 000 labour force
2001

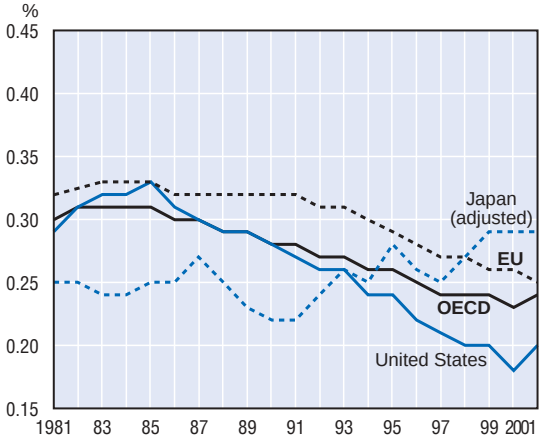


Trends in R&D expenditure in the higher education and government sectors
As a percentage of GDP

Higher education



Government



Source: OECD, R&D and MSTI databases, May 2003.

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A.6.1. Biotechnology R&D, venture capital and patents

- Although the field of biotechnology has grown markedly owing to scientific advances in areas such as genomics and genetic engineering, internationally comparable data remain scarce (see box). In particular, it is not possible to include the United States and Japan, countries which invest quite heavily in biotechnology R&D. Available data indicate that publicly funded biotechnology R&D varies considerably across OECD countries. In Denmark, Canada and New Zealand, biotechnology has shares above 10%.
- Venture capital is important for biotechnology firms, which often have high R&D expenditure and limited revenues for several years. Canada and the United States are the countries in which the largest shares of venture capital go to biotechnology.
- In the 1990s, biotechnology patent applications to the European Patent Office (EPO) grew faster than total patent applications. On average, biotechnology patents in the OECD area increased about 9.9% a year compared with 6.7% for total patents.
- In 1999, the United States accounted for just under half of all OECD biotechnology patent applications to the EPO; Germany and Japan accounted for about 10% each.
- In terms of biotechnology patents, Denmark and Canada are highly specialised with a specialisation index of 2.2. (The specialisation index indicates a country's share of biotechnology patents divided by its share in total patents – see Box A.4.3.) The Slovak Republic is also quite specialised, although it has relatively small numbers of patents relative to other countries. The European Union (index of 0.7) is less specialised in biotechnology than North America.

Measuring biotechnology R&D and patents

Because of the scarcity of internationally comparable data on biotechnology R&D in OECD countries, the OECD has developed a provisional statistical definition of biotechnology: "The application of science and technology to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services." An (indicative, not exhaustive) list of biotechnology techniques and applications is used as an interpretative guide and includes:

- DNA (the coding): genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering.
- Proteins and molecules (the functional blocks): protein/peptide sequencing/synthesis, lipid/protein glyco-engineering, proteomics, hormones and growth factors, cell receptors/signalling/pheromones.
- Cell and tissue culture and engineering : cell/tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine/immune stimulants, embryo manipulation.
- Process biotechnologies: Bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurization, bioremediation, and biofiltration.
- Sub-cellular organisms: gene therapy, viral vectors.

In 2002, to encourage internationally comparable biotechnology statistics, the OECD's *Frascati Manual* suggested including a biotechnology R&D question in R&D surveys. The OECD is currently developing a model survey on the use and development of biotechnology. Some countries have already tested such a survey and the OECD encourages other countries to do so.

The OECD has worked towards developing statistics on biotechnology patents. It currently proposes to define a biotechnology patent as a patent having one of the following International Patent Classification (IPC) codes:

A01H 1/00 + A01H 4/00 + A61K 38/00 + A61K 39/00 + A61K 48/00 + C02F 3/34 + C07G 11/00 + C07G 13/00 + C07G 15/00 + C07K 4/00 + C07K 14/00 + C07K 16/00 + C07K 17/00 + C07K 19/00 + C12M + C12N + C12P + C12Q + C12S + G01N 27/327 + G01N 33/53* + G01N 33/54* + G01N 33/55* + G01N 33/57* + G01N 33/68 + G01N 33/74 + G01N 33/76 + G01N 33/78 + G01N 33/88 + G01N 33/92

For further information on biotechnology statistics, see OECD (forthcoming), "Compendium of Biotechnology Statistics Based Mainly on Official Sources", STI *Working Paper*, Paris. More detailed descriptions of IPC codes are available on the IPC Web site: *www.uspto.gov/go/classification*

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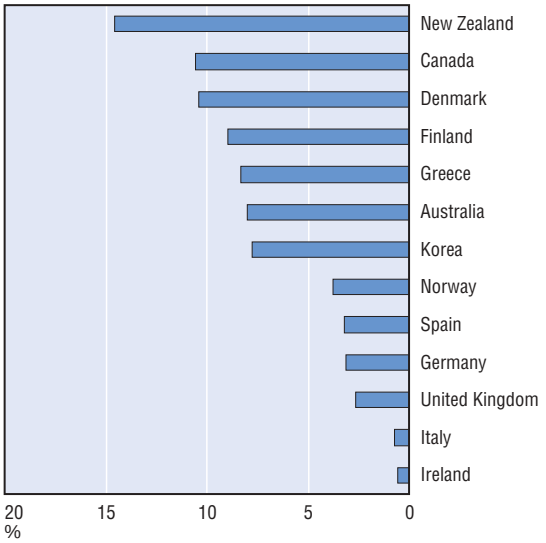
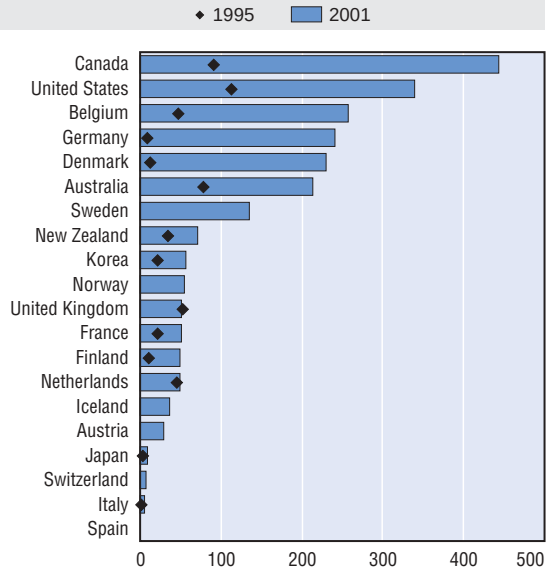
A.6.1. Biotechnology R&D, venture capital and patents

Biotechnology R&D as a percentage of public R&D, 2000, or nearest available year



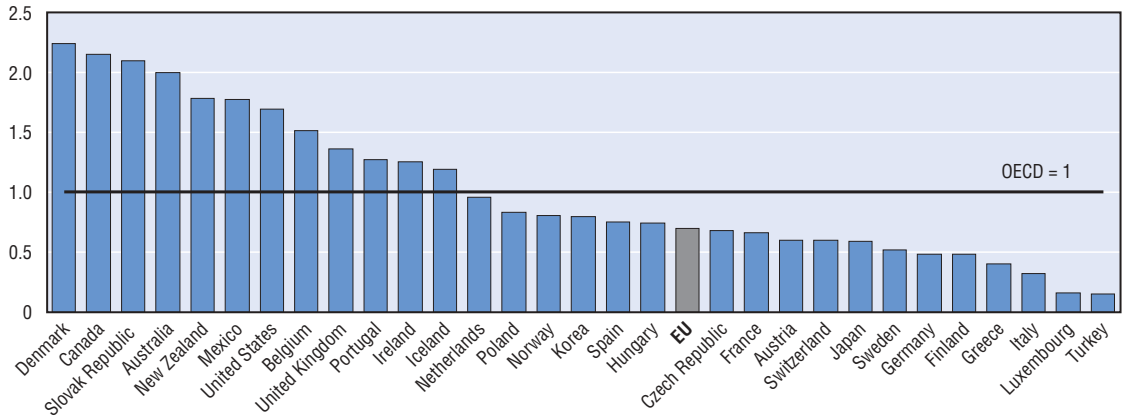
Note: R&D definitions vary across countries, especially with respect to inclusion or exclusion of biotechnology R&D performed by the higher education sector. The data are based on: government budget appropriations or outlays for R&D (GBAORD) for Australia, Canada, Germany, Greece, Ireland, Italy, Korea, Spain and the United Kingdom; government-financed gross domestic expenditure on R&D (GERD) for Norway; and the sum of R&D performed by the government, higher education and private non-profit sectors for Denmark, Finland and New Zealand.
Source: Eurostat and national sources, May 2003.

Biotechnology[1] venture capital per million units of GDP, 2001



1. Medical/health biotechnology venture capital for Australia, Japan, Korea and New Zealand.
Source: OECD Venture capital database, April 2003.

Average EPO[1] biotechnology patent application specialisation index[2] for priority years 1995-99



1. European Patent Office.
2. Share of a country's biotechnology patents divided by its share in total patents.
Source: OECD, Patent database, May 2003.

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A.6.2. Health-related R&D

- R&D expenditures for health are of great interest because of the sector's size and expected growth as the population in many OECD countries ages. They are difficult to measure, however, because of institutional complexity and diversity (*e.g.* health R&D may be publicly or privately funded and carried out in firms, universities, hospitals and private not-for-profit institutions).
- In 2001, government direct support in OECD countries for health-related R&D based on government budget appropriations for R&D (GBAORD – see box for definition) was about USD 27.8 billion (in current USD PPP), or approximately 0.1% of their combined GDP.
- Compared to the European Union and Japan, direct support for health R&D is high in the United States. In 2002, it represented well over 0.2% of GDP, far above the levels for the European Union (0.05% in 2001) and Japan (0.03% in 2002). Between FY 1998 and FY 2003, the US government doubled the funding for the National Institutes for Health, the main recipient in this category. Direct health R&D funding actually fell in the late 1990s in a number of countries.
- The data on direct support for health R&D suggest that the United States accounts for over 75% of the OECD total (compared with only 16% for the European Union). However, when data from additional GBAORD categories are used to adjust for some of the institutional differences in the funding of health R&D, a different picture emerges. The United States is no longer an outlier: health R&D budgets relative to GDP are similar to that of the United States in a number of countries. Sweden, with one of the lowest direct government budgets for health R&D as a percentage of GDP, is a case in point.
- Another indicator often used as a component of health-related R&D is R&D expenditure by the pharmaceutical industry. In 2001, it represented close to 0.6% of GDP in Sweden, compared to 0.47% in 1999 and only 0.25% in 1991. It also exceeded 0.3% in Belgium, Denmark and the United Kingdom.
- The share of pharmaceutical R&D in business sector R&D is above 20% in Denmark, the United Kingdom and Belgium. While the ratio of pharmaceutical R&D to GDP is low in Ireland and Spain (less than 0.1%), this sector accounts for a significant share of total business sector R&D in both countries (around 10%).

Measuring government support for health-related R&D

One way of measuring health-related R&D expenditure is to compile data from funders of R&D. The data on central government support for R&D are derived from budgets and are referred to as government budget appropriations or outlays for R&D (GBAORD). GBAORD can be broken down by socio-economic objectives (SEO), such as the protection and improvement of public health which is defined as follows:

> "This category covers research aimed at protecting, promoting and restoring human health broadly interpreted to include health aspects of nutrition and food hygiene. It ranges from preventative medicine, including all aspects of medical and surgical treatment both for individuals and groups and provision of hospital and home care to social medicine and paediatric and geriatric research." (*Frascati Manual*, OECD, 2002).

The GBAORD health category is used here as a proxy for total central government funding of health R&D. However, it should be borne in mind that it only covers programmes for which health is the primary objective. Furthermore, the classification of programme and institutional funding depends on how governments present their R&D priorities as well as on the formal mandate of the institutions concerned. For example, long-term research may be the responsibility of a medical research body classified in health objectives (*e.g.* the National Institutes of Health in the United States) or of a general research council whose funds are mainly awarded for the advancement of research (*e.g.* the National Council for Scientific Research in France). Arrangements for funding R&D in hospitals also vary between countries.

To address some of the limitations mentioned above and to provide a more complete picture of health-related R&D, funding of medical sciences via non-oriented research and general university funds (GUF) are included when available as are other relevant funds, notably general support for R&D in hospitals.

For further information, see *Deriving Data on Health-related R&D from Regular R&D Statistics*, Annex 4 of the *Frascati Manual* (OECD, 2002).

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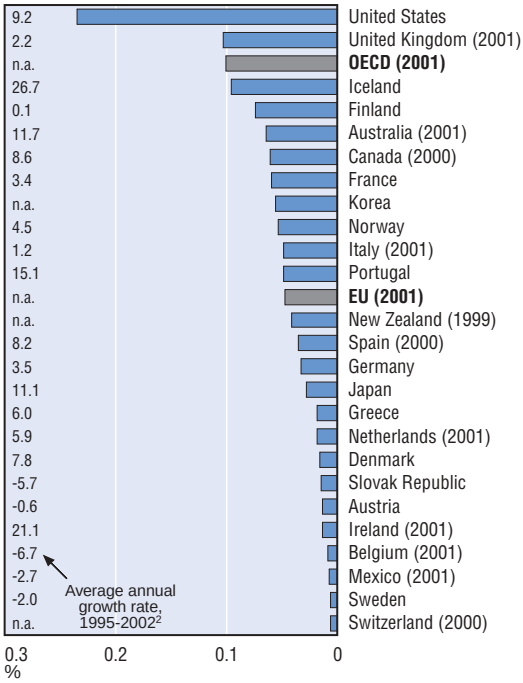
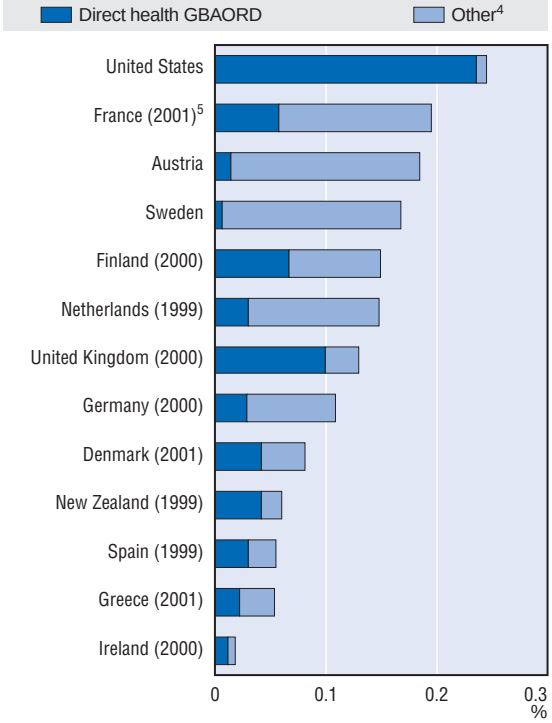
A.6.2. Health-related R&D

Health R&D in government budgets (GBAORD[1]) as a percentage of GDP, 2002



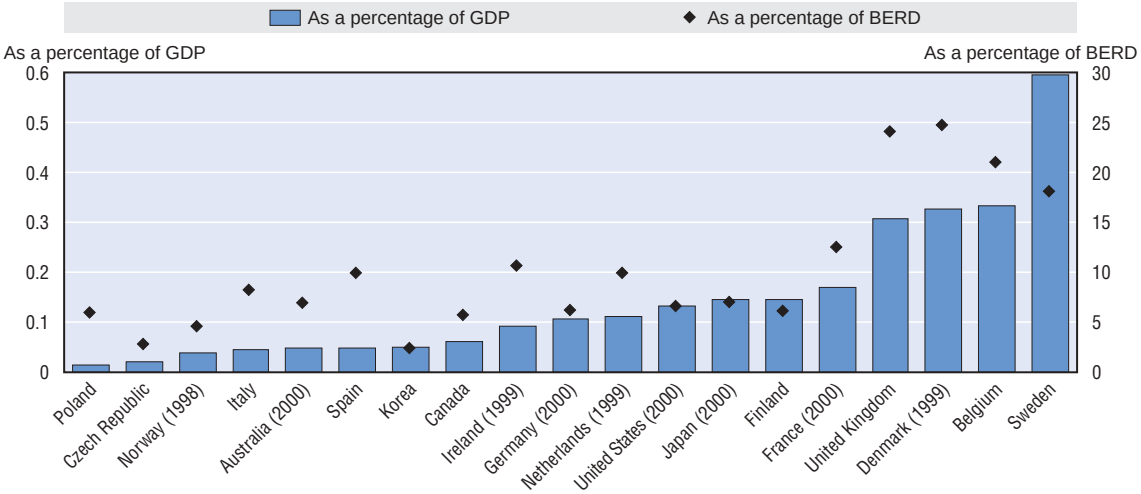
Source: OECD, R&D database, June 2003.

Effect of including other health-related NABS[3] categories in health GBAORD, 2002



Source: OECD, Eurostat and national publications, June 2003.

R&D expenditure in the pharmaceutical industry as a percentage of GDP and BERD,[6] 2001



1. Government budget appropriations or outlays for R&D.
2. Growth rate: Australia, Belgium, Ireland, Italy, Mexico, Netherlands, United Kingdom (1995-2001); Canada, Spain (1995-2000); Finland (1997-2002); Iceland, Sweden, Switzerland (1998-2002).
3. Nomenclature for the analysis of science budgets.
4. Comprises non-oriented R&D, general university funds (GUF) and other relevant national and international categories.
5. Includes some other life sciences research.
6. Business enterprise expenditure on R&D.

Source: OECD, ANBERD database, June 2003.

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A.6.3. Basic research

- There is evidence that innovation efforts draw increasingly on basic research, owing to greater possibilities for commercialising the results. For example, the Human Genome Project should soon lead to commercial applications.
- In OECD countries for which data are available, the ratio of basic research to GDP varies between 0.1% and 0.7%, or 10-40% of gross domestic expenditure on R&D (GERD). In the United States, this ratio increased from 0.4% to 0.6% in the second half of the 1990s, mainly owing to the increasing role played by the business enterprise sector.
- In most countries, the share of basic research in total R&D remained relatively stable throughout the 1990s. Exceptions are Mexico, where it decreased by more than 12 percentage points between 1995 and 1997, and the Czech Republic, where it almost doubled in two years to over 40% in 2001.
- In countries with high R&D intensity (except Switzerland), basic research usually accounts for one-fifth or less of total R&D.
- In Mexico, Portugal, Poland and Hungary, the ratio of basic research to GDP is low compared with other OECD countries, but their basic research expenditure relative to total R&D expenditure is among the highest of all OECD countries. This is due to the business sector's relatively low share in total GERD and the high shares of the government and higher education sectors (see A.3), which perform the bulk of basic research. In Mexico, Hungary, Poland and Italy, more than 90% of basic research is conducted in the higher education or government sectors.
- In Austria, Portugal and Norway, the higher education sector performed the largest shares of basic research (more than 70%), while it performed the smallest in the Czech Republic and the Slovak Republic (less than 30%).
- Relative to other OECD countries, basic research is carried out more frequently in the business sector in Korea, the Czech Republic, Japan and the United States, where this sector performs more than one-third of basic research.

Basic research

R&D covers three activities: basic research, applied research, and experimental development. Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. When there is a significant time lapse before the "results" of basic research can be applied, this is considered long-term research whose results are sometimes utilised at a much later date and to ends not foreseen by the initial researcher.

Analysis by type of activity is of undoubted science policy interest but is based on a simplified model of the workings of the scientific and technological system and involves an important element of subjective assessment.

Data on basic research are often estimated in large part by national authorities, notably for the higher education sector, which is the main performer of basic research in most countries. Germany, the United Kingdom and Canada, countries with high levels of R&D expenditure, do not report basic research data.

The breakdown may be applied at the project level or, if necessary, at a more detailed level, and, for the purposes of international comparison, should be based on current expenditures only.

The magnitude of estimated resources allocated to basic research is also affected by the inclusion or exclusion of capital expenditure. The latter is included by half of the countries for which information is available (Australia, the Czech Republic, France, Iceland, Italy, Japan, Korea, the Netherlands, Portugal, Switzerland and Turkey). In the United States, capital write-downs are included instead of capital expenditure in the business enterprise sector.

For more details, see Annex Tables A.6.3.1 *and* A.6.3.2.

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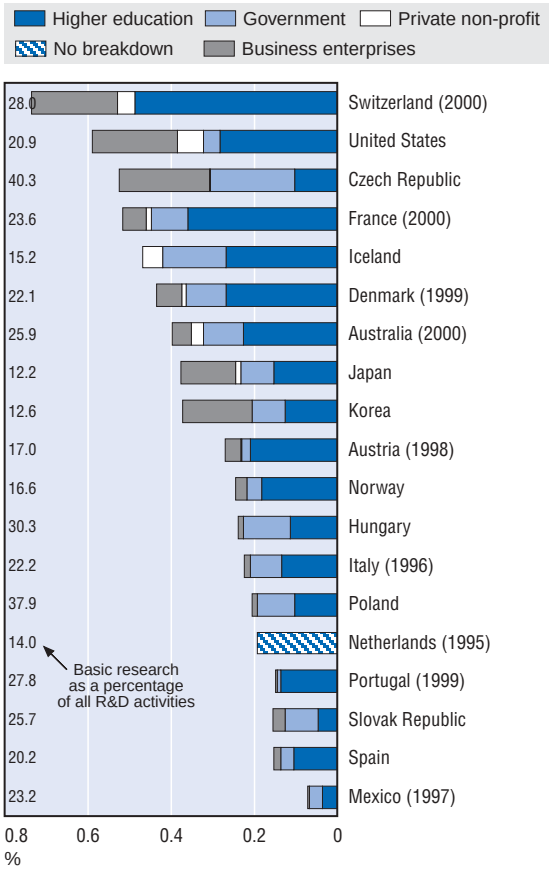
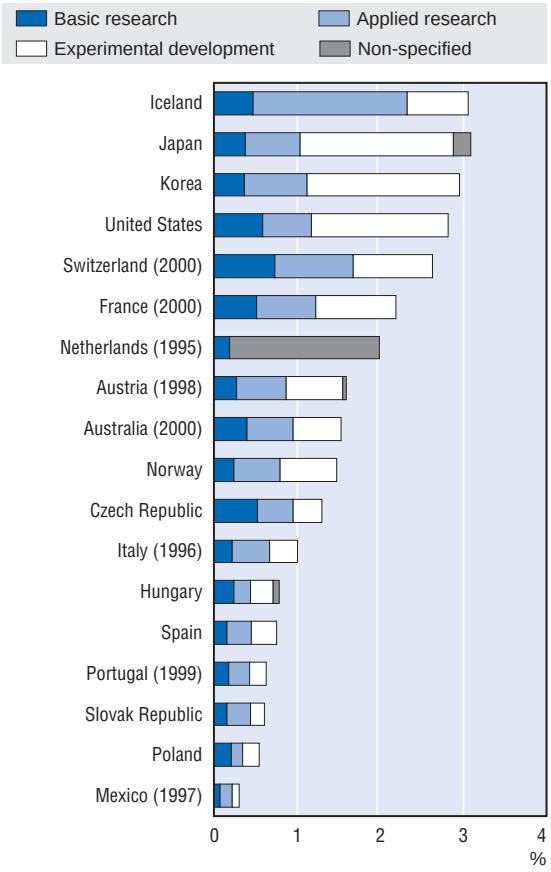
A.6.3. Basic research

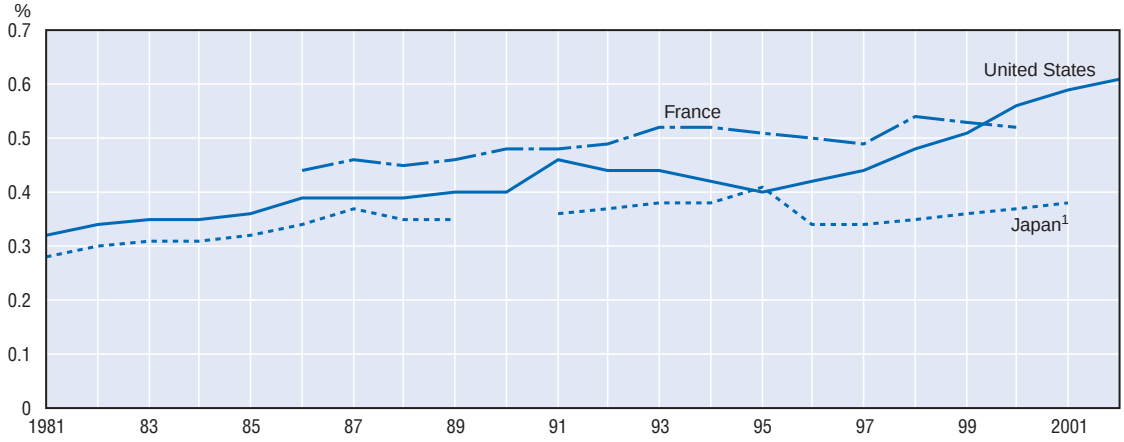
Basic research as a percentage of GDP by sector of performance, 2001



Breakdown of R&D expenditure by type of research as a percentage of GDP, 2001



Basic research as a percentage of GDP in three OECD countries, 1981-2001



1. Break in series between 1995 and 1996.
Source: OECD, R&D database, May 2003.

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A.6.4. Defence R&D in government budgets

- Data on GBAORD (see box for definition) provide an indication of the relative importance of various socio-economic objectives, such as defence, health and the environment, in public R&D spending.
- In 2001, the United States accounted for more than three-quarters of the overall OECD-area budget for defence R&D, or more than four times the EU total.
- After a decline in the early 1990s, the US government defence R&D budget has remained stable as a share of GDP since 1995 and stood at 0.54% in 2003. This is more than double the ratio for Spain and France, which have the second- and third-highest ratios (about 0.25% of GDP in 2001).
- The United States also has the largest share of GBAORD devoted to defence R&D, over 54% of the total. Spain was second with more than one-third of its GBAORD allocated to defence in 2001. The United Kingdom was the only other OECD country for which the share exceeded one-quarter.
- During the second half of the 1990s, the share of defence R&D budgets relative to GDP remained stable or declined in most countries, largely owing to the overall decline in military expenditure. In contrast to the general trend, the share of defence research relative to GDP increased markedly in Spain and to a lesser extent in Sweden. The United Kingdom is the only country that experienced a significant drop.

Characteristics of GBAORD

GBAORD (government appropriations or outlays for R&D) measures the funds committed by the federal/central government for R&D to be carried out in one of the four sectors of performance – business enterprise, government, higher education, private non-profit sector – at home or abroad (including by international organisations). The data are usually based on budgetary sources and reflect the views of the funding agencies. They are generally considered less internationally comparable than the performer-reported data used in other tables and graphs but have the advantage of being more timely and reflecting current government priorities, as expressed in the breakdown by socio-economic objectives.

A first distinction can be made between defence programmes, which are concentrated in a small number of countries, and civil programmes, which can be broken down as follows:

- Economic development: agricultural production and technology; industrial production and technology; infrastructure and general planning of land use; production, distribution and rational utilisation of energy.
- Health and environment: protection and improvement of human health, social structures and relationships, control and care of the environment, exploration and exploitation of the Earth.
- Exploration and exploitation of space.
- Non-oriented research.
- Research financed from general university funds (GUF): the estimated R&D content of block grants to universities.

It should be noted that the series for Japan excludes the R&D content of military procurement. In the United States, general support for universities is the responsibility of state governments and therefore GUF is not included in total GBAORD. In France, a change in the method of evaluating defence R&D resulted in a reduction in the defence objective as from 1997. This has reinforced the general trend.

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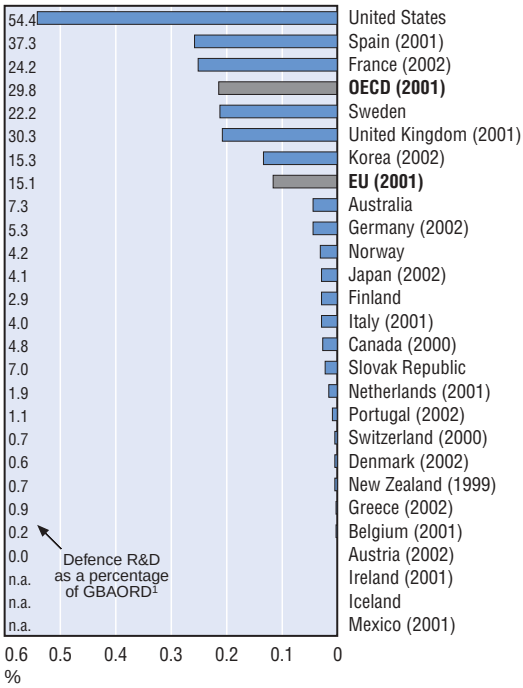
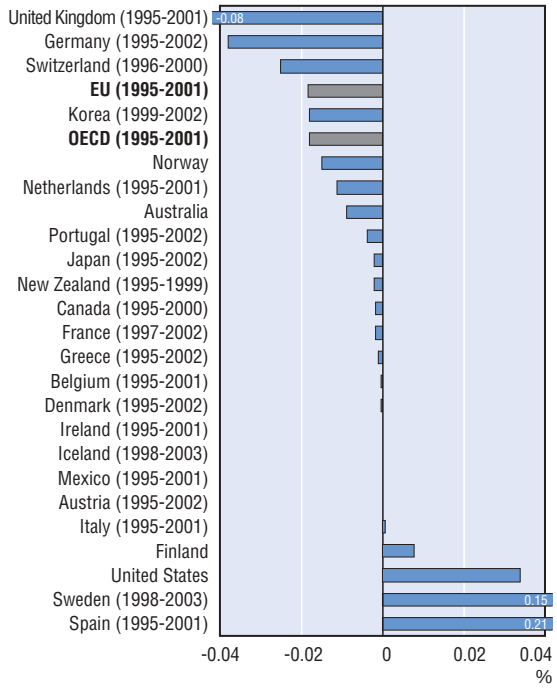
A.6.4. Defence R&D in government budgets

Defence R&D budgets
As a percentage of GDP,
2003 or latest available year



Change in defence R&D budgets
As a percentage of GDP,
1995-2003 or closest available years



1. Government budget appropriations or outlays for R&D.
Source: OECD, MSTI database, May 2003.

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A.6.5. Space R&D and innovation

- In 1999, USD 13 billion were allocated by OECD governments to civil space R&D programmes, 94% by the G7 countries and more than half by the United States. Not only does the United States have the largest budget for space R&D, it also devotes the largest share of its budget to space R&D, at 14.5% of total GBAORD (see box for definition). France and Japan also contributed significantly to the OECD-wide public budget for space R&D, with 11% and 9%, respectively, of total GBAORD.
- France, Germany and Italy account for almost 80% of the European space effort, although countries such as Belgium and Spain also devote a large share of their public R&D budget to space.
- OECD countries undertake most of the patenting of space-related inventions. From 1980 to 2001, they accounted for 97% of total applications to the European Patent Office (EPO) and nearly all grants at the United States Patent and Trademark Office (USPTO).
- The United States is the leader in space-related patent applications to the EPO, with 48% of the total, and it accounts for more than three-quarters of all such grants by the USPTO. Among European countries, France and Germany account for the bulk of patents for space-related inventions at both offices.

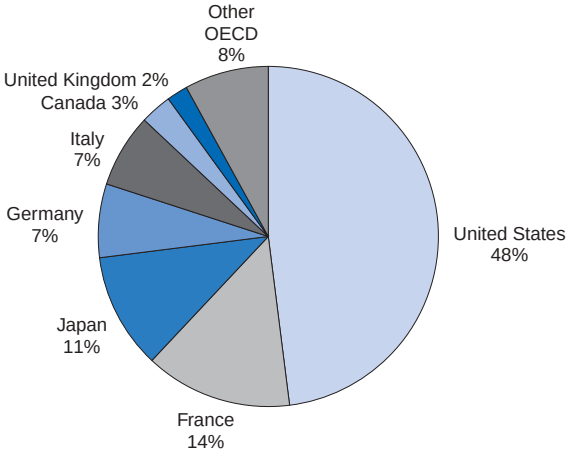
Measuring government support for civil space R&D

There are two ways of measuring how much governments spend on R&D. The first surveys the performing units that actually carry out R&D. A second uses data collected from budgets. The budget-based data are referred to as "government budget appropriations or outlays for R&D" (GBAORD). GBAORD measures the funds committed by the federal/central government for R&D to be carried out in one of the four sectors of performance – business enterprise, government, higher education, private non-profit sector – at home or abroad (including by international organisations). Public R&D allocations are also classified by primary socio-economic objective. GBAORD therefore reflects current government priorities.

GBAORD does not refer directly to any national government's budgetary practice. Although some government-supported R&D programmes have only one purpose, others may have more. Consequently, GBAORD data are less accurate than performance-based data, and the level of strict international comparability is probably lower than for other R&D input series considered in the OECD's *Frascati Manual*. For the space category, there is the additional problem that part of the budget allocated to space may fall under defence-related R&D. That part is not included here, but may be quite substantial in some countries.

OECD budget for space R&D by country

As a percentage of total OECD GBAORD to civil space programmes



Source: OECD R&D database, February 2003.

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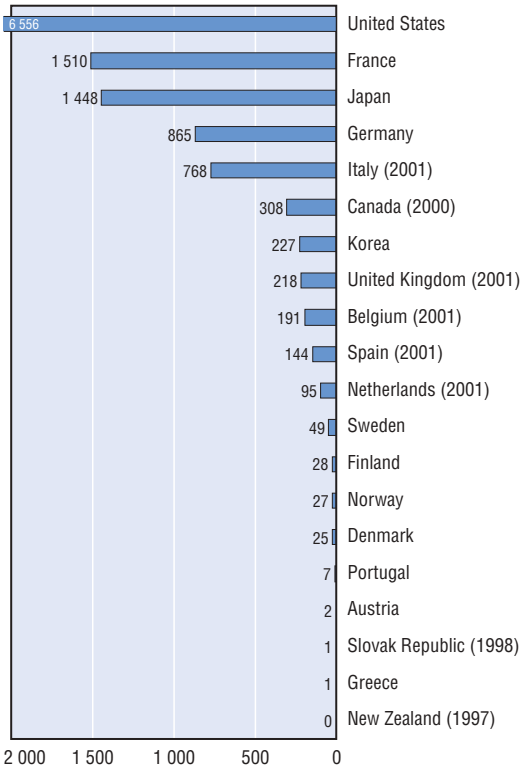
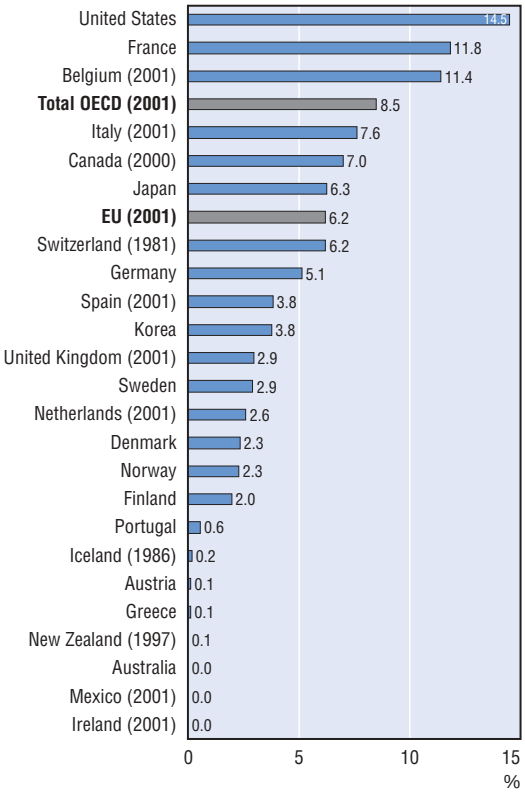
A.6.5. Space R&D and innovation

Civil GBAORD for space programmes in the OECD area, 2002

Millions of current USD using PPPs

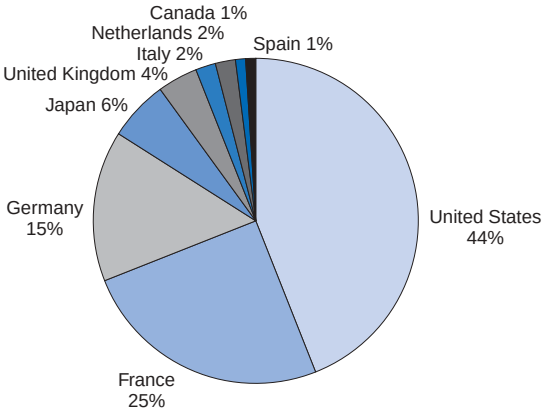


As a percentage of total civil GBAORD

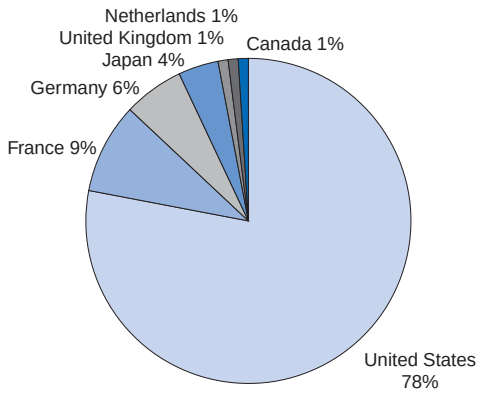


Country share in space-related patenting at the EPO and the USPTO, 1980-2001

As a percentage of EPO patent applications for space-related patents



As a percentage of USPTO patent grants for space-related patents



Source: OECD, Main Science and Technology Indicators database and Patent database, February 2003.

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A.6.6. Tax treatment of R&D

- Most OECD countries have special tax treatment for R&D expenditures, such as immediate write-off of current R&D expenditures (all countries) and various types of tax relief such as tax credits (11 countries in 2001) or allowances against taxable income (six countries in 2001).
- As a policy instrument, tax relief is on the rise in OECD countries. These schemes resulted in tax subsidies for R&D in 13 OECD countries in 2001 for large firms and in 15 for small firms. The United Kingdom and Norway have recently introduced such schemes.
- While tax subsidies for R&D (for large firms) increased significantly between 1995 and 2001 in ten countries, they decreased slightly in three.
- Depending on the country, tax relief can be "flat rate" (*e.g.* on the amount of R&D, as in Canada) or "incremental" (taking account of the difference between current R&D and a past reference point, as in the United States). Certain countries (*e.g.* Spain) have both.
- In ten countries, small firms or start-ups benefit from special treatment, such as higher rates or cash refunds (for firms not subject to tax).
- Spain, Portugal and Australia provide the highest subsidies for large firms; Italy, Spain and the Netherlands are the most generous to small firms.

The B index

The amount of tax subsidy to R&D is calculated as 1 minus the B index. The B index is defined as the present value of before-tax income necessary to cover the initial cost of R&D investment and to pay corporate income tax, so that it becomes profitable to perform research activities. Algebraically, the B index is equal to the after-tax cost of an expenditure of USD 1 on R&D divided by one minus the corporate income tax rate. The after-tax cost is the net cost of investing in R&D, taking into account all the available tax incentives.

$$B\ index = \frac{(1-A)}{(1-\tau)}$$

where A = the net present discounted value of depreciation allowances, tax credits and special allowances on R&D assets; and τ = the statutory corporate income tax rate (CITR). In a country with full write-off of current R&D expenditure and no R&D tax incentive scheme, A = τ, and consequently B = 1. The more favourable a country's tax treatment of R&D, the lower its B index.

The B index is a unique tool for comparing the generosity of the tax treatment of R&D in different countries. However, its computation requires some simplifying assumptions. It should therefore be examined together with a set of other relevant policy indicators. Furthermore, its "synthetic" nature does not allow for distinguishing the relative importance of the various policy tools it takes into account (*e.g.* depreciation allowances, special R&D allowances, tax credit, CITR). Finally, these calculations are based on reported tax regulations and do not take into account country-specific exemptions and other practices.

B indexes have been calculated under the assumption that the "representative firm" is taxable, so that it may enjoy the full benefit of the tax allowance or credit. For incremental tax credits, calculation of the B index implicitly assumes that R&D investment is fully eligible for the credit and does not exceed the ceiling if there is one. Some detailed features of R&D tax schemes (*e.g.* refunding, carryback and carryforward of unused tax credit, or flowthrough mechanisms) are therefore not taken into account.

The effective impact of the R&D tax allowance or credit on the after-tax cost of R&D is influenced by the level of the CITR. An increase in the CITR reduces the B index only in those countries with the most generous R&D tax treatment. If tax credits are taxable (as in Canada and the United States), the effect of the CITR on the B index depends only on the level of the depreciation allowance. If the latter is over 100% for the total R&D expenditure, an increase in the CITR will reduce the B index. For countries with less generous R&D tax treatment, the B index is positively related to the CITR.

For further information, see J. Warda (2001), "Measuring the Value of R&D Tax Treatment in OECD Countries", STI *Review* No. 27, OECD, Paris.

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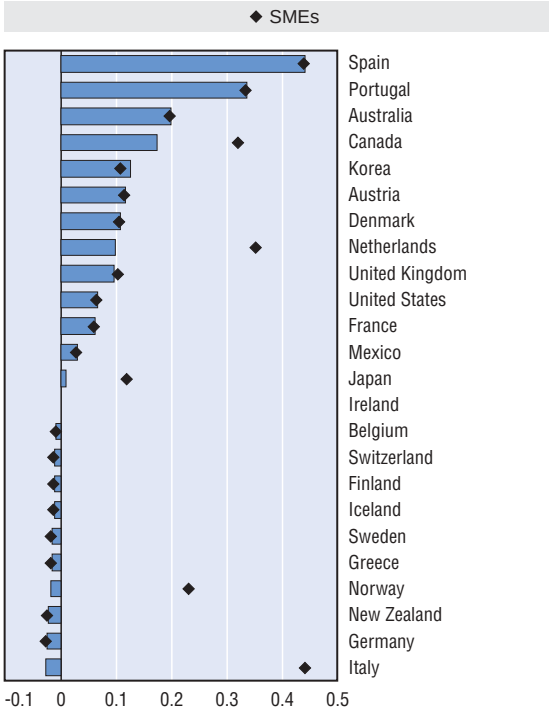
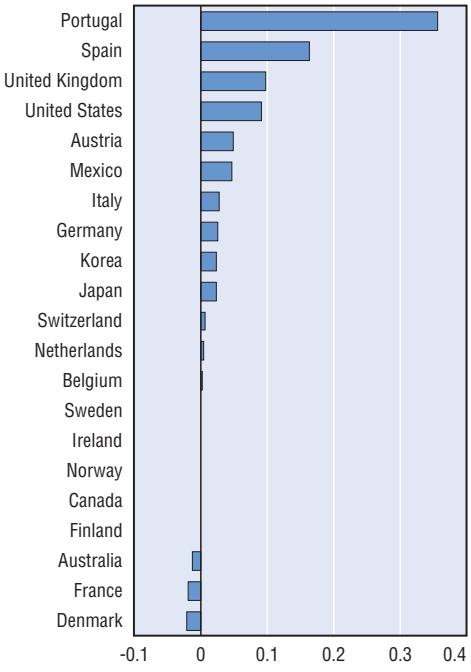
A.6.6. Tax treatment of R&D

Rate of tax subsidies for USD 1 of R&D,[1] large firms and SMEs, 2001



Change in the rate of tax subsidies for USD 1 of R&D,[1] large firms, between 1995 and 2001



1. Tax subsidies are calculated as 1 minus the B index. For example, in Spain, 1 unit of R&D expenditure by large firms results in 0.44 unit of tax relief.

Source: OECD, STI/EAS Division, May 2003.

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A.6.7. Nanotechnology

- In recent years, nanotechnology, the science of the very small, has been high on the policy agenda of many countries around the world. Because of its promising economic potential, it has become a target for increased R&D. Indeed, over 30 countries have established R&D programmes in nanotechnology.
- Although it is difficult to estimate government R&D funding precisely owing to the lack of an agreed definition of nanotechnology and the inclusion of nanotechnology-related R&D in many broader research activities, such as biotechnology and materials, available figures show that between 1997 and 2000, government R&D funding for nanotechnology grew from approximately USD 114.4 million to more than USD 210.5 million in the European Union, from USD 102.4 million to USD 293 million in the United States and from USD 93.5 million to USD 189.9 million in Japan.
- Related to the rise in governmental R&D spending is an increase in scientific output, as measured by the number of scientific publications in this area, which increased from 10 575 in 1997 to 15 667 in 2000. Over the period, scientific output was largely dominated by the United States, Japan and Germany, followed by France, the United Kingdom and Italy.

Understanding and measuring nanotechnology

Nanotechnology refers to a range of new technologies that aim to manipulate individual atoms and molecules in order to create new products and processes: computers that fit on the head of a pin or structures that are built from the bottom up, atom-by-atom. Radically different laws of physics based on quantum mechanics come into play when dealing with materials, systems and instruments involving matter at the nanometric scale, *i.e.* one billionth of a meter. The characteristics of materials change substantially, in particular their colour, strength, conductivity and reactivity. For instance, a material that is red or flexible at the meter scale may be green or stronger than steel at the nanometric scale.

Although understanding the essence of nanometric scale research does not pose particular difficulties, there is no single definition of nanotechnology. For some, it refers to a spectrum of new technologies that seek to manipulate atoms and molecules to create new products or to all research activities undertaken at the nanometric scale. Whereas the word "biotechnology" gives some idea of what material is being exploited and controlled – bio (*i.e.* life) – nanotechnology only indicates the scale at which the material is manipulated. For others, nanotechnology encompasses all research activities carried out at nanometric scale that exploit the specific properties of matter at that level. This definition is more restrictive as it only encompasses research that addresses the specific properties of matter at the nanometric scale. According to this definition, most research in the field of biotechnology or macromolecular chemistry that has been carried out at the nanometric scale over the past two decades is not included. This definition also excludes most of the work on the miniaturisation of transistors as it exploits well-known principles of micro-electronics. Indicators presented here are mostly based on the first definition of nanotechnology, *i.e.* all research activities undertaken at the nanometric scale.

In addition, nanotechnology is not distinguished in the two standard classification schemes that are used in standard R&D surveys, namely field of science and socio-economic objective. The first looks at the nature of the R&D performed, but although nanotechnology is a multidisciplinary field which borrows from several fields that figure in the classification (physics, chemistry, life sciences, mathematics), it is not separately identified. The second examines the purpose of the R&D, and while nanotechnology can be directed towards most of the objectives distinguished in the classification, it should not be considered as a socio-economic objective in itself.

See E. Hassan and J. Sheehan (2003), "Scaling Up Nanotechnology", OECD *Observer*, May; ETC Group (2003), *The Big Down: From Genomes to Atoms*, Winnipeg; and Conseil de la Science et de la Technologie (2001), *Les nanotechnologies: la maîtrise de l'infiniment petit*, Gouvernement du Québec.

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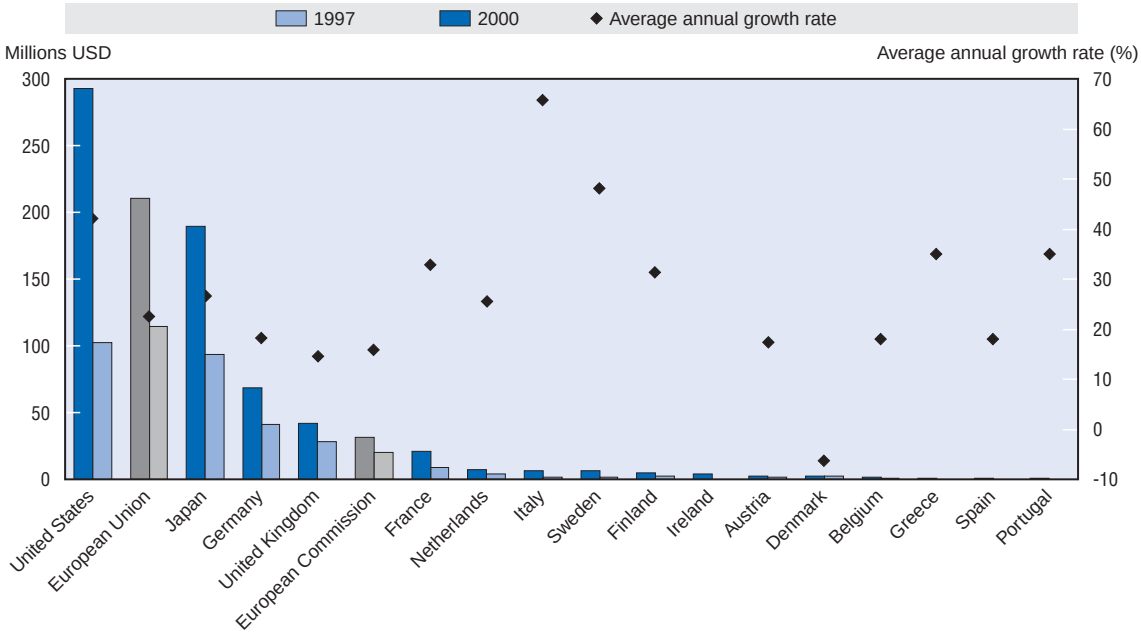
A.6.7. Nanotechnology

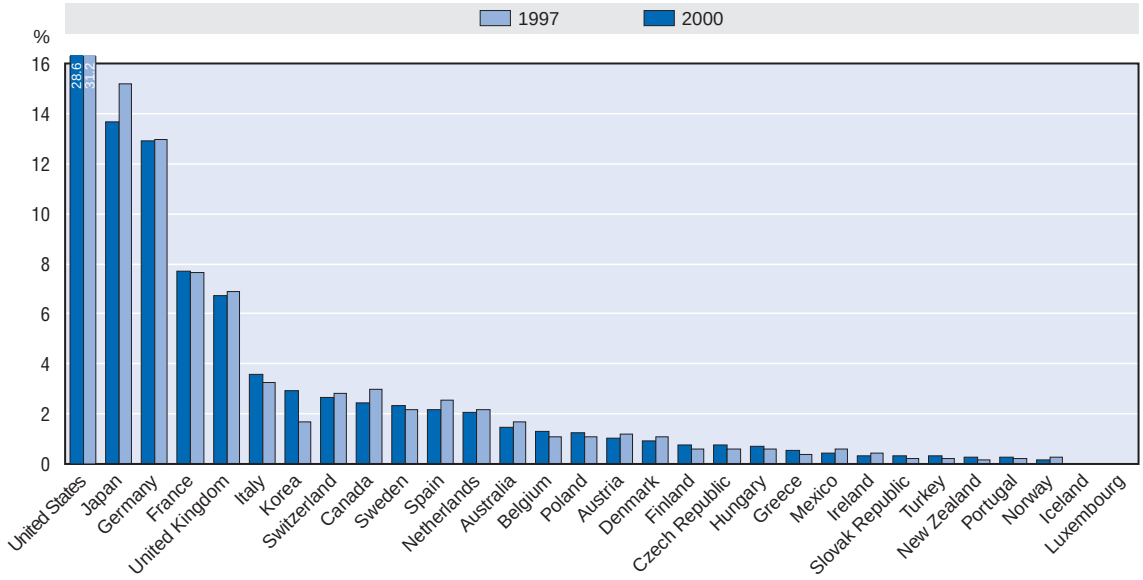
Estimated government R&D spending on nanotechnology, 1997-2000

USD millions



Source: European Commission.

Share of OECD countries in nanotechnology publications, 1997-2000



Source: Institute for Scientific Information (ISI), Centre for Science and Technology Studies (CWTS).

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A.7. Venture capital

- Relative to GDP, venture capital investment is quite small, but it is a major source of funding for new technology-based firms. It plays a crucial role in promoting the radical innovations often developed by such firms.
- Over 1998-2001, the United States and Iceland had the largest venture capital investment as a share of GDP, at nearly 0.5%. Other OECD countries had substantially less. About one-third of venture capital goes to firms in their early stages and two-thirds to those in the expansion stage. In Finland, Ireland and Switzerland, half is attributed to firms in early stages.
- High-technology firms attract half of OECD venture capital investment, but disparities among countries are large. In Canada and Ireland, they receive more than 80% of total venture capital, but in Australia and Japan they account for less than a quarter. In the United States, they attract over half of venture capital, of which about half goes to the communications industry. In Canada and Ireland, investment tends to focus on IT firms, while in central European countries and Italy communications firms attract most of the investment. In Denmark, health and biotechnology firms account for over 25% of total venture capital investment and in Canada and Hungary for almost 20% of the total.
- International flows of venture capital are also important. US firms increasingly invest in Europe and Asia, and there is significant cross-border investment within Europe and Asia. In Sweden and the United Kingdom, domestic firms manage more venture capital than they receive from international flows. In contrast, international flows of venture capital to Denmark and Ireland (country of destination) are more than double the investments managed by domestic venture capital firms (country of management).

Venture capital

Venture capital 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).

Data on venture capital are collected by national or regional venture capital associations from their members. Statistics only capture formal venture capital (provided by specialised intermediaries). As business angels are excluded, international comparisons may be affected since in the United States business angels have tended to invest much more in new firms than venture capital funds. This is probably much less the case in other OECD member countries.

The development of a venture-backed company has three basic financing stages:

- *Seed capital* is provided to research, assess and develop an initial concept.
- *Start-up* financing is provided for product development and initial marketing. Companies may be being set up or may have been in business for a short time, but have not yet sold their product commercially.
- *Expansion* financing is provided for the growth and expansion of a company that is breaking even or trading profitably. Capital may be used to finance increased production capacity, market or product development and/or to provide additional working capital.

Not all funds managed by a venture capital firm operating in a given country are from investors in that country. In fact, there are substantial and increasingly important cross-border flows of funds, both inflows and outflows. Venture capital data can be collected using two different approaches: country of management and country of destination. The former refers to the geographic location of the venture capital firms that raise and invest these funds. The latter indicates the geographic destination of investments made by firms. This distinction between country of management and country of destination is important as investment in a country may matter more than investment by a country.

For further information, see G. Baygan and M. Freudenberg (2000), "The Internationalisation of Venture Capital Activity in OECD Countries: Implications for Measurement and Policy", STI *Working Paper* 2000/7, OECD, Paris.

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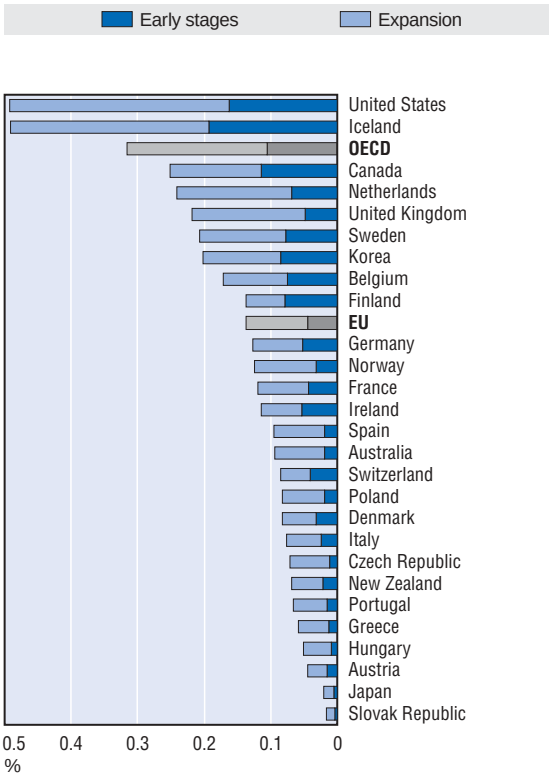
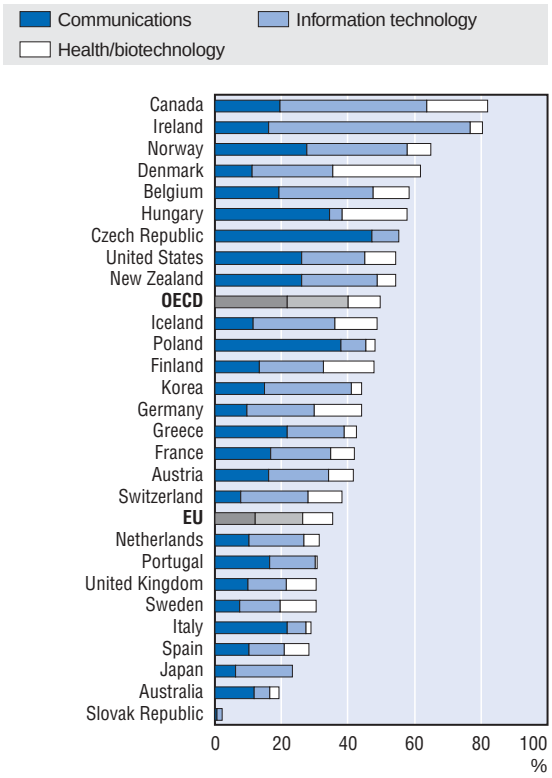
A.7. Venture capital

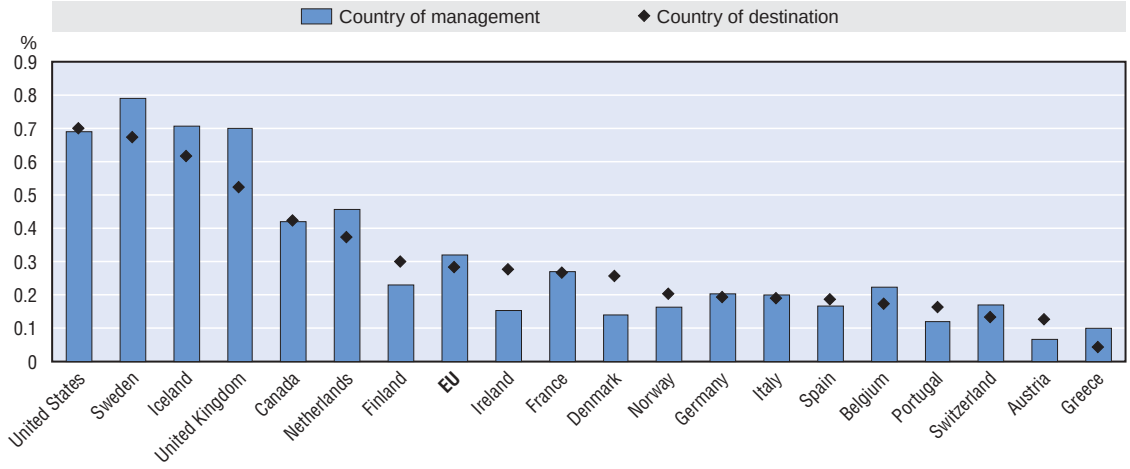
Investment in venture capital, 1998-2001
As a percentage of GDP



Share of high-technology sectors in total venture capital, 1998-2001
As a percentage of total venture capital investment



Venture capital investment by country of management and destination, 1999-2001
As a percentage of GDP



Source: OECD, based on data from EVCA (Europe); NVCA (United States); CVCA (Canada); *Asian Venture Capital Journal (The 2003 Guide to Venture Capital in Asia).*

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A.8.1. Human resources

- Educational attainment is the most commonly used proxy for human capital. The data presented here refer to the population as a whole; the educational attainment of the active labour force is examined in A.8.3.
- In the OECD area, one-quarter of the population aged 25-64 has completed tertiary-level education (see box). The share is much higher in the United States (37%) and Japan (34%) than in the European Union (21%). It exceeds 30% in Canada, Ireland, Finland and Sweden. In contrast, it is below 15% in southern, Central and Eastern Europe (Austria, Hungary, Poland, the Czech Republic, the Slovak Republic, Italy, Portugal and Turkey).
- The share of women with tertiary education exceeds that of men in half of the OECD countries and, with the exception of Japan, in all those that are above the OECD average in terms of educational attainment. Their share is particularly low in Korea (37.4%), Turkey (36.5%) and Switzerland (31.1%).
- In the OECD area, 45% of young people enter university. However, entry rates vary substantially. In Finland, Sweden, Hungary and Poland they reach more than 60%, but in Mexico, the Czech Republic and Turkey they are around or below 25%. Entry rates to tertiary-type (5B) programmes (see box) are on average three times lower (15%) but in Denmark, for example, they compensate for relatively low university entry rates.
- Expenditure per student for tertiary-level education varies by a factor of five between Poland and the United States. Expenditure per student is highest in the United States (USD 19 220 in purchasing power parities – PPP) and in Switzerland (USD 17 997 in PPP), more than 1.5 times the OECD average (USD 11 422 in PPP). Expenditure per student in southern, Central and Eastern European countries as well as in Korea and Mexico is less than half the OECD average.

Measuring human capital stocks and investment in human capital

Human capital is heterogeneous: no single type of attribute can adequately represent the many human characteristics that bear on the economy and society. While the level of individuals' skills, knowledge and competencies can be taken to represent the "stock" of human capital at any one time, these various attributes cannot be easily quantified.

There are several approaches to estimating human capital stocks and investment in human capital:

- The highest level of education completed by each adult (educational attainment) reflects his/her skills level. The International Standard Classification of Education (ISCED-1997) classifies educational attainment in six categories of educational programmes, two of which (categories 5A and 6) are for university degree or equivalent. ISCED 5A programmes are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements. ISCED 5B programmes are generally more practical/technical/occupationally specific. ISCED 6 programmes lead to an advanced research qualification and are devoted to advanced study and original research (*e.g.* PhDs).
- Educational attainment is related to the stock of knowledge and skills in the population. Tertiary level is defined as ISCED-1997 levels 5B, 5A and 6.
- Education expenditure per student provides some indication of the resources allocated to investment in human skills. Investment in human resources is here restricted to tertiary-level education because it is closely associated with acquiring new knowledge (skills), enhancing existing knowledge and diffusing knowledge. Expenditure per student for a particular level of education is calculated by dividing the total expenditure at that level by the corresponding full-time equivalent enrolment. Data in national currencies are converted into USD PPP.
- University entry rates reflect the accessibility and attractiveness of high-level knowledge. They represent the proportion of those in a given age cohort who enter university at some point during their lives. Net entry rates are defined as the sum of net entry rates for single ages. The total net entry rate is therefore the sum of the shares of new entrants aged *i* to the total population aged *i*, at all ages. Since data by single years are only available for ages 15-29, net entry rates for older students are estimated from data for five-year age bands. When no data on new entrants by age are available, gross entry rates are calculated. These are the ratio of all entrants, regardless of age, to the size of the population at the typical age of entry.

For further information, see OECD (2002), *Education at a Glance*, OECD *Indicators*, OECD, Paris; OECD and Eurostat (1995), *Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual*, OECD, Paris; OECD (1998), *Human Capital Investment*, OECD, Paris.

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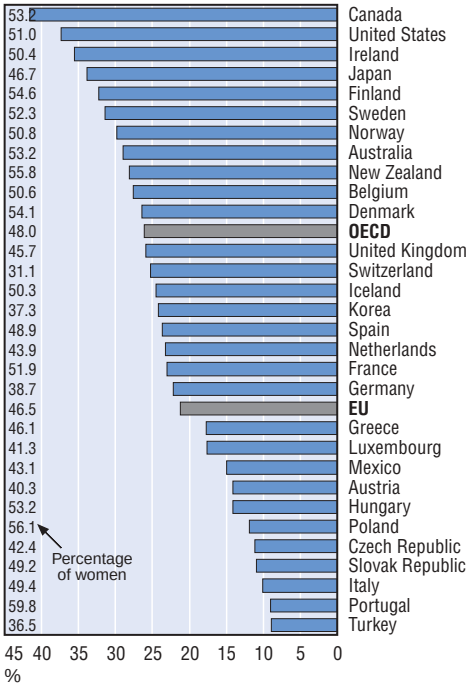
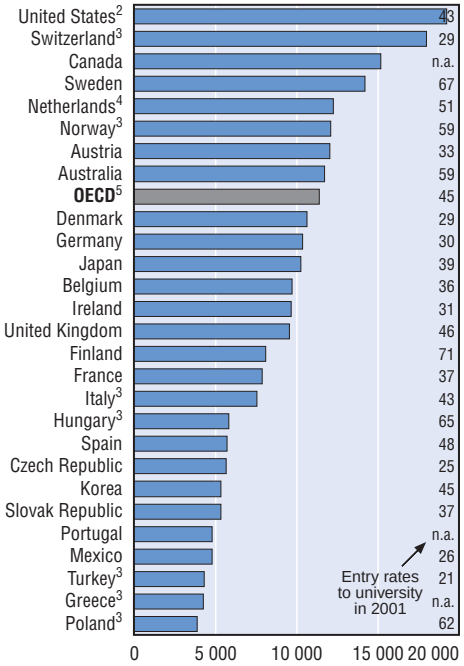
A.8.1. Human resources

Share of the population aged 25-64 with tertiary level education
2001



Expenditure per student for tertiary level education,[1]
1999 USD in PPP



Source: OECD, Educational Attainment Database, May 2003.

1. Data refer to total tertiary education (ISCED 5A, 5B and 6).
2. Public and independent private institutions only.
3. Public institutions only.
4. Public and government-dependent private institutions only.
5. Average of the available countries.

Source: OECD, Education database, May 2003.

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A.8.2. Flows of university graduates

- Flows of university graduates are an indicator of a country's potential for diffusing advanced knowledge and supplying the labour market with highly skilled workers.
- On average in 2000, 26% of the OECD population at the typical age for graduation completed a university degree, and 1% received a doctoral degree. For the latter, Switzerland and Sweden had the highest shares at over 2.5%; Germany and Finland had almost 2%.
- While the United States and the European Union award approximately the same shares of total OECD university degrees, 32% and 30%, respectively, the European Union awards 36% of science and engineering (S&E) degrees while the United States only awards 24%. The gap widens for PhD degrees. The European Union awarded 30 189 PhD degrees in S&E in 2000 and the United States 16 287, that is 51% and 24%, respectively, of the OECD total.
- One out of three university students graduates in social sciences, law or business. The next most important fields are humanities, arts and education. S&E degrees represent 21.6% of total degrees awarded in OECD countries, 26.4% in the European Union and 15.8% in the United States. However, S&E PhDs represent a much higher percentage of total PhDs, an indication that holders of a first university degree in S&E are more likely to continue their studies than graduates in other fields.
- In the OECD area, Ireland, France and the United Kingdom have the largest share of science degrees. Two-thirds of OECD countries deliver more engineering degrees than science degrees. Finland, Japan, Korea and Sweden award the largest shares of engineering degrees.
- OECD governments are concerned about the presence of women in scientific studies and careers. The data confirm that women are less likely than men to get university degrees in S&E. While women receive more university degrees than men in two-thirds of OECD countries, this does not hold for PhD degrees (except in Italy) and even less for S&E degrees. Women only account for 30% of university degrees in S&E and 27% of PhDs. In Japan, the shares are only around 10%.

Flows of university graduates

The higher education system is the main source of human resources in science and technology for the labour market. It is complemented by immigration of highly skilled workers from abroad and internal mobility flows. The output of higher education, that is graduates, is therefore an important indicator.

The data presented here cover total flows of university graduates, scientific and engineering (S&E) degrees and graduation rates for advanced research programmes.

- Total flows of university graduates include all degrees delivered at the 5A and 6 levels of ISCED-1997 (see Box A.8.1).
- S&E degrees include the following fields of study according to the 1997 International Standard Classification of Education (ISCED). Science includes: life sciences (42), physical sciences (44), mathematics and statistics (46) and computing (48). Engineering includes: engineering and engineering trades (52), manufacturing and processing (54) and architecture and building (58).
- Graduation rates for advanced research programmes represent the number of persons receiving a PhD-level degree (level 6 of ISCED-1997) as a percentage of the population at the typical age of graduation. Graduation rates in the figure refer to net graduation rates, calculated by summing graduation rates by individual years of age. However, for a few countries for which the net graduation rate is unavailable, the gross graduation rate is used. Gross graduation rates are calculated as the percentage of graduates in the population at the typical age of graduation.

For further information, see OECD (2002), *Education at a Glance*: OECD *Indicators*, OECD, Paris; OECD and Eurostat (1995), *Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual*, OECD, Paris.

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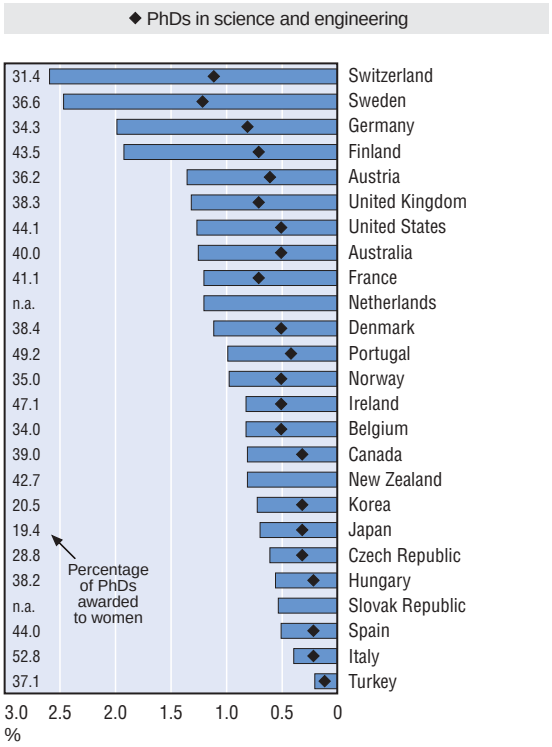
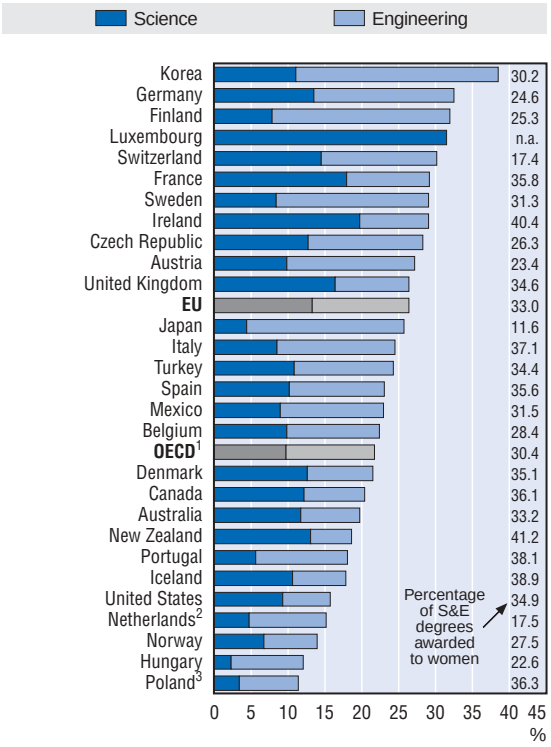
A.8.2. Flows of university graduates

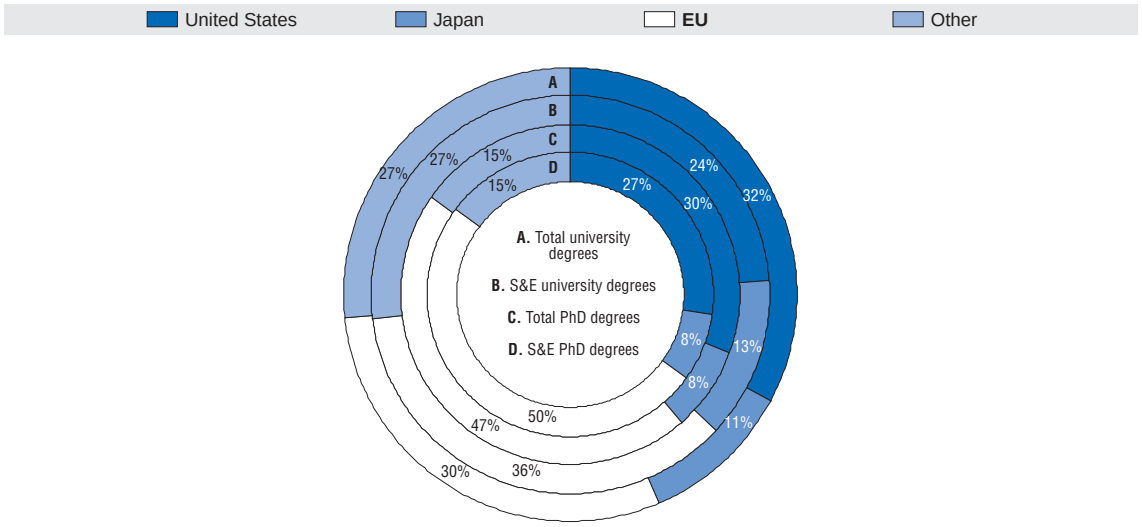
Graduation rates at PhD level
2000



S&E degrees as a percentage of total new degrees
2000



OECD flows of university graduates broken down by region, 2000



1. Average of the available countries.
2. Excludes advanced research programmes.
3. Excludes tertiary-A second degree programmes and advanced research programmes.

Source: OECD, Education database, May 2003.

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A.8.3. Employment of tertiary-level graduates

- Large investments in education over the past decades have led to a general rise in educational attainment, which is reflected in employment. On average, 28.2% of employed persons in OECD countries have a tertiary-level degree. However, the shares vary from 9.9% in Portugal to 41.9% in Canada. The United States (36.8%) and Japan (36.5%) rank far ahead of the European Union (24.0%). Europe also has large cross-country disparities: Ireland (40.0%), Belgium (33.9%), Finland (33.6%) and Sweden (31.6%) score high; Portugal, Turkey, the Czech Republic, Italy and Poland remain below 15%.
- In recent years, growth in employment of tertiary-level graduates has ranged between 2% and 6% a year. For the period 1997-2001, the OECD and EU averages are 3.5% and 3.9%, respectively. The outsiders are Ireland (14.5%) and Spain (10.2%) at the high end and Germany (0.7%) and the Netherlands (–0.9% for 1998-2001) at the low end. Except in the Netherlands, total employment has increased much more slowly (when it has not decreased) at 1.6% and 1.1% in the OECD area and the EU, respectively.
- Growth in employment of those with tertiary-level education owes more to women than to men because of their greater propensity to graduate at the tertiary level. In most countries, however, women are still less numerous than men in this category. They represent on average 44.5% of tertiary-level employment with extremes in Portugal (60%) and Switzerland (28%).
- In a span of only four years (1997-2001), the share of employed tertiary graduates aged 45-64 has increased in all OECD countries except Turkey, Spain, Portugal, Luxembourg, Poland and Denmark. A closer look at the age distribution of employed tertiary-level graduates shows that in Turkey, Korea, Portugal, Spain, Ireland and Mexico, those aged 25-34 account for more than 40% of the total. Conversely, in Germany, New Zealand, the Czech Republic, Sweden, Hungary, Denmark and the United States, those aged 45-64 represent over 40%.
- Unemployment rates are generally much lower for university graduates than for the overall population, at 2% or below in countries with low overall unemployment rates. They exceed 5% in Italy, Poland, Greece, Spain and Turkey, where the overall unemployment rates are also among the highest.
- Unemployment rates are generally higher for women with a university degree than for men. They are significantly higher in countries with the highest overall unemployment rates for university graduates (Turkey, Greece, Spain, Italy, Poland and France). Unemployment rates are also more than twice as high for women than for men in the Netherlands, Luxembourg, Switzerland and Portugal.

Employment of tertiary-level graduates

The share of tertiary-level graduates in total employment is an important indicator of the labour market's innovative potential. The data presented here show the deployment and characteristics of tertiary-level graduates in employment.

The OECD Educational Attainment Database provides data on population at different levels of education distributed by sex, age and work status (employed, unemployed, inactive). It is compiled by the OECD from member countries' labour force surveys and/or the European labour force survey. Adjustments are made to ensure comparability across countries, notably concerning national levels of education, which are recoded according to the International Standard Classification of Education-1997 (ISCED-1997).

Tertiary-level graduates are defined as holders of degrees at the ISCED-1997 levels 5B, 5A and 6 (see Box A.8.1).

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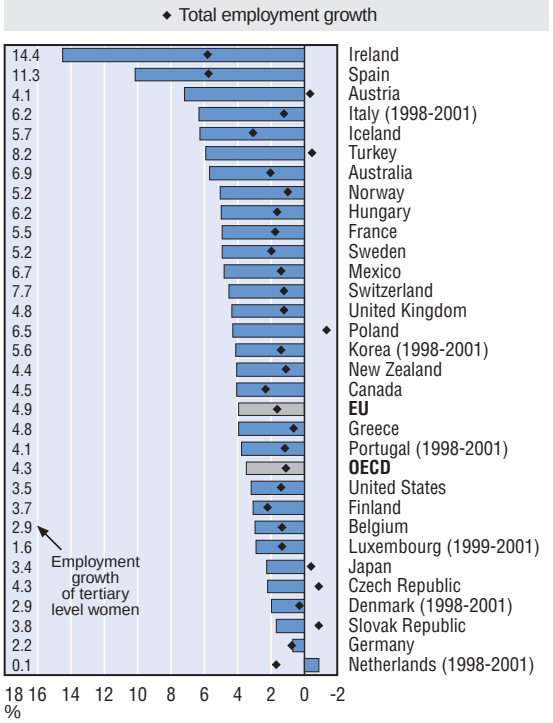
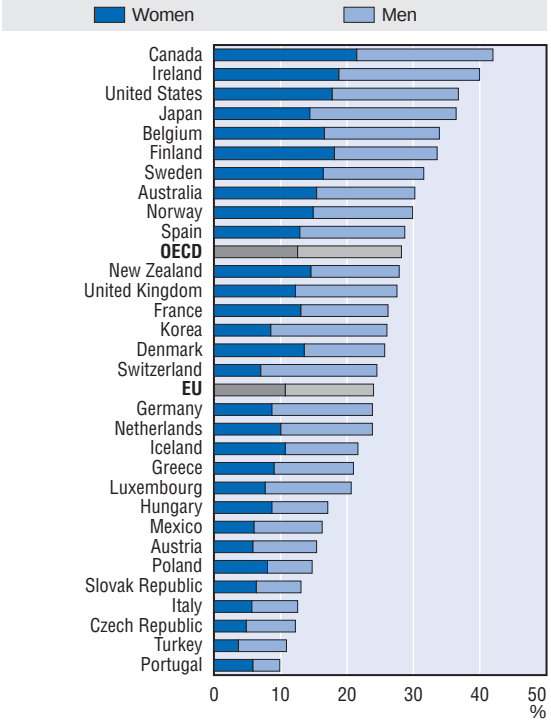
A.8.3. Employment of tertiary-level graduates

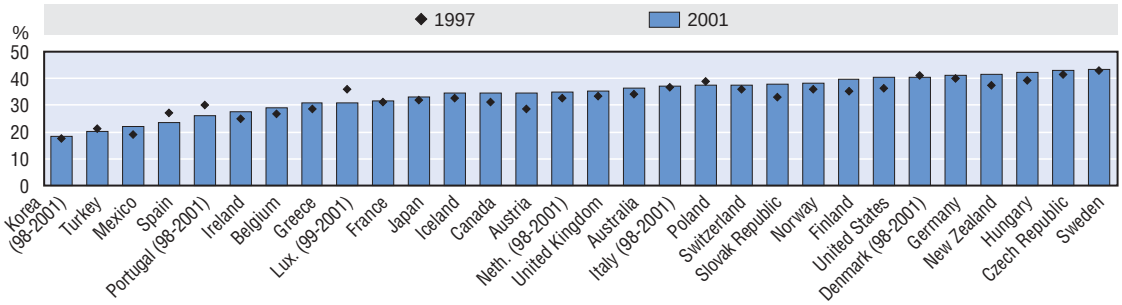
Employment growth of tertiary-level graduates
Average annual growth rate, 1997-2001[1]



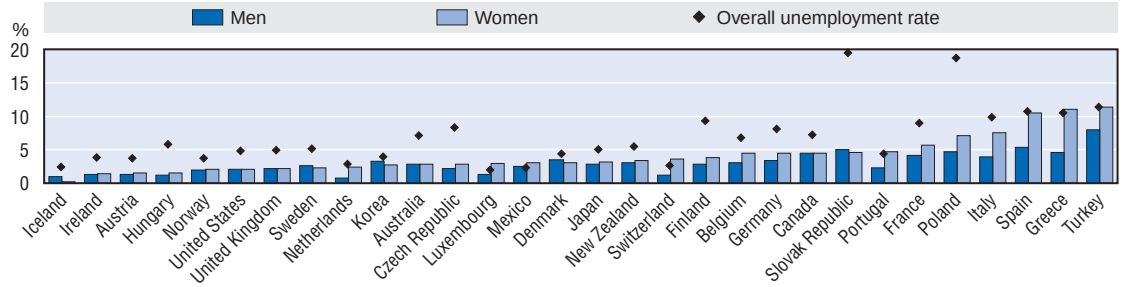
Employment of tertiary-level graduates as a percentage of total employment, 2001



Share of 45-64 year olds in employed tertiary graduates[1]



Unemployment rates of university graduates, 2001



1. 1998-2001 for Denmark, Italy, Korea, the Netherlands and Portugal; 1999-2001 for Luxembourg.
Source: OECD, Educational Attainment database, May 2003.

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A.9.1. Human resources in science and technology

- As measured here, human resources in science and technology (HRST) encompass workers in professional and technical occupations (see box). The definition goes far beyond R&D by including workers actively involved in the creation and diffusion of knowledge and technological innovation.
- Professionals and technicians represent between 20% and 35% of total employment in most OECD countries. Their share is over 35% in Sweden, Switzerland, Australia and Denmark and below 20% in Greece, Korea, Japan and Portugal (data for Japan are, however, probably underestimated).
- The share of professionals is particularly high (*i.e.* above 17%) in Belgium, Australia, Sweden and the Netherlands. The breakdown between professionals and technicians varies across countries, but there are generally more technicians than professionals.
- The share of women in these professions is at least equal to that of men in half of all OECD countries. It is particularly high (more than 60%) in Hungary, Poland and the Slovak Republic and lowest in Switzerland, the United Kingdom, Italy, Luxembourg and Korea.
- Professional and technical occupations have grown at a much faster rate than overall employment over 1995-2002, except in Finland, Portugal and Hungary. In the last two of these countries, employment of professionals and technicians has in fact decreased. This is also the case in Poland, where overall employment decreased even more rapidly between 1999 and 2001. In Spain, Norway, Ireland, Iceland and Luxembourg, professional and technical occupations grew by 5% a year.

Human resources in science and technology

Human resources in science and technology (HRST) are defined according to the *Canberra Manual* (OECD and Eurostat, 1995) as persons fulfilling one of the following conditions:

- Successful completion of tertiary-level education.
- Not formally qualified as above, but employed in an S&T occupation where the above qualification is normally required [corresponding to professionals and technicians – ISCO-88 (International Standard Classification of Occupations) levels 2 and 3 and also certain managers, ISCO 121, 122 and 131].

Data relating to HRST reported here focus on occupations and only include the following categories: all persons employed in occupations which are classified in ISCO-88 major groups 2 (Professionals) or 3 (Technicians and associate professionals). Persons employed in managerial occupations (ISCO 121, 122, 131) are not included because of the quality of the data and problems of international comparability.

The data presented here are drawn from member countries' labour force surveys and/or censuses. While data from the EU Community Labour Force Survey are harmonised, they are not harmonised for other OECD countries. In addition, occupational data are among the most difficult to collect, and national classifications are not always compatible with ISCO-88. For these reasons, some of the data, which are presented for the first time, are OECD estimates based on national data. They should be interpreted with caution.

For further information, see OECD and Eurostat (1995), *Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual*, OECD, Paris.

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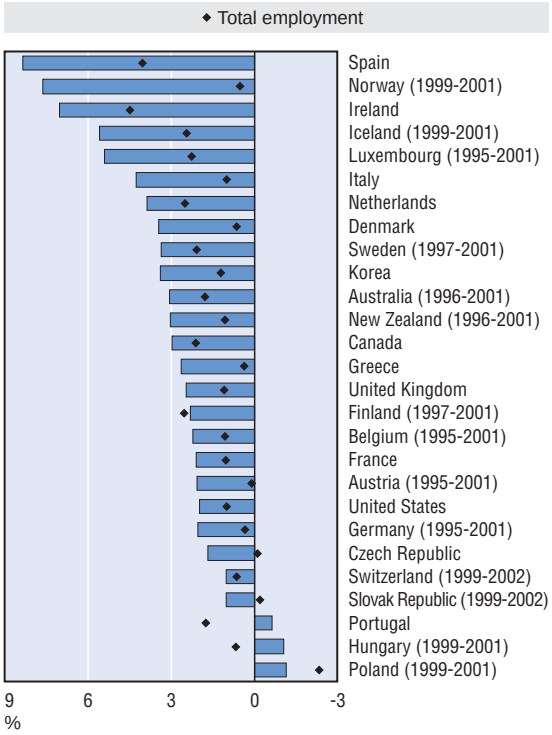
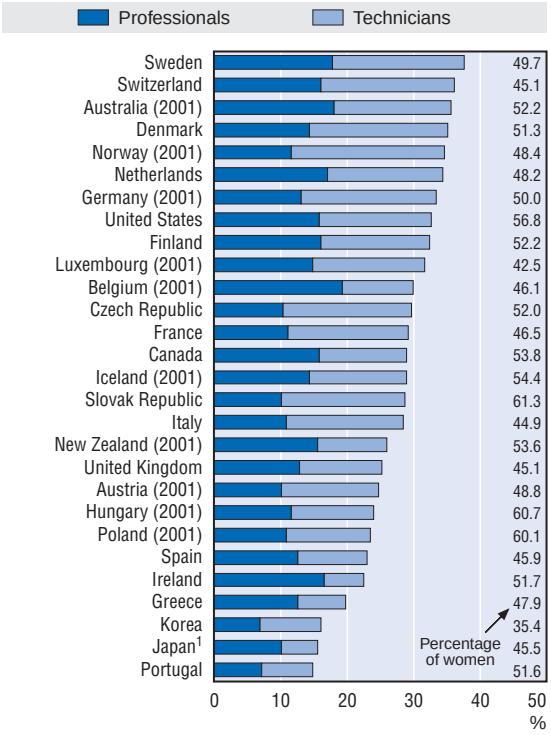
A.9.1. Human resources in science and technology

Growth of HRST occupations
Average annual growth rate, 1995-2002



HRST occupations as a percentage of total employment, 2002



1. Data for Japan are national estimates.

Source: OECD calculations and estimates, based on data from the Eurostat Community Labour Force Survey, the US Current Population Survey, the Canadian and Japanese labour force surveys, the Korean Economically Active Population Survey and the Australia and New Zealand censuses, May 2003.

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A.9.2. Researchers

- In 2000, approximately 3.4 million researchers were engaged in research and development (R&D) in the OECD area. This corresponds to about 6.5 researchers per thousand employees, a significant increase from the 1991 level of 5.6 researchers per thousand.
- Among the major OECD regions, Japan has the highest number of researchers relative to total employment, followed by the United States and the European Union. However, around 38% of all OECD-area researchers reside in the United States, 29% in the European Union and 19% in Japan.
- The R&D intensity of Finland, Sweden, Japan and the United States, in terms of both researchers and R&D expenditure (see A.2), is substantially above the OECD average.
- In 2000, approximately 2.1 million researchers (about 64% of the total) were employed by the business sector in the OECD area.
- In the major economic zones, the share of business researchers in the national total differs widely. In the United States, four out of five researchers work in the business sector but only one out of two in the European Union.
- Finland, the United States, Japan and Sweden are the only countries where business researchers in industry exceed 6 per thousand employees; in the large European economies, they are only 3 or 4 per thousand employees.
- Mexico, Turkey, Portugal, Greece and Poland have a low intensity of business researchers (fewer than 1 per thousand employees in industry). This is mainly due to national characteristics; in these countries, the business sector plays a much smaller role in the national innovation system than the higher education and government sectors. Business sector R&D expenditure in these countries accounts for only 25-35% of total R&D expenditure (see A.3).
- Growth in the number of business researchers is most dynamic in smaller OECD economies such as Mexico, Iceland, Turkey and Portugal, where the number of business researchers increased by more than 12% annually over the last decade.
- Countries in transition in Central and Eastern Europe have been affected by the reduction in numbers of business researchers in the 1990s, although the trend has reversed in the Czech Republic and Hungary in the past few years. Italy is the only other OECD country where the number of business researchers has decreased.

Researchers

Researchers are viewed as the central element of the research and development system. They are defined as professionals engaged in the conception and creation of new knowledge, products, processes, methods and systems and are directly involved in the management of projects. For those countries that compile data by qualification only, data on university graduates employed in R&D are used as a proxy. The number of researchers is here expressed in full-time equivalent (FTE) on R&D (*i.e.* a person working half-time on R&D is counted as 0.5 person-year) and includes staff engaged in R&D during the course of one year. FTE data on researchers give an indication of member countries' research effort and are different from headcount data, which are a measure of the stock of researchers employed. The data have been compiled on the basis of the methodology of the *Frascati Manual*.

The magnitude of estimated resources allocated to R&D is affected by national characteristics (see Box A.2).

Underestimation of researchers in the United States is due to the exclusion of military personnel in the government sector (see Box A.5).

The business enterprise sector covers researchers carrying out R&D in firms and business enterprise sector institutes. While the government and the higher education sectors also carry out R&D, industrial R&D is more closely linked to the creation of new products and production techniques, as well as to a country's innovation efforts.

For further information, see OECD (2002), *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*, OECD, Paris.

For more details, see Annex Tables A.9.2.1 *and* A.9.2.2.

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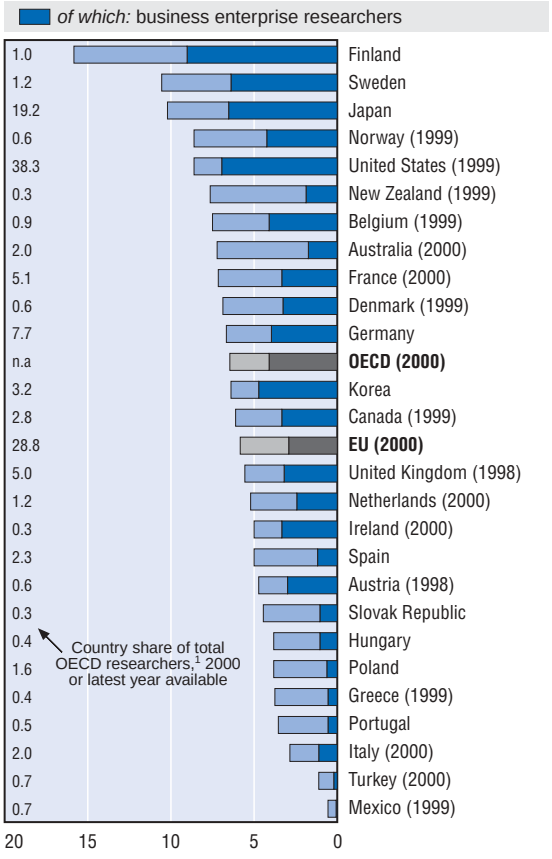
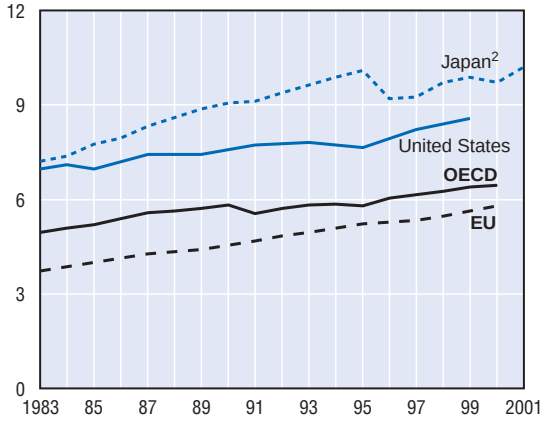
A.9.2. Researchers

Researchers per thousand total employment
2001

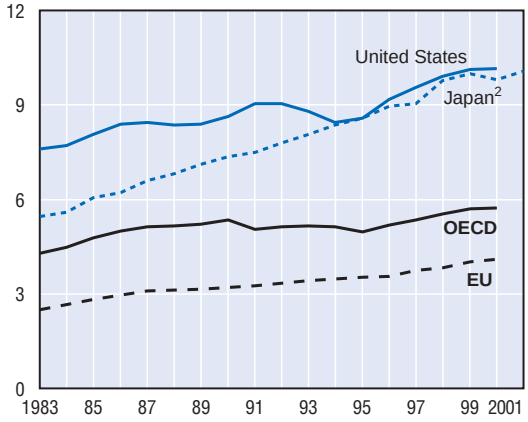


Growth of business researchers
Average annual growth rate, 1991-2001

Researchers per thousand total employment, by area, 1983-2001



Business researchers per thousand employment in industry, by area, 1983-2001



1. Country share relates to latest available data. For example, the country share for Italy is calculated as: the number of researchers in Italy in 1999 as a percentage of total OECD researchers in 1999.
2. Adjusted up to 1995.

Source: OECD, MSTI database, May 2003.

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A.10.1. International mobility of human capital

- In recent years, the international mobility of highly skilled workers (often referred to as "brain drain") has received increasing attention from policy makers and the media. However, internationally comparable data on international flows of scientists and researchers are extremely scarce. In the United States, for example, data on foreign-born scientists and engineers (S&Es) only cover inflows and thus provide only part of the picture of international mobility (see box).
- In the United States, the largest number of foreign-born scientists and engineers with S&E doctorates born in the OECD area come from the United Kingdom and Canada; relatively few are from Germany and Japan. If non-OECD countries are taken into account, there are three times as many foreign-born scientists from China and twice as many from India as from the United Kingdom. The share of women by country of origin varies greatly.
- In 2002 in the European Union countries, the relative share of non-national human resources in science and technology (HRST), as defined by occupational groups ISCO 2 and 3 (see box), was between 3% and 3.5%, but there are large differences among countries. As a percentage of national HRST, Luxembourg employs by far the largest share (38%), in part because of a sizeable banking sector, a small labour market and the presence of various EU institutions. Belgium also employs a relatively large share: 7.5% for all occupational groups and 5.5% for HRST, again in part because of the presence of various European institutions and the European headquarters of many multinationals. Austria and the United Kingdom also have relatively high shares. In the United Kingdom, the relative share of non-national HRST is higher than that of non-nationals for all occupational groups.
- The share of women employed as non-national HRST varies from around 35% to 50% and is lower than the share of all women in HRST occupations in all OECD countries (see A.9.1) except the Netherlands.

International mobility of human capital

Two indicators are used here to gauge the extent of international mobility in the OECD area. The first relates to scientists and engineers in the United States with a doctorate qualification who are not US citizens. The data are based on a sample survey and include all non-US citizens with S&E doctorates from a US university. They also include S&E doctorate holders with degrees from non-US universities who were in the country in 1990, the date of the US Census which provided the framework for NSF surveys throughout the 1990s. S&E doctorate holders who entered the United States after 1990 are not included unless they earned a US doctorate in S&E. Given the strong growth of the US economy, the high immigration rate and the efforts made to attract highly trained personnel, especially in the information technology sector, the estimates are a lower bound.

The second indicator relates to human resources in science and technology defined according to occupational groups (see Box 9.1 for a definition of HRST). This indicator includes all persons in International Standard Classification of Occupations (ISCO-88) major groups 2 (Professionals) and 3 (Technicians and associate professionals). These groups cover activities such as science and engineering, computing, architecture, health, education, business and legal activities. Data for the European countries are from the EU Community Labour Force Survey. The advantage of using this type of survey is that it allows for cross-country comparisons. However, there are drawbacks, such as sampling variability; this is an issue for measuring international migration, as the flows tend to be small relative to total population and not all relevant inflows can be identified. Nonetheless, the survey provides valuable, up-to-date information on international mobility of HRST.

For further information, see OECD (2002), *Education at a Glance*, OECD *Indicators*, OECD, Paris; and OECD and Eurostat (1995), *Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual*, OECD, Paris.

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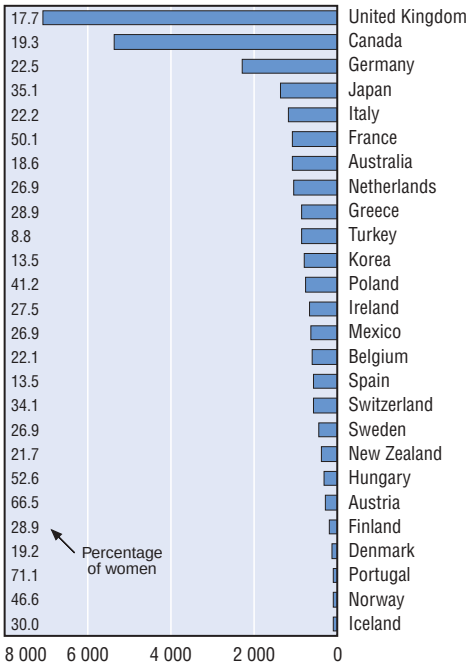
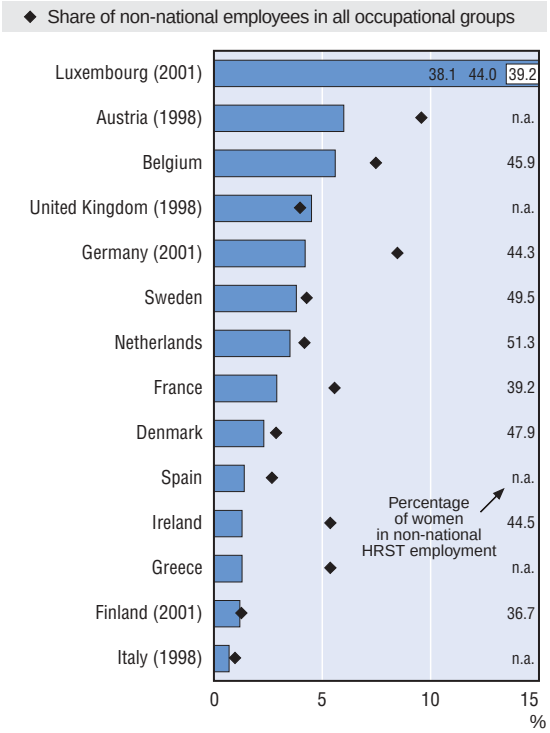
A.10.1. International mobility of human capital

Non-US OECD citizens with science and engineering doctorates in the United States, 1999



Source: OECD, based on data from National Science Foundation/SRS, SESTAT database, May 2003.

Relative share of non-national HRST[1] employment in the European Union, 2002



1. Human resources in science and technology defined according to occupational groups. HRST includes only ISCO-88 major groups 2 and 3 (professionals and associated professionals).

Source: OECD, based on data from the Eurostat Labour Force Survey, May 2003.

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A.10.2. International mobility of PhD students

- International mobility of PhD students is an indicator of the internationalisation of both the higher education sector and the research system. New PhDs may seek post-doctoral positions in the country in which they received their degrees. While preparing their thesis, they contribute to the advancement of research in the host country, although they may later take their experience home.
- The available data for Europe show that foreign students represent more than one-third of PhD enrolments in Switzerland, Belgium and the United Kingdom; comparable data for France and Germany are not available. The corresponding shares are 27% for the United States, 21% for Australia, 18% for Denmark and 17% for Canada.
- Denmark is the only country where more foreign women than men are enrolled in PhD programmes. Elsewhere, women represent between 31% (Italy) and 47% (Portugal) of foreign PhD students. However, they account for only 18% in the Slovak Republic.
- In absolute numbers, the United States has many more foreign PhD students than other OECD countries, with around 79 000. The United Kingdom follows with some 25 000. The language used in the country plays a role in the choice of destination, notably for English-speaking countries, but also for Spain, which receives many students from Central and South America. However, language is not the sole basis of choice.
- With a few exceptions (the Czech Republic, Denmark, Portugal, the Slovak Republic and Spain), 20-25% of PhD students enrolled in foreign universities come from the European Union. These shares reach 50% in Austria and 73% in Switzerland. European students also represent 28% of foreign PhD students enrolled in New Zealand and 19% of those in Canada, but only 0.5% of those in Korea.
- Data available for ten countries show that most foreign PhD students are enrolled in the social sciences, business and law or in arts and humanities, a profile that does not differ from that of other national students, whatever their level of studies and origin. In Finland and Switzerland, however, science and engineering programmes are chosen by of 37% and 35%, respectively, of foreign PhD students.

International mobility of PhD students

The data used are from the Indicators for Education Systems (INES) project conducted jointly by the OECD, UNESCO and Eurostat. The number of students from each country enrolled abroad is measured from data available in OECD member countries. Therefore, foreign students in countries that do not provide these data or those migrating to non-member countries are not included. Students are classified as foreign students if they are not citizens of the country for which the data are collected. Countries unable to provide data or estimates of non-nationals on the basis of passports were requested to substitute data on the basis of alternative criteria (*e.g.* country of residence). The number of students studying abroad is obtained from the reports of countries of destination.

The educational level of students is based on the classification developed by UNESCO, the International Classification of Education (ISCED 1997). ISCED 1997 level 6 corresponds to programmes that lead to an advanced or research qualification, equivalent to a PhD. International mobility of PhD students is of particular interest for two reasons: first, they are an important subset of HRST, as they have completed tertiary education; second, they are involved in R&D activities abroad while preparing their PhD.

For further information, see OECD (2002), *Education at a Glance*: OECD *Indicators*, OECD, Paris; "Student Mobility between and towards OECD Countries: A Comparative Analysis", in OECD (2002), *International Mobility of the Highly Skilled*, OECD, Paris.

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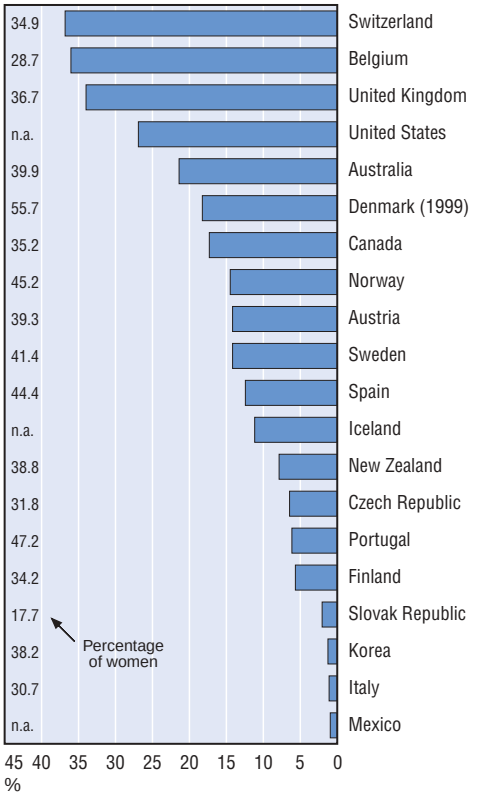
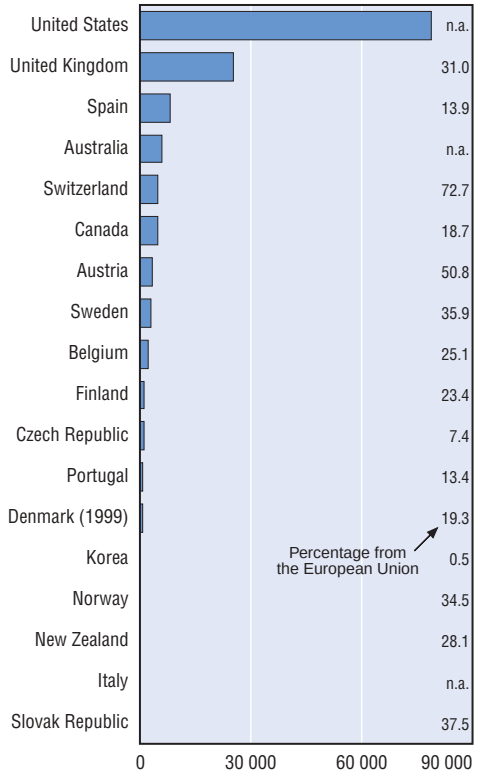
A.10.2. International mobility of PhD students

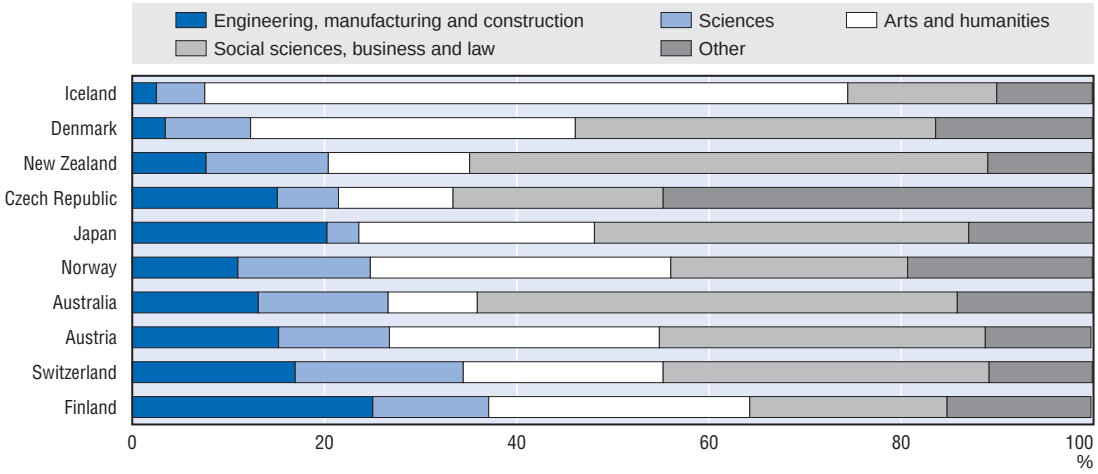
Foreign PhD students[1] as a percentage of total PhD enrolment, 2000



Distribution of foreign PhD students in OECD countries by host country, 2000



Distribution of foreign PhD students by field of study, 1998



1. Includes foreign students in university education from both OECD and non-OECD countries.

Source: OECD, Education database, May 2003.

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A.11.1. Patent applications to the European Patent Office

- In 1999, OECD countries made 99 268 patent applications to the European Patent Office (EPO), based on priority date, a 68% increase from 1991. Because Patent Co-operation Treaty (PCT) applications transferred to the EPO are included in this number, the latest available data are for 1999 (see box).
- The European Union (EU) accounted for 47% of total OECD patent applications to the EPO, significantly above the United States (28%) and Japan (18%). However, this share somewhat overstates the EU's inventive performance, as patents taken at the EPO primarily reflect EU countries' domestic market ("home advantage").
- Among European countries, Germany has by far the largest share with 20.5% of total EPO applications, more than the combined shares of France, the United Kingdom, Italy and the Netherlands.
- Patent applications from Korea, Ireland and Finland increased sharply over the 1990s (annual growth rates of 16% or more). The rise in patent applications from large countries, such as France, Japan and the United Kingdom, was below the OECD average (6.7%).
- To standardise for country size, patent applications are expressed relative to population. Here, differences in the propensity to patent of the three major OECD regions are smaller than the differences observed for absolute patent numbers. Switzerland (339), Finland (265), Germany (248) and Sweden (239) have a high propensity to patent. The 1999 figures for these countries are significantly above those for 1991.
- There is a strong positive correlation between patent applications and business sector R&D expenditure (BERD) across OECD countries.

Patents as indicators of technological performance

Patent data are readily available from patent offices and contain much information (applicant, inventor, technology, claims, etc.). Patents have certain weaknesses as indicators of technological performance, however. For instance, many inventions are not patented, and the propensity to patent differs across countries and industries. Another drawback is related to differences in patent regulations among countries, which hamper international comparability. Changes in patent law may also affect patent time series. Finally, the value distribution of patents is skewed: many patents have no commercial application (hence little value), while a few have great value. It is therefore important to rely on methods for counting patents that minimise statistical biases while conveying a maximum amount of information. In particular, four methodological choices have to be made.

- *Geographical distribution of patents.* Three main criteria can be used: *i*) counts by priority office (country where the first application is filed, before protection is extended to other countries); *ii*) counts by the inventor's country of residence, which indicates the inventiveness of the local labour force; *iii*) counts by the applicant's country of residence (the owner of the patent at the time of application), which indicates control of the invention. The method most widely used is patent counts by the inventor's country of residence.
- *Patents with multiple inventors from different countries.* Such patents can either be partly attributed to each country mentioned (fractional count) or fully attributed to every relevant country, thus generating multiple counting. It is better to use fractional counting procedures.
- *Reference date.* The choice of one date, among the set of dates included in patent documents, is important. The priority date (first filing worldwide) is the earliest and therefore closest to the invention date. Counts by application date introduce a bias owing to a one-year lag between residents and foreigners: the latter usually first file a patent application at their domestic office (the priority office) and later in other countries. The lag increases to 2.5 years for Patent Co-operation Treaty (PCT) applications. To measure inventive activity, patent time series should be computed with respect to the priority date.
- *Increasing use of the* PCT *procedure.* This is an option for future filing, which can eventually be exercised (transferred to regional or national offices such as the EPO or USPTO) and become actual patent applications. Since there is a lag of about three years between priority and publication of transfer, patent statistics would be already out of date when published. In order to have recent patents counts, one must estimate ("nowcast") transfers before they are actually performed.

For further information, see: H. Dernis, D. Guellec and B. van Pottelsberghe (2001), "Using Patent Counts for Cross-country Comparisons of Technology Output", STI *Review* No. 27, OECD, Paris.

For more details, see Annex Table A.11.1.

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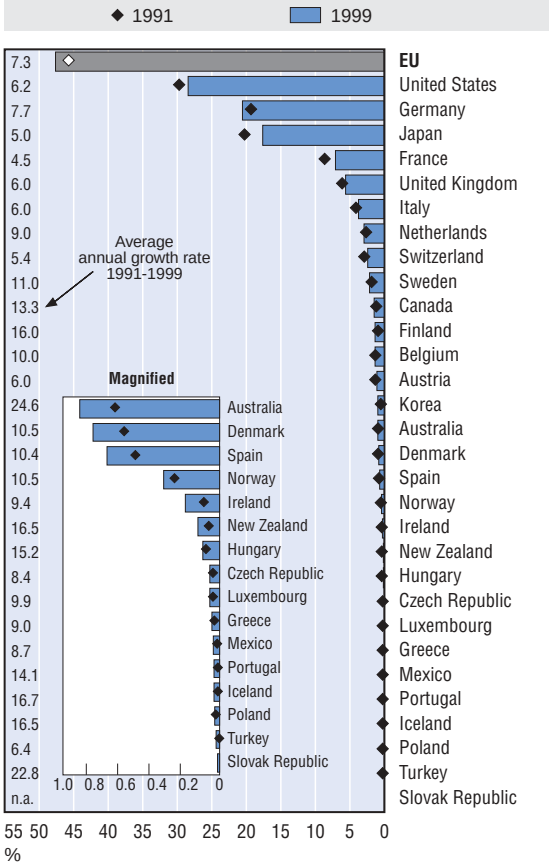
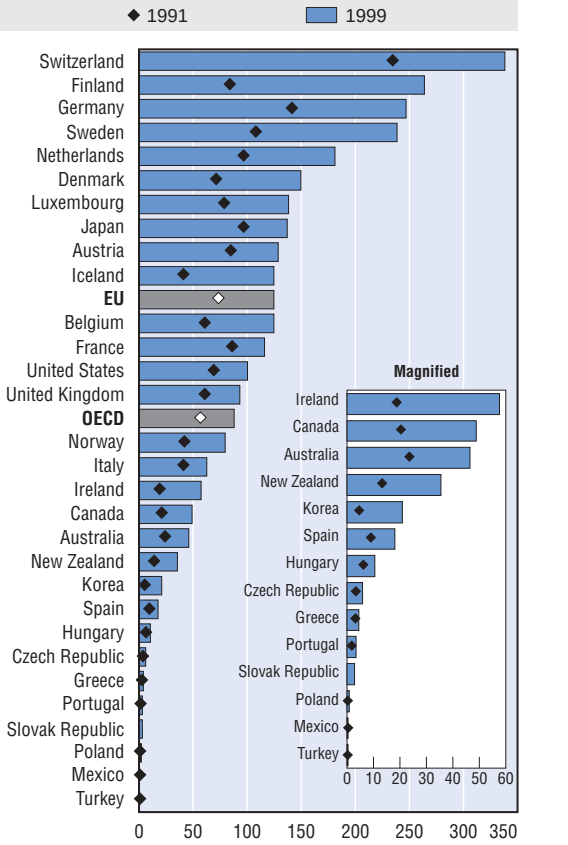
A.11.1. Patent applications to the European Patent Office

Share of countries in EPO[1] patent applications, 1999

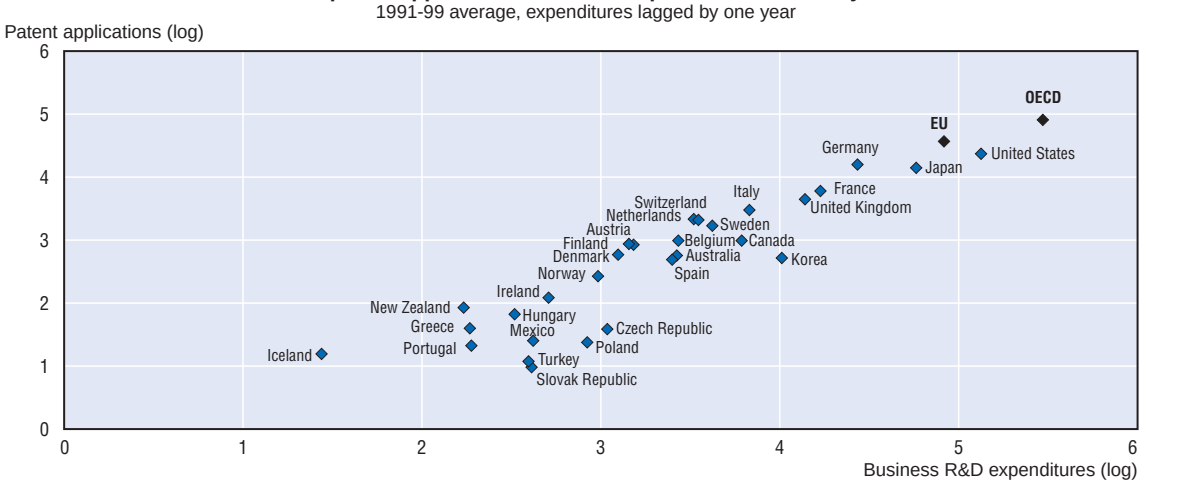


Number of EPO[1] patent applications per million population, 1999



EPO[1] patent applications and R&D expenditure in industry[2]

1991-99 average, expenditures lagged by one year



1. Patent applications to the European Patent Office (EPO) by inventor's country of residence and priority date, counted using a fractional counting procedure.
2. Business enterprise expenditure on R&D (BERD) in millions of 1995 USD using purchasing power parities (average over the period 1990-98).

Source: OECD, Patent database, May 2003.

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A.11.2. Patent families

- Patent-based indicators are generally constructed on the basis of patent applications issued by a single patent office (national or regional). However, such indicators have a "home advantage" bias. To eliminate the bias and improve international comparability, the OECD has developed "patent families" (see box). Patent families eliminate the "home advantage" bias and generally represent patents of high value.
- In 1998, there were more than 40 000 patent families in the OECD area, a 32% increase from 1991. The United States accounted for around 36% of the OECD total, followed by the European Union (33%) and Japan (25%). Over the 1990s the European Union's share of patent families converged towards that of the United States, while that of Japan declined.
- Between 1991 and 1999, the shares of Japan and France decreased by 4 and 1 percentage points, respectively.
- When population is taken into account, Switzerland and Sweden had the highest propensity to patent among OECD countries. In 1998, Switzerland had 119 patent families per million population and Sweden had 107. Japan (81), Finland (75), Germany (70) and the United States (52) also had a high propensity to patent. In contrast, Turkey, Mexico, Poland, Portugal, the Slovak Republic and the Czech Republic had a low propensity to patent.
- There is a positive correlation between the number of patent families and business enterprise expenditure on R&D (BERD). The United States, Japan, Germany, France and the United Kingdom have both a high level of BERD and a high number of patent families. Iceland, Portugal, Greece and Turkey have both a low level of BERD and a low number of patent families.

Patent families

Patent-based indicators provide a measure of the output of a country's R&D: its inventions. However, the methodology used can influence the results. Simple counts of patents filed at an intellectual property office are affected by various sources of bias, such as weaknesses in international comparability (home advantage for patent applications) or highly heterogeneous patent values. The OECD has developed a set of indicators based on patent families which suppresses the major weaknesses of traditional patent indicators.

A patent family is defined as a set of patents taken in various countries to protect a single invention. The OECD patent families indicator relates to patents applied for at the European Patent Office (EPO) and the Japanese Patent Office (JPO) and patents granted by the US Patent and Trademark Office (USPTO); the patents from these offices are linked by priority date to form patent families.

Patent families improve international comparability of patent-based indicators. Inventors usually take a patent first in their home country and may later file patents abroad. Patent families concern patenting at this set of patent offices. The "home advantage" disappears as the measures are no longer affected by the region in which patents are taken (a country generally takes more patents in its domestic market than in other regions).

To create a patent family, a patent must be filed in several countries. A patentee takes on additional costs to extend protection to other countries only if it seems worthwhile to do so. Thus, patents that are members of families will generally be of higher value than those filed in a single country.

As for traditional patent counts, it is important to rely on a method for counting patent families:

- *Geographical distribution*: patent families are based on a fractional count by country of residence of the inventors (see A.11.1).
- *Reference date*: patent families are presented according to the earliest priority date associated with each set of patents in the family (several priorities can be associated with elements of the family). However, counting patent families according to earliest priority date increases the drawback of traditional patent counts with respect to timeliness (1995 is the most complete series currently available) (see box in A.11.1).

For further information, see, H. Dernis, D. Guellec and B. van Pottelsberghe (2001), "Using Patent Counts for Cross-country Comparisons of Technology Output", STI *Review* No. 27, OECD, Paris; and H. Dernis and M. Khan, "Patent Families Methodology", STI *Working Paper*, forthcoming. See: *www.oecd.org/sti/measuring-scitech*

For more details, see Annex Table A.11.2.

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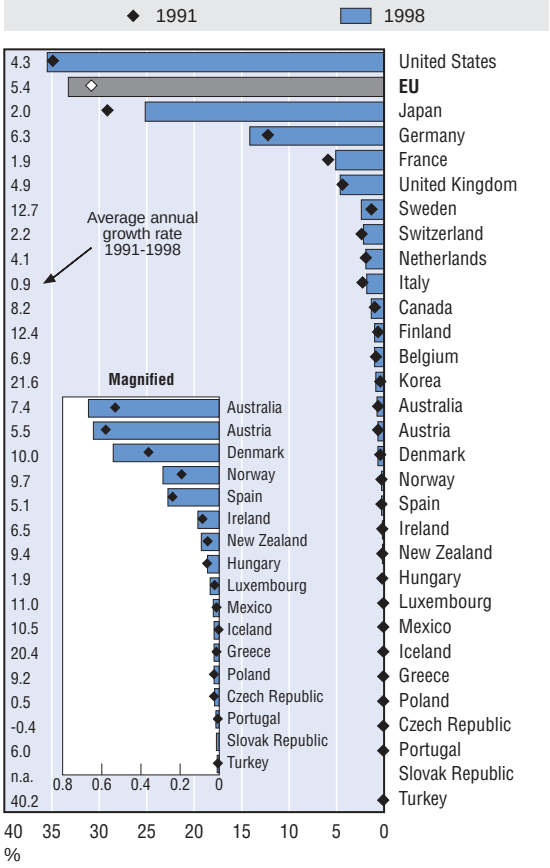
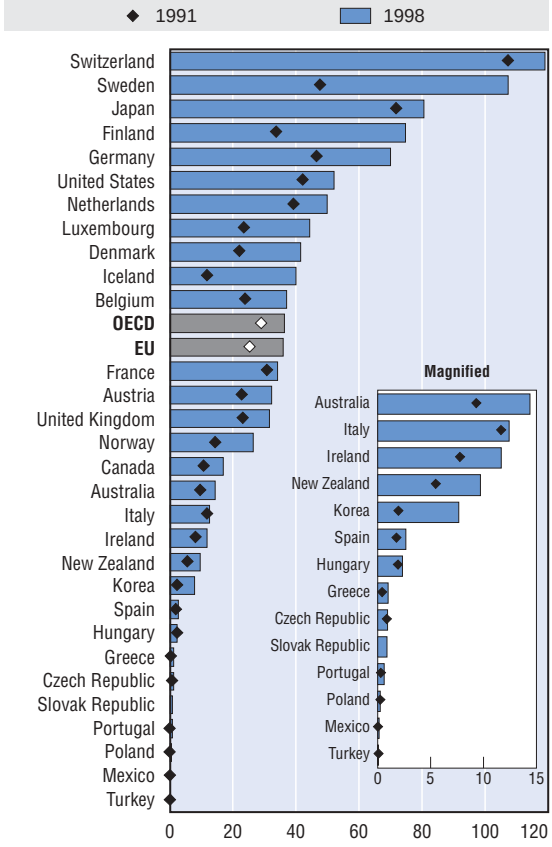
A.11.2. Patent families

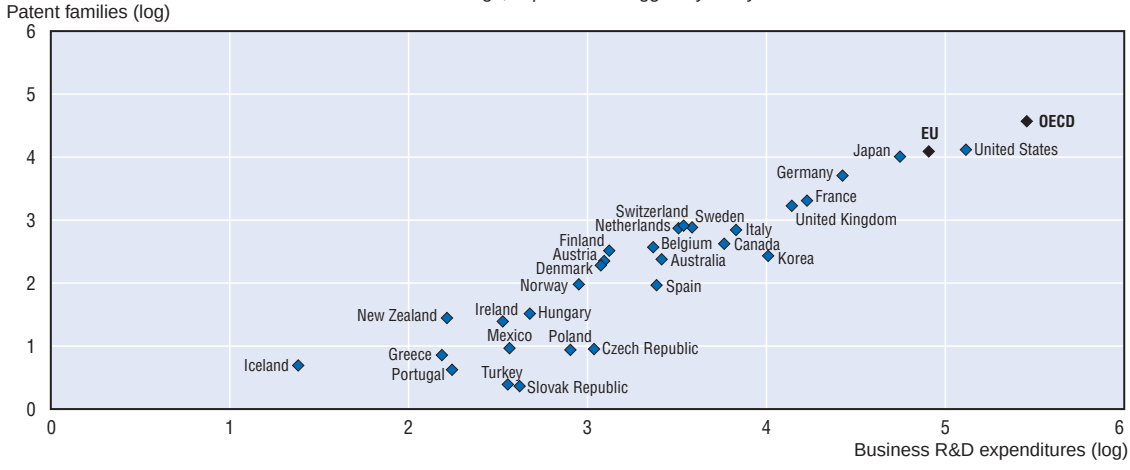
Share of countries in "triadic"[1] patent families
1998



Number of patents in "triadic"[1] patent families per million population, 1998



"Triadic"[1] patent families and R&D expenditure in industry[2]
1991-98 average, expenditures lagged by one year



1. Patents filed at the European Patent Office (EPO), the US Patent & Trademark Office (USPTO) and the Japanese Patent Office (JPO).
2. Business enterprise expenditure on R&D (BERD) in millions of 1995 USD using purchasing power parities (average over the period 1990-97).

Source: OECD, Patent database, May 2003.

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A.12.1. R&D in non-OECD economies

- Non-OECD economies account for a growing share of the world's R&D. When combined with that of OECD countries, the non-OECD economies included here account for 17% of R&D expenditure. They are most likely to increase that share in coming years.
- In 2001, Israel allocated 4.8% of GDP to R&D (excluding R&D for defence), more than Sweden, which has the highest R&D intensity in the OECD area, at 4.3%.
- R&D expenditure in China has grown rapidly over the past decade and in 2001 reached almost USD 60 billion in current purchasing power parity (PPP). It is behind the United States (282 billion) and Japan (104 billion), but ahead of Germany (54 billion). In 2000-01, India is estimated to have spent USD 19 billion (PPP) on R&D, which puts it among the top ten worldwide. Spending by non-OECD economies such as Brazil, the Russian Federation and Chinese Taipei follows closely that of the G7 countries and Korea.
- In most of Central and Eastern Europe and South America, R&D intensity is below 1%, far below the OECD average. Except for Russia and Brazil, their absolute levels of R&D expenditure are also low.
- From 1993 to 2001, the three Asian economies for which calculations are possible have experienced high average annual growth of R&D expenditure (in constant 1995 USD PPP). The countries acceding to the EU as well as Russia have growth rates around the OECD average; the Latin American economies, Bulgaria and Romania have low or negative growth.
- In the more developed Asian economies, as in the OECD area, the business enterprise sector carries out most of its total expenditure on R&D. In less developed non-OECD economies as in less developed OECD countries, on the other hand, most R&D is performed by the government and higher education sectors.

Measuring R&D in non-OECD economies

R&D data for Argentina, Chile, China, Israel, Romania, the Russian Federation, Singapore, Slovenia and Chinese Taipei are included in the OECD database and are – except for Chile – published in OECD's *Main Science and Technology Indicators* (MSTI). Data for Bulgaria, Cyprus, Estonia, Latvia and Lithuania are from Eurostat's NewCronos database. Data for Brazil; Hong Kong, China; India and South Africa are from national S&T ministries (or equivalent) or the central statistical office.

The R&D data for non-OECD economies that are included in the MSTI database largely comply with the recommended methodology of the *Frascati Manual* (OECD, Paris, 2002), and the same can be said for the data from Eurostat's database. Data for the other economies included here are not necessarily completely in accordance with the guidelines of the *Frascati Manual*. Therefore, the latest available year is given but no growth rates or time series.

When looking at the data, the following notes should be kept in mind.

- In Brazil, data for the business enterprise sector are collected through innovation surveys; response rates are very low. The estimated totals only reflect those for the 1 100 enterprises that responded at least once to the innovation survey since 1993. Hence, data for the business sector are underestimated. Data for the government sector and the higher education sector are estimated using budgetary information and are probably underestimated.
- In Chile, the services sector is not covered. Data for the manufacturing sector are drawn from innovation surveys, which are held every three years. These surveys collect data for two out of the three years, and data for the third year are estimates.
- In India, the higher education sector and the small-scale industry sector are only partially covered. Data for the year 2000-01 have been estimated by applying the sector-wise growth rates for the period 1994-95 to 1998-99.
- In Israel, Lithuania, Chinese Taipei and South Africa, defence R&D is not covered. Furthermore, in Israel, humanities and law are only partially covered in the higher education sector.
- In Latvia, the business enterprise sector is not fully covered, hence data for this sector are underestimated.
- In Romania and the Russian Federation, much of the R&D is traditionally performed by public enterprises, which are classified in the business enterprise sector.
- In South Africa, apart from defence R&D, research done by non-governmental research organisations (NGOs) and research consultancies is excluded.

For more information on the indicators presented, see A.2 and A.3.

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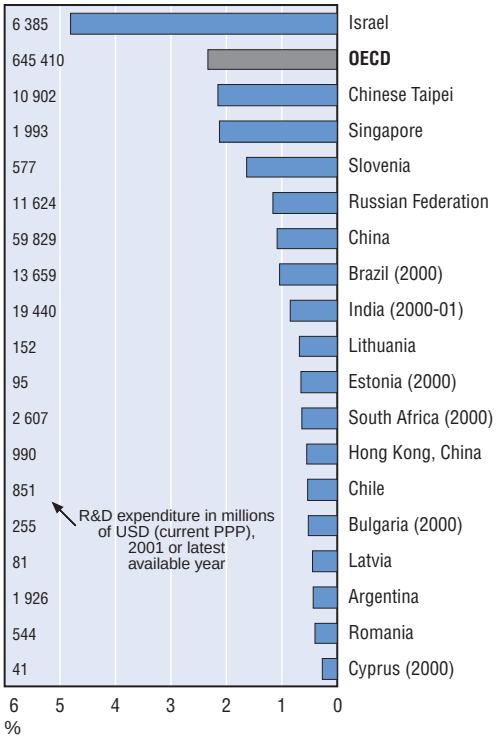
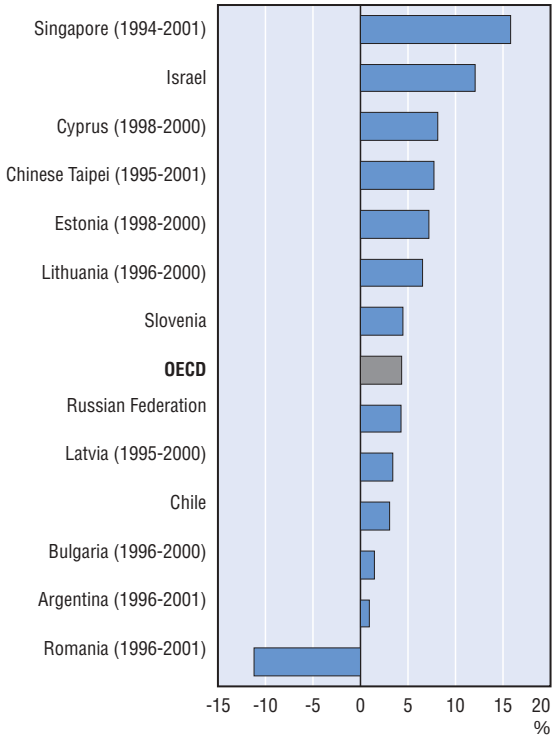
A.12.1. R&D in non-OECD economies

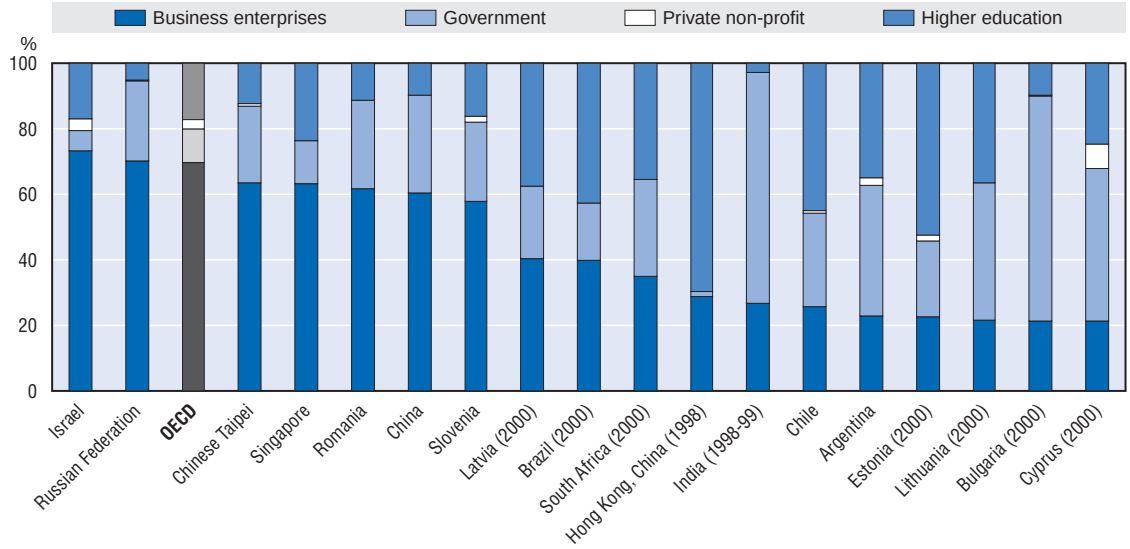
R&D intensity[1]
2001



Evolution of gross domestic expenditure on R&D
Average annual growth rate, 1993-2001



R&D expenditure by performing sector
Percentage share in national total, 2001



1. Gross domestic expenditure on R&D as a percentage of GDP.

Source: OECD, MSTI database, May 2003; Eurostat, NewCronos database, May 2003; and OECD, based on national sources.

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A.12.2. Patenting in non-OECD economies

- Non-OECD economies make only a minor contribution to global patenting activity. Indeed, OECD countries accounted for 97.6% of patent applications to the European Patent Office (EPO) by priority date in 1999 and for 95.5% of (estimated) patents granted by the United States Patent and Trademark Office (USPTO) by priority date in 1998, yet they only accounted for 86% of business R&D in 2000/01. During the 1990s, the 12 non-member economies shown here were responsible on average for 86% of EPO patent applications and for 94% of USPTO patents granted to non-OECD economies.
- In 1999, Israel – at 122 patent applications per million population – was the only non-member economy whose patent applications at the EPO exceeded the OECD average of 88. Israel also had 166 patents per million population granted by the USPTO in 1998, also above the OECD average (143) but after Chinese Taipei, which had 223 patents granted per million population.
- The 1990s was a period of catch-up. Except for applications to the EPO by Hong Kong, China, all these economies had growth rates superior to the OECD average, at both the EPO and the USPTO. In particular, Slovenia, India, China and Singapore had annual average growth rates of more than 20% at the EPO, while Singapore, Romania, Chinese Taipei and India had similar growth rates for USPTO patents.
- Of a world total of around 41 000 patent families in 1998, non-OECD economies accounted for only 1.5%, up from 1% in 1991. Among the non-OECD economies, Israel was responsible for the highest number of patent families (see A.11.2). It ranked 16th worldwide with 241 families, far ahead of the Russian Federation (61), Chinese Taipei (59), Singapore (50) and China (45).
- All non-OECD economies presented here saw their number of patent families grow between 1991 and 1998 at rates considerably above the overall OECD growth rate.
- Almost two-thirds of Singapore's patent applications to the EPO in 1999 were in information and communications technology (ICT); it has a high specialisation index of 1.9 in this area. Hong Kong, China, and Israel also have a strong comparative advantage in ICT. Data for India and Israel, and to a lesser extent for Argentina and Singapore, show a strong specialisation in biotechnology, which again is reflected in USPTO data.
- International co-operative research is important for non-OECD economies. A significant share of their EPO patents during 1997-99 had foreign co-inventors. Foreign ownership of domestic inventions is high in most of these non-OECD economies, ranging from 22% in Chinese Taipei to 65% in Russia, all above the OECD average of 14%. Conversely, there is much less domestic ownership of foreign inventions. Most fall around or below the OECD average of 14%, with the exception of Hong Kong, China; Romania; Singapore; and China.

Patenting in non-OECD economies

The patent data used here are extracted from the European Patent Office (EPO), the US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO). To obtain more timely data, USPTO data for 1996-98 were nowcasted. Patent families are calculated by the OECD (see *www.oecd.org/sti/measuring-scitech* and click on "Current work on patents").

The economies selected for review here are those published in OECD's *Main Science and Technology Indicators*. Certain other economies which are important from the point of view of patenting (Brazil; Hong Kong, China; India; South Africa) are also included.

For more information on the indicators, see A.4.3, A.6.1, A.11.1, A.11.2, C.5.2 and C.5.3.

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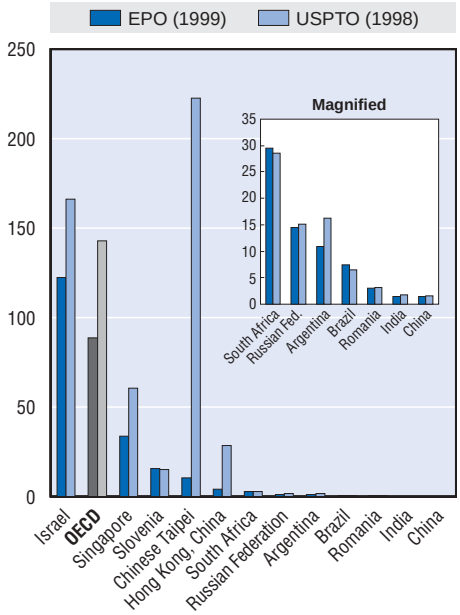
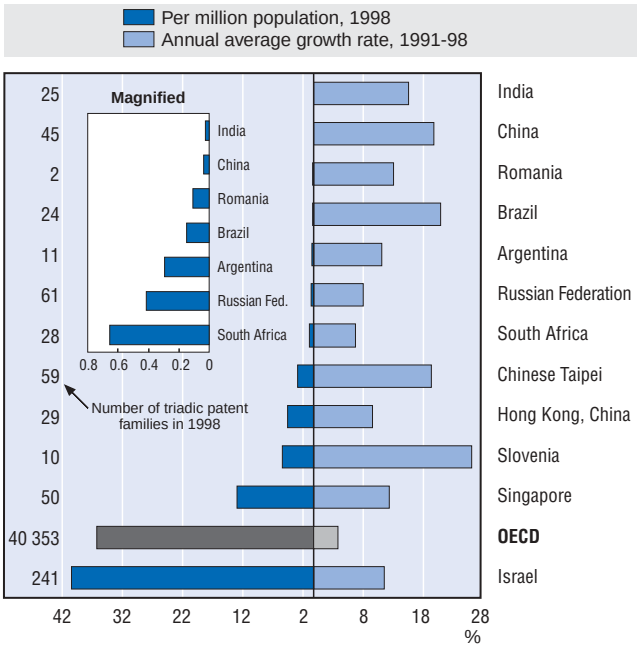
A.12.2. Patenting in non-OECD economies

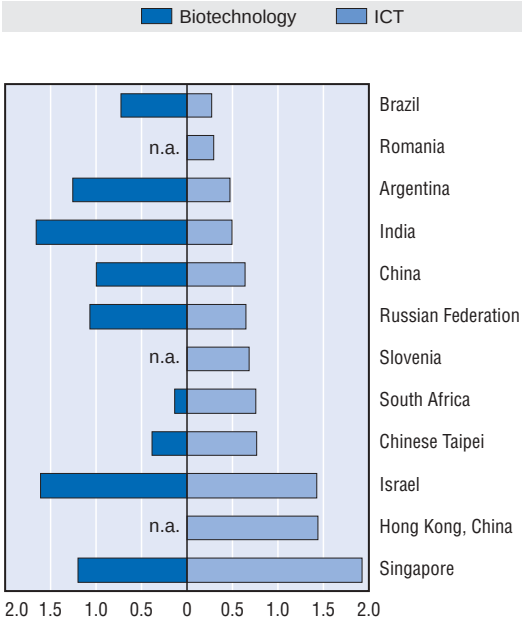
Patents per million population
EPO 1999 and USPTO 1998



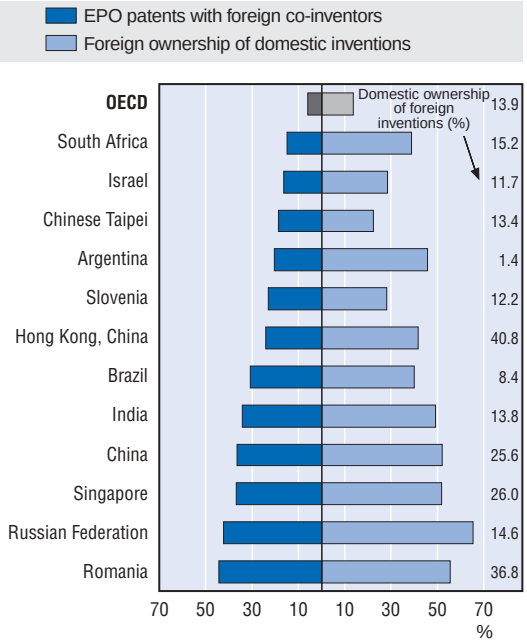
Triadic patent families, 1998



EPO specialisation indices, 1999
(OECD = 1)



International co-operation in S&T and cross-border ownership of inventions
EPO 1997-99 priority years



Source: OECD, Patent database, May 2003.

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A.12.3. Human resources in non-OECD economies

- Researchers in non-OECD economies accounted for almost one-third of the combined total of OECD and non-OECD researchers presented in the graphs. This is much higher than their share in R&D expenditure (see A.12.1), as expenditure per researcher is considerably lower in less developed countries (because of lower wages, less and cheaper support staff, less expensive equipment, etc.).
- In 2001, China had the second highest number of researchers in the world (743 000), behind the United States (1.3 million), but ahead of Japan (648 000) and Russia (505 000). As a share of total employment, Singapore and Russia employed more researchers than the OECD average, while India, Brazil and China were far below the average, owing to the size of their populations and their pattern of development.
- Russia suffered a decline of 21% in the number of researchers between 1994 and 1998, followed by a slight recovery.
- China produced 739 000 university graduates in 2000, equivalent to 13% of the OECD total in that year (5.6 million). India (687 000) and Russia (611 000) also contributed substantially to the world total, followed by the Philippines, Brazil and Indonesia.
- In 2000, Russia had 26 000 graduates of advanced research programmes (equivalent to PhDs), and Brazil and Thailand had around 20 000 each. In comparison, the OECD turned out 147 000 graduates of advanced research programmes in 2000.
- In 2000, 1.4 million students began university education in China and a similar number in Russia. Based on total enrolments, the number of new entrants in India is likely to have been of the same order of magnitude.
- In 2000, 1.5 million foreign students were enrolled in higher education in OECD countries, equal to 3.8% of total enrolment, of which 44% from other OECD countries and 56% from outside the OECD area. Of the non-OECD total, China (13%) and India (6%) accounted for the largest shares.
- Almost 10% of the 575 000 doctoral scientists and engineers employed in the United States in 2001 were not US citizens. Most (40 000) were permanent residents, and the other 17 000 were temporary residents. Almost two-thirds were born in Asia – mainly in China and India. Those born in Europe followed at a distance (17%).

Measuring human resources for science and technology in non-OECD economies

Data for researchers are drawn from the same sources as the R&D presented in section A.12.1 and are measured according to the *Frascati Manual* guidelines. Researcher data are expressed in full-time equivalents (FTE). The notes in section A.12.1 apply to these data. In addition:

- In Chinese Taipei, postgraduate students engaged in R&D are not included in the higher education sector. Moreover, researchers must have a university degree or above.
- Data on FTE for Brazil were calculated by applying the headcount/FTE ratio for Argentina to headcount data for Brazil.

Data on students and graduates of university education and on foreign students in higher education are from the OECD Education database, with the exception of graduates of advanced research programmes in India, which are from national sources.

Data on doctoral scientists and engineers employed in the United States are from the National Science Foundation.

For more information on the indicators, see A.8.2, A.9.2 and A.10.1.

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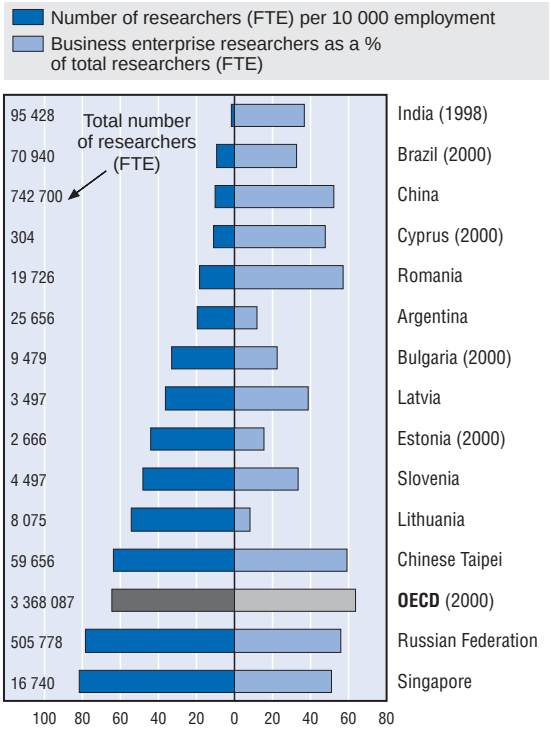
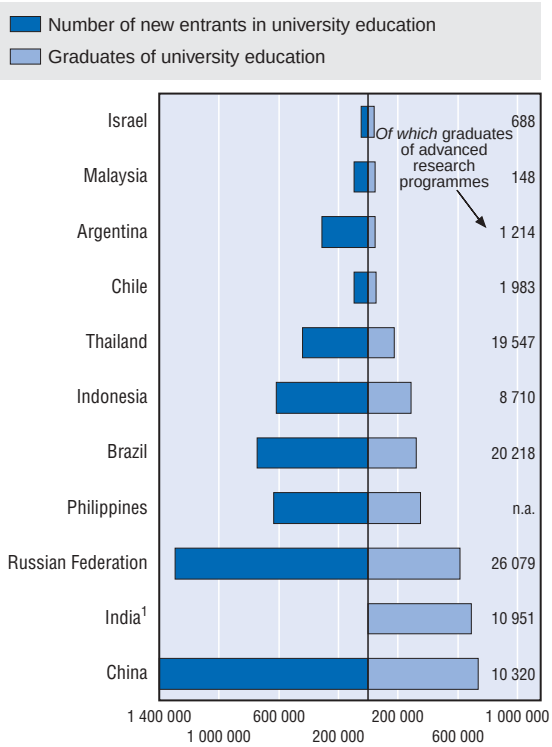
A.12.3. Human resources in non-OECD economies

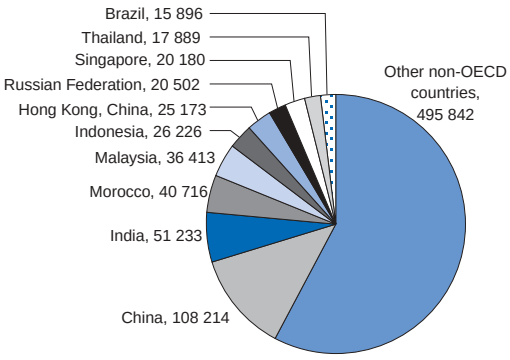
Researchers
2001



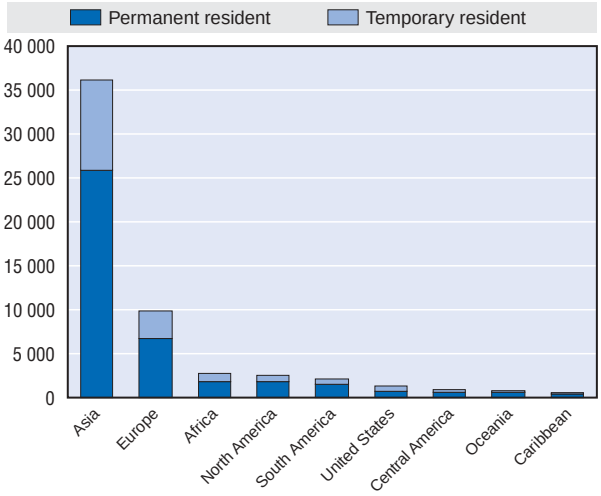
Entry to and graduation from university education
2000



Foreign students enrolled in higher education studies in OECD countries
By country of citizenship, 2000



Employed doctoral scientists and engineers in the US
Non-US citizens by place of birth, 2001



1. Graduates of advanced research programmes are for 1999 and university graduates cover second degree qualifications only.

Source : OECD, MSTI database, May 2003; Eurostat, NewCronos database, May 2003; OECD, Education database, May 2003; National Science Foundation/SRS; and OECD, based on national sources.

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A.13. Scientific publications

- Publications are the major output of scientific research and are frequently used to measure stocks and flows in the world knowledge base. Most publications result from research carried out by the academic sector. With the increase in scientific activity and the incentives for researchers to publish (publications are used to evaluate researchers in many countries), the number of publications in OECD countries has grown steadily over the past decade, except in Canada and the United States.
- The number of scientific publications relative to the population is high in Switzerland, the Nordic and the English-speaking countries. In 1999, Switzerland led in per capita output of scientific publications (979 per million population), followed by three Nordic countries whose per capita output is significantly above the OECD average of 402. The country ranking has remained more or less stable over the past decade.
- In absolute numbers, five countries account for 70% of the OECD total: the United States (36%), Japan (11%), United Kingdom (9%), Germany (8%) and France (6%). The combined share of these five countries in scientific publications is similar to their combined R&D expenditure, about 79% of the OECD total.
- The number of publications of the three major OECD zones has diverged over the 1990s; it has increased in the European Union and Japan and decreased in the United States.
- The life sciences account for more than half of the scientific publications in most countries. They represent a high share of total output in the Nordic countries. The physical sciences take the largest share in eastern European countries, Korea and Portugal. The social and behavioural sciences take a relatively small share in most OECD countries, except Luxembourg, the United States, New Zealand and the United Kingdom.

Scientific publications

The output of scientific research is varied: it includes improvement of skills (especially for doctorates and post-doctorates), new scientific instruments and intermediate products, new methods, prototypes and publications. The last of these is the major output and partly captures the other outputs. Moreover, scientific publications contain the theoretical knowledge that is the essential element of most discoveries (*e.g.* formulae, experimental proof).

Scientometrics, the domain of science that is concerned with measuring scientific output, addresses various types of counts of scientific publications. Publication counts are affected by certain statistical difficulties:

- The propensity to publish differs across countries and across scientific fields, biasing the relationship between actual output and publication-based indicators.
- As publishing is increasingly used as an instrument for evaluating researchers in university and government laboratories, the quantity of publications often seems more important than their quality.
- Publications can also be weighted by citations, the aim of which is to correct for quality. However, at aggregate level (country level), citation-weighted counts do not give a very different result from simple counts.

Article counts of scientific research are based on scientific and engineering articles published in approximately 5 000 of the world's leading scientific and technical journals. Article counts are based on fractional assignments; for example, an article with two authors from different countries is counted as one-half article to each country. Articles are assigned to fields based on journal field classifications developed by CHI Research, Inc.

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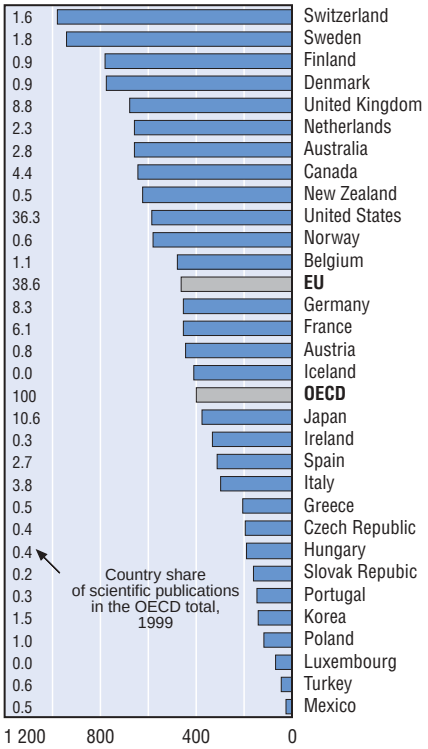
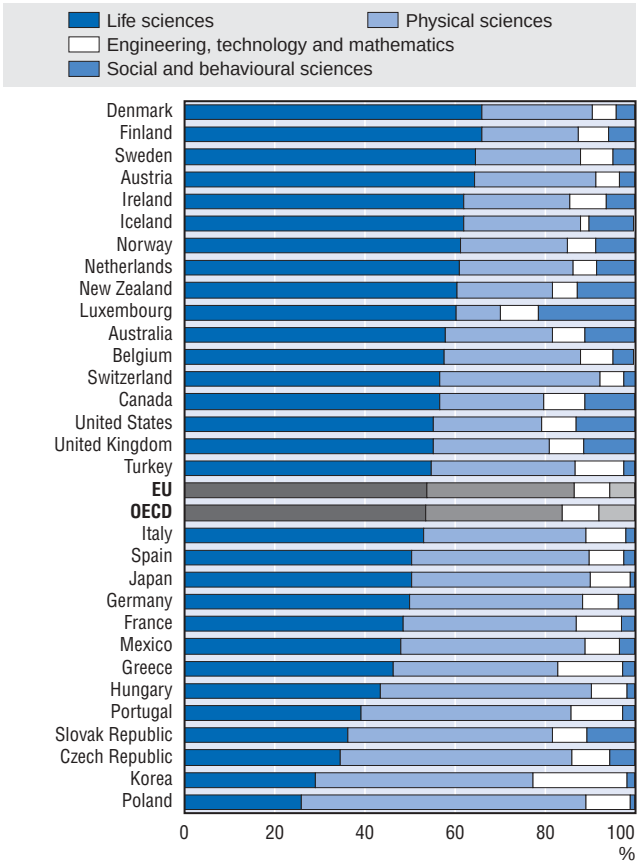
A.13. Scientific publications

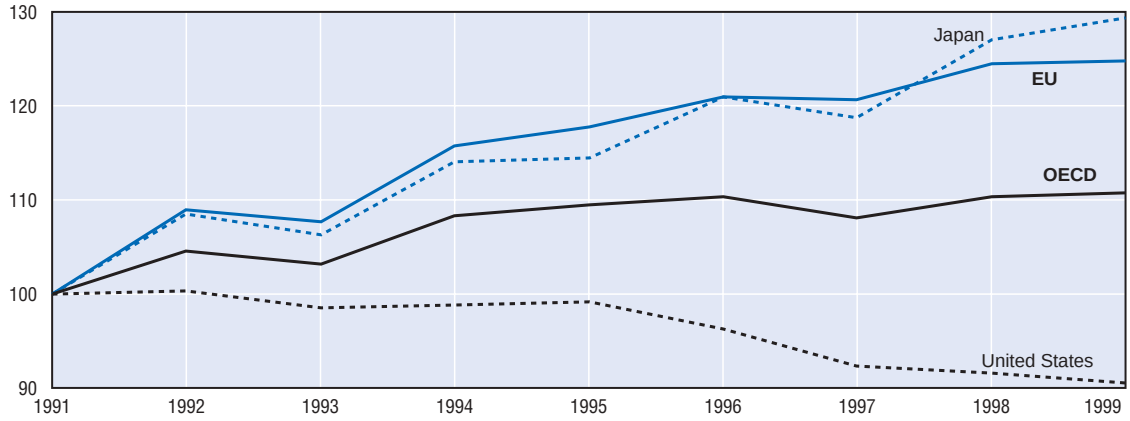
Scientific publications per million population
1999



Distribution of scientific publications by field,[1]
1999



Trends in the number of scientific publications
1991 = 100



1. The life sciences encompass clinical medicine, biomedical research and biology. The physical sciences encompass chemistry, physics and earth and space sciences. The social and behavioural sciences encompass social science, psychology, health and professional fields.

Source: National Science Foundation, *Science and Engineering Indicators* – 2002, *www.nsf.gov/*

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B.1. Investment in ICT equipment and software

- Investment in physical capital is important for growth. It is a way to expand and renew the capital stock and enable new technologies to enter the production process. Information and communication technology (ICT) has been the most dynamic component of investment in recent years.
- ICT's share in total non-residential investment doubled and in some cases even quadrupled between 1980 and 2000. In 2001, ICT's share was particularly high in the United States, the United Kingdom and Sweden.
- Software has been the fastest-growing component of ICT investment. In many countries, its share in non-residential investment multiplied several times between 1980 and 2000. Software's share in total investment is highest in Sweden, Denmark and the United States.
- By 2000, software accounted for almost three-quarters of total ICT investment in Denmark and Sweden. Communications equipment was the major component of ICT investment in Austria, Portugal and Spain. IT equipment was the major component in Ireland.
- Data on investment in ICT for 2001 are currently only available for some OECD countries. They are of great interest because of the recent downturn and the large investments for Y2K. Available data indicate that ICT's share in total investment has declined from 2000 to 2001. However, while the share of IT hardware in total investment has declined everywhere, that of investment in software has grown in some countries.

Measuring investment in ICT equipment and software

Correct measurement of ICT investment in both nominal and volume terms is crucial for estimating the contribution of ICT to economic growth and performance. Data availability and measurement of ICT investment based on national accounts (SNA93) vary considerably across OECD countries, especially as regards measurement of investment in software, deflators applied, breakdown by institutional sector and temporal coverage. In the national accounts, expenditure on ICT products is considered as investment only if the products can be physically isolated (*i.e.* ICT embodied in equipment is considered not as investment but as intermediate consumption). This means that ICT investment may be underestimated and the order of magnitude of the underestimation may differ depending on how intermediate consumption and investment are treated in each country's accounts.

In particular, it is only very recently that expenditure on software has been treated as capital expenditure in the national accounts, and methodologies vary greatly across countries. Only the United States produces estimates of expenditure on the three different software components (*i.e.* pre-packaged, own account and customised software); other countries usually provide estimates for some software components only. The difficulties for measuring software investment are also linked to the ways in which software can be acquired, *e.g.* via rental and licences or embedded in hardware. Moreover, software is often developed on own account. To tackle the specific problems relating to software in the context of the SNA93 revision of the national accounts, a joint OECD-EU Task Force on the Measurement of Software in the National Accounts has developed recommendations concerning the capitalisation of software. For further information, see F. Lequiller, N. Ahmad., S. Varjonen, W. Cave and K.H. Ahn (2003), "Report of the OECD Task Force on Software Measurement in the National Accounts", Statistics Directorate *Working Paper* 2003/1, OECD, Paris; and N. Ahmad (2003), "Measuring Investment in Software", STI *Working Paper* 2003/6, OECD, Paris.

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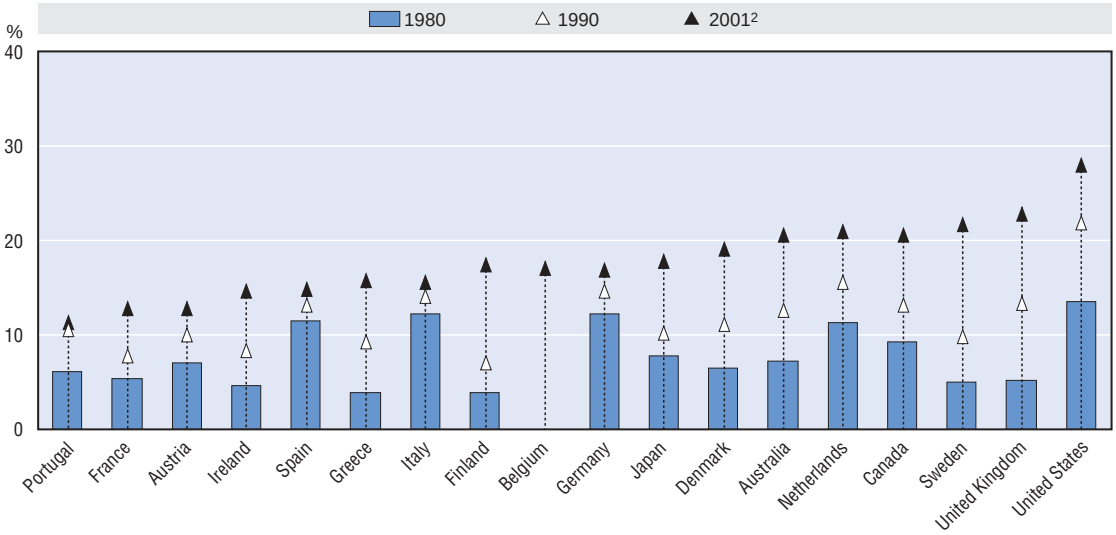
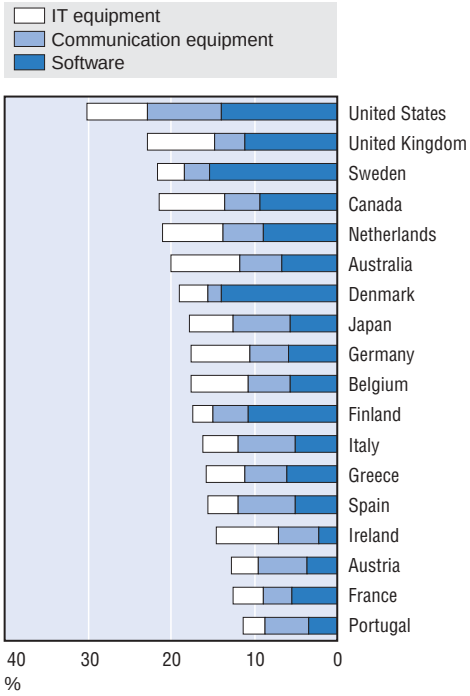
B.1. Investment in ICT equipment and software

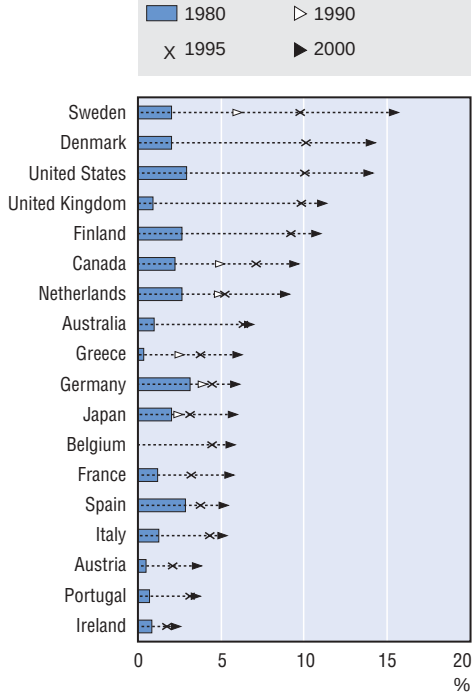
ICT investment[1] in OECD countries, 1980-2001
Percentage of non-residential gross fixed capital formation, total economy



ICT investment by asset[1] in OECD countries, 2000
Percentage of non-residential gross fixed capital formation, total economy



Software investment[1] in OECD countries, 1980-2000
Percentage of non-residential gross fixed capital formation, total economy



1. ICT equipment is defined as computer and office equipment and communication equipment ; software includes both purchased and own account software. Software investment in Japan is likely to be underestimated, owing to methodological differences.
2. 2001 for France, Spain, Italy, Belgium, Germany, Australia, Canada and the United States, and 2000 for the other countries.

Source: OECD, Database on Capital Services, May 2003.

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B.2. Occupations and skills in the information economy

- Although the recent economic slowdown has resulted in an easing of tensions on the IT labour market, policy makers continue to need indicators relating to the skills required for the information economy. The data show that ICT-related occupations – both high-skill and low-skill – grew during the second half of the 1990s in the United States and Europe. In Europe, the differences between northern and southern Europe are significant.
- In the mid-1990s, the share of ICT workers was around 2.7% of total occupations in both the United States and the European Union. It has grown slightly faster in the United States than in the European Union and reached 3.4% and 3.2%, respectively, in 2001. The share of highly skilled workers in the ICT workforce remained relatively stable between 1995 and 2001 in the United States at around 80%; it increased significantly in the European Union from 48% to 63%.
- During the second half of the 1990s, highly skilled ICT workers were the fastest-growing group of highly skilled workers. In Spain and Finland in recent years, annual growth rates have been just under 20%. In 2001, their share in total occupations was highest in Sweden (3.8%) and the Netherlands (3.5%) and lowest in Greece (0.6%), Portugal (1.2%) and Italy (1.3%). The EU average was about 2%; the US average was 2.6%.
- More than eight highly skilled ICT workers in ten are computer workers (see box). Over the period 1995-2001, the number of computer workers increased substantially faster in northern Europe than in southern Europe.

Measuring ICT-related skills

Skills are difficult to measure, and proxies are often used to capture observable characteristics such as educational attainment, on the supply side, and occupations, on the demand side. While an international classification of occupations exists (ISCO-88, International Standard Classification of Occupations, International Labour Office), there is no internationally agreed list of ICT-related occupations. An attempt was made here to match data on occupations from the US Current Population Survey (CPS) with ISCO-88-based occupation data from the Eurostat Labour Force Survey. Owing to data availability, only 3-digit ISCO-88 occupational classes could be used. To compare US and European trends in the absence of an official concordance between CPS and ISCO-88, similar classes were selected from the CPS. Some of the low-skill ICT occupations were not included in the calculations because they could not be matched to the ISCO-88 3-digit classification. These estimates of ICT-related occupations therefore constitute a lower bound. Another limitation of this type of data is that they are based on occupations that are self-declared by household members.

For Europe, the high-skill ICT-related occupations (ISCO-88) selected were computing professionals (213, including computer systems designers and analysts, computer programmers, computer engineers); computer associate professionals (312, including computer assistants, computer equipment operators, Industrial robot controllers); optical and electronic equipment operators (313, including photographers and image and sound recording equipment operators, broadcasting and telecommunications equipment operators). For low-skill ICT occupations, the only class that could be selected was electrical and electronic equipment mechanics and fitters (ISCO-88, 724). Computer workers are defined as the sum of ISCO-88 213 and 312.

For the United States, data from the Current Population Survey, US Bureau of the Census, were used. High-skill ICT occupations include: computer systems analysts and scientists (64); operations and systems researchers and analysts (65); computer programmers (229); tool programmers, numerical control (233); electrical and electronic technicians (213); broadcast equipment operators (228); computer operators (308); peripheral equipment operators (309). Low-skill ICT occupations include: data processing equipment repairers (525); electrical power installers and repairers (577); telephone line installers and repairers (527); telephone installers and repairers (529); electronic repairers, communications and industrial equipment (523). Although the US Standard Occupational Classification (SOC) was recently revised (in 2000, see http://stats.bls.gov/soc/), the previous version of the US SOC was used to enable the estimation of time series.

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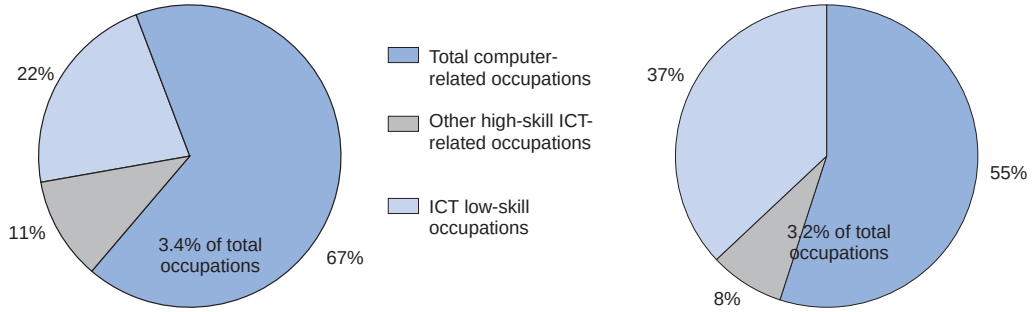
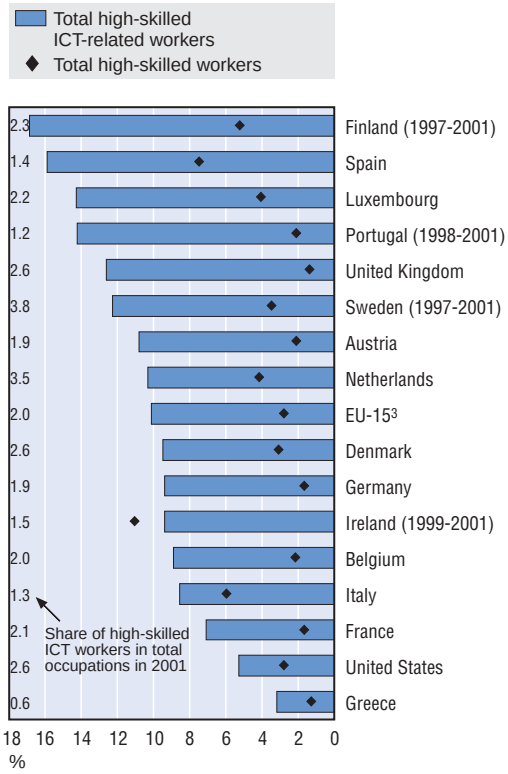
B.2. Occupations and skills in the information economy

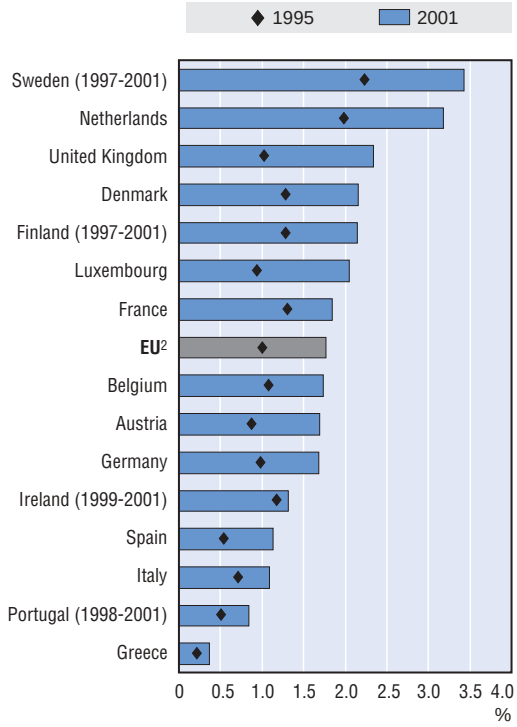
Share of high and low skills in ICT-related occupations in the European Union and the United States, 2001[1]



Highly skilled ICT workers[1] and highly skilled workers[2] in the European Union and the United States
Average annual employment growth (1995-2001)



Computer workers[1] in the European Union
Share in total occupations, 1995 and 2001



1. High-skill ICT-related occupations are defined here as ISCO-88 classes 213, 312 and 313; computer workers refer only to the sum of the first two classes, see box.
2. High-skill occupations refer to ISCO-88 classes 1, 2 and 3.

Source: OECD, based on the Eurostat Labour Force Survey and the US Current Population Survey, May 2003.

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B.3.1. Telecommunication networks

- In 25 out of 30 OECD countries, inhabitants generally have access to more than one telecommunication network (fixed or wireless). Luxembourg, the Nordic countries, Switzerland and the Netherlands have the highest rates of network penetration. Telecommunications networks have grown rapidly in recent years, especially in countries with lower penetration rates, such as Poland, Mexico and Hungary. Sweden, where penetration rates were already high, and Australia, Canada and the United States, are the only countries with average annual growth rates of under 10%.
- In 2001, most OECD countries had more than 50 fixed access channels for every 100 inhabitants. Luxembourg, Sweden, Switzerland and Denmark all had more than 70. In Mexico and Turkey penetration rates of fixed access channels are low.
- Luxembourg has the highest penetration rate for wireless networks, with close to one wireless subscriber per inhabitant. Italy, Austria, Iceland, Norway, Netherlands, Sweden and Finland also have high rates with more than 80 wireless subscribers per 100 inhabitants.
- The balance between wireless and fixed access channels is also of interest. Some three-quarters of OECD countries currently have more wireless than fixed access channels. Density of wireless access channels is generally relatively higher in countries where growth rates in telecommunication networks are quite high, such as Italy, Portugal and Austria. There are significantly fewer wireless than fixed access channels in Canada and the United States.
- Digital subscriber lines (DSL), cable modems and other broadband connections (see box) are an increasingly important indicator of broadband penetration, as they can carry telephony as well as large amounts of data. Broadband has diffused most widely in Korea, Canada, Sweden, Denmark, Belgium and the United States.

Measuring telecommunication networks

In the past, the penetration of standard access lines provided a reasonable indication of the extent to which basic telecommunications connections were available to users. Today, use of standard access lines would give a distorted view of network development, since in more than half of OECD countries, the number of standard access lines has begun to decrease as the take-up of ISDN (integrated services digital network) has increased.

A different methodology from the one traditionally used for the penetration of standard access lines measures the penetration of telecommunication channels. Particularly problematic is the measurement of ISDN connections. Telecommunication carriers generally report data for ISDN connections in two ways. One is to report the number of basic and primary ISDN connections. A basic ISDN connection can provide two channels and a primary connection can provide 30. Alternatively, some telecommunication carriers report the total number of ISDN channels by multiplying the number of basic and primary connections by the number of channels they can provide.

To appreciate overall telecommunication penetration rates across the OECD area, it is also increasingly necessary to take into account the development of mobile communication networks and of "broadband" Internet access. The two leading technologies currently used to provide high-speed Internet access are cable modems and digital subscriber lines (DSL). Other broadband connections include satellite broadband Internet access, fibre-to-home Internet access, Ethernet LANs, and fixed wireless access (at downstream speeds greater than 256 kbps).

For further information, see OECD (2003), *Communications Outlook* 2003, OECD, Paris.

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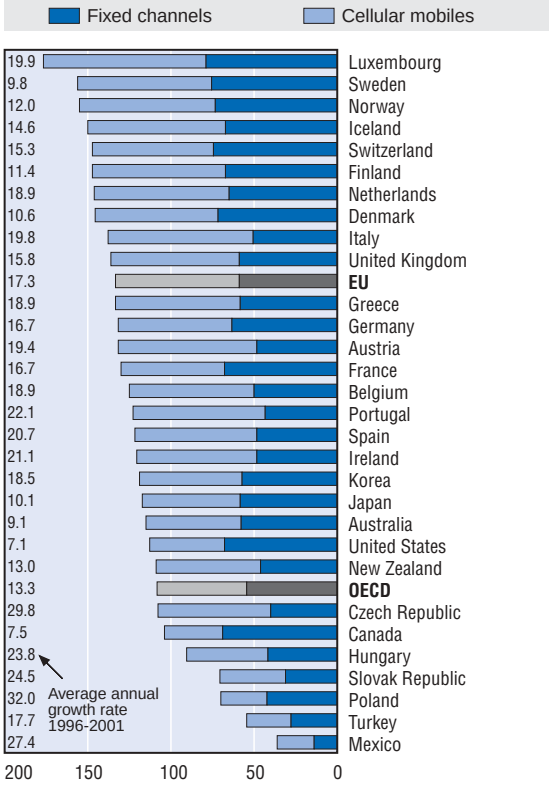
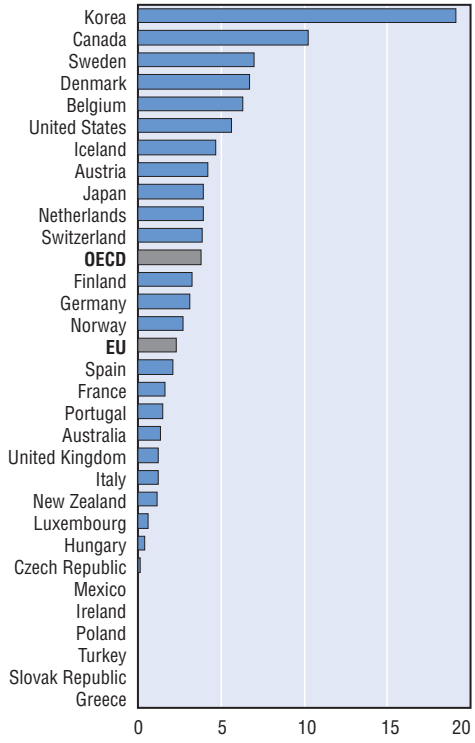
B.3.1. Telecommunication networks

Access paths[1] per 100 inhabitants, 2001



Broadband penetration rates in OECD countries

Number of DSL[2], cable modem and other broadband connections[3] lines per 100 inhabitants, June 2002



1. Telecommunication access paths include the total of fixed access channels (standard telecommunication lines and ISDN connections) and cellular mobile subscribers.
2. Digital subscriber lines.
3. Other broadband connections includes satellite broadband Internet, fibre-to-home Internet access, Ethernet LANs, and fixed wireless subscribers (at downstream speeds greater than 256 kbps).

Source: OECD, Telecommunications database, March 2003.

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B.3.2. Internet infrastructure

- The Internet continues to grow rapidly. In July 2002, there were almost 36 million Internet Web sites in the OECD area, almost double the 19 million in July 2000.
- Web sites per 1 000 population is an indicator of Internet diffusion. In July 2002, the OECD average was 34.1 sites per 1 000 inhabitants; the EU average was 37.9. At 84.7 Web sites per 1 000 inhabitants Germany had the highest number, followed by Denmark (71.7) and Norway (66.4). Mexico, Turkey, Greece and Japan all had fewer than three Web sites per 1 000 inhabitants.
- Web sites per 1 000 population grew fastest in Germany, almost doubling each year between 2000 and 2002. Denmark's annual growth rate was over 85%. Canada and the United States, which already had large numbers of Web sites in 2000, grew more slowly at approximately 20%.
- Business connections to the Internet indicate a country's level of infrastructure development. In Denmark and Sweden, one out of five enterprises accesses the Internet through a connection faster than 2Mbps. In Italy and Greece, relatively few enterprises have such a rapid Internet connection.
- In many countries, and particularly in Denmark, Finland and Spain, many enterprises have digital subscriber lines (DSL). ISDN (integrated services digital network) accounts for over 30% of all connections and is the technique most commonly used to access the Internet in countries for which information is available. In Austria and Luxembourg, more than half of all enterprises have an ISDN connection to the Internet. The use of conventional dial-up connections is also widespread. In Canada, Ireland, Spain and Sweden, more than 40% of enterprises still connect to the Internet via dial-up.

Measuring the size and growth of the Internet

Netcraft surveys Web servers in order to provide information about the software used on computers connected to the Internet. The data can be used to estimate the number of active Web sites under each domain, as well as the number of Web sites in each country, by distributing gTLD and ccTLD registrations according to the country allocation of IP address blocks.

- Servers are computers that host World Wide Web content.
- A top-level domain name (TLD) can either be a country code (for example .be for Belgium) or one of the generic top level domains (a so-called gTLD such as .com, .org, .net).
- Internet protocol (IP) addresses are the numbers used to identify computers, or other devices, on a TCP/IP network.

For more information, see OECD (2003), *Communications Outlook* 2003, OECD, Paris.

Data on connection of enterprises to the Internet cover all enterprises, except for those in the financial sector for some countries. Small enterprises (those with fewer than ten employees) are also excluded. If they were included, the picture would probably be different.

In addition, an enterprise may have various ways to connect to the Internet. It should therefore not be assumed that a certain percentage of enterprises use DSL exclusively since they may also use other means such as a conventional dial-up connection.

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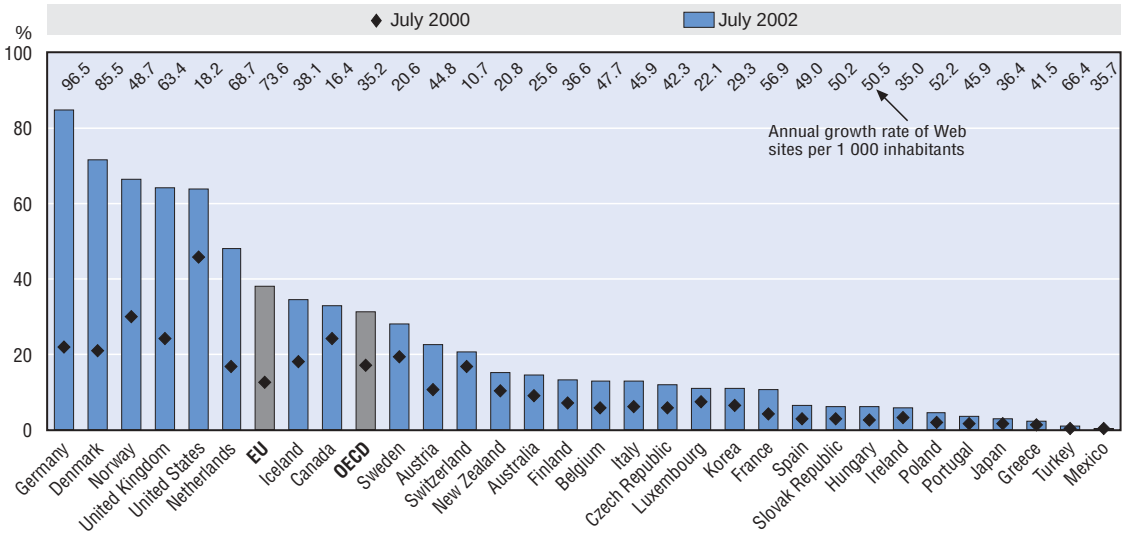
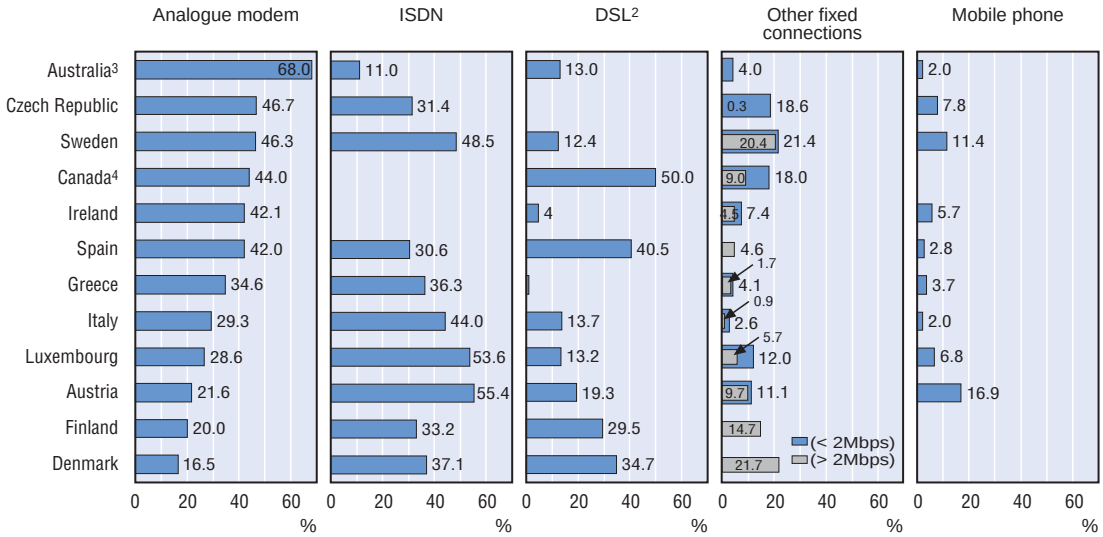
B.3.2. Internet infrastructure

Web sites by country per 1 000 inhabitants, July 2000-July 2002
Adjusted for gTLDs[1]



1. Generic top-level domains (gTLDs) are distributed to country of location.
Source: OECD, Telecommunications database, calculations based on Netcraft *(www.netcraft.com)*, March 2003.

Broadband access in enterprises, 2002
Connection to the Internet of enterprises with ten or more employees[1]



1. Excludes the financial sector in Czech Republic, Denmark, Germany, Ireland and Italy.
2. Digital subscriber lines.
3. Connections to the Internet via mobile phone include satellite connections; connections to the Internet via other fixed connections (< 2 Mbps) equals other high-speed access.
4. For Canada DSL equals high-speed ISDN/DSL line. Connection to the Internet via other fixed connections (> 2 Mbps) equals cable modem, and connections to the Internet via other fixed connection (< 2 Mbps) equals T1 line or greater (≥ 1.544 Mbps).

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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B.4.1. Internet subscribers and number of secure servers

- As the number of Internet subscribers increases, so does its potential uses. Tracking the diffusion and use of the Internet is therefore of interest, despite the few internationally harmonised measures.
- At the end of 2001, there were 77.5 million Internet subscribers to fixed networks in the United States, approximately 24 million in Japan, more than 23 million in Korea, almost 15 million in Germany and 13.6 million in the United Kingdom. Between 1998 and 2001, subscriber numbers grew rapidly, fuelled by "subscription-free" Internet service providers (ISPs) and new connection technologies such as digital subscriber lines (DSL).
- A ranking in terms of Internet subscribers per capita places Iceland, Korea, Denmark, Sweden and Switzerland at the top of the list. Between 1999 and 2001 almost half of all OECD countries doubled the number of subscriptions per capita. Portugal, Austria and Iceland more than tripled the number.
- Netcraft's Secure Socket Layer (SSL) surveys measure the number of servers with secure software, which are commonly used for purchasing goods and services or transmitting privileged information over the Internet. The number of servers with secure software is a proxy for the number of Internet applications that use a trust-enhancing mechanism. Such applications include e-commerce, e-banking, teleworking applications and e-government, which allows citizens and enterprises to communicate with the authorities.
- The number of secure servers per capita increased significantly between July 1998 and July 2002, a sign of the growing importance of secure servers for Internet applications. Iceland has the highest number of secure servers per capita, followed by the United States, Australia, Canada and New Zealand.

Measuring Internet access using information on subscribers

Many public-sector and private-sector organisations report on the number of "users", "people" or "households" on line. National statistical agencies typically measure Internet access on the basis of surveys of businesses, households or individuals (see Box B.4.2). Some statistical offices also collect information on Internet subscribers by surveying Internet service providers (ISPs). These surveys are timely and provide a wide range of information, for example on type of subscriber (business, household, government), type of technology used (dial-up, cable, WAP, etc.), and sometimes even length of connection and volume of data downloaded. A problem for such surveys is the dynamism of the ISP industry with its high numbers of entries, exits and mergers.

An alternative approach is to compile information on Internet subscribers from reports by the largest telecommunication carriers. These provide information on the number of subscribers to their Internet services and their estimates of market share. As these carriers manage connectivity via public switched telecommunication networks, they are often well placed to know subscriber numbers and associated market shares on an industry-wide basis. Moreover, "subscribers" has a more specific meaning than, for example, "users". For most carriers, "subscribers" implies registered Internet accounts that have been used during the previous three months.

For further information, see OECD (2003), *Communications Outlook* 2003, OECD, Paris.

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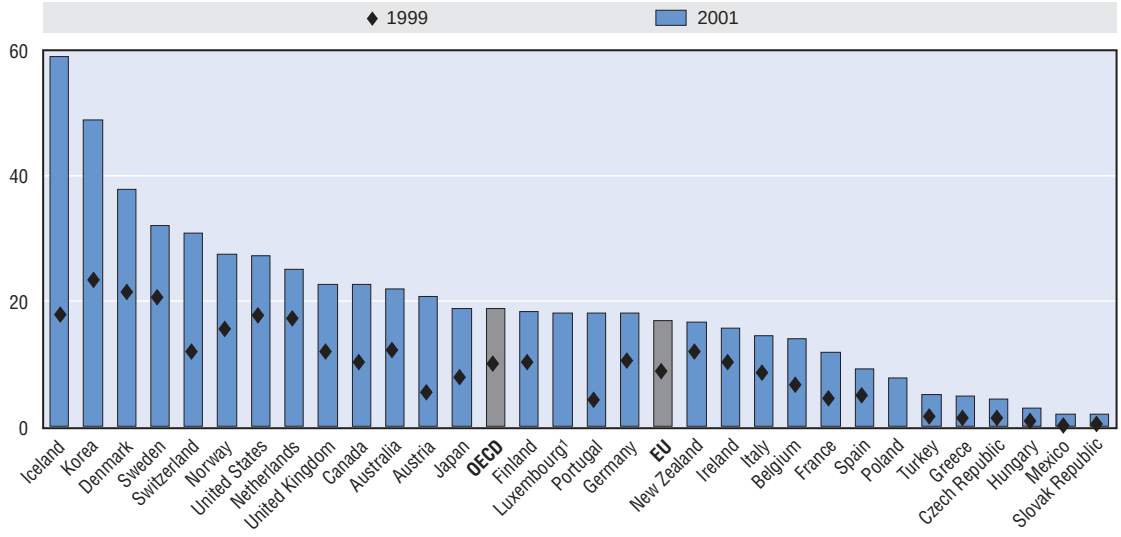
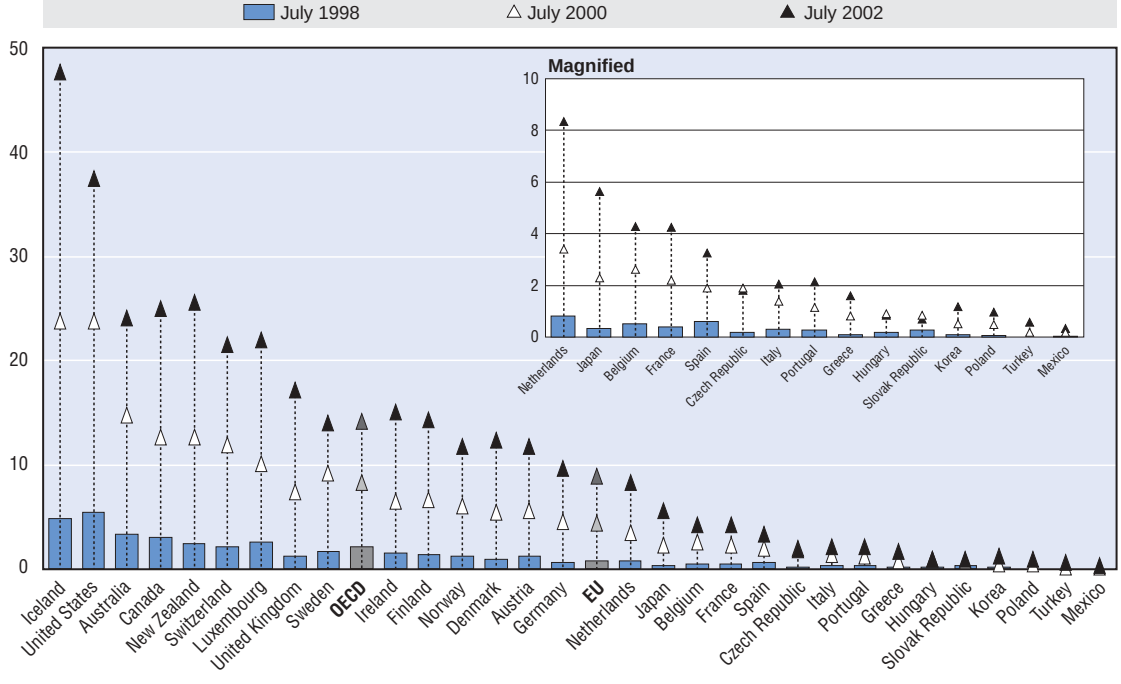
B.4.1. Internet subscribers and number of secure servers

Internet subscribers per 100 inhabitants
2001 and 1999



1. Only includes P&T subscribers for 1999-2000.
Source: OECD, Telecommunications database, March 2003.

Secure servers in OECD countries, per 100 000 inhabitants
July 1998-July 2002



Source: OECD, Telecommunication database, calculations based on Netcraft *(www.netcraft.com)*, March 2003.

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B.4.2. ICT access by households

- Computers are increasingly present in homes both in OECD countries with high penetration rates and in those where adoption has lagged. Given differences in reference periods, survey methodologies and household structure, however, it is difficult to compare countries. Penetration rates are high in Denmark, Sweden and Switzerland, where approximately two-thirds of households had access to a home computer in 2001. The share in many other OECD countries is less than 50%. Some countries for which 2002 data are available, such as Germany, have seen a rapid rise in home computers over the past two years.
- The picture of households with Internet access is similar. In Denmark, Sweden and the United States, more than half of households had Internet access in 2001. In France and Portugal, on the other hand, less than one-fifth had Internet access in that year.
- Data on Internet access by household size are available for the United Kingdom, Finland, Austria and Germany. They show that more households with children have Internet access than households without children.

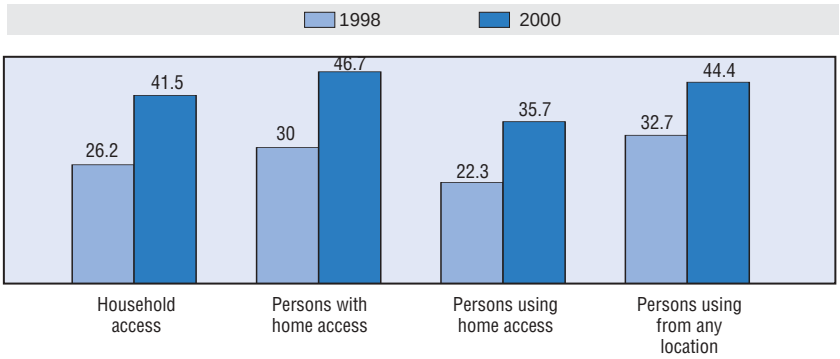
Comparability of household- and person-based indicators of Internet access and use and the OECD model questionnaire on ICT use in households/by individuals

Over a very short period, national statistical offices have made great progress in providing high-quality, timely indicators of the use of information and communication technology (ICT). From an international perspective, the major drawback of official statistics on ICT use is that they remain based on different standards and measure rapidly changing behaviour at different points in time. Most countries use existing surveys, such as labour force, time use, household expenditure or general social surveys. Others rely on special surveys. A first issue for international comparability is to address differences in the timeliness, scope and coverage of indicators.

Another important issue for international comparability is the choice between households and individuals as the survey unit. Household surveys generally provide information on both the household and the individuals in the household. Person-based data typically provide information on the number of individuals with access to a technology, those using the technology, the location at which they use it and the purpose of use. Statistics on ICT use by households may run into problems of international comparability because of structural differences in the composition of households (similarly, differences in countries' industrial structure affect comparability of statistics on business use of ICT). On the other hand, statistics on individuals may use different age groups, and age is an important determinant of ICT use. Household- and person-based measures yield different figures in terms of levels and growth rates. The example below uses US data referring to households and individuals aged three years and more (see *Falling through the Net: Toward Digital Inclusion*, US Department of Commerce, October 2000). Such differences complicate international comparisons and make benchmarking exercises based on a single indicator of Internet access or use misleading, since country rankings change according to the indicator used.

Household- and person-based measures of Internet access and use

Percentages



The OECD Working Party on Indicators for the Information Society (WPIIS) has addressed issues of international comparability by developing a model survey on ICT use in households/by individuals The model survey is designed to be flexible; it uses modules addressing different topics so that additional components can be added as technologies reflecting usage practices and policy interests change.

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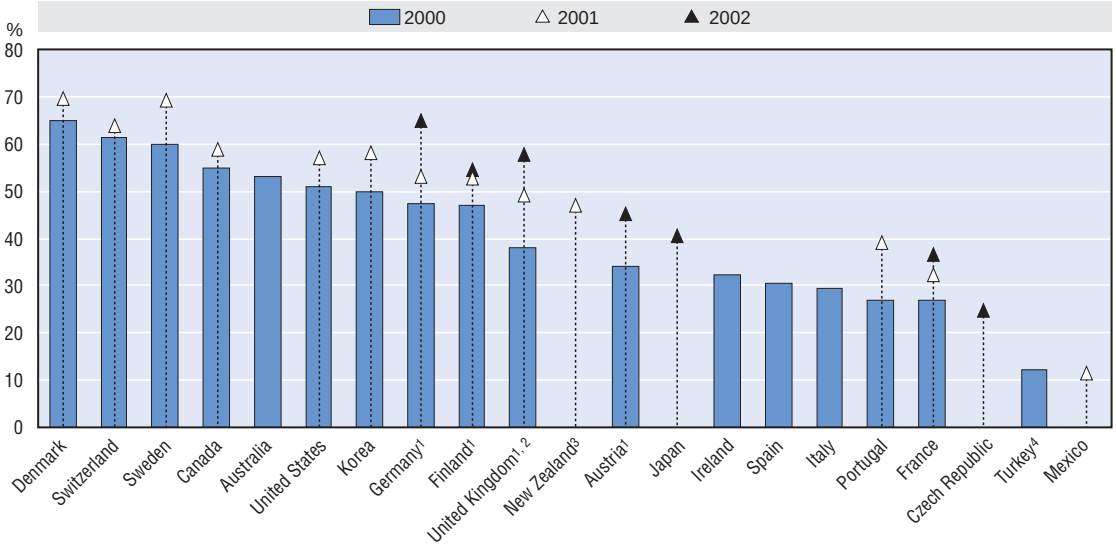
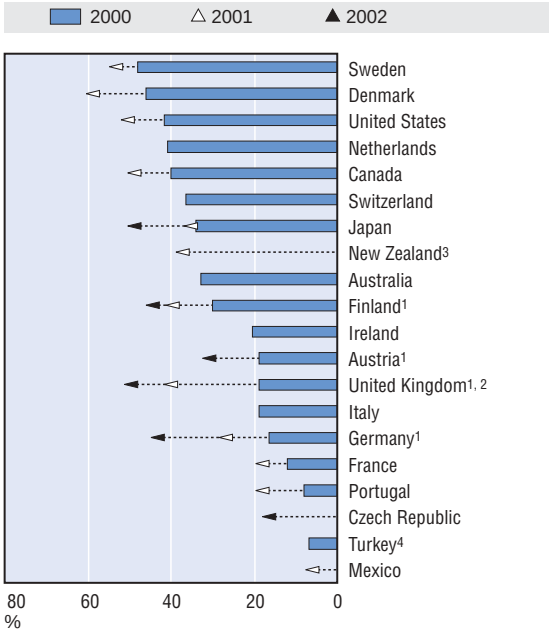
B.4.2. ICT access by households

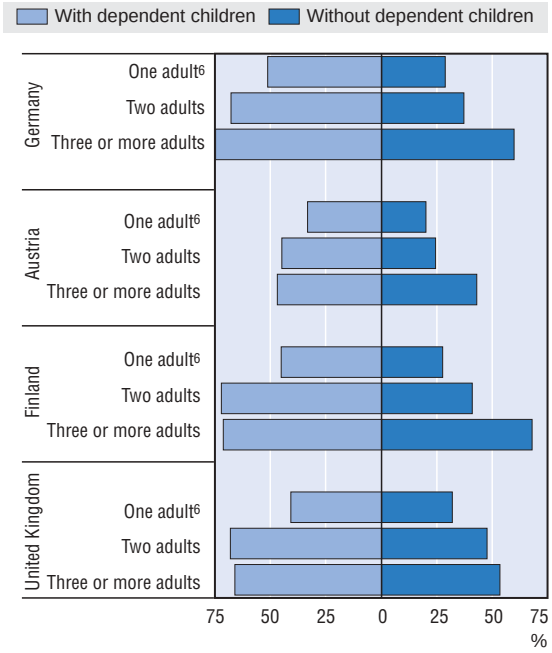
Households with access to a home computer, 2000-02
Percentage of all households



Households with access to the Internet,[5] 2000-02
Percentage of all households



Household Internet access by household size, 2002[1]
Percentage of households in different size classes



1. For 2002, data from the EU Community Survey on household use of ICT relate to the first quarter.
2. March 2001-April 2002 (fiscal year) instead of 2001.
3. July 2000-June 2001.
4. Households in urban areas only.
5. For 2000 and 2001, Internet access via any device except for Denmark, the Netherlands, Ireland, Austria, France and Turkey where Internet access is via a home computer.
6. Single parent with dependent children, or one adult without children.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in households 2002, May 2003.

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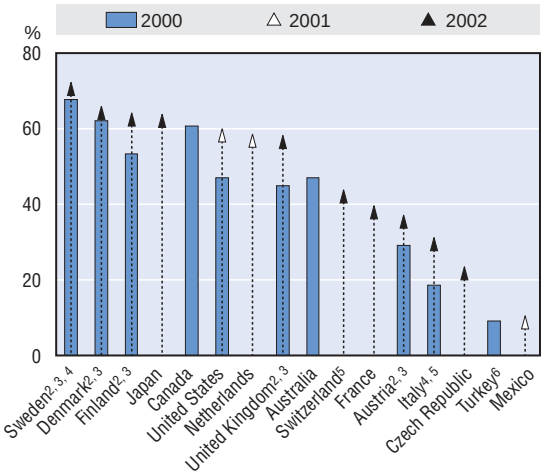
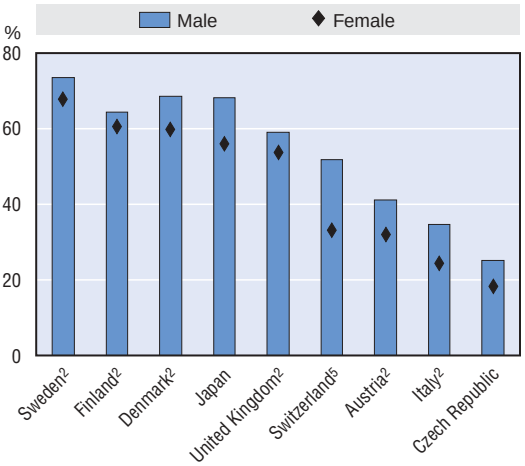
B.4.3. Use of the Internet by individuals

- In many countries over half of all adults use the Internet from home, work or another location. Countries with the highest rates of Internet use by adults are Sweden (70%), Denmark (64%) and Finland (62%). However, Internet use is growing more slowly in these countries than in other OECD countries, a sign that they are reaching saturation.
- Men make greater use of the Internet than women in all countries for which data are available. The gap is largest in Switzerland where one-half of men but only one-third of women use the Internet.
- The Internet is used for different purposes in different countries. More than eight out of ten Internet users in Switzerland, Austria, the United States, Denmark and Sweden use e-mail. It is also commonly used to find information about goods and services, particularly in Sweden, Denmark and Finland, small countries with high Internet penetration rates.
- E-business is also an important area for Internet use. In the United States, almost 40% of Internet users buy on line, as do many users in Denmark, Sweden and Finland. In Sweden and the United States, almost two-thirds of individuals use the Internet to read and/or download on-line newspapers or news magazines.
- In Portugal and Sweden, about half of all Internet users play games on line and/or download games and music. In Sweden and Denmark, more than half of all Internet users utilise e-banking and in Finland, one-third do so.

Individuals[1] using the Internet from any location, 2000-02
Percentage of all individuals



Individuals[1] using the Internet from any location by gender, 2002
Percentage of individuals by gender



1. Age cut-off: 16 years and older except for Canada, Czech Republic and Finland (15+), the United States (3+), Italy (11+), Austria (6+), Mexico and the Netherlands (12+) and Australia and Turkey (18+).
2. First quarter of 2002.
3. For 2002, individuals aged 16-74 years, except for Switzerland (14+).
4. For 2000, individuals aged 16-64 years.
5. October 2001-March 2002.
6. Individuals belonging to households in urban areas.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in households 2002, June 2003.

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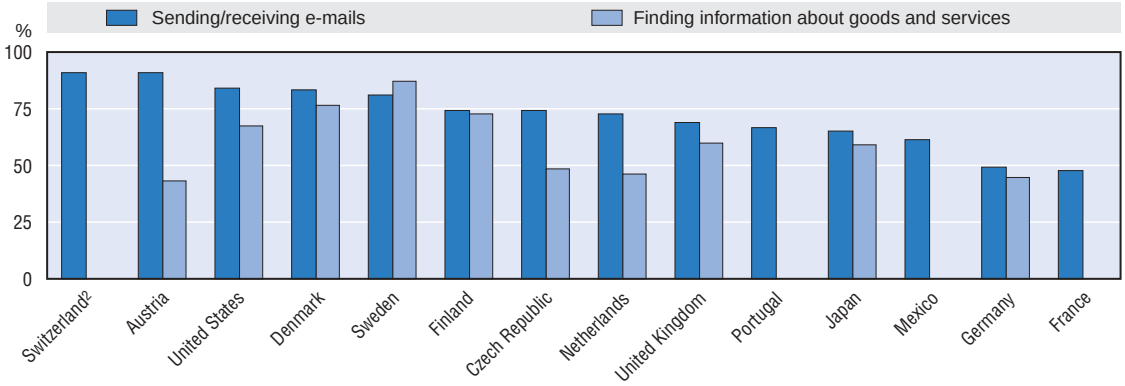
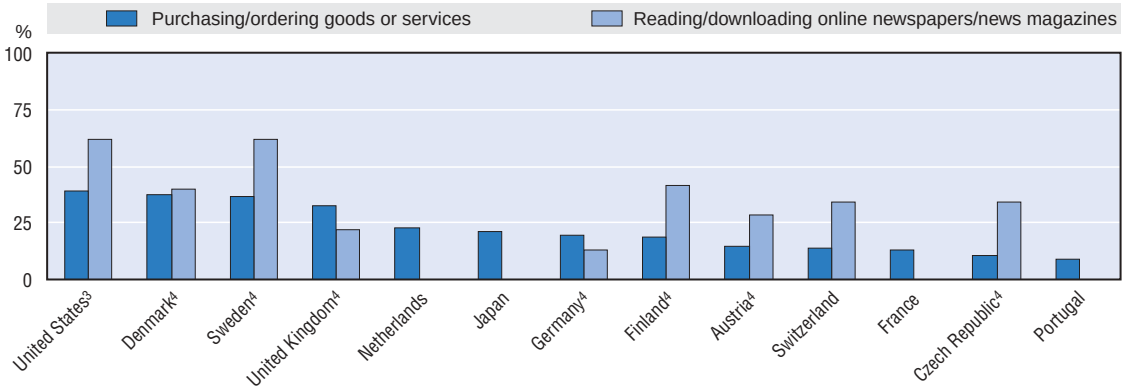
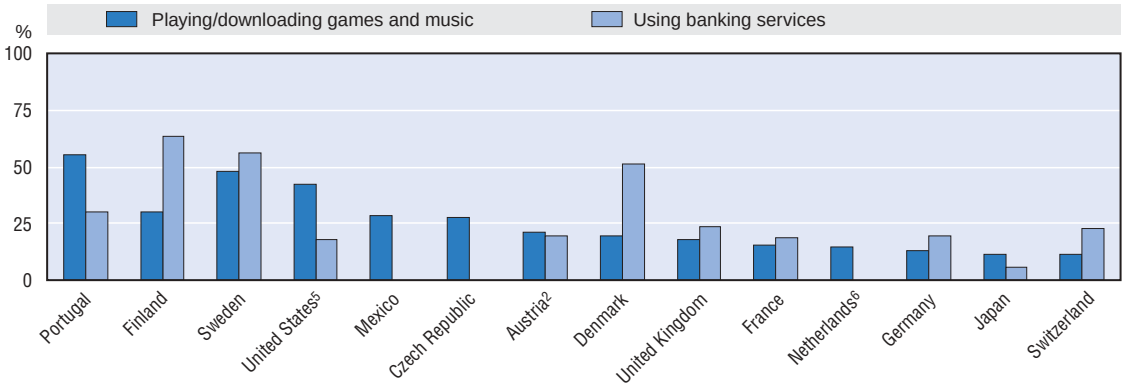
B.4.3. Use of the Internet by individuals

Internet use by type of activity, 2002 or latest available year[1]
Percentage of individuals using the Internet







1. 2001 for France, Mexico, Netherlands, Portugal, Switzerland and the United States. Beginning of 2002 for Austria, Denmark, Finland, Germany, Sweden, the United Kingdom and 2002 for Japan.
2. Only sending e-mails instead of sending and receiving e-mails.
3. Reading/downloading newspapers also includes movies.
4. Purchasing/ordering goods or services excludes shares/financial services.
5. Playing games only instead of downloading games and music.
6. Downloading music only instead of games and music.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in households 2002, June 2003.

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B.4.4. Internet access and use by enterprise size and industry

- In many countries almost all enterprises with ten or more employees use the Internet. Frequent use of the Internet seems to be positively correlated with a country's number of enterprise Web sites. In Finland, Denmark, Canada, Sweden and Ireland, two-thirds or more of all enterprises with ten or more employees have Web sites.
- The Internet is less used by smaller than by larger enterprises, and differences among countries are more striking when small enterprises are compared. Finland has the highest share of Internet use by enterprises with 10-49 employees, almost double that of Mexico, which has the lowest share in this size class.
- Internet penetration among enterprises with ten or more employees varies considerably across sectors, and this may be one source of aggregate differences. In the financial sector, almost all firms use the Internet. The retail sector seems to be lagging, particularly in countries with low overall Internet use by enterprises.

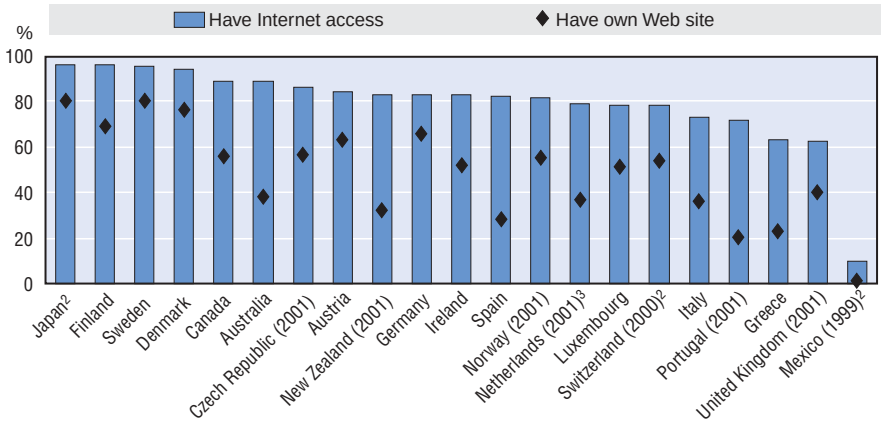
Measuring ICT access and use by businesses: OECD efforts to improve international comparability

Technology diffusion varies with business size and industry, so that indicators based on the overall "number" (proportion) of businesses using a technology can give rise to misleading international comparisons. "Share of businesses" is extremely sensitive to the size of enterprises, *e.g.* measured by number of employees, covered by national surveys. Moreover, international comparisons of information and communications technology (ICT) usage indicators are affected by differences in the sectoral coverage of surveys (see the footnotes to the figures).

International comparisons are made more difficult by the lack of harmonisation in the definitions of indicators. The OECD has developed a model survey, approved by OECD member countries in 2001, which is intended to provide guidance for the measurement of indicators of ICT, Internet use and electronic commerce. It is composed of separate, self-contained modules to ensure flexibility and adaptability to a rapidly changing environment.

Business use of the Internet and Web sites, 2002 or latest available year

Percentage of business with ten or more employees[1]



1. In European countries, only enterprises in the business sector, but excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT. In Australia, all employing businesses are included, with the exception of businesses in: general government, agriculture, forestry and fishing, government administration and defence, education, private households employing staff and religious organisations. Canada includes the industrial sector. Japan excludes agriculture, forestry, fisheries and mining industries. New Zealand excludes electricity, gas and water supply and only includes enterprises with NZD 30 000 or more in turnover. Switzerland includes the industry, construction and services sectors.
2. For Japan, businesses with 100 or more employees. For Switzerland, five or more employees. For Mexico, businesses with 21 or more employees.
3. Internet and other computer-mediated networks.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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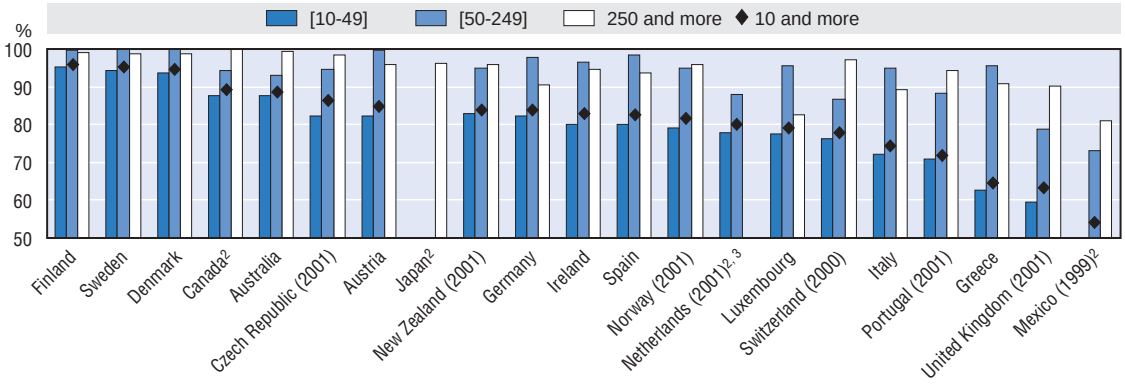
B.4.4. Internet access and use by enterprise size and industry

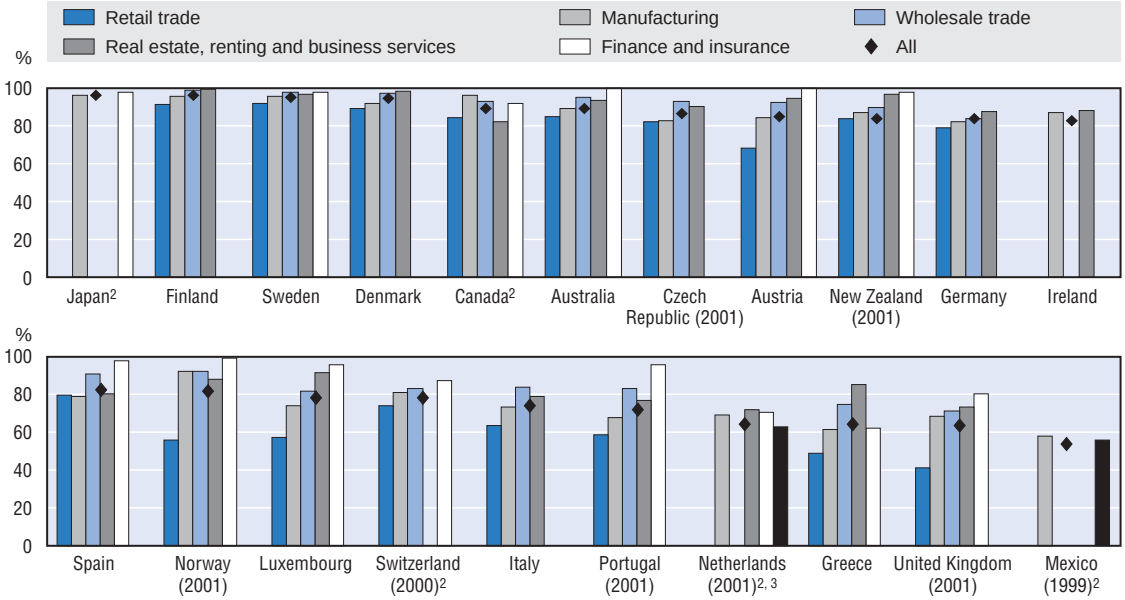
Internet penetration by size class, 2001 or latest available year

Percentage of businesses with ten or more employees using the Internet[1]



Internet penetration by activity, 2002 or latest available year

Percentage of businesses with ten or more employees using the Internet[1]



1. In European countries, only enterprises in the business sector, but excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT. In Australia, all employing businesses are included, with the exception of businesses in general government, agriculture, forestry and fishing, government administration and defence, education, private households employing staff and religious organisations. Canada includes the industrial sector. Japan excludes agriculture, forestry, fisheries and mining. New Zealand excludes electricity, gas and water supply, and only includes enterprises with NZD 30 000 or more in turnover. Switzerland includes the industry, construction and service sectors.
2. For Canada, 50-299 employees instead of 50-249 and 300 or more instead of 250 or more. For Japan, businesses with 100 or more employees. For the Netherlands, 50-199 employees instead of 50-249. For Switzerland, 5-49 employees instead of 10-49 and 5 or more employees instead of 10 or more. For Mexico, businesses with 21 or more employees, 21-100 employees instead of 10-49, 101-250 instead of 50-249, 151-1 000 instead of 250 or more.
3. Internet and other computer-mediated networks.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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B.4.5. Internet and electronic commerce by size of enterprise

- A number of countries have started to measure the value of Internet and electronic sales (see box). Total Internet sales range between 0.3% and 3.8% of total sales. Electronic sales, *i.e.* sales over any kind of computer-mediated network, reach 10% or more of sales in Austria, Sweden, Finland and Ireland. In the US retail sector, the share of electronic sales in total sales grew by 70% between the fourth quarter of 2000 and the fourth quarter of 2002.
- Large firms use the Internet more frequently than small ones to sell goods and services. In Denmark, where e-commerce is widespread, one-fifth of enterprises with 10-49 employees sold over the Internet as did more than one-third of enterprises with 250 or more employees. It is more common to purchase than to sell over the Internet. As many as two-thirds or more of enterprises with 250 or more employees in Australia, Canada, Denmark, Sweden and Finland buy goods or services via the Internet.

Measuring electronic commerce: OECD definitions of Internet and electronic transactions

Only a few years ago, there were no internationally comparable official statistics of electronic commerce transactions. In April 2000, OECD member countries endorsed two definitions of electronic transactions (electronic orders), based on narrower and broader definitions of the communications infrastructure. According to the OECD definitions, the method used to place or receive the order, not the payment or the channel of delivery, determines whether the transaction is an Internet transaction (conducted over the Internet) or an electronic transaction (conducted over computer-mediated networks). In 2001, the OECD developed guidelines for interpreting the definitions of electronic commerce and encouraged member countries to use them when developing their questionnaires. To date, comparisons still need to take into account differences in the type of definition used in surveys and in their coverage.

Official estimates of Internet and electronic commerce transactions,[1]
2001 or latest available year
Percentage of total sales or revenues

	Internet commerce, *i.e.* sales over the Internet	Electronic commerce, *i.e.* sales over any kind of computer-mediated network
Business sector (Broad)	0.5% Canada 0.7% Australia (2000-01) 0.3% New Zealand[2] (2000-01)	
Business sector (excluding financial sector)	2.0% Norway 0.7% Czech Republic 1.0% Denmark[3] 1.0% Germany[3] 0.5% Greece[3] 0.3% Spain[3] 3.8% Ireland[3] 0.3% Italy[3] 0.4% Luxembourg[3] 2.2% Austria[3] 1.1% Finland[3] 2.1% Sweden[3]	10.0% Norway 3.3% Czech Republic 6.6% Denmark[3] 4.7% Germany[3] 0.8% Greece[3] 2.6% Spain[3] 15.1% Ireland[3] 2.6% Italy[3] 3.4% Luxembourg[3] 8.2% Austria[3] 11.5% Finland[3] 9.5% Sweden[3]
Retail sector (Narrow)	0.6% Canada 0.4% Australia (2000-01)	1.50% (United States, 1st Q 2003) 1.65% (United States, 4th Q 2002) 1.31% (United States, 4th Q 2001) 1.17% (United States, 4th Q 2000)

1. For more information, see *Measuring the Information Economy;* www.oecd.org/sti/measuring-infoeconomy
2. Data for New Zealand exclude electricity, gas and water supply and only cover entreprises with six or more full-time equivalent employees and NZD 30 000 or more in turnover.
3. Enterprises with ten or more employees. Data exclude NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation).

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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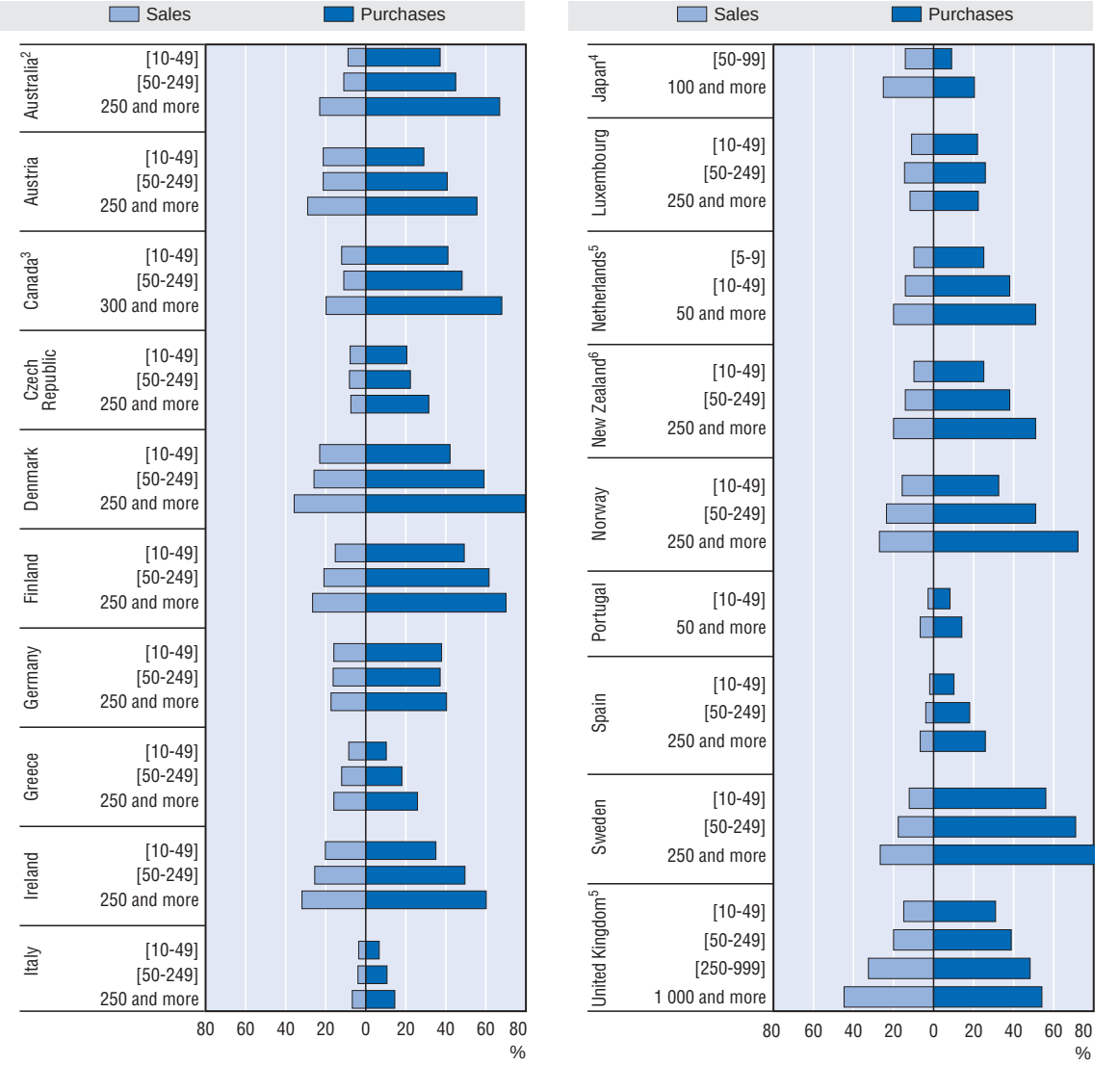
B.4.5. Internet and electronic commerce by size of enterprise

Internet sales and purchases by size class, 2001 or latest available year
Percentage of businesses in each size class selling or purchasing[1]



1. In European countries, except the Netherlands, Portugal and the United Kingdom, the figures refer to orders received and placed over the Internet during 2001. Only enterprises in the business sector, excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT. All other countries, unless indicated otherwise here, refer to 2000.
2. Data for sales and purchases refer to 2001-02. All employing businesses are included, with the exception of businesses in general government, agriculture, forestry and fishing, government administration and defence, education, private households employing staff and religious organisations.
3. Data refer to 2002 and include the industrial sector.
4. Data refer to 2002 and exclude agriculture, forestry, fisheries and mining industries.
5. Orders received or placed over the Internet and other computer-mediated networks.
6. Data refer to 2001 and include enterprises with a turnover of NZD 30 000 or more in all industries except electricity, gas and water; government administration and defence; and personal and other services.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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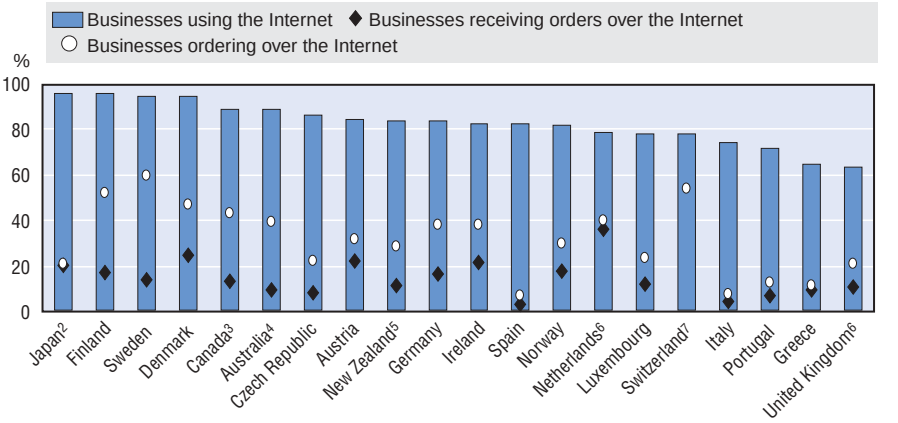
B.4.6. Internet and electronic commerce by activity of enterprise

- Today, enterprises commonly use the Internet, although there are still substantial differences between larger enterprises and the smallest, those with fewer than ten employees. For example, more than 95% of Swedish and Danish enterprises with ten or more employees now use the Internet.
- The Internet is used more frequently as a tool for ordering goods and services than for selling, particularly in countries where a large share of enterprises use the Internet.
- Use of the Internet to sell goods or services varies among sectors. In many countries, the real estate and wholesale sectors make the most use of the Internet as a sales channel. More than one-fifth of enterprises in the wholesale sector in Austria, Denmark, Finland and Japan use the Internet for this purpose. Retail sales are less common, although one-fifth of Canadian and Danish retail firms sell via the Internet.
- Real estate and wholesale trade are also the sectors that purchase the most via the Internet. In many countries, more than half of the firms in these sectors do so.

Businesses using the Internet for purchasing and selling, 2001 or latest available year[1]

Percentage of business with ten or more employees



1. In European countries, except the Netherlands, Portugal and the United Kingdom, the figures refer to orders received and placed over the Internet in 2001, while the use of the Internet refers to the beginning of 2002. Only enterprises with ten or more employees in the business sector, excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT. All other countries, unless otherwise noted, refer to enterprises at the beginning of 2001 for Internet use and to 2000 for purchases and sales.
2. Data refer to 2002 and to enterprises with 100 or more employees. Agriculture, forestry fisheries and mining are excluded.
3. Data refer to 2002 and include the industrial sector.
4. Data to Internet use refer to 2002 while data for sales and purchases refer to 2001-02. All employing businesses are included, except businesses in: general government, agriculture, forestry and fishing, government administration and defence, education, private households employing staff and religious organisations.
5. Data refer to 2001 and include enterprises with more than ten employees in all industries except electricity, gas and water; government administration and defence; and personal and other services.
6. Use, orders received and placed refer to Internet and other computer-mediated networks.
7. Data refer to 2000 and include industry, construction and services.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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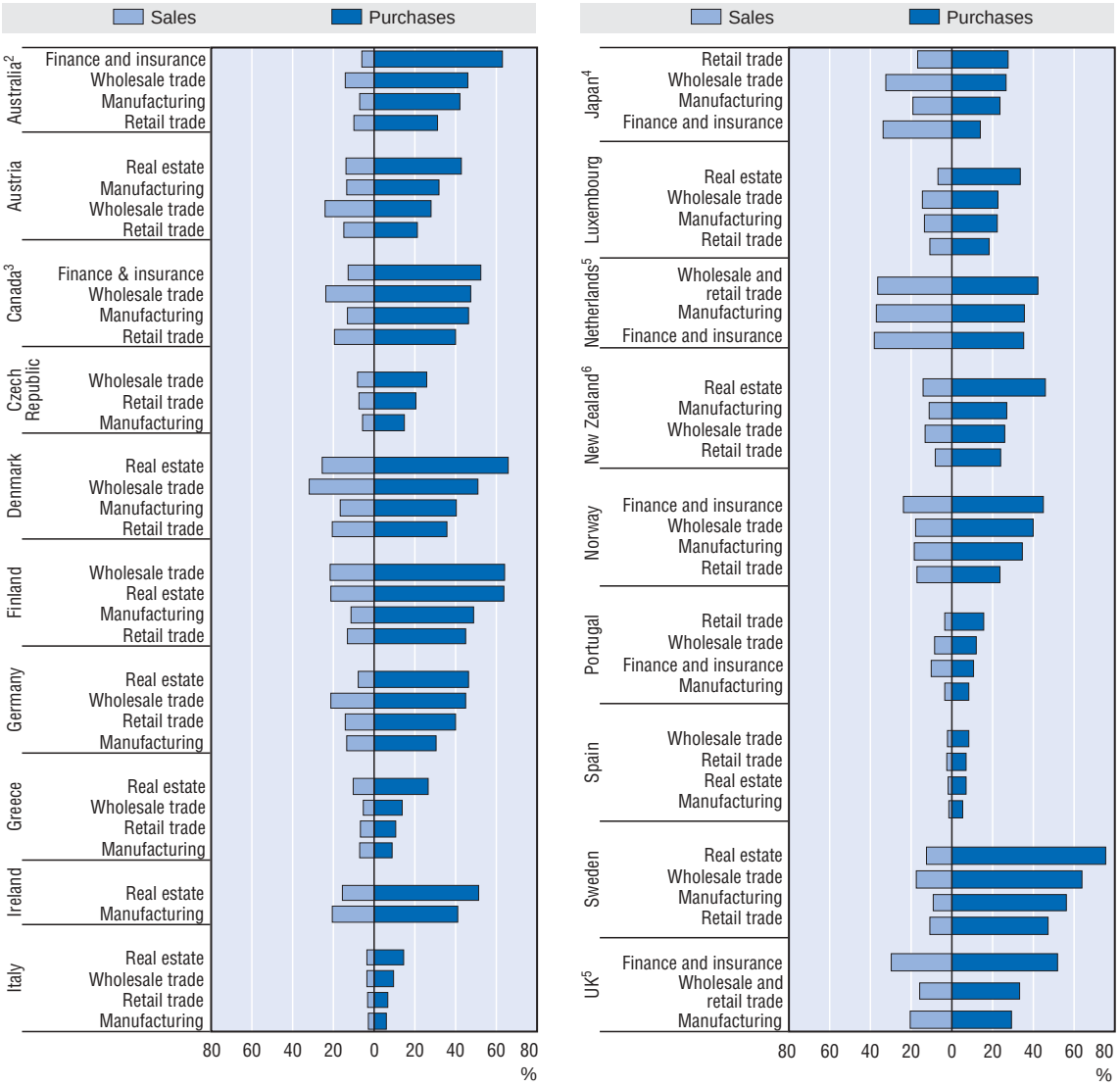
B.4.6. Internet and electronic commerce by activity of enterprise

Internet purchases and sales by activity, 2001 or latest available year[1]

Percentage of businesses in each activity class



1. In European countries except the Netherlands, Portugal and the United Kingdom, the figures refer to orders received and placed over the Internet in 2001. Only enterprises with ten or more employees in the business sector, excluding NACE activity E (electricity, gas and water supply), NACE activity F (construction) and NACE activity J (financial intermediation), are included. The source for these data is the Eurostat Community Survey on enterprise use of ICT. All other countries, unless otherwise noted, refer to 2000.
2. Data for sales and purchases refer to 2001-02. Sales for different industries refer to enterprises with ten or more employees. All employing businesses are included, except businesses in: general government, agriculture, forestry and fishing, government administration and defence, education, private households employing staff and religious organisations.
3. Data refer to 2002 and include the industrial sector.
4. Data for manufacturing and finance and insurance refer to 2002 and to enterprises with more than 100 regular employees. The data for total enterprises and other sectors refer to enterprises with more than 50 employees.
5. Orders received and placed refer to Internet and other computer-mediated networks.
6. Data refer to 2001 and include enterprises with six or more employees and a turnover of NZD 30 000 or more in all industries except electricity, gas and water; government administration and defence; and personal and other services.

Source: OECD, ICT database and Eurostat, Community Survey on ICT usage in enterprises 2002, May 2003.

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B.5. The price of Internet access and use

- Increased competition in the telecommunications industry has been driving down the cost of Internet access. Prices of leased lines, which provide the infrastructure for business-to-business electronic commerce, have fallen significantly, particularly since 1998, in the wake of widespread liberalisation in Europe's communication sector. Competition is not yet strong in all markets, however, and large price differences remain. The Nordic countries have the lowest charges for leased lines, at about one-fifth of the OECD average. Elsewhere, the least expensive countries are Switzerland, Luxembourg, Ireland, Germany, and the United States. At the other end of the spectrum, the charges in the Czech Republic and the Slovak Republic are more than twice the OECD average.
- Prices for ordinary consumers also differ substantially across countries. For a dial-up Internet connection, they must often pay a fixed telephone charge, a telephone usage charge and an Internet service provider charge. The ratio of these charges differs considerably among countries.
- The total cost for 40 hours of Internet access at peak times also differs noticeably. Internet access is cheapest in Korea and Canada, where the total charge is roughly one-third of the OECD average. France, New Zealand, the United States and Finland are also among the least expensive OECD countries.
- There is no direct link between Internet access and cost. For example, Denmark and Sweden, where Internet connections at home are common, are not among the countries with the lowest cost. To assess the impact of price on Internet take-up by households, the complex structure of access prices and the means available for connecting to the Internet have to be taken into account. More in-depth information on Internet infrastructure and Internet pricing can be found in the OECD *Communications Outlook* 2003.

OECD Internet access price baskets

Leased lines (private lines in North America) provide the infrastructure for business-to-business electronic commerce. They give users that need to transmit high volumes of traffic lower prices than the public switched telephone network (PSTN). They also provide them with control over their telecommunications facilities and traffic. The basket of national leased lines includes total charges (excluding taxes) for leased lines that can carry two megabits of information per second (Mbps).

For consumers and small businesses, the price of local communication access is a significant cost for engaging in electronic commerce. The OECD basket includes line rental, public switched telephony network (PSTN) usage charges and the Internet service provider (ISP) fee. The line rental charge helps to balance countries that traditionally did not charge for local calls and had higher fixed charges against those that charged for local calls and had lower fixed charges. The use of a fixed charge does not imply that customers need an additional line to connect to the Internet, as most residential customers use their PSTN line for this purpose. In addition, some of the prices shown for a defined duration include further amounts of on-line time. This is the case for countries with unmetered access or packages that include large amounts of on-line time.

The comparisons use prices as of September 2002 for the largest telecommunications carrier in each country. Changes that had been announced but were not yet in place are not included.

- Fixed charge: the monthly line rental for residential users.
- Usage charge: the price of local telephone calls (or special rates for Internet access) to an ISP for residential users.
- ISP charge: the price of Internet access from the largest telecommunications operator.
- Peak and off-peak times: the price of local calls at 11:00 hours (peak) and at 20:00 hours (off-peak) during weekdays.

For further information, see OECD (2003), *Communications Outlook* 2003, OECD, Paris.

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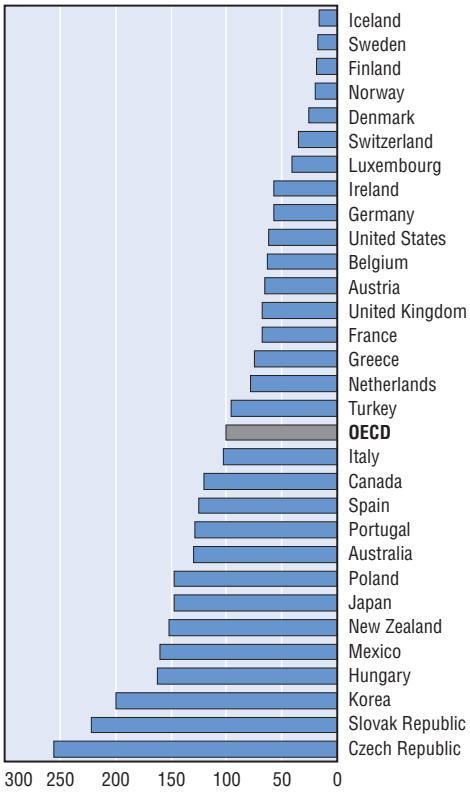
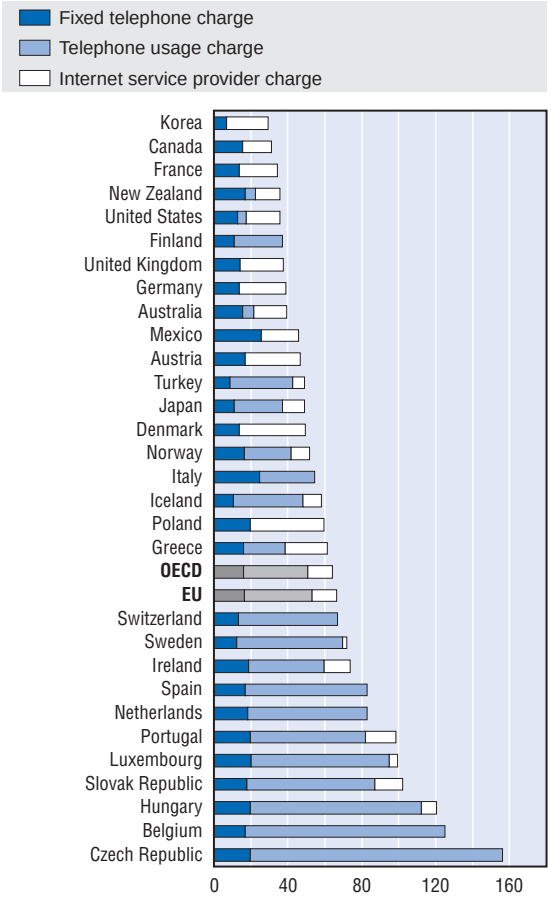
B.5. The price of Internet access and use

Price of national leased line charges, August 2002

Charges for a basket of national leased lines of 2 megabits per second, OECD average = 100



OECD Internet access basket for 40 hours at day-time discounted PSTN rates,[1] September 2002, including VAT, in USD PPP



1. In some countries ISP and PSTN usage charges are bundled.

Source: OECD, Telecommunications database, March 2003.

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B.6.1. Size and growth of the ICT sector

- Information and communication technologies (ICT) have been at the heart of economic changes for more than a decade. ICT-producing sectors play an important role, notably by contributing to rapid technological progress and productivity growth.
- The ICT sector grew strongly in OECD economies over the 1990s. Rapid growth was especially apparent in Finland, Sweden and Norway. In Finland, the ICT sector's share of value added doubled over 1995-2001 and now represents over 16.4% of total business sector value added. In 2000, the ICT sector represented between 5% and 16.5% of total business sector value added in OECD countries. The average share in a group of 25 OECD countries was about 9.8%; it was 8.7% in the European Union.
- Ireland, Finland, Korea, Japan and Mexico are specialised in the manufacturing of ICT goods. In Finland, for example, ICT accounts for almost 23% of total manufacturing value added. Except for Ireland, where computing and office equipment accounts for over 10% of manufacturing value added, the largest contribution to economic activity typically comes from the manufacture of telecommunications equipment. ICT services, such as telecommunication and computer services, often constitute between 70% and 90% of total ICT sector value added.
- In most OECD countries, ICT services have increased their relative share of the ICT sector, owing to the increasing importance of telecommunication services and software in OECD economies and, more broadly, a general shift towards a services economy.
- Most OECD countries already have a well-developed telecommunication services sector, which makes a sizeable contribution to ICT sector value added. Hungary and the Czech Republic have the highest relative share of telecommunication services. At the same time, there is a noticeable increase in the contribution of computer and related services, mainly software services. The share of computer and related services in business services value added was highest in Ireland (7% in 1999), Sweden (5.7% in 2000), and the United Kingdom (5% in 2001). Software consultancy accounts for between 60% and 80% of computer services.

The OECD definition of the ICT sector

In 1998 the OECD countries reached agreement on an industry-based definition of the ICT sector based on Revision 3 of the International Standard Industrial Classification (ISIC Rev. 3). The principles underlying the definition are the following:

For *manufacturing* industries, the products of a candidate industry:

- Must be intended to fulfil the function of information processing and communication including transmission and display.
- Must use electronic processing to detect, measure and/or record physical phenomena or control a physical process.

For *services* industries, the products of a candidate industry:

- Must be intended to enable the function of information processing and communication by electronic means.

The classes included in the definition are as follows:

Manufacturing: 3000 – Office, accounting and computing machinery; 3130 – Insulated wire and cable; 3210 – Electronic valves and tubes and other electronic components; 3220 – Television and radio transmitters and apparatus for line telephony and line telegraphy; 3230 – Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods; 3312 – Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process equipment; 3313 – Industrial process equipment.

Services: 5150 – Wholesaling of machinery, equipment and supplies (if possible only the wholesaling of ICT goods should be included); 7123 – Renting of office machinery and equipment (including computers); 6420 – Telecommunications; 72 – Computer and related activities.

The existence of a widely accepted definition of the ICT sector is the first step towards making comparisons across time and countries possible. However, the definition is not as yet consistently applied and data provided by member countries have been combined with different data sources to estimate ICT aggregates compatible with national accounts totals. For this reason, statistics presented here may differ from figures contained in national reports and in previous OECD publications.

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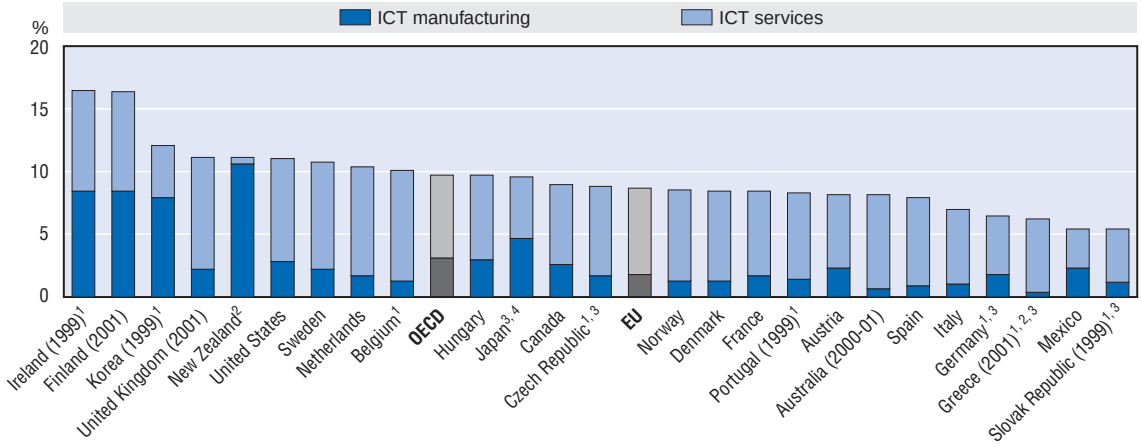
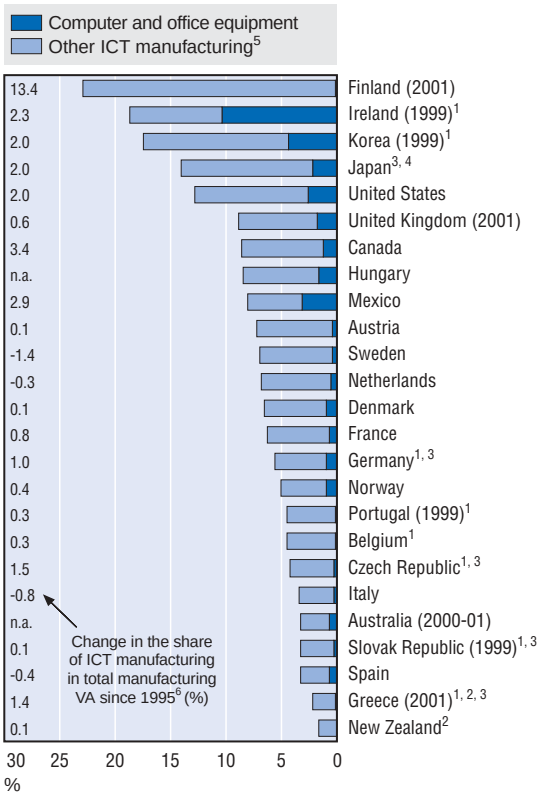
B.6.1. Size and growth of the ICT sector

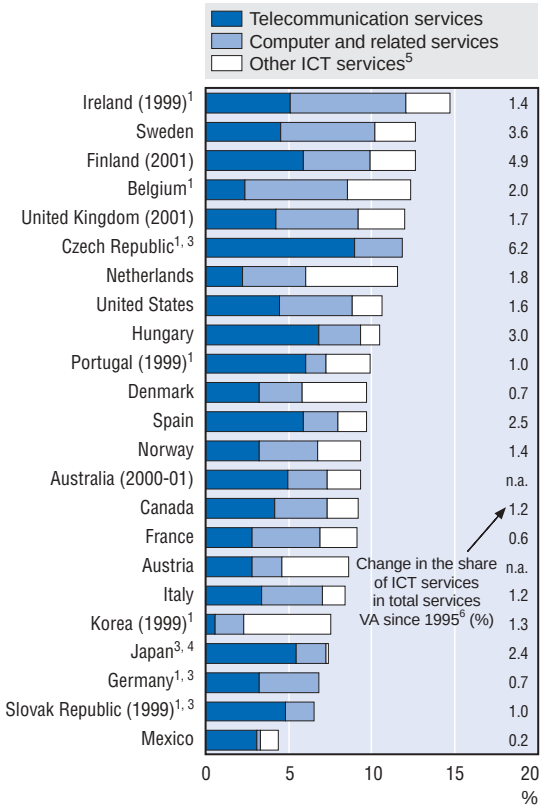
Share of ICT value added in business sector value added, 2000



Share of ICT manufacturing in total manufacturing value added, 2000



Share of ICT services in total business services value added, 2000



1. Data for rental of ICT goods (7123) are not available.
2. Postal services included with telecommunications services.
3. Data for ICT wholesale (5150) are not available.
4. Includes only part of computer related activities (72).
5. "Other ICT manufacturing" includes communication equipment, insulated wire and cable and precision instruments. "Other ICT service" includes wholesale and rental of ICT goods.
6. 1996 instead of 1995 for New Zealand, Norway and Portugal.

Source: OECD estimates, based on national sources; STAN and National Accounts databases, June 2003.

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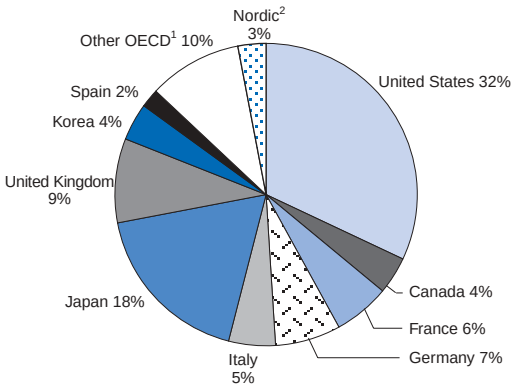
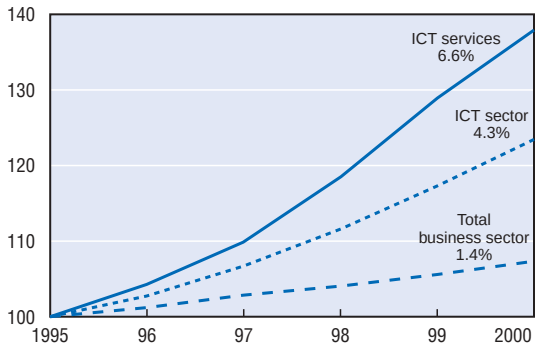
B.6.2. Contribution of the ICT sector to employment

- In 2000, the 21 OECD countries for which estimates are available employed 16.1 million persons in the ICT sector (see Box B.6.1), about 6.6% of total business employment. The United States and the EU (excluding Greece, Iceland, Ireland and Luxembourg) each represented 34% of the total; Japan employed 18% of the total.
- The ICT sector has been a major source of employment growth. Over the period 1995-2000, OECD-area employment in the sector grew by more than 3 million, *i.e.* an average annual growth rate of over 4.3% a year, more than three times that of overall business sector employment. ICT services were clearly the driver of growth, as ICT manufacturing has generally followed the decline of overall manufacturing employment, albeit to a lesser extent. Exceptions are Finland and Korea, where ICT manufacturing employment grew by over 9% a year, and Canada, the Czech Republic, the Nordic countries, Spain and the United Kingdom where it grew between 2% and 4%.
- Over 1995-2000, ICT services employment grew everywhere except in Austria. Annual growth rates in the United Kingdom (10.5%), the Netherlands (10.2%), Finland (9.8%), the United States (9.5%) and Spain (7.3%) were above the average of the 21 OECD countries for which data are available (6.6%). Employment in computer-related services, mainly software services, was the most dynamic component, growing by an average of over 11% a year in the OECD area and by over 19% in the United Kingdom.
- In 2000, ICT employment had a larger share in total business sector employment than the OECD average in Finland (10.8%), Sweden (9.2%), Canada (8.3%), the Netherlands (8%), Japan (about 8.2%), Belgium, France and the United Kingdom (about 7.3%), Hungary (7.1%) and Denmark and Norway (6.8%).
- Over 1995-2000, the contribution of ICT manufacturing to total manufacturing employment was stable in most OECD countries. It varied widely across the OECD area, ranging from 13.8% in Korea to 1.3% in Italy. The average share of ICT services employment in market services, instead, has grown over time to reach about 5.9% in the OECD area in 2000.

Employment in the ICT sector, selected OECD countries, 2000
Percentage share



The contribution of ICT services to business sector employment growth, selected OECD countries
Average annual growth rate 1995-2000, index 1995 = 100



1. "Other OECD": Australia, Austria, Belgium, Czech Republic, Hungary, Mexico, the Netherlands, Spain and Portugal.
2. "Nordic": Denmark, Finland, Norway and Sweden.

Source: OECD estimates, based on national sources; STAN and National Accounts databases, June 2003.

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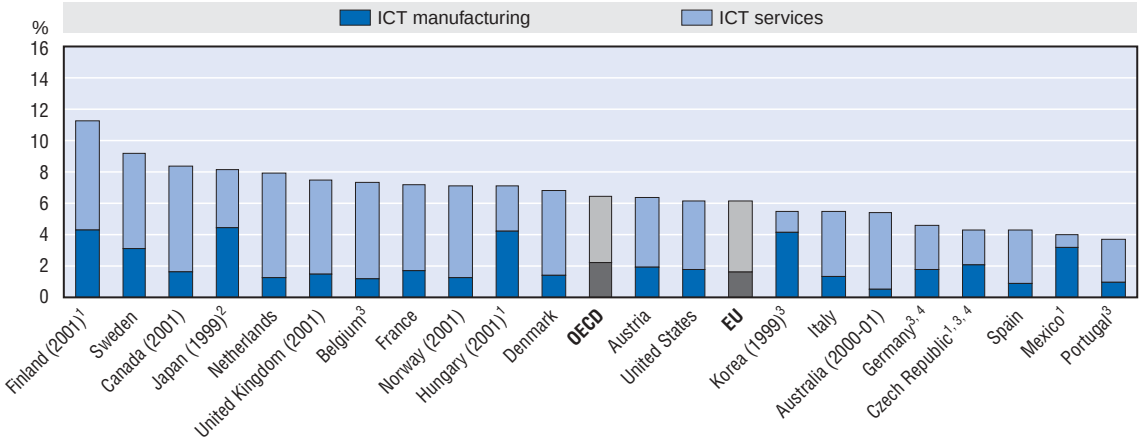
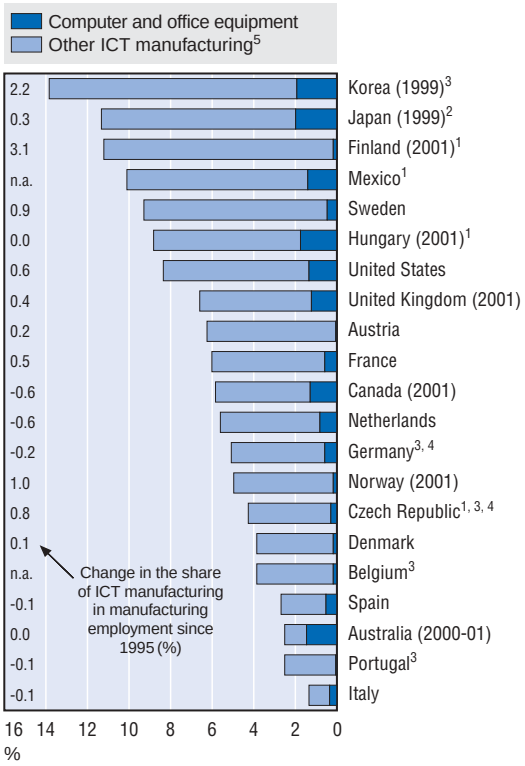
B.6.2. Contribution of the ICT sector to employment

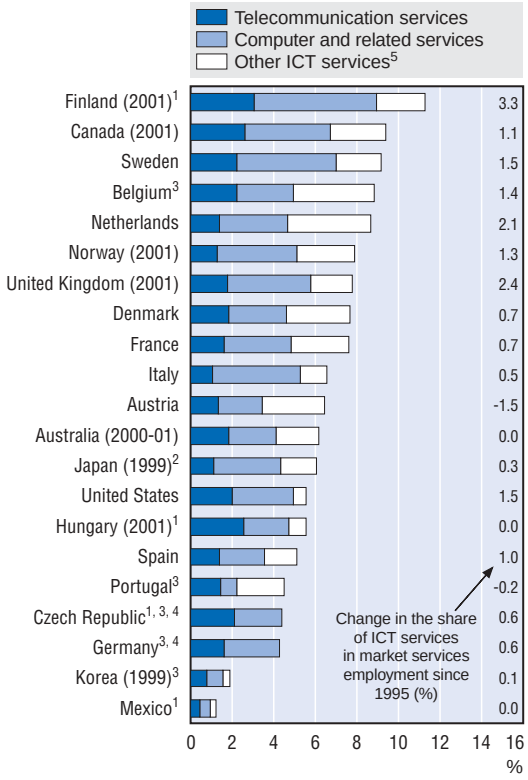
Share of the ICT sector in business sector employment, 2000



Share of ICT manufacturing in total manufacturing employment, 2000



Share of ICT services in market services employment, 2000



1. Based on data for employees only.
2. ICT services include market research and public opinion polling.
3. Rental of ICT goods (7123) not available.
4. ICT wholesale (5150) not available.
5. "Other ICT manufacturing" includes communication equipment, insulated wire and cable and precision instruments. "Other ICT services" includes wholesale and rental of ICT goods.

Source: OECD estimates, based on national sources; STAN and National Accounts databases, June 2003.

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B.7. Contribution of the ICT sector to international trade

- In OECD countries, the 1990s marked a shift in the composition of international trade in manufactured goods towards ICT products. Converting trade in ICT products into trade in the ICT manufacturing sector (see box) shows the growing importance of the ICT sector in total manufacturing trade. In 1990, trade in ICT goods, defined as the average of imports and exports, accounted for over 13% of OECD-wide trade in goods. By 2000, the share had reached almost 20%. ICT imports and exports contributed to total imports and exports by roughly the same amount (18% of imports and 17% of exports).
- However, the data for 2001 mark a reversal in trend. Compared to 2000, the share of ICT manufacturing in total manufacturing trade dropped on average by 2 percentage points, with Korea and Sweden experiencing decreases of over 4 and 5 percentage points respectively. In Ireland, the share of ICT trade increased by 3.5 percentage points.
- The ICT manufacturing sector plays a particularly important role in Ireland (41% of manufacturing trade) and Korea (30%). In Hungary, the Netherlands, Mexico and Japan, it represented about a quarter of total manufacturing trade in 2001.
- The overall trade balance shows countries' relative comparative advantage in ICT manufacturing. Only six countries showed a positive ICT trade balance in 2001. The surplus was highest in Ireland, Korea and Japan. The main source of comparative advantage in Finland and Sweden is trade in telecommunications equipment; in Ireland, it is trade in computers.

Measuring ICT sector trade

In the absence of tables of international trade in goods and services by detailed industrial activity which are compatible with the national accounts, ICT sector exports and imports at current prices have been estimated using the OECD's International Trade in Commodity Statistics (ITCS) database. The OECD definition of the ICT manufacturing sector, based on ISIC Rev. 3 has been used as the basis for the ICT trade indicators. Current price exports and imports for this sector have been derived from the product-based data in the ITCS database by applying a standard Harmonised System Rev. 1 (HS1) to the ISIC Rev. 3 conversion key. Thus, the trade indicators constructed here reflect trade in goods for which the ICT manufacturing sector can be considered the origin (exports) or the destination (imports) according to the UN standard conversion table. This type of aggregation, as well as the use of a single conversion key for all OECD countries, means that the figures reported here are not strictly comparable with those published in national accounts.

Data on selected ICT services (telecommunications and computer and related services) are instead estimated within a Balance of Payments (BPM5) framework and, as a general rule, cannot be compared to data on trade in ICT goods based on customs returns and related surveys. It was therefore not possible to calculate indicators of overall trade in ICT goods and services.

Finally, individual countries' data for both imports and exports include imported goods that are subsequently re-exported. Imports and subsequent re-exports may be in the same or in different reference periods. In the latter case, both the indicators of countries' relative trade performance and the indicators of their trade balances may be affected.

The ICT sector trade balance is calculated as ICT exports minus ICT imports divided by total manufacturing trade (the average of exports and imports).

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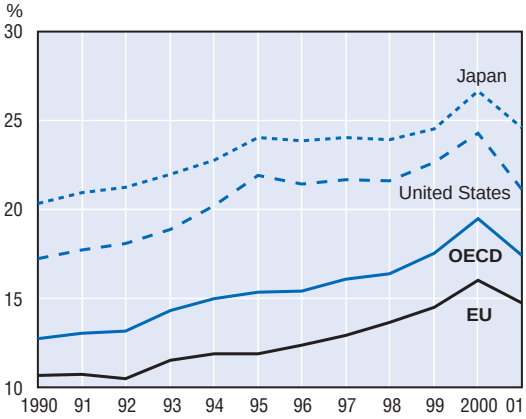
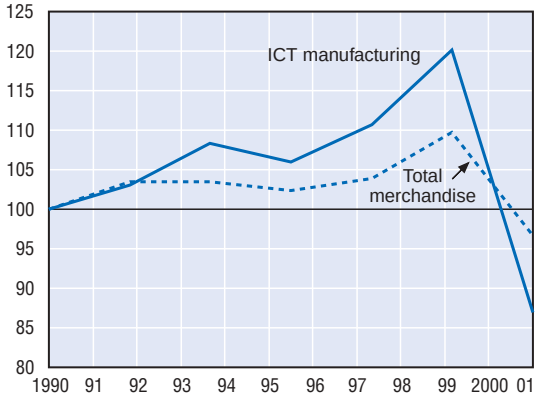
B.7. Contribution of the ICT sector to international trade

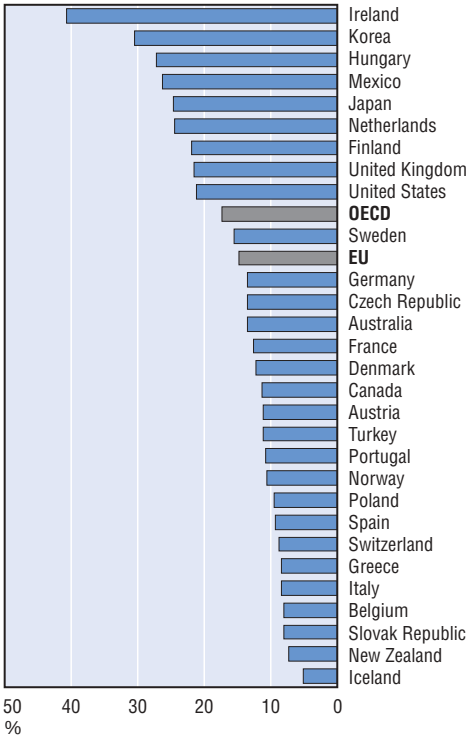
ICT trade by area, 1990-2001[1, 2]
Share of total manufacturing trade



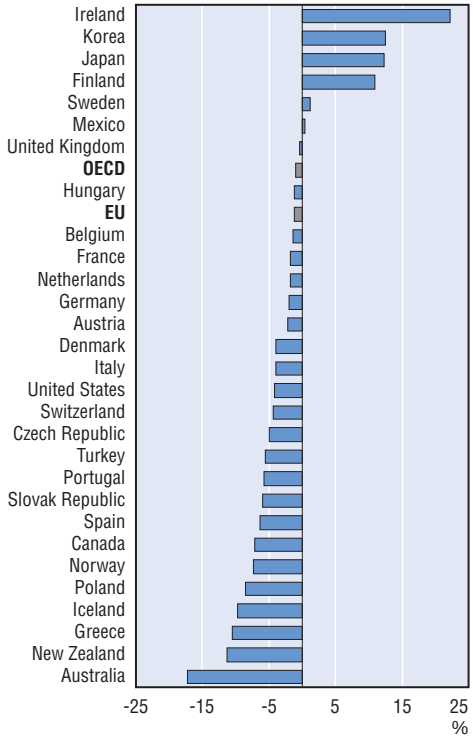
OECD and ICT-related trade, 1995 = 2001[2]
Index : 1995 = 100



ICT manufacturing trade,[1] 2001
Share of total goods trade



ICT sector trade balance, 2001



1. Average of imports and exports.
2. From 1990 to 1994, the EU includes all EU member states except Austria, Belgium and Luxembourg (EU-12). From 1990 to 1994, the OECD includes member countries with complete data from 1990 to 2001: EU-12, Australia, Canada, Iceland, Japan, Mexico, New Zealand, Norway, Switzerland, Turkey and the United States (OECD-22). In 1995 and 1996, the OECD includes all member countries except the Slovak Republic and Luxembourg (OECD-28).

Source: OECD, International Trade in Commodity Statistics (ITCS) and Structural Analysis (STAN) databases, May 2003.

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C.1. Trends in international trade and investment flows

- Globalisation is a dynamic, multidimensional process. National economies can integrate their activities and internationalise through various channels, *e.g.* trade in goods and services, capital and labour flows, transfer of production facilities and/or technology.
- Even though such economic linkages are not new, the intensity and multiplicity of transactions have accelerated over the past decade, making the concept of "globalisation" elusive and its economic implications harder to quantify.
- Several interdependent factors have contributed to the globalisation process of the 1990s, *e.g.* more advanced information and communication technology, lower transport costs, firms' strategies regarding location and the need to exploit worldwide technological and organisational advantages, liberalisation of trade and financial flows, etc.
- As a result, the structure of international trade and financial transactions has been gradually evolving over the past decade. Financial transactions (direct investment, investment income, portfolio investment) constituted the fastest-growing segment of international transactions. The upsurge in direct investment and portfolio investment was especially significant in the second half of the 1990s.
- However, such investment flows have also proven to be highly volatile; periods of decline were followed by periods of high growth in investment flows, and *vice versa*. Portfolio investment, for instance, declined in the early 1990s, tripled between 1995 and 1999 and declined again from 1999, one year before the decline in foreign direct investment.
- The lowering of trade and non-trade tariff barriers has contributed to the steady rise in international trade. The share of trade in international transactions has remained persistently high, averaging 15% of OECD GDP in the 1990s.
- In terms of the composition of international trade, the share of trade in goods is four times the share of trade in services.

Main components of international trade and investment

Trade in goods and services. Data relating to trade in goods and services correspond to each country's exports to, and imports from, the rest of the world. These data are collected to compile the balance of payments. Data relating to international trade in goods are also collected in customs surveys, but as a general rule they are not comparable to balance of payment data. Since data on trade in services are collected solely for use in compiling balances of payments, the latter have been chosen as source data to ensure that trade in goods and trade in services are comparable.

Foreign direct investment. Foreign direct investment is defined as an investment in which an investor resident in another economy owns 10% or more of the ordinary shares or voting power in the firm in which the investment is made (direct investment enterprise). This 10% limit means that the direct investor is able to influence and participate in the management or the control of a foreign investment enterprise. Direct investment comprises not only the initial transaction establishing the relationship between the investor and the enterprise but also all subsequent transactions between them and among affiliated enterprises, both incorporated and unincorporated.

Portfolio investments. In cases where the foreign investor holds less than 10% of the capital (ordinary shares or voting power) of a firm, the investment is considered to be a "portfolio investment". This type of investment usually corresponds to investment transactions in which the investor has no intention of influencing the management of a firm.

Investment income. This covers two types of transactions between residents and non-residents: *i*) those involving compensation of employees which is paid to non-resident workers; and *ii*) those involving investment income receipts and payments on external financial assets and liabilities. Included in the latter are receipts and payments on direct investment, portfolio investment, other investment and receipts on reserve assets.

Other investment. This is a residual category that includes all financial transactions not covered in direct investment, portfolio investment or reserve assets. This type of investment comprises trade credits, loans, currency and deposits and other assets and liabilities.

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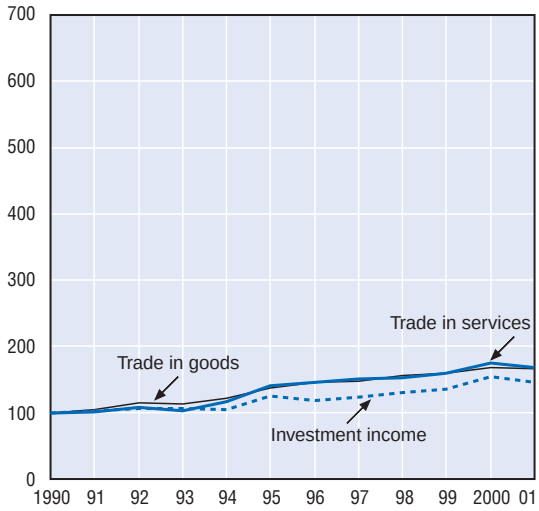
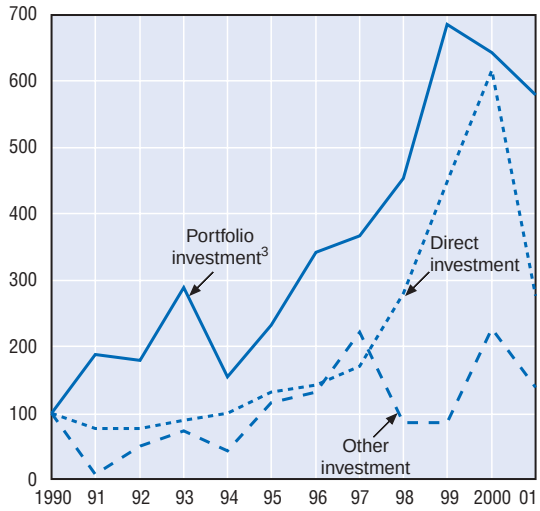
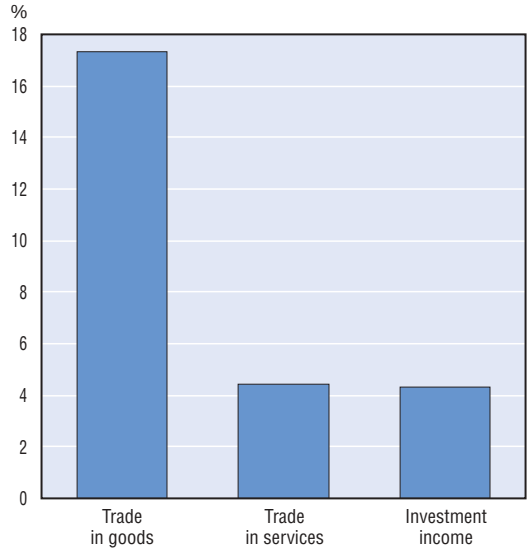
C.1. Trends in international trade and investment flows

Trends in international trade and investment components,[1] 1990-2001
OECD[2], 1990 = 100

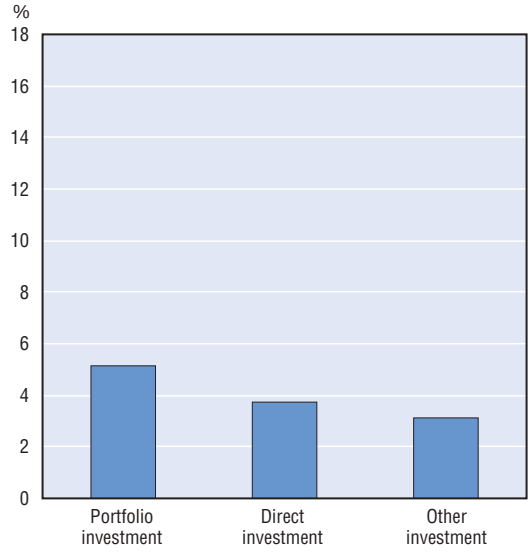




Main components of the current account as a percentage of GDP,[4] OECD[5]
Gross basis, average 1999-2001



Main components of the financial account as a percentage of GDP,[6] OECD[5]
Net basis, average 1999-2001



1. Average imports + exports or average assets + liabilities.
2. OECD excludes the Czech Republic, Hungary and the Slovak Republic, 1990-92; Greece, 1998; Iceland and the Slovak Republic, 2001.
3. Excluding financial derivatives.
4. Imports + exports divided by 2 and by GDP.
5. OECD excludes Iceland and the Slovak Republic in 2001.
6. Assets + liabilities (in absolute terms) divided by 2 and by GDP.

Source: IMF, Balance of Payments Statistics; and OECD, Annual National Accounts database, January 2003.

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C.2.1. International trade

- Traditionally, international trade in goods has been the principal channel of economic integration. In the 1990s, however, other forms of exchange became prevalent as firms increasingly implemented global strategies.
- In the 1990s, international trade in goods constituted on average about 15% of OECD GDP. The share of international trade in services was substantially lower, accounting for around 4% of GDP. In the second half of the decade, international trade in services as a share of GDP picked up slightly in the OECD area. This is partly the result of a gradual change in the nature of services, certain of which, *e.g.* software, financial services and accounting, have become more internationally tradable.
- Aggregate trade figures in goods and services hide significant cross-country differences in the OECD area. The international trade-to-GDP ratio is high (over 50%) for Luxembourg, Ireland, Belgium, the Netherlands and certain eastern European countries, *e.g.* the Slovak Republic, the Czech Republic and Hungary.
- In contrast, the trade-to-GDP ratio is only around 10% for the United States and Japan as well as the European Union when intra-EU trade flows are excluded. During the 1990s, the international trade-to-GDP ratio grew on average about 2 percentage points in the European Union and the United States, while it remained stable in Japan.
- As a share of GDP, trade in services rose faster than trade in goods in several OECD countries in the 1990s. Average annual growth in the trade-to-GDP ratio in services was over 6% for Hungary, Ireland, Turkey and Greece. It was negative for the Czech Republic, Mexico, the Slovak Republic, France and Norway. Trade in goods rose most rapidly in Hungary, Turkey and the Czech Republic over the 1990s.

The trade-to-GDP ratio

The most frequently used indicator of the importance of international transactions relative to domestic transactions is the trade-to-GDP ratio, which is the average share of exports and imports of goods and services in GDP.

International trade tends to be more important for countries that are small (in terms of size or population) and surrounded by neighbouring countries with open trade regimes than for large, relatively self-sufficient countries or those that are geographically isolated and thus penalised by high transport costs. Other factors also play a role and help explain differences in trade-to-GDP ratios across countries, such as history, culture, (trade) policy, the structure of the economy (especially the weight of non-tradable services in GDP), re-exports and the presence of multinational firms (intra-firm trade).

The trade-to-GDP ratio is often called the trade openness ratio. However, the term "openness" to international competition may be somewhat misleading. In fact, a low ratio for a country does not necessarily imply high (tariff or non-tariff) obstacles to foreign trade, but may be due to the factors mentioned above, especially size and geographic remoteness from potential trading partners.

For more details, see Annex Table C.2.1.

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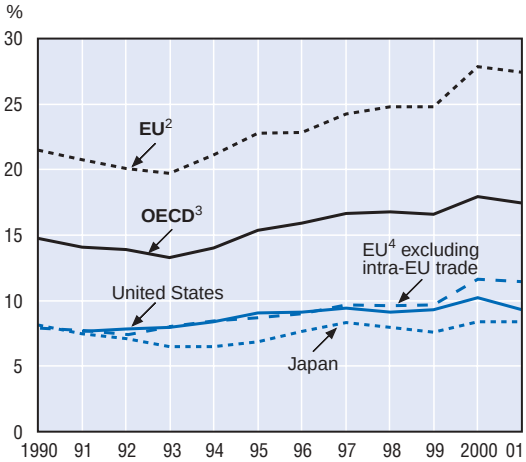
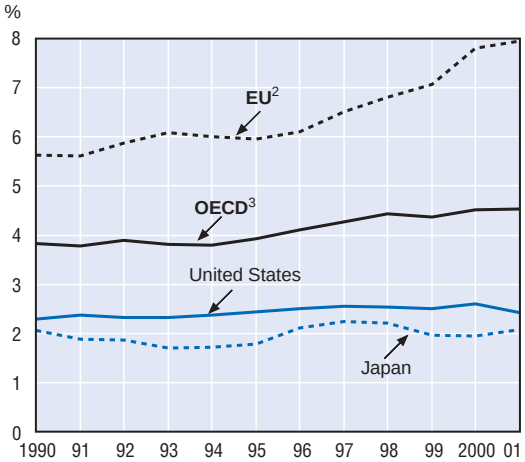
C.2.1. International trade

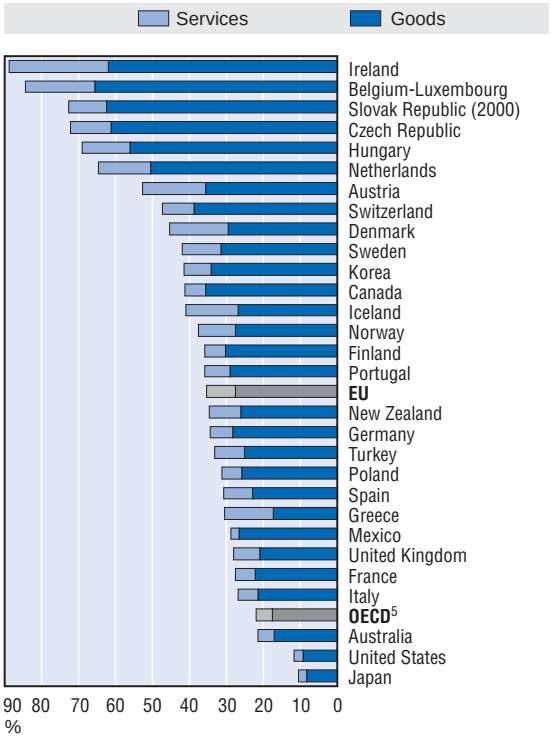
Trade in goods as a share of GDP[1]



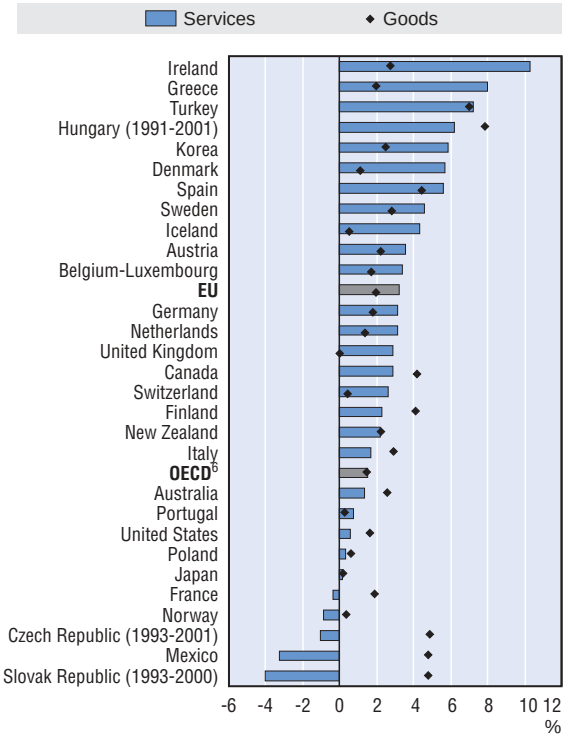
Trade in services as a share of GDP[1]



Trade-to-GDP ratios,[1] 2001



Average annual growth in trade-to-GDP ratios,[1] 1990-2001



1. Average of imports and exports as a share of nominal GDP.
2. Includes intra-EU trade.
3. Excludes Hungary 1990, the Czech Republic and the Slovak Republic 1990-92, Iceland and the Slovak Republic 2001.
4. Excludes intra-EU trade (calculation based on ITCS database).
5. Excludes the Slovak Republic.
6. Excludes the Czech Republic, Hungary and the Slovak Republic.

Source: IMF, Balance of Payments Statistics; and OECD, National Accounts database, June 2003.

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C.2.2. Exposure to international trade competition by industry

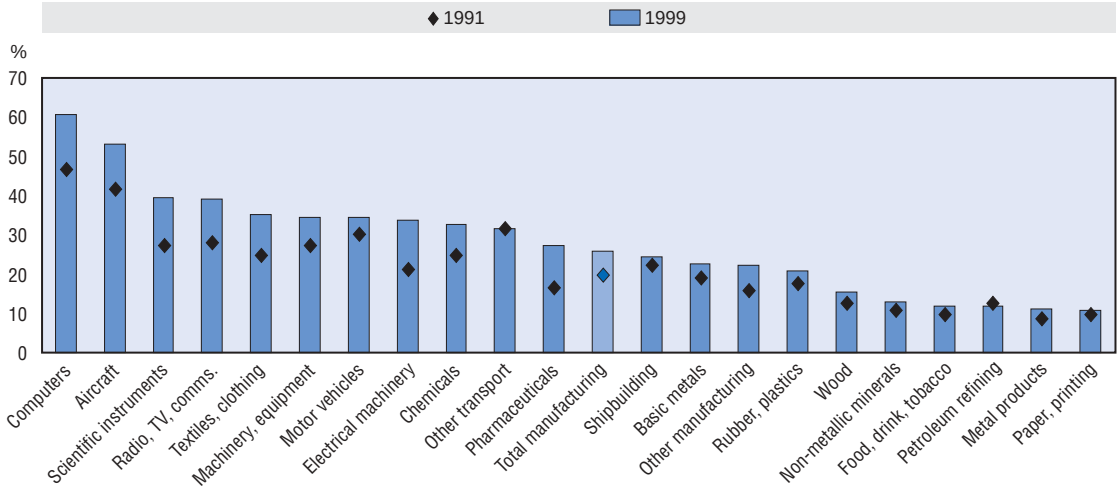
- The exposure of manufacturing industries to international trade has increased in OECD countries in the past decade. Over the 1990s, the average export ratio and import penetration rate rose for virtually all manufacturing industries.
- The export ratios and import penetration rates for the United States, Japan and the European Union (excluding intra-EU trade) show similar patterns of internationalisation across manufacturing industries. Computers, aircraft, scientific instruments and radio and television communication equipment have high exposure to international trade competition, whereas that of paper, printing, metal products and food, drink, tobacco is low.
- A strong difference between the export ratio and import penetration rate could indicate patterns of national specialisation. For instance, the United States has a strong export orientation in aircraft, while Japan and the European Union have a strong export orientation in shipbuilding, motor vehicles and machinery and equipment.
- For other industries, import penetration rates are high. This is the case, for example, for textiles, computers and motor vehicles in the United States; aircraft, scientific instruments, computers and textiles in Japan; and computers and aircraft in the European Union.
- Owing to international sourcing and intra-industry trade (see C.2.3), strongly export-oriented industries can also have a high import penetration rate. This is the case for computers and electrical machinery in the United States and for scientific instruments and aircraft in Japan and the European Union.

Export ratio and import penetration

The *export ratio* indicates the share of output Y which is exported X, *i.e.* X / Y, and the *import penetration rate* shows to what degree domestic demand D is satisfied by imports M, *i.e.* M / D = M / (Y – X + M). As for the trade-to-GDP ratio (C.2.1), a low penetration rate does not necessarily imply the existence of high import barriers. In fact, it may reflect industry-specific characteristics unfavourable to international trade, such as high transport costs for goods with a low value per ton. A low penetration rate may also reflect the presence of highly competitive domestic firms capable of resisting foreign competition, especially if the export ratio is high at the same time. Conversely, a high import penetration rate may reflect weak competitiveness of domestic firms, especially if the export ratio is low. Both indicators are high for some industries, thereby reflecting their internationalisation, especially owing to sourcing of intermediate goods, intra-industry trade and intra-firm trade.

Exposure to international trade competition for manufacturing industries in selected OECD countries[1]

Average of export ratio and import penetration



1. OECD includes Australia, Austria, Canada, Denmark, Finland, France ,Germany, Ireland, Italy, Japan, Norway, Portugal, Spain, Sweden, the United Kingdom, the United States.

Source: OECD, STAN database, June 2003.

For more details, see Annex Tables C.2.2.1. *and* C.2.2.2.

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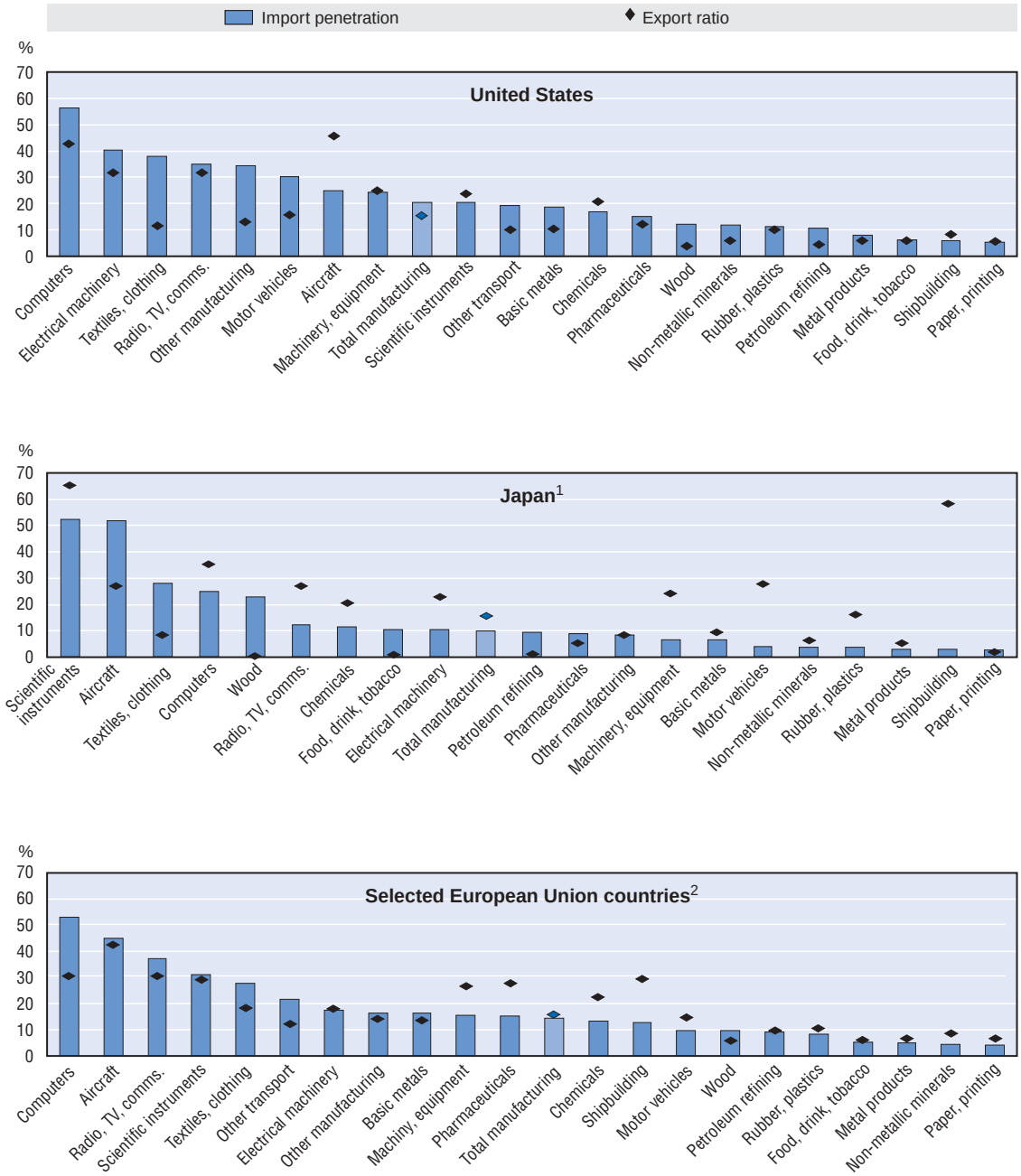
C.2.2. Exposure international trade competition by industry

Exposure of manufacturing industries, 1999



1. Motor vehicles (ISIC 34) includes Other transport (ISIC 352 + 359).
2. EU includes Austria, Denmark, Finland, France, Germany, Ireland, Italy, Portugal, Spain, Sweden, the United Kingdom. Intra-EU trade is excluded.

Source: OECD, STAN and Bilateral Trade database, June 2003.

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C.2.3. Intra-firm trade in total trade

- The share of intra-firm exports in the total exports of manufacturing affiliates under foreign control ranges between 35% and 60% in the OECD countries for which data are available.
- This proportion held steady at around 50% throughout the 1990s in the United States, Canada and the Netherlands, but it rose sharply in Sweden (from 35% to 80%) and declined in Japan (from 35% to 20%). In 1999, in other words, only 20% of the exports of affiliates under foreign control in Sweden were destined for non-affiliated firms, while the corresponding share for affiliates under foreign control in Japan was 80%.
- More detail is available for intra-firm exports and imports between US parent companies and their foreign affiliates in relation to aggregate US trade. Overall, these ratios amount to 25% for exports and 15% for imports.
- For exports, the ratio of intra-firm trade of US parent companies is highest with Singapore, Switzerland, Ireland, Canada, the Netherlands and Hong Kong (China). For imports it is highest with Singapore, Hong Kong (China), Ireland, Canada and Mexico.
- Over 80% of US parent company exports to their affiliates in Singapore involve computers and other electronics products; the imports from these affiliates are mainly computers. Exports to Ireland include computers and products related to chemicals and pharmaceuticals, while imports mainly consist of computers. Exports to Canada are largely cars, while imports are more varied and include cars, computers and distribution services.
- It should be borne in mind that ratios of intra-firm trade with partner countries, even if they attain substantial values, may account for only a small percentage of overall intra-firm trade. For example, intra-firm imports from Canada account for less than 30% of aggregate US imports, as opposed to more than 65% in the case of Singapore. However, in absolute value they account for nearly 39% of aggregate US intra-firm imports (*i.e.* double the share for Europe) but scarcely 7.5% in the case of Singapore.

Intra-firm trade

Intra-firm trade is trade between enterprises belonging to the same group, but located in different countries. The ratio of intra-firm trade to total trade in countries that publish the relevant data is quite high. Once foreign investments have been made, these transactions reflect centralised decisions made as part of a group's global strategy. A significant portion of intra-firm trade may reflect the fact that affiliates have a better understanding of local market demand. Parent corporations and other firms in the group often prefer to export to their own affiliates, which then sell the goods as received to local consumers. In fact, parent corporations could sell these products directly to local distributors, without involving their affiliates. It is difficult to determine whether such transactions would be less numerous if they did not go through their affiliates.

Two indicators are shown here, both for inward investment, although indicators can also be derived for outward investment. They refer to exports (X_F^{intra}) and imports (M_F^{intra}) by the foreign-controlled affiliates in compiling countries with parent companies and other affiliates located abroad to total exports (X) and imports (M) of the compiling countries:

$$X_F^{intra}/X,\ M_F^{intra}/M$$

These indicators might also be calculated in terms of these firms' total exports and imports, and by industrial sector and by country of origin and destination.

In the case of imports by affiliates under foreign control in host countries and by parent companies controlled by compiling countries, it is also useful to distinguish between imports destined for use in their own production, those resold as same-state goods on the domestic market, and those re-exported, either as received or after further processing.

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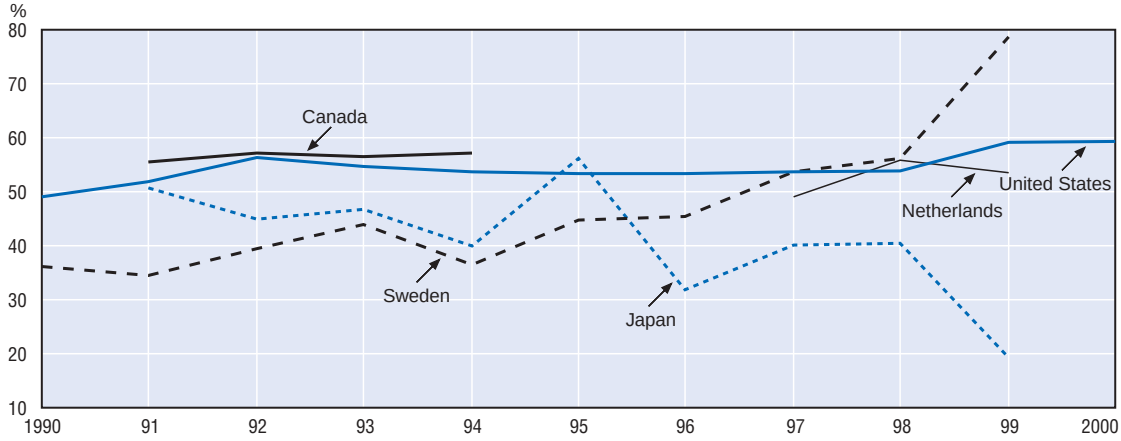
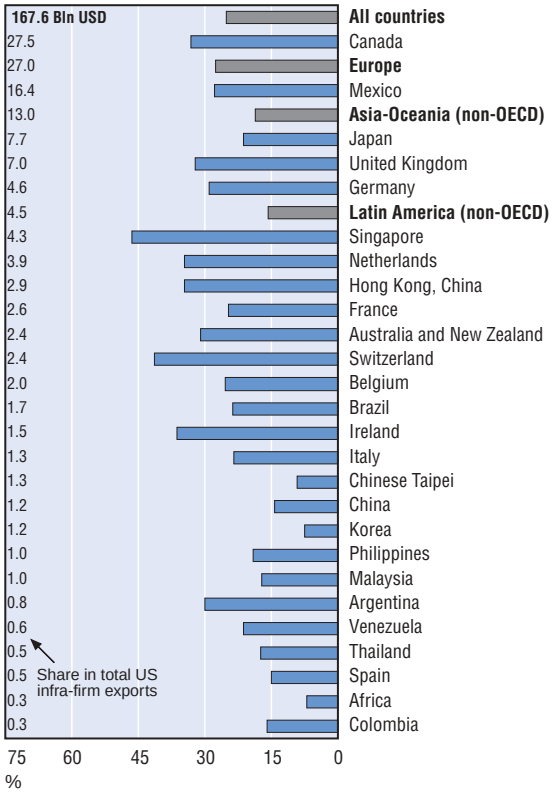
C.2.3. Intra-firm trade in total trade

Share of intra-firm trade in total exports of affiliates under foreign control (inward investment)[1]

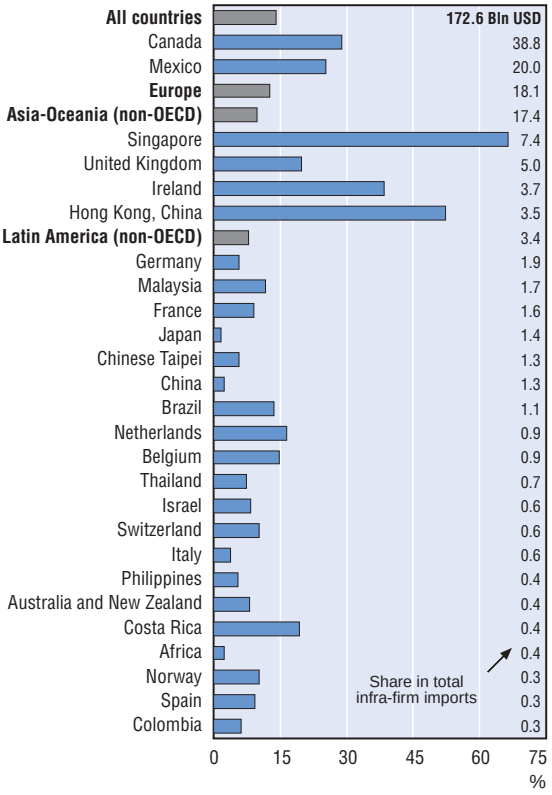


United States intra-firm trade in goods from outward investment

Intra-firm exports of goods in total exports of goods to partner country, 2000



Intra-firm imports of goods in total imports of goods to partner country, 2000



1. The US data also include minority controlled affiliates. For the United States and the Netherlands (from 1998), trade in goods only.
Source: OECD, AFA and ITS databases, May 2003.

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C.2.4. Import content of exports

- Importing in order to export is an essential characteristic of economic integration and the globalisation of production. Imports vital to the production of exported goods may come from affiliates controlled by the exporter or from non-affiliated firms.
- In the Netherlands, for example, the import content of exports exceeds 40%. In contrast, Japan and the United States are the least dependent on imports for exports.
- Between 1980 and 1997, dependency on imports for subsequent exports increased in Canada, Germany, Australia and the United States. It decreased in France, Japan, Denmark and the Netherlands. If the energy imports needed to manufacture goods for export are excluded, the above percentages are reduced by 2 to 3 points.

Import content of exports

The link between a country's exports and imports is an important but little known aspect of globalisation. It may be a complex one if a number of countries produce parts of the same final goods and services. One way of measuring the relationship is to use input-output tables. These tables make it possible to measure the relationships between the producers of goods and services (including imports) in an economy and the users of these goods and services (including exports). They can therefore be used to estimate the contribution made by imports to the production of any good (or service) for export. For example, if a motor car manufacturer imports certain components (*e.g.* the chassis), the direct import contribution will be the ratio of the value of the chassis to the total value of the car. If the car manufacturer purchases other components from domestic manufacturers, who in turn use imports in their production process, those imports must be included in the car's value. These indirect imports should be included in any statistic that attempts to measure the contribution of imports to the production of motor cars for export. The total direct and indirect imports are known as embodied imports. In an input-output framework, the relationship between producers and consumers can be described as follows:

$g = A*g + y$, where g is an $n*1$ vector of the output of n industries within an economy; A is an $n*n$ matrix describing the relationships among industries [(I-A) is known as the Leontief matrix], where a_{ij} is the ratio of inputs from domestic industry i used in the output of industry j and Y is an $n*1$ vector of final demand for domestically produced goods and services, including exports.

Assuming that no other imports (re-exports) are recorded, total imports embodied in exports can be shown as $m*(1\text{-}A)^{-1}*e$ where m is a $1*n$ vector with components m_j (the ratio of intermediate imports purchased to output produced, in industry j) and e is an $n*1$ vector of exports by industry.

Estimates of imports of goods embodied in exports of goods can be calculated by including only imported goods in m and setting all exports of services in e to zero, assuming that goods industries produce goods only and services industries produce services only. By adapting the equation above to reflect supply-use table data sources, this assumption can be relaxed. In this case the equation above can be rewritten as $m*(1\text{-}DB)^{-1}*Dx$, where x is a $n*1$ vector of exports by product, DB = A and $Dx = e$, B is an $n*n$ matrix where b_{ij} is the ratio of inputs of domestically produced product i used in the output of industry j. This approach can be applied to the equation below by replacing each occurrence of A and e with DB and Dx.

Thus, the import content of exports (the share of imports used in production to make one unit of export) is equal to:

$m*(I\text{-}A)^{-1}*e/E$ where $E = \sum_{i=1}^{n} e_i$ (total exports)

Similarly, the embodied imports in exports by industry j can be shown as $\sum m_i*L_{ij}$ where L_{ij} is the ij^{th} element of the Leontief inverse $(I\text{-}A)^{-1}$.

In addition, the share of imports used in the production process to produce exports is equal to $m*(I\text{-}A)^{-1}*e/M$, where $M = m*g$ (total imports).

In the same way, one can estimate the total indirect and direct contribution of exports to value added by replacing the import vector m above with an equivalent vector that shows the ratio of value-added to output (v). Thus, the contribution of exports to value added is equal to $v*(I\text{-}A)^{-1}*e$; the value-added content of exports = $v*(I\text{-}A)^{-1}*e/E$; and the share of value added embodied in exports = $v*(I\text{-}A)^{-1}*e/V$, where V = total value added.

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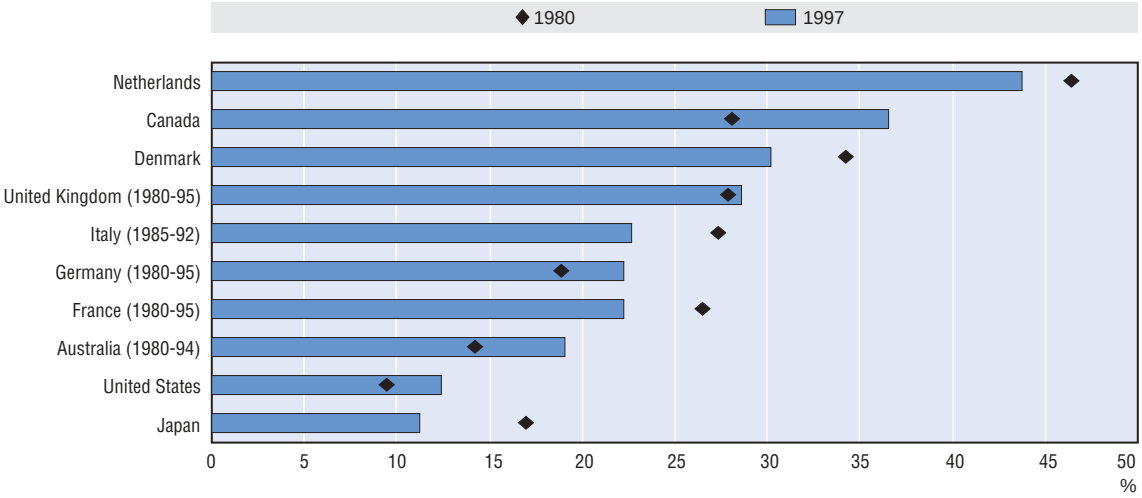
C.2.4. Import content of exports

Import content of exports of goods (including energy), 1980 and 1997



Source: OECD, Input-Output database, February 2003.

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C.3.1. Foreign direct investment flows

- Since the second half of the 1980s, foreign direct investment (FDI) has played a fundamental role in furthering international integration. The bulk of this investment has gone for acquisition or capacity enlargement of existing firms, *i.e.* changes of ownership rather than creation of a new enterprise.
- All flows of direct investment dropped sharply as of 2000. The United States is the main foreign investor and the leading host country for foreign investment. The United Kingdom is the second outward investor, and in 2000 it ranked ahead of the United States. In 2001, however, its outward investment dropped sharply, declining more than that of other large countries.
- In 2000, France, which invests more abroad than it receives at home, became the third outward investor, after the United States and the United Kingdom. In contrast, Japan, despite the size of its economy, invested less abroad over 1994-2001 than the Netherlands or Germany.
- Between 1994 and 2001, Belgium-Luxembourg held second place in absolute value as a host country for FDI. This may be due to the presence of financial holding companies, which make their own investments, often in other countries.

Foreign direct investment flows

Main definitions

A foreign investment is classified as a direct investment if the foreign investor holds at least 10% of the ordinary shares or voting power in an enterprise and exerts some influence over its management. Any investment amounting to less than 10% of ordinary shares is posted as portfolio investment.

Direct investment is measured in terms of flows and stocks. Direct investment flows, whether inward or outward, comprise investors' net capital contributions, net loans and undistributed (reinvested) profits.

Main limitations of the data

Only one OECD country has not yet adopted the threshold of 10% of assets or voting rights held in a company as the rule for distinguishing between direct and portfolio investment. However, inward direct investment statistics in Belgium, Korea, Mexico, Netherlands, Norway and Portugal include transactions between a resident enterprise and its direct investor when the foreign investor has an effective voice in management, even though the investor owns less than 10% of the enterprise's assets.

A number of foreign investors may hold a majority stake in some companies, although each may own less than 10% of ordinary shares. These should not be counted as direct investments, and the companies should not be considered as direct investment enterprises.

Direct investment flows do not include investments made through the host country's capital market or via other financial sources which do not pass through the investor country or via other investor enterprises, although such investments may represent a significant part of the actual total investment. In the balance of payments approach to flows of foreign direct investment, it the immediate investor is more relevant, the investor's country of origin needs to be taken into account. If the ultimate beneficiary is more relevant, the investor and the country of origin may be different.

For example, data on the activity of foreign affiliates in the services sector in Denmark by country of origin show that the most important immediate investors are the Netherlands (27%), Sweden (18.1%) and the United Kingdom (11.7%), while the United States represents only 8.1%. If the ultimate beneficial owner (UBO) is taken into account, the United States becomes the first investor country with 20%. This is because significant US holding companies, which fund most American investments in Europe, are located in the Netherlands. In the balance of payments approach, the FDI flows from the Netherlands to Denmark are considered as European investments while in the UBO approach, these investments are not European but American.

For more details, see Annex Table C.3.1

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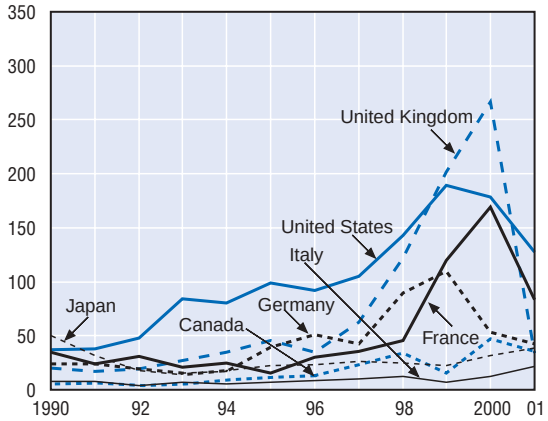
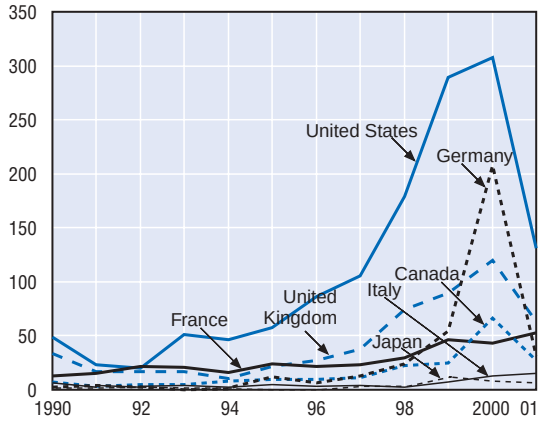
C.3.1. Foreign direct investment flows

Outward 1990-2001, G7 countries
Billion USD

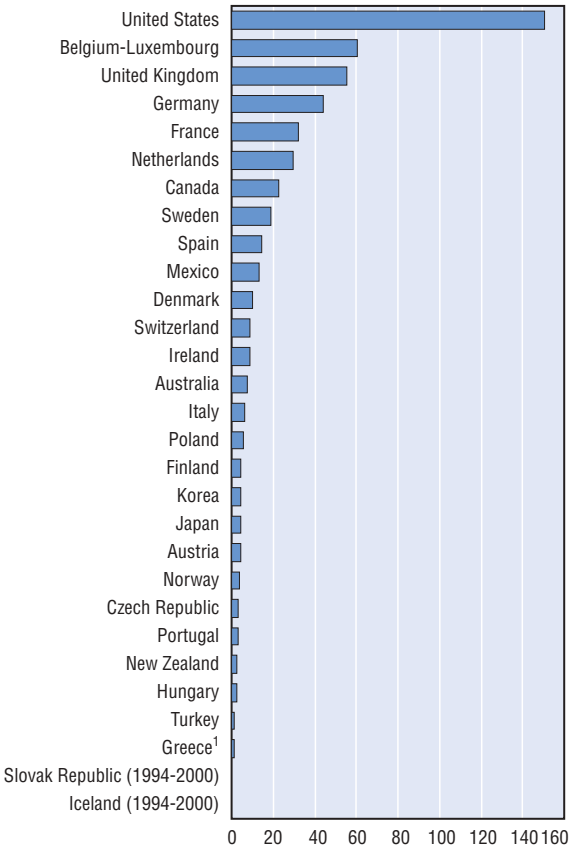


Inward 1990-2001, G7 countries
Billion USD



Outward, average 1994-2001
Billion USD

Inward, average 1994-2001
Billion USD



1. Excluding 1998.
Source: IMF, *Balance of Payments Statistics,* January 2003.

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C.3.2. Cross-border mergers and acquisitions

- Mergers and acquisitions are the most common form of foreign direct investment (FDI) Firms engage in cross-border mergers and acquisitions for several reasons: to strengthen their market position, to expand their businesses, to exploit other firms' complementary assets, *e.g.* technology, expertise, brand names, or to realise efficiency gains by restructuring their businesses on a global basis.
- During the 1990s, cross-border mergers and acquisitions increased more than five-fold worldwide on a value basis. The upsurge in deal value and number of deals was especially strong between 1995 and 1999.
- The United States was the main target country for mergers and acquisitions during 1995-2001, attracting on average 25% to 30% of the OECD total and 50% more in terms of value than the United Kingdom, the second target country. Germany, Canada and France were the other important countries for inward mergers and acquisitions.
- Over the same period, the United Kingdom was the principal acquirer, with deals valued at close to USD 120 billion on average, followed by the United States, France and Germany.
- Large-scale transactions account for the bulk of the increase in the value of cross-border mergers and acquisitions. In the telecommunications sector, for example, the deal between Mannesmann (Germany) and Vodafone AirTouch (United Kingdom) in 2000 was valued at USD 202.8 billion.
- Cross-border mergers and acquisitions take place in manufacturing and in services and are changing the shape of industry worldwide in sectors such as motor vehicles, chemicals and pharmaceuticals, telecommunications and financial industries. During the 1990s, the most active sectors in terms of mergers and acquisitions at global level were oil, motor vehicles, banking, finance and telecommunications.

Cross-border mergers and acquisitions

A merger is an operation in which two or more companies decide to pool their assets to form a single company. In the process, one or more companies disappear completely. An acquisition does not constitute a merger if the acquired company does not disappear. Mergers are less frequent than acquisitions.

Cross-border mergers and acquisitions can be either inward or outward. Inward cross-border mergers and acquisitions imply an inward capital movement through the sale of domestic firms to foreign investors, while outward cross-border mergers and acquisitions imply an outward capital movement through the purchase of all or parts of foreign firms.

The data are taken from the Mergers and Acquisitions Global database (Dealogic). The limitations on data collection methods create a credibility problem, as data collected by different private sources show significant differences in overall merger and acquisition activity across countries.

A detailed analysis of mergers and acquisitions can be found in OECD (2001), *New Patterns of Industrial Globalisation: Cross-border M&As and Alliances*, OECD, Paris; and in Nam-Hoon Kang and Sara Johansson, "Cross-border Mergers and Acquisitions: Their Role in Industrial Globalisation", STI *Working Papers* 2000/1, as well as in *International Investment Perspectives*, No. 1, OECD, 2002.

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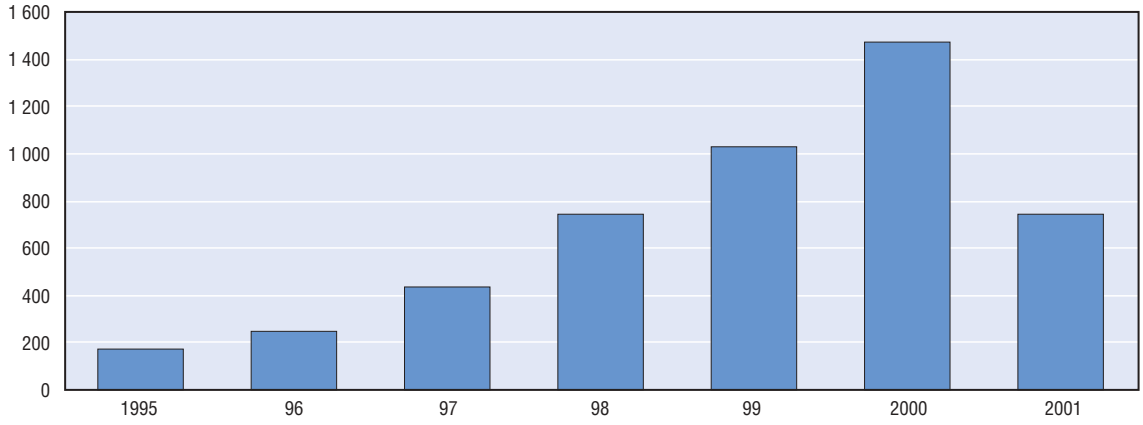
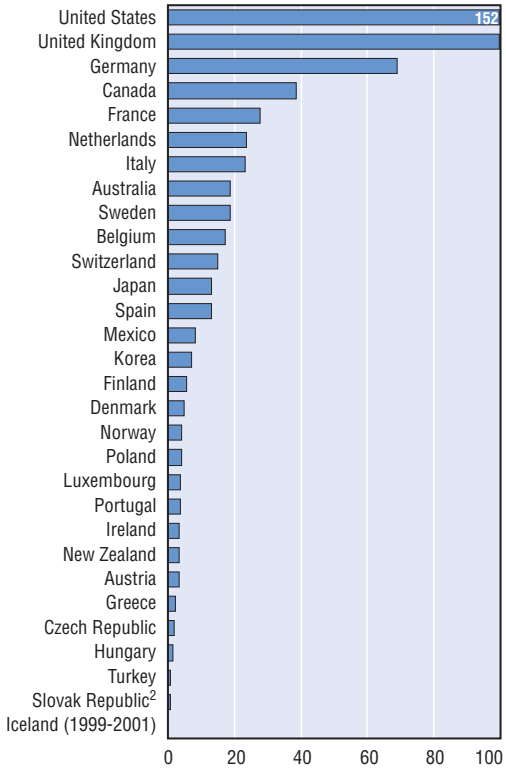
C.3.2. Cross-border mergers and acquisitions

Trends in cross-border mergers and acquisitions, world total
Billions USD



Outward mergers and acquisitions in OECD countries, average 1995-2001
Billions USD

Inward mergers and acquisitions in OECD countries, average 1995-2001
Billions USD



1. 1995 and 1997 not available.
2. 1996-97 not available.

Source: Dealogic, M&A Global database, March 2003.

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C.4.1. Activity of affiliates under foreign control in manufacturing

- Firms increasingly adopt global strategies and establish overseas sales, marketing, production and research units to cope with new competitive pressures and innovation methods. Foreign direct investment (FDI) data do not capture this phenomenon. While they indicate the magnitude of financial flows between firms related through foreign investment, they are typically not classified by type of investment activity. Indicators on the activity of foreign affiliates are thus an important complement to information on FDI when analysing the weight and economic contribution of such firms in host countries.
- Available data on the share of foreign affiliates in manufacturing turnover and employment show considerable variation across OECD countries. The share of turnover under foreign control in the manufacturing sector ranges from over 70% in Hungary and Ireland to under 3% in Japan. For 1995-2000, however, the shares of foreign affiliates in manufacturing turnover rose in nearly all countries for which data are available. The shares of foreign affiliates in manufacturing employment range from around 50% in Ireland, Luxembourg and Hungary to 4% in Germany.
- The available data also indicate that the export and import ratios of foreign affiliates in manufacturing are high. This tends to confirm the view that foreign affiliates have a better knowledge of international markets and distribution networks and engage heavily in intra-firm trade (see C.2.3).
- Comparisons of domestic firms and foreign affiliates should be made with caution. The latter usually do not have the same profile as domestic firms, they are generally larger and concentrated in relatively more productive and capital-intensive industries, and they typically require a higher level of skills than the average national firm.
- In the second half of the 1990s, manufacturing employment in firms controlled by the compiling countries declined except in Norway, Sweden and Ireland. On the other hand, employment numbers in foreign affiliates rose in all countries except Germany and Netherlands.
- The generally rapid growth in employment and production for foreign affiliates as compared with national firms does not necessarily point to the creation of new foreign affiliates. In most cases, it reflects changes of ownership owing to acquisitions.

Activity of foreign affiliates

The criterion of possession of 10% of a company's voting shares or voting power is deemed to indicate the existence of a direct investment relationship and of influence over the management of the firm in question.

In contrast, control implies the ability to shape a company's activities. This entails ownership of a majority of ordinary shares (more than 50%) or voting power on the board of directors. Variables such as turnover, number of employees or exports are attributed in full to the investor that controls the company.

The term "foreign affiliate" is restricted to foreign affiliates that are majority-owned. Accordingly, the geographical origin of a foreign affiliate is defined as the country of the parent company if it holds, directly or indirectly, more than 50% of the affiliate's voting shares.

However, the majority holding criterion is not used for the United States and Hungary, since minority foreign-owned firms are also included in their statistics.

For more details, see Annex Table C.4.1.

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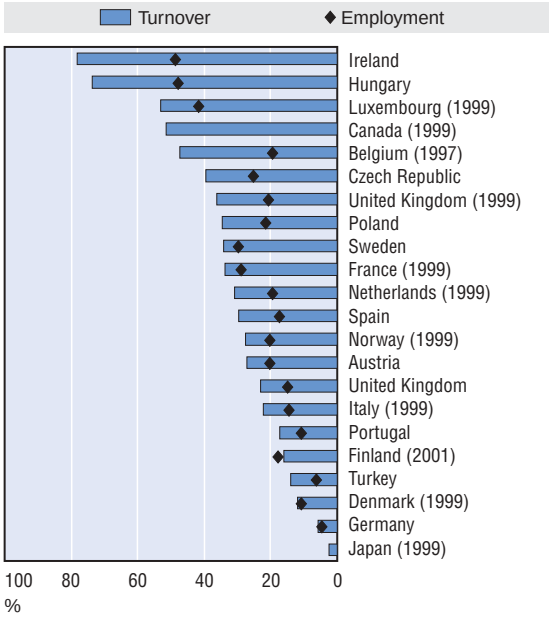
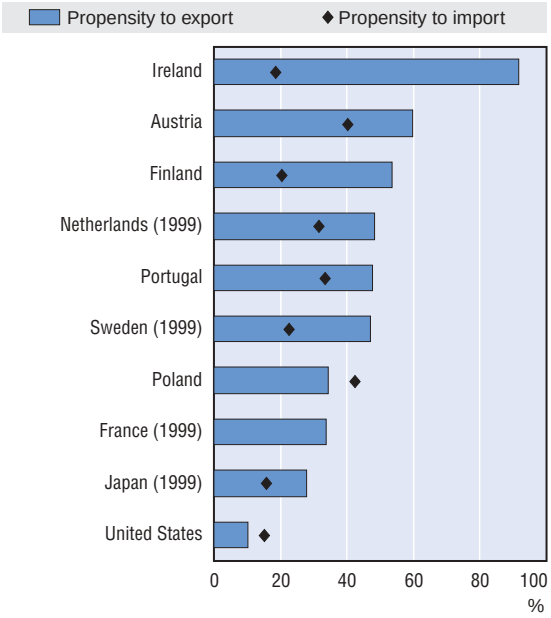
C.4.1. Activity of affiliates under foreign control in manufacturing

Share of affiliates under foreign control in manufacturing turnover[1] and employment
2000 or latest available year

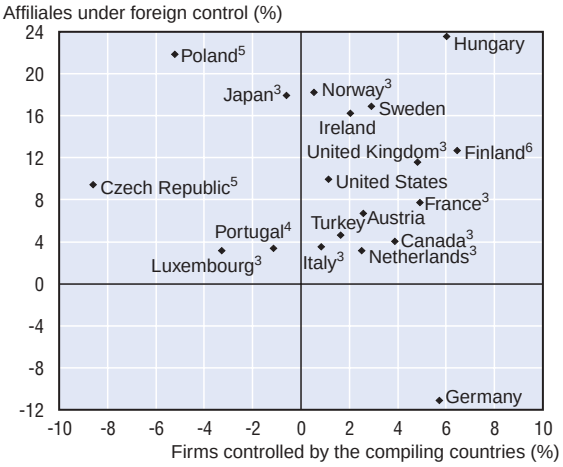


Export and import propensity[2] of foreign affiliates in manufacturing
2000 or latest available year

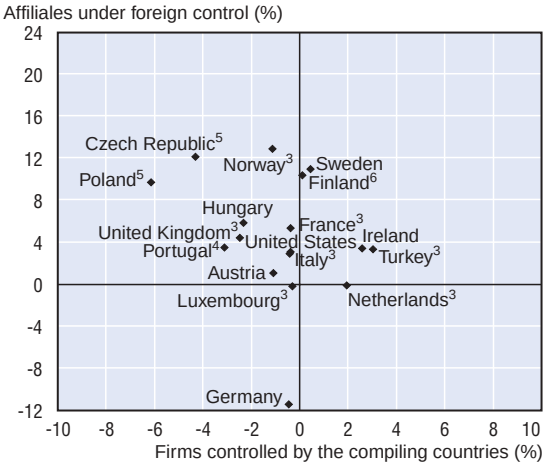


Employment and turnover[1] of foreign affiliates and firms controlled by the compiling countries in manufacturing
Average annual growth rate 1995-2000

Turnover



Employment



1. Production instead of turnover for Canada and Ireland.
2. Exports or imports as a share of turnover (except Ireland for which production is used).
3. 1995-1999.
4. 1996-2000.
5. 1997-2000.
6. 1996-2001.

Source: OECD, AFA and FATS databases, May 2003.

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C.4.2. Activity of affiliates under foreign control in services

- Collection of data on the activity of foreign affiliates in services did not start until the second half of the 1990s, and data are not yet available for all OECD countries. However, the growing availability of data confirms the increasing importance of foreign affiliates in the services sector.
- The share of turnover under foreign control in the services sector is relatively high, at over 20%, for Hungary, Belgium, Ireland, the Czech Republic, Poland and Italy. In terms of employment, the share of foreign affiliates ranges from 19% in Belgium and around 15% in Hungary, Poland, the Czech Republic and Ireland to less than 1% in Japan.
- In all countries except Finland, the share of turnover of foreign affiliates is greater for manufacturing than for services (see C.4.1).
- In terms of employment, penetration of foreign affiliates seems evenly distributed between services and manufacturing in Belgium, Finland, Portugal and the Czech Republic. The largest differences are in Hungary, Ireland and Luxembourg.
- In Japan, the penetration of foreign affiliates is similar in services and manufacturing with respect to employment and turnover, but the shares are quite low compared with those of other OECD countries.

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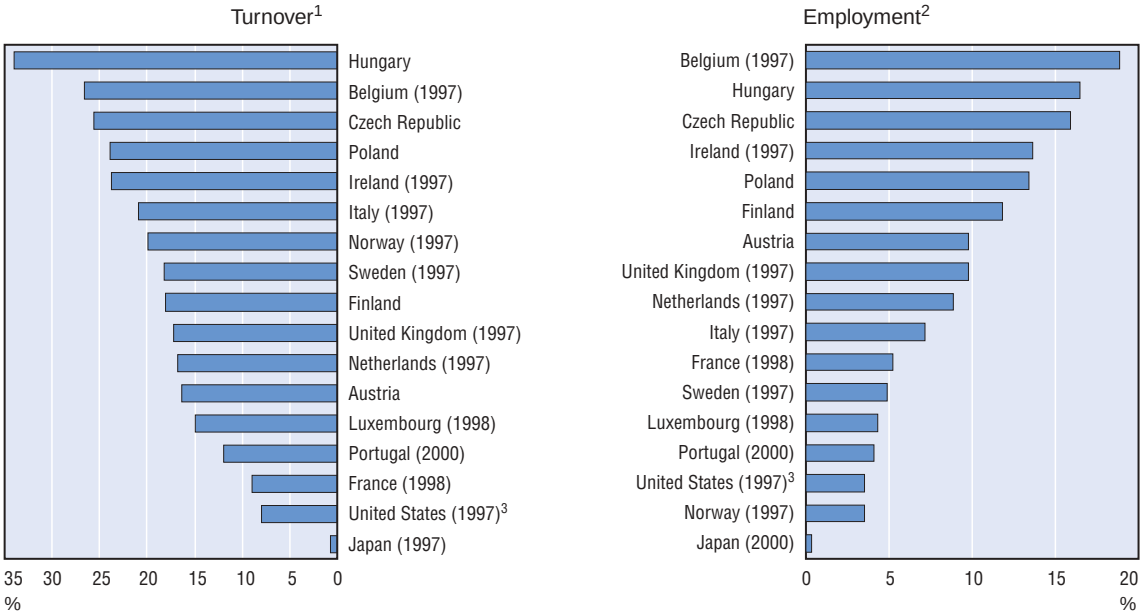
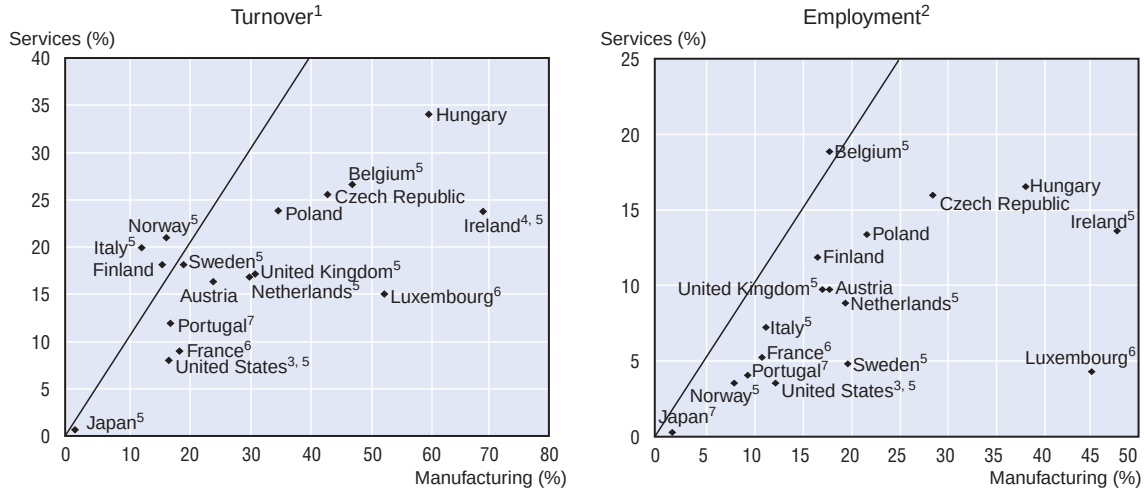
C.4.2. Activity of affiliates under foreign control in services

Share of affiliates under foreign control in services, 2001 or latest year available



Comparative share in national turnover and employment for services and manufacturing, 2001



1. Financial intermediation (ISIC 65 to 67) is excluded from turnover for all countries except France, Hungary, Norway and Poland. Insurance (ISIC 66) is also included for Austria, Luxembourg and the United States. Community, social and personal services (ISIC 75 to 99) are excluded for Austria, Belgium, Ireland, Italy, Japan, Netherlands (except ISIC 90 and 93) and the United Kingdom.
2. Financial intermediation (ISIC 65 to 67) is excluded from employment for all countries except Austria, Finland, France, Hungary, Luxembourg, Norway and Poland. Insurance (ISIC 66) is also included for the United States. Community, social and personal services (ISIC 75 to 99) are excluded for Austria, Belgium, Ireland, Italy, Japan, Netherlands (except ISIC 90 and 93) and the United Kingdom.
3. The data used here for affiliates under foreign control are broken down by industry of sales to be compatible with national total data.
4. Production instead of turnover for manufacturing.
5. 1997 instead of 2001.
6. 1998 instead of 2001.
7. 2000 instead of 2001.

Source: OECD, FATS database, December 2002.

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C.4.3. The contribution of multinationals to value added and labour productivity

- In Ireland, over 85% of value added in the manufacturing sector in 2000 was generated by firms under foreign control. In Hungary, their contribution was over 70%. In Sweden, France, the Netherlands, Norway, the United Kingdom and Spain, their contribution was between 25% and 35%. In other countries, it was below 20%.
- The value added shares show that Ireland is the only country in which the value added of affiliates under foreign control is substantially higher than the share of those same affiliates' turnover in total manufacturing turnover (see C.4.1). For most other countries, the contribution of these affiliates' value added to that of manufacturing as a whole is lower or roughly the same as their contribution to turnover.
- In the United States and the United Kingdom, the share of foreign affiliates in value added is lower than their shares in turnover, possibly because affiliates under foreign control import more intermediate products from their parent companies abroad or because they outsource a significant portion of their production. Ireland's situation may be just the opposite.
- Hungary is the only country where the share in total value added of affiliates in services under foreign control is slightly higher than those same affiliates' share in turnover (see C.4.2). In other countries, foreign affiliates in services have a slightly lower share in value added than in turnover.
- The comparison of employment and labour productivity trends of firms under foreign control between 1995 and 2000 reveals some striking differences as well as some groupings with common characteristics.
- Germany, the Czech Republic and Poland differ widely. Germany saw a drop in employment and stagnant labour productivity. The Czech Republic experienced a sharp rise in employment, largely due to acquisitions, accompanied by a slight upturn in productivity. Poland's significant growth in employment occurred along with a sharp rise in labour productivity, the sharpest recorded in any of the OECD countries.
- In Ireland, Hungary, the United States, the United Kingdom and Austria, productivity improved more than employment. In Italy, Portugal and Turkey, employment inched up slightly but productivity was low or declined. In Sweden, Finland, Japan, Norway, employment far outpaced labour productivity.

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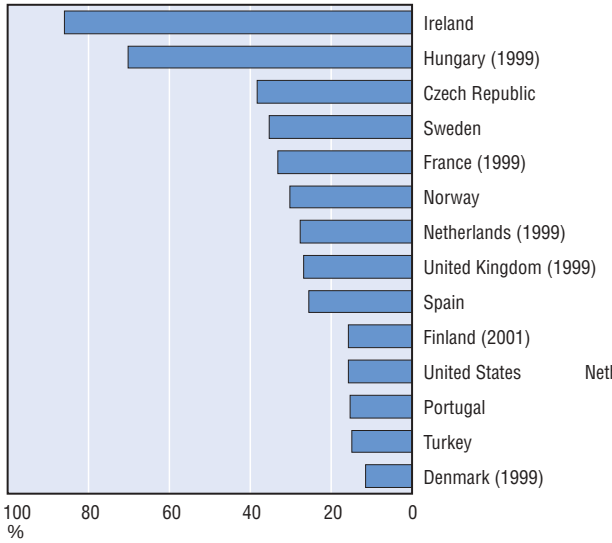
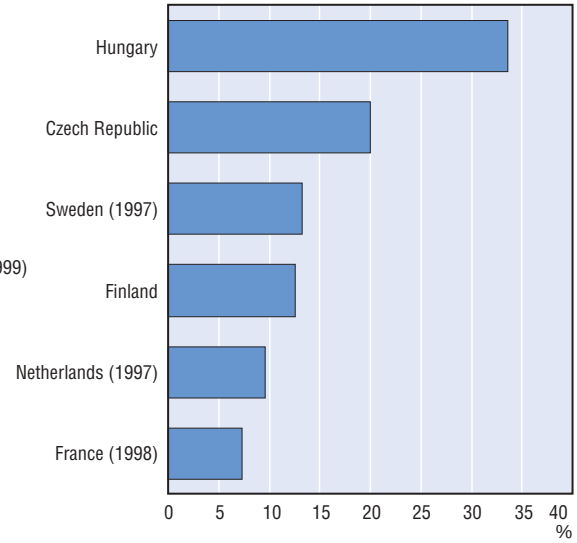
C.4.3. The contribution of multinationals to value added and labour productivity

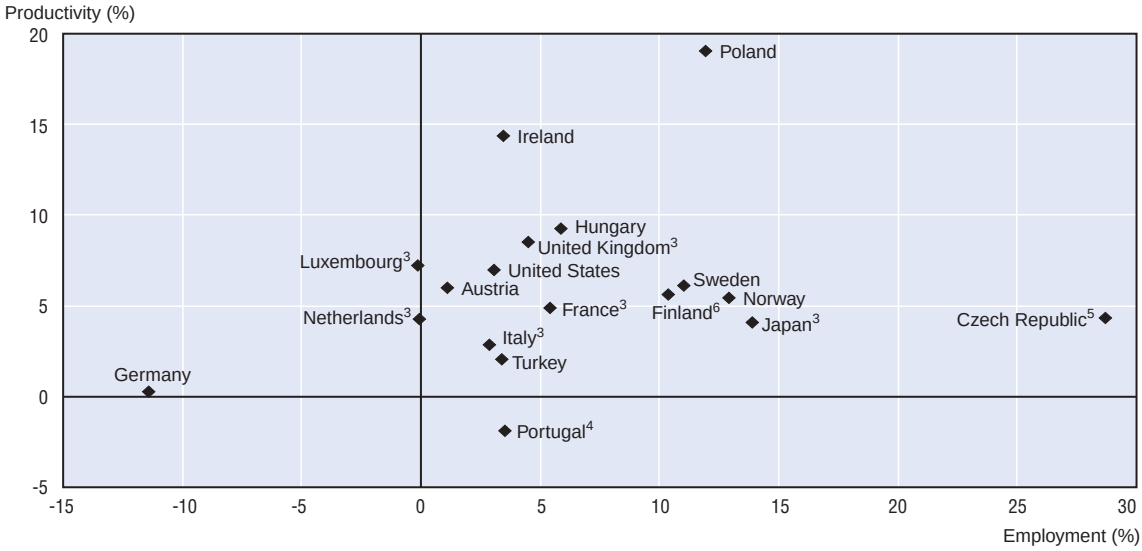
Share of affiliates under foreign control in manufacturing value added
2000 or latest available year



Share of affiliates under foreign control in services[1] value added
2000 or latest available year



Trends in manufacturing employment and labour productivity[2] of affiliates under foreign control
Average annual growth rate 1995-2000



1. Excluding financial intermediation (ISIC Rev. 3, 65 to 67).
2. Turnover to employment.
3. 1995-99.
4. 1996-2000.
5. 1997-2000.
6. 1996-2001.

Source: OECD, AFA and FATS databases, May 2003.

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C.5.1. Internationalisation of manufacturing R&D

- In many OECD countries, R&D activities are less internationalised than production. This is changing as more multinationals set up offshore R&D laboratories.
- Evaluating the net effect of R&D performed by foreign affiliates is a complex process. Ideally, the presence of research-performing foreign affiliates enables the host country to benefit from their technological and organisational capabilities. However, the available data indicate that R&D activities abroad consist primarily of design and development to help the parent company establish a market presence in the host country.
- The share of foreign affiliates in industrial R&D varies widely across countries, ranging from less than 5% in Japan to over 70% in Hungary and Ireland. At over 30%, the share of R&D conducted by foreign affiliates is also high in Spain, Sweden, Canada, the Netherlands, the United Kingdom and Portugal.
- These differences primarily reflect the contribution of foreign affiliates to industrial activity (see C.4.1). For instance, the share of foreign affiliates in manufacturing production or turnover is high in Ireland and low in Japan.
- The share of foreign affiliates in R&D also reflects the size of their R&D effort relative to that of domestic firms. In Hungary and Ireland, for example, foreign affiliates carry out relatively more R&D than national firms. In most other OECD countries, and particularly in Japan, the opposite is true.
- Other factors, such as the quality of scientific personnel and research centres and the scale of technology transfers from parent companies to affiliates abroad in relation to the independent R&D activity of those affiliates, may also play a part.

Internationalisation of manufacturing R&D

The marked growth in R&D expenditures in OECD countries from the first half of the 1980s was accompanied by two major trends:

- First, the growing internationalisation of R&D activities of multinational firms as the result of an increase in the number of R&D laboratories located abroad.
- Second, the emergence and development of international networks of co-operation agreements or alliances either between firms or between firms and government or university R&D bodies.

While the first of these trends is restricted to multinationals, the second characterises all categories of firms. The decentralisation of their R&D activities by multinational firms, *i.e.* the establishment of laboratories outside the home country of the parent company, is by no means a new phenomenon. Decentralised R&D facilities have been used for some time to serve and support overseas production units. Until recently, owing to the absence of data on the R&D activities of multinational firms, it was thought that internationalisation of R&D was marginal to the general process of economic globalisation. The OECD's surveys, which cover more fully the activities of foreign affiliates in OECD countries and of national firms abroad (AFA database), show that R&D performed abroad and by foreign affiliates represents on average well over 12% of total expenditure on industrial R&D in the OECD area. In most OECD countries, the share of foreign affiliates in manufacturing R&D is increasing. In Sweden, Spain, Portugal, Hungary and Ireland, it exceeds 35%.

For further information see OECD (1998), *Internationalisation of Industrial R&D: Patterns and Trends*, OECD, Paris.

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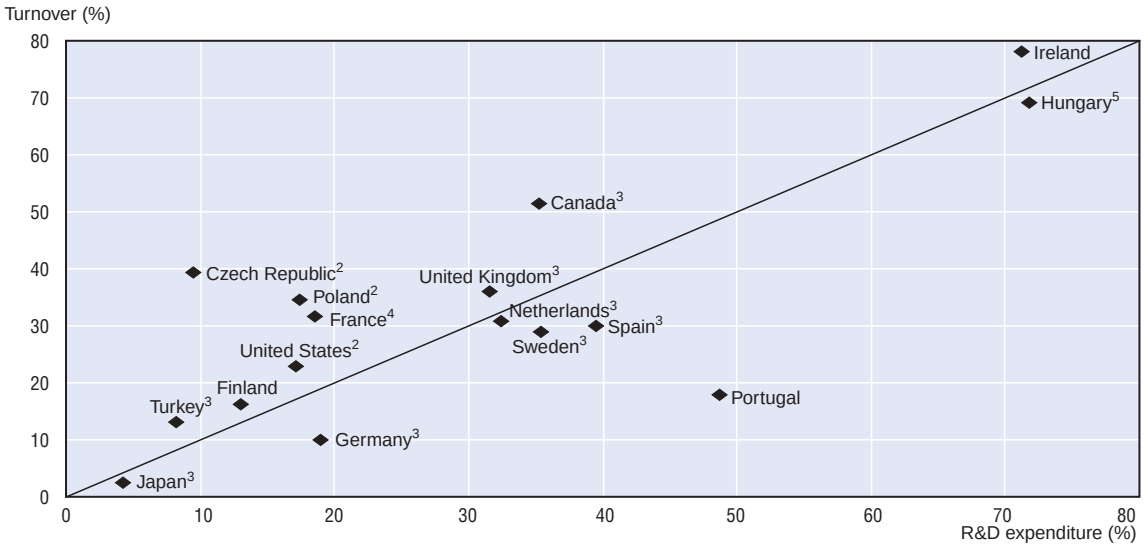
C.5.1. Internationalisation of manufacturing R&D

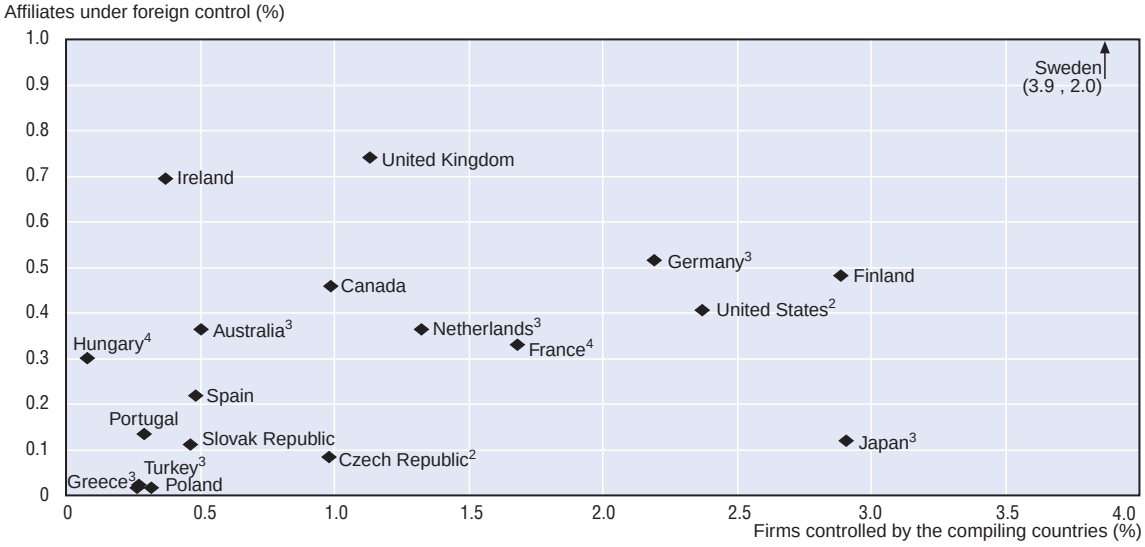
Share of R&D and turnover of affiliales under foreign control in total manufacturing R&D and turnover

2001 or latest available year



R&D intensities[1] of foreign affiliales and firms controlled by the compiling countries

Manufacturing sector, 2001 or latest available year



1. R&D expenditure as a share of value added in industry.
2. 2000.
3. 1999.
4. 1998.
5. 1997.

Source: OECD, AFA database, May 2003.

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C.5.2. Cross-border ownership of inventions

- As firms progressively relocate their production and research facilities abroad as part of their internationalisation strategies (see C.5.1), an increasing share of technology is owned by firms of a country that is not the inventor's country of residence.
- In the late 1990s as in the mid-1990s, an average of 14% of all inventions in any OECD country were owned or co-owned by a foreign resident. Likewise, OECD countries owned around 14% of inventions made abroad.
- Foreign ownership of domestic inventions is high in Iceland, Luxembourg, Belgium, Portugal and Mexico, as well as in Poland, the Czech Republic and Hungary. It is also high in Canada and the United Kingdom, where a large share of inventions is owned by US companies and is related to the inventive activity of their foreign affiliates.
- Domestic ownership of inventions made abroad is also high in small open countries. For example, more than 80% of all inventions owned by residents of Luxembourg were made abroad. This share is also high in Switzerland (44%), Ireland (38%), Portugal (37%) and the Netherlands (31%). Although the United States, because of its size, is one of the largest owners of patents covering foreign inventions, the share of foreign inventions in its patent portfolio is only 16%. This figure has increased since the mid-1990s, when it was 13%.
- Japan and Korea, on the other hand, are much less internationalised in terms of cross-border ownership of inventions. Linguistic barriers, low penetration of foreign affiliates and geographical distance from Europe and the United States may help explain this.

Cross-border ownership of inventions

Patents are increasingly recognised as a rich source of information about technological performance. Patent files show the inventor and the applicant (the owner of the patent at the time of application), their addresses and hence their country of residence. For most patents, the applicant is an institution (generally a firm, university or public laboratory), and sometimes an individual, but inventors are always individuals.

An increasing share of European Patent Office (EPO) patent applications is controlled by applicants whose country of residence is different from the country of residence of the inventor(s). Cross-border ownership practices are mainly the result of activities of multinationals; the applicant is a conglomerate and the inventors are employees of a foreign subsidiary. It is therefore possible to trace the international circulation of knowledge from "inventor" countries to "applicant" countries. Such information can be used to compute two main types of indicators:

- The first evaluates the extent to which foreign firms control domestic inventions by dividing the number of domestic inventions controlled by a foreign resident by the total number of domestic inventions.
- The second provides a mirror image: it evaluates the extent to which domestic firms control inventions made by residents of other countries. The number of foreign inventions controlled by resident applicants is divided by the total number of domestic applications. For example, a multinational from country A has research facilities in both country A and country B. This indicator provides the share of patents from its facilities in country B in the total number of patents.

The analysis is based on the database of patent applications to the EPO. Patents granted by the United States Patent and Trademark Office (USPTO) and the EPO show similar internationalisation trends.

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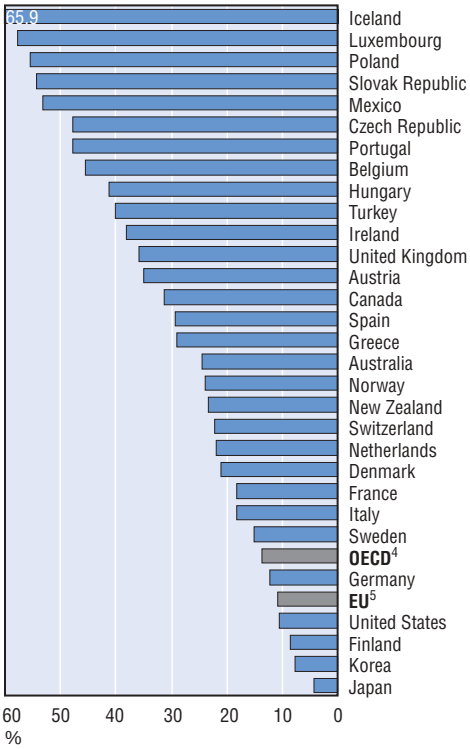
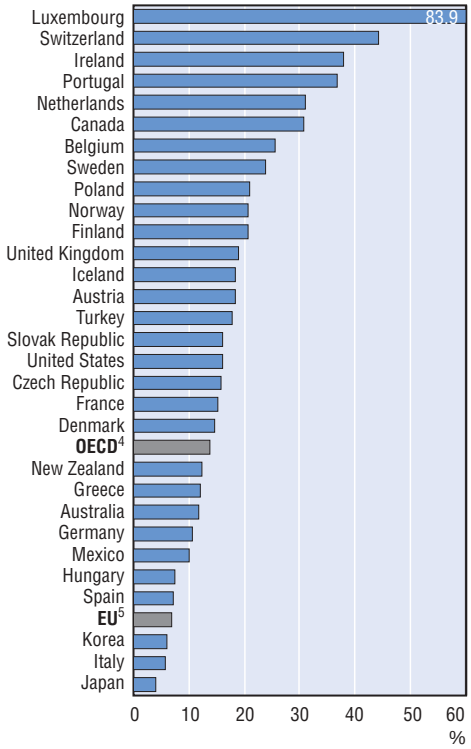
C.5.2. Cross-border ownership of inventions

Foreign ownership of domestic inventions[1]
1997-99[3]



Domestic ownership of inventions made abroad[2]
1997-99[3]



1. Share of patent applications to the European Patent Office (EPO) owned by foreign residents in total patents invented domestically.
2. Share of patent applications to the EPO invented abroad in total patents owned by country residents.
3. Priority years.
4. Patents of OECD residents' that involve international co-operation.
5. The EU is treated as one country; intra-EU co-operation has been netted out.

Source: OECD, Patent database, May 2003.

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C.5.3. International co-operation in science and technology

- The production of scientific research and technological know-how increasingly depends on research conducted in other countries. Indicators of cross-border co-authorship of scientific articles and co-invention of patents seek to shed light on this trend.
- Scientific collaboration with large OECD countries is generally much more widespread than with smaller ones. Researchers in 160 countries co-authored at least 1% of their internationally co-authored papers with US researchers. The United Kingdom, France and Germany also play a leading role in international scientific collaboration.
- By the late 1990s, about 6% of patents of OECD residents were the result of international collaborative research. Several factors may affect the degree of a country's internationalisation in science and technology: size, technological endowment, geographical proximity to regions with high research activity, language, industrial specialisation, existence of foreign affiliates, etc.
- Internationalisation tends to be higher in smaller European countries. For example, 56% of Luxembourg's patents have foreign co-inventors and 30% of Iceland's and Belgium's. International co-operation in science and technology is also relatively high in Poland, the Czech Republic and the Slovak Republic.
- When intra-EU co-operation is factored out, international collaboration in patenting is lower in the European Union than in the United States. In Japan, international co-operation in science and technology is rather limited.

International co-operation in science and technology

Patent data include the name and address of all inventors (individuals). An increasing share of European Patent Office (EPO) patent applications involves inventors with different countries of residence. International collaboration by researchers can take place either within a multinational corporation (research facilities in several countries) or through a research joint venture among several firms.

The propensity to collaborate internationally can be derived from the address of the inventors listed in the patent file. Here, it is approximated as the ratio of the number of inventions involving a country's residents and at least one inventor with foreign residence to the total number of inventions involving a country's residents. An increasing share of patents involves inventors with residences in more than two countries.

The indicator of scientific collaboration is based on data from the US National Science Foundation. It describes the number of countries that have jointly authored papers (based on institutional address) with the countries indicated. The information is based on data from the Institute for Scientific Information, Science Citation and Social Science Citation Indexes; from CHI Research, Inc., Science Indicators database; and from the National Science Foundation, Division of Science Resources Statistics (NSF/SRS).

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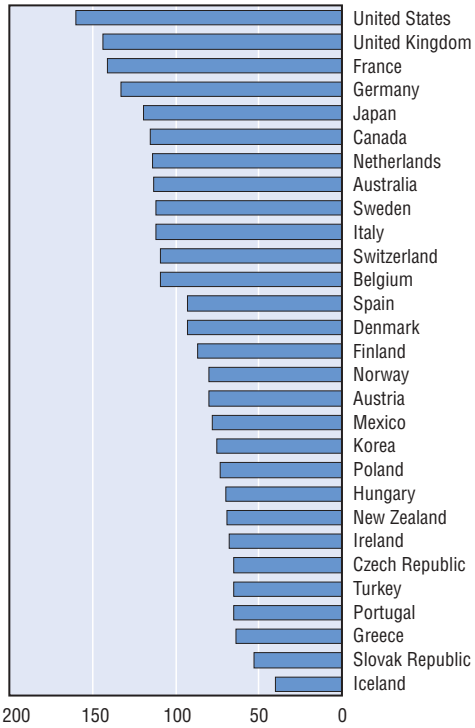
C.5.3. International co-operation in science and technology

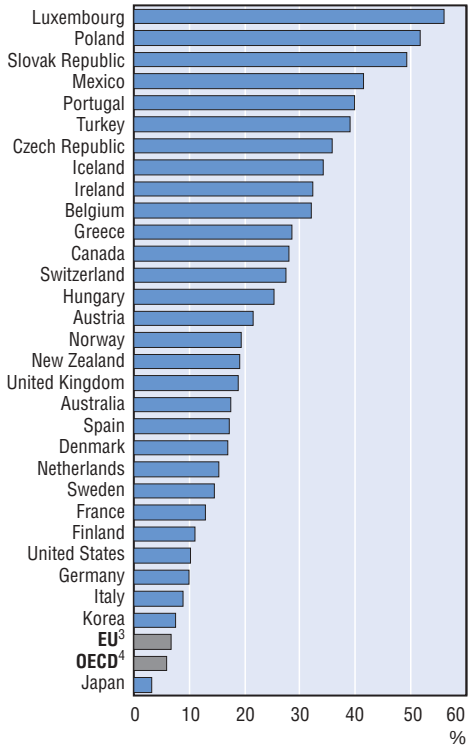
Breadth of international scientific collaboration by country, 1999



Note: The figure shows the number of countries that shared at least 1% of their internationally co-authored papers with the country.

Source: OECD, based on data from the National Science Foundation, *Science and Engineering Indicators* – 2002.

Percentage of patents[1] with foreign co-inventors 1997-99[2]



1. Patents applications to the European Patent Office.
2. Priority years.
3. The EU is treated as one country; intra-EU co-operation has been netted out.
4. Patents of OECD residents that involve international co-operation.

Source: OECD, Patent database, May 2003.

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C.5.4. Technology balance of payments

- The technology balance of payments measures international technology transfers: licences, patents, know-how, research and technical assistance. These payments are for commercial technologies and are therefore different from R&D expenditure.
- In most OECD countries, technological receipts and payments increased sharply during the 1990s. Overall, the OECD area maintained its position as a net exporter of technology as compared to the rest of the world.
- The European Union, however, continued to run a deficit on its technology balance of payments. This does not necessarily indicate low competitiveness. It may be the result of increased imports of foreign technology into the European Union.
- The main technology exporters as a percentage of GDP are the United Kingdom, Switzerland, Belgium, Denmark, the United States, the Czech Republic, Japan and Canada. Ireland, Korea, Hungary and Portugal imported more technology than they exported.
- The magnitude of the deficit in Ireland's technology payments is due to the strong presence of foreign affiliates (mainly US and UK firms), which import technology from their home countries.

Technology balance of payments

Technology receipts and payments constitute the main form of disembodied technology diffusion. Trade in technology comprises four main categories:

- Transfer of techniques (through patents and licences, and disclosure of know-how).
- Transfer (sale, licensing, franchising) of designs, trademarks and patterns.
- Services with a technical content, including technical and engineering studies, as well as technical assistance.
- Industrial R&D.

Although the balance reflects a country's ability to sell its technology abroad and its use of foreign technologies, a deficit does not necessarily indicate low competitiveness. In some cases, it results from increased imports of foreign technology; in others, it is due to declining receipts.

Likewise, if the balance is in surplus, this may be the result of a high degree of technological autonomy, a low level of technology imports or a lack of capacity to assimilate foreign technologies. Most transactions also correspond to operations between parent companies and affiliates, which may create distortions in the valuation of the technology transfer. Thus, additional qualitative and quantitative information is needed to analyse correctly a country's deficit or surplus position in a given year.

There is also the difficulty of dissociating the technological from the non-technological content of trade in services, which falls under the heading of pure industrial property. Thus, trade in services may be underestimated when a significant portion does not give rise to any financial payments or when payments are not in the form of technology payments.

For more details, see Annex Table C.5.4.

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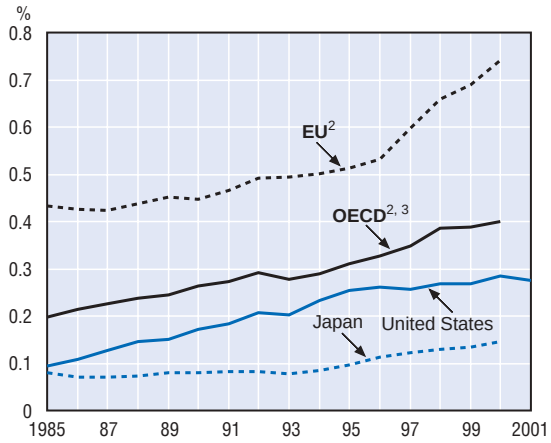
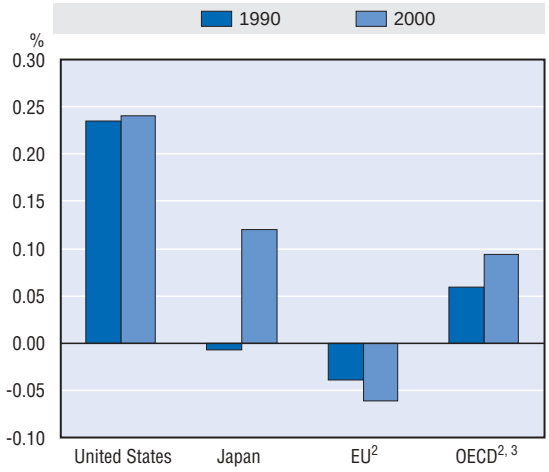
C.5.4. Technology balance of payments

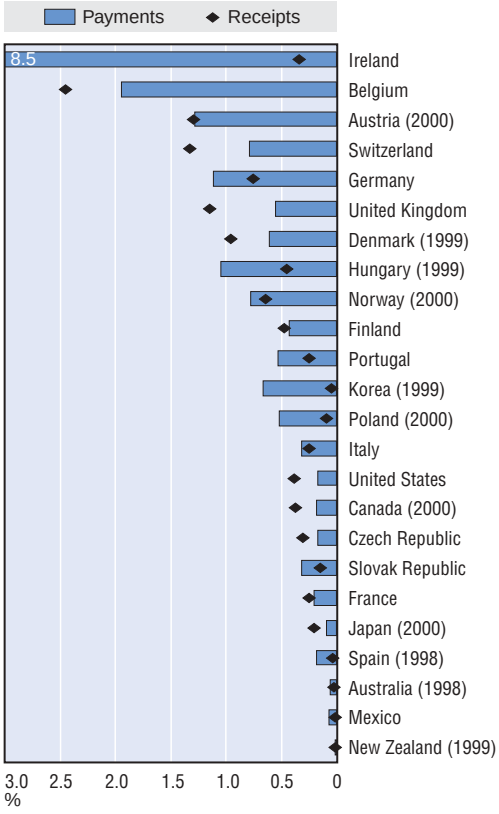
Trends in technology flows[1]
as a percentage of GDP by geographical area



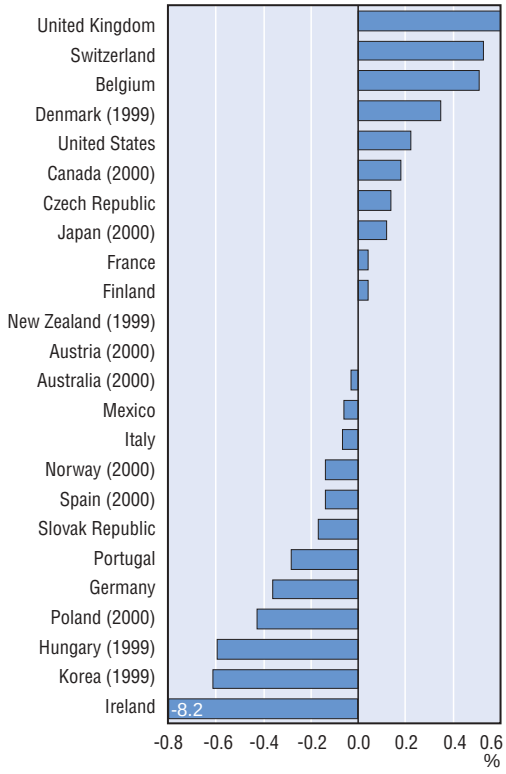
Change in the balance of payments
as a percentage of GDP, 1990 and 2000



Flows[1] as a percentage of GDP
2001 or latest available year



Technology balance of payments
as a percentage of GDP
2001 or latest available year



1. Average of technological payments and receipts.
2. Includes intra-area flows. Excludes Denmark and Greece. Data partially estimated.
3. Excludes the Czech Republic, Hungary, Iceland, Poland, the Slovak Republic and Turkey.

Source: OECD, Technology Balance of Payments (TBP) database, May 2003.

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D.1. Differences in income and productivity

- In 2002, GDP per capita in the OECD area ranged from over USD 35 000 in Luxembourg, Norway and the United States to less than half of that in Mexico, Korea and the Eastern European countries. For the majority of OECD countries, income levels are 70-85% of US income levels.
- The differences in income reflect a combination of labour productivity and labour utilisation. A country's labour productivity level is typically the most significant factor in determining differences in income, particularly in countries with low levels of GDP per capita.
- Relative to the United States, most OECD countries have higher levels of GDP per hour worked than GDP per capita because they have lower levels of labour utilisation. The difference between income and productivity levels is largest in European countries; GDP per hour worked surpasses the US productivity level in several countries, whereas income levels are substantially lower than in the United States.
- In many OECD countries, labour use, as measured by hours worked per capita, is substantially lower than in the United States. This is because of disparities in working hours but also in several countries because of high unemployment and low participation of the working-age population in the labour market. In Iceland and Korea, however, labour input per capita is considerably higher than in the United States, owing to relatively long working hours and high rates of labour force participation.

Comparisons of income and productivity levels

Comparisons of income and productivity levels face several measurement problems. First, they require comparable data on output. In the 1993 System of National Accounts (SNA), the measurement and definition of GDP are treated systematically across countries. Most countries have now implemented this system; in the OECD area, Switzerland and Turkey are the only exceptions, and their output is likely to be understated relative to other OECD countries. Other differences, such as the measurement of software investment, also affect the comparability of GDP across countries, although the differences are typically quite small.

The second problem is the measurement of labour input. Some countries integrate the measurement of labour input in the national accounts; this may ensure that estimates of labour input are consistent with those of output. In most countries, however, employment data are derived from labour force surveys which are not entirely consistent with the national accounts. Labour input also requires measures of hours worked, which are typically derived either from labour force surveys or from business surveys. Several OECD countries estimate hours worked from a combination of these sources or integrate these sources in a system of labour accounts, which are comparable to the national accounts. The cross-country comparability of hours worked therefore remains somewhat limited, with a margin of uncertainty in estimates of productivity levels.

Third, international comparisons require price ratios to convert output expressed in a national currency into a common unit. Exchange rates are of limited use for this purpose because they are volatile and reflect many influences, including capital movements and trade flows. The alternative is to use purchasing power parities (PPP), which measure the relative prices of the same basket of consumption goods in different countries. The estimates shown here use official OECD PPPs for 2002.

For more details, see Annex Table D.1.

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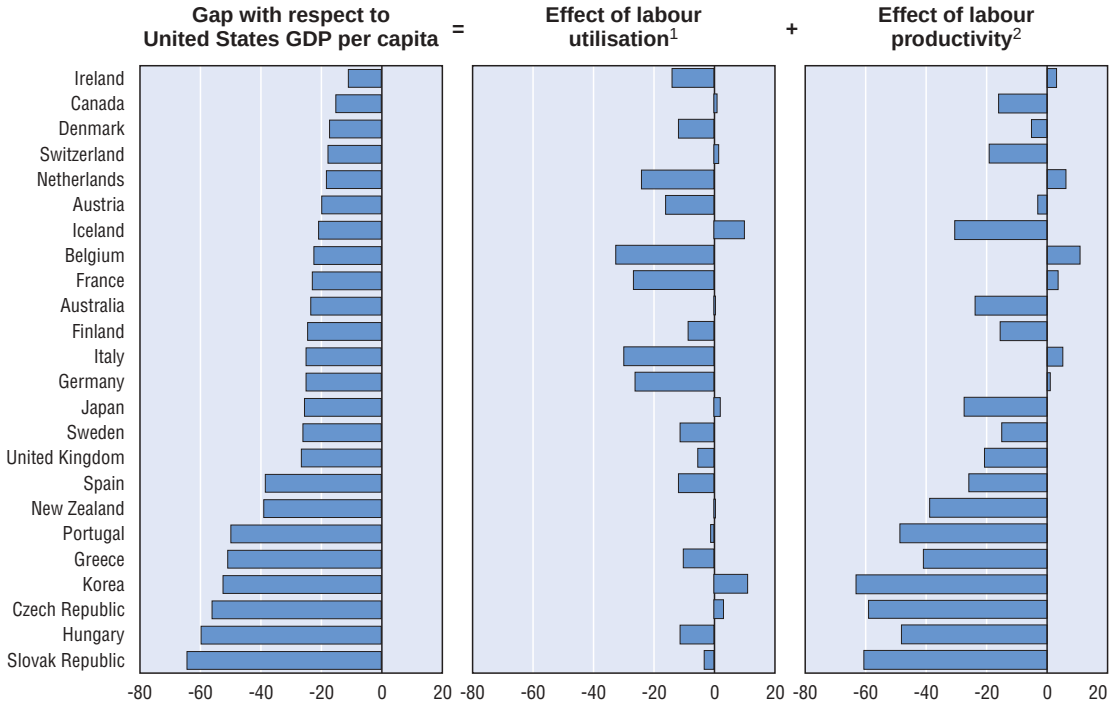
D.1. Differences in income and productivity

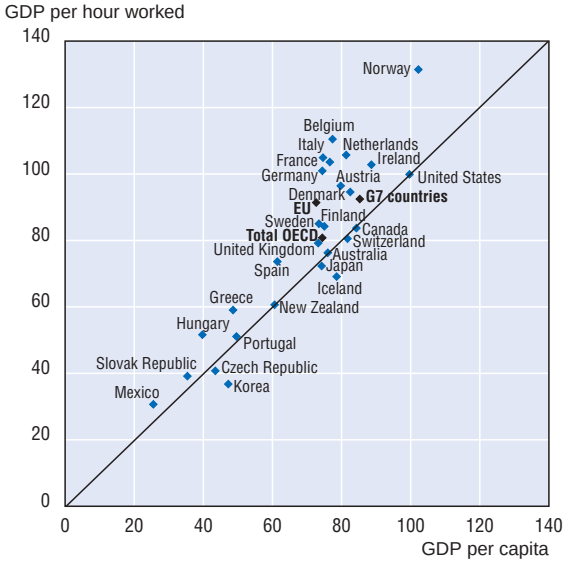
Income and productivity levels, 2002

Percentage point differences with respect to the United States



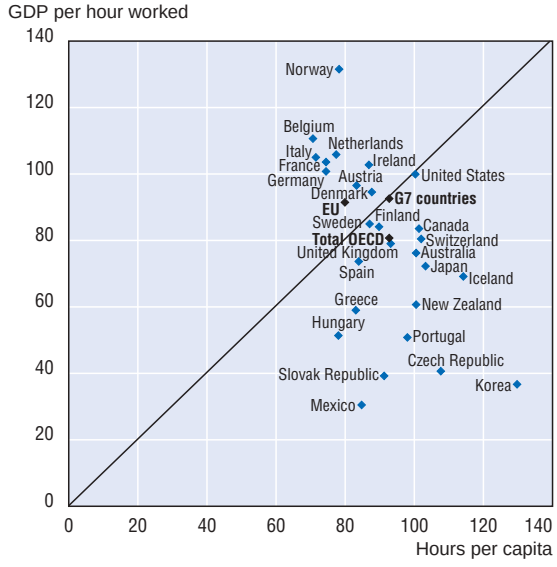
GDP per capita and GDP per hour worked

United States = 100



GDP per hour worked and hours per capita

United States = 100



Note: Total OECD excludes Poland and Turkey.

1. Based on hours worked per capita.
2. GDP per hour worked.

Source: OECD, *National Accounts* and *Labour Force Statistics*, 2003. Hours worked from the *OECD Employment Outlook*.

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D.2. Income and productivity levels in the OECD area, 1950-2002

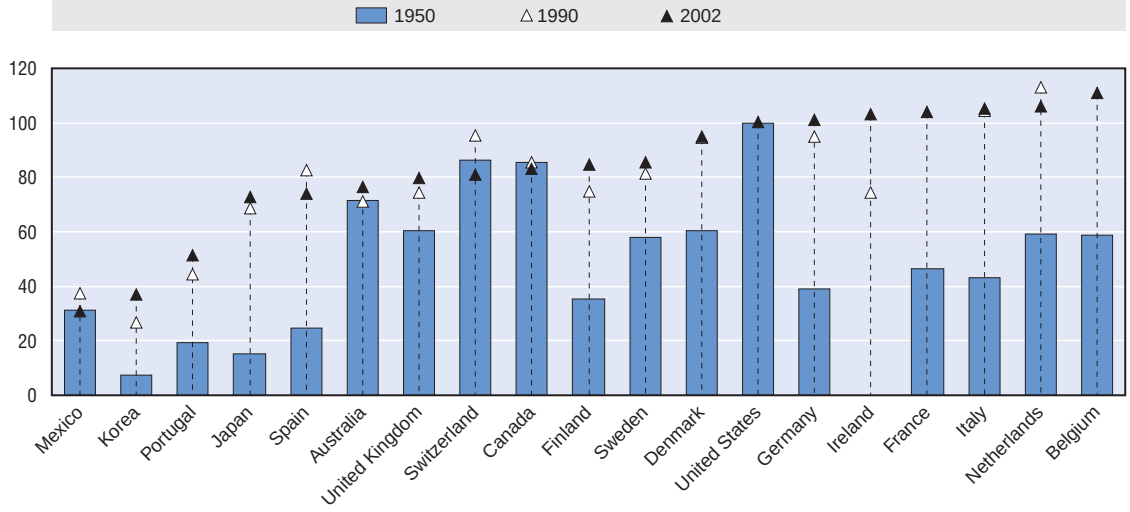
- Cross-country differences in GDP per capita and labour productivity in the OECD area have eroded considerably since the 1950s. Over the 1950s and 1960s, income levels in OECD countries were catching up with those of the United States except in Australia, New Zealand and the United Kingdom. In the 1970s, this phenomenon was less widespread and the rate of catch-up fell except in Korea. In the 1980s, there was even less catch-up, as GDP per capita grew more slowly than in the United States in 19 OECD countries. The same was true for 15 OECD countries in the 1990s with Ireland being the most notable exception.
- Japan and Korea had the highest rates of catch-up over the period 1950-2002, with GDP per capita growing more rapidly than in the United States, by 2.5% and 3.3%, respectively. Rates of catch-up were much lower, typically below 1% a year, in most of western Europe. Australia, New Zealand, the United Kingdom and Canada already had relatively high income levels in 1950 and have done little catching up with the United States. Switzerland has seen a marked decline in its relative income level. Eastern European countries, Mexico and Turkey started with low income levels in the 1950s and have only caught up a little.
- Changes in levels of GDP per hour worked show a slightly different pattern. Out of 19 OECD countries for which data are available, only Mexico, Canada and Australia have not been catching up almost continuously with US productivity levels over the post-war period. Several European countries now stand even with the United States in terms of average labour productivity and some have even surpassed US productivity levels.

Income and productivity levels over time

Comparisons of income and productivity levels for a particular year (see D.1) can be updated over time by using time series for GDP, population, employment and hours worked. Time series for GDP, population and employment are all derived from the OECD's newly established productivity database. This OECD database only dates back to the early 1970s, however. For earlier years, estimates were derived by using data for GDP, population, employment and hours worked from Angus Maddison (2001), *The World Economy: A Millennial Perspective*, OECD Development Centre, OECD, Paris. The OECD Internet site also provides estimates of comparative income levels of OECD member countries at: *www.oecd.org/statistics*

GDP per hour worked in the OECD area, 1950, 1990 and 2002

United States = 100



Source: 2002 productivity levels from Annex Table D.1; previous years based on GDP, employment and hours worked from the OECD productivity database and Angus Maddison (2001), *The World Economy: A Millennial Perspective*, Development Centre Studies, OECD, Paris.

For more details, see Annex Table D.2.

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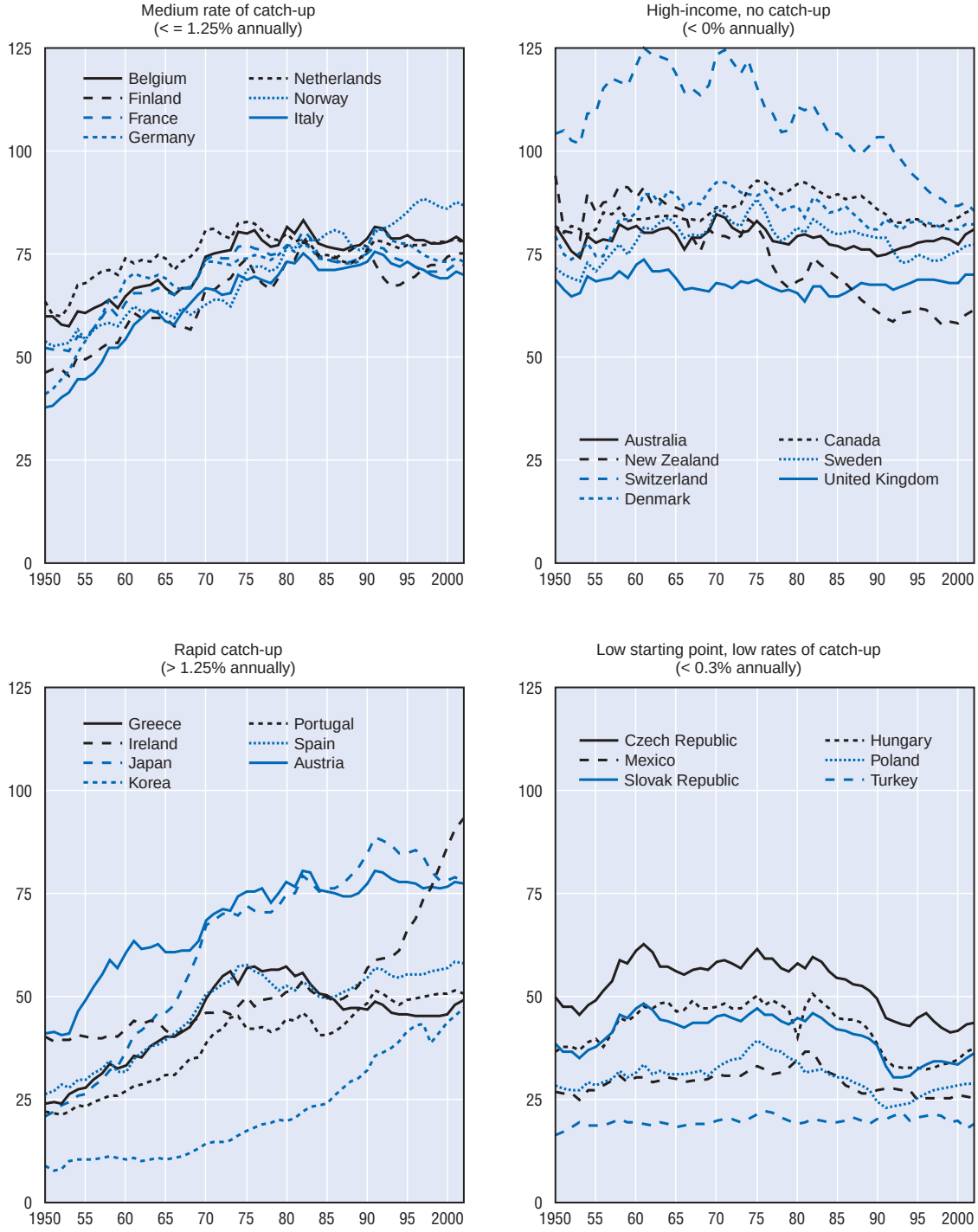
D.2. Income and productivity levels in the OECD area, 1950-2002

Catch-up and convergence in OECD income levels, 1950-2002, United States = 100



Source: 2002 income levels from Annex Table D.1.1; previous years based on GDP and population data from the OECD productivity database and Angus Maddison (2001), *The World Economy: A Millennial Perspective,* Development Centre Studies, OECD, Paris.

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D.3. Labour productivity growth

- Productivity growth can be measured by relating changes in output to changes in one or more inputs to production. The most common productivity measure is labour productivity, which links changes in output to changes in labour input. It is a key economic indicator and is closely associated with standards of living.
- Estimates of the increase in GDP per hour worked for OECD countries for 1990-2002 show that rates of labour productivity growth were highest in Korea and Ireland. In Ireland, Australia, Greece and Sweden, they were substantially higher in the 1990s than in the 1980s. In Korea, Japan and France, they were much lower in the 1990s than in the 1980s.
- Labour productivity growth has varied considerably over the decade. In Ireland, Greece, Iceland, the United States, Mexico and New Zealand, it grew much faster in the second half than in the first. In other OECD countries, notably Korea, Portugal, Norway, Germany, the United Kingdom, Spain, Denmark and Italy, it slowed over the 1990s.

OECD measures of productivity

The* OECD *Productivity Manual. There are many different approaches to the measurement of productivity. The calculation and interpretation of the different measures are not straightforward, particularly for international comparisons. To give guidance to statisticians, researchers and analysts who work with productivity measures, the OECD released the OECD *Productivity Manual* in 2001. It is the first comprehensive guide to various productivity measures and focuses on the industry level. It presents the theoretical foundations of productivity measurement, discusses implementation and measurement issues and is accompanied by examples from OECD member countries to enhance its usefulness and readability. It also offers a brief discussion of the interpretation and use of indicators of productivity. See: *www.oecd.org/sti/measuring-ind-performance*

Development of an* OECD *Productivity Database. Productivity measures rely heavily on the integration of measures of output and input. Some of the most important differences among studies of labour productivity growth are linked to choice of data, notably the combination of employment, hours worked and GDP. To address this problem, OECD is developing a reference database on productivity at the aggregate level, with a view to resolving the problem of data consistency.

OECD *estimates of productivity adjusted for the business cycle.* For its work on economic growth, the OECD has developed estimates of productivity growth adjusted for the business cycle. Most productivity measures are procyclical; they tend to accelerate during periods of economic expansion and decelerate during periods of recession. This is partly a question of measurement: variations in volume output tend to be relatively accurately reflected in economic statistics, but variations in the rate of utilisation of inputs are picked up only partially at best. Even if capacity utilisation is measured accurately, the standard model of productivity fits the realities of the business cycle somewhat awkwardly. Much economic and index number theory relies on long-term, equilibrium relationships involving few unforeseen events for economic actors. The economic model of productivity measurement is therefore easier to implement and interpret during periods of continued and moderate expansion than during a rapidly changing business cycle. It is therefore appropriate to examine productivity growth over longer periods or to adjust productivity estimates for cyclical fluctuations. Adjustments for the business cycle are explained in more detail in S. Scarpetta, A. Bassanini, D. Pilat and P. Schreyer (2000), "Economic Growth in the OECD Area: Recent Trends at the Aggregate and Sectoral Level", Economics Department *Working Paper* No. 248, OECD, Paris.

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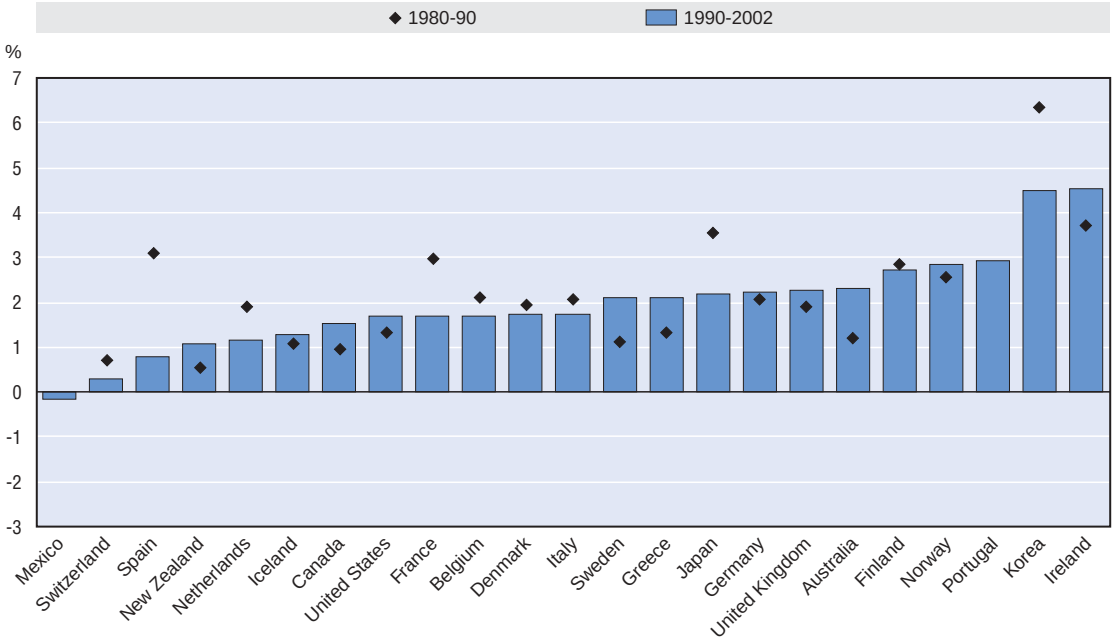
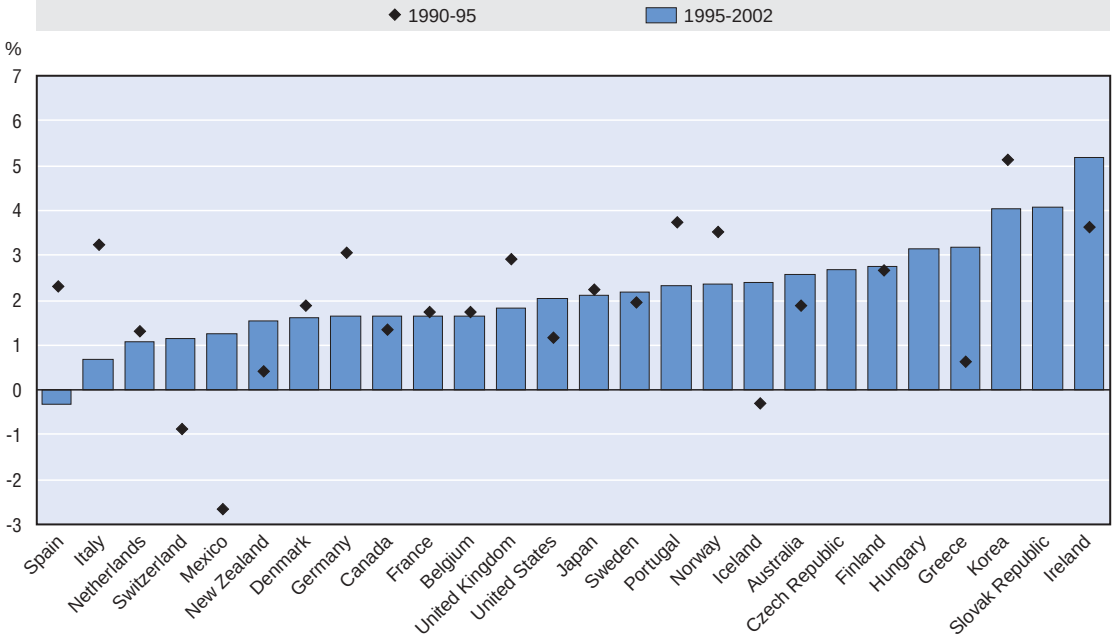
D.3. Labour productivity growth

Growth in GDP per hour worked, 1980-90 compared with 1990-2002
Total economy, percentage change at annual rate



Growth in GDP per hour worked, 1990-95 compared with 1995-2002
Total economy, percentage change at annual rate



Source: OECD, Productivity database, June 2003.

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D.4. Growth accounting for OECD countries

- Investment in information and communication technology (ICT) accounted for between 0.35 and 0.8 percentage points of growth in GDP over the period 1995-2001. The United States, Canada, the Netherlands and Australia received the largest boost; Japan and the United Kingdom a more modest one; and Germany, France and Italy a much smaller one. Investment in software accounted for up to one-third of the contribution of ICT capital. In several countries, ICT accounts for the bulk of capital's contribution to GDP growth.
- Stronger growth in some OECD countries over the 1990s is due to several factors, including higher labour utilisation, capital deepening, notably in ICT, and more rapid multi-factor productivity (MFP) growth. In France, Germany, Italy and the United Kingdom, the contribution of labour input to growth was negative in the first half of the 1990s but positive for 1995-2001.
- In most OECD countries, the contribution of ICT capital to growth of GDP increased over the 1990s. In countries such as Australia and Japan, this was accompanied by a decline in the contribution of non-ICT capital.
- Over the second half of the 1990s, multi-factor productivity growth also accounted for a considerable part of overall growth of GDP, particularly in Finland, Greece, Ireland and Portugal.

Growth accounting

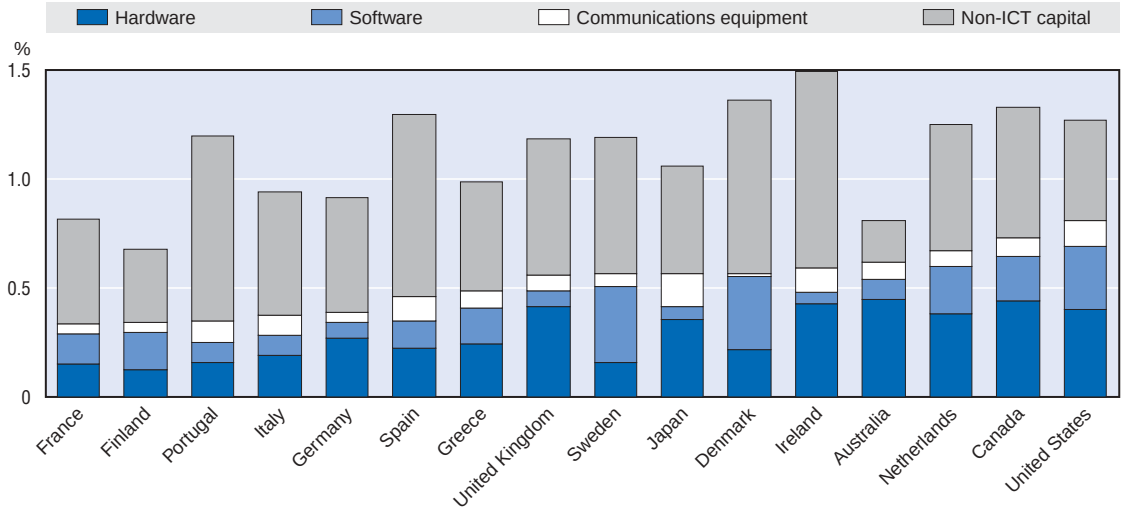
Growth accounting involves breaking down growth of GDP into the contributions of labour input, capital input and multi-factor productivity. The growth accounting model is based on the microeconomic theory of production and rests on a number of assumptions, among which the following are important: *i*) production technology can be represented by a production function relating total GDP to the primary inputs labour L and capital services K; *ii*) this production function exhibits constant returns to scale; and *iii*) product and factor markets are characterised by perfect competition.

For any desired level of output, the firm minimises costs of inputs, subject to the production technology shown above. Factor input markets are competitive, so that the firm takes factor prices as given and adjusts quantities of factor inputs to minimise costs. The rate of growth of output is a weighted average of the rates of growth of the various inputs and of the multi-factor productivity term. The weights attached to each input are the output elasticities for each factor of production. Output elasticities cannot be directly observed, however, and the factor shares of labour and capital are often used as weights.

Further details on growth accounting are available in OECD (2001), OECD *Productivity Manual*, OECD, Paris. The estimates of capital services used here are described in P. Schreyer, P.E. Bignon and J. Dupont (2003), "OECD Capital Services Estimates: Methodology and a First Set of Results", OECD Statistics Working Paper, Paris. Details on growth accounting results can be found in A. Wölfl (2003), "Growth Accounts for OECD countries", STI *Working Paper*, OECD, forthcoming.

Contributions of capital to GDP growth, 1995-2001

Percentages



Note: Countries are ranked according to the contribution of ICT capital to GDP growth over the period 1995-2001.
Source: OECD Productivity Database and Database on Capital Services, June 2003.

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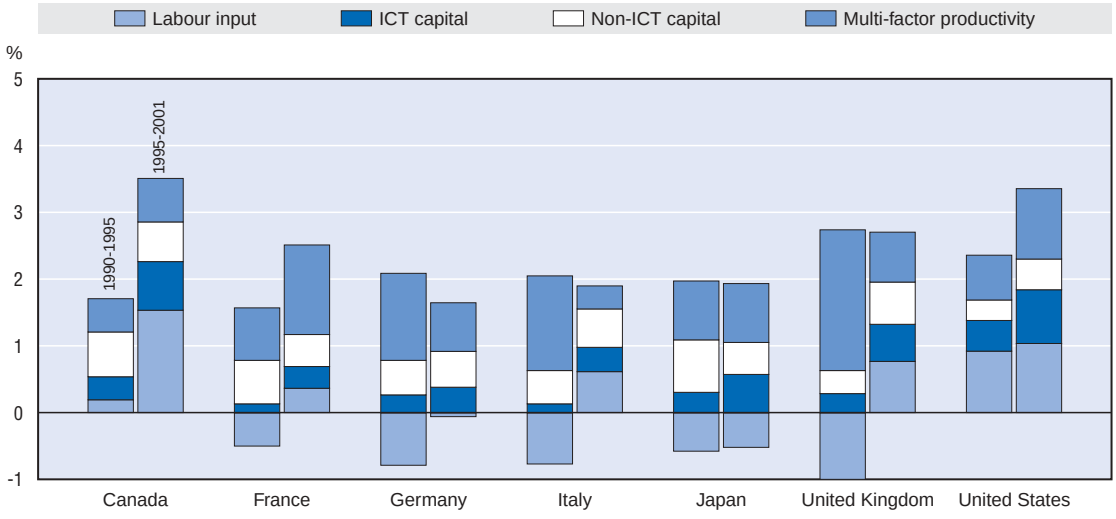
D.4. Growth accounting for OECD countries

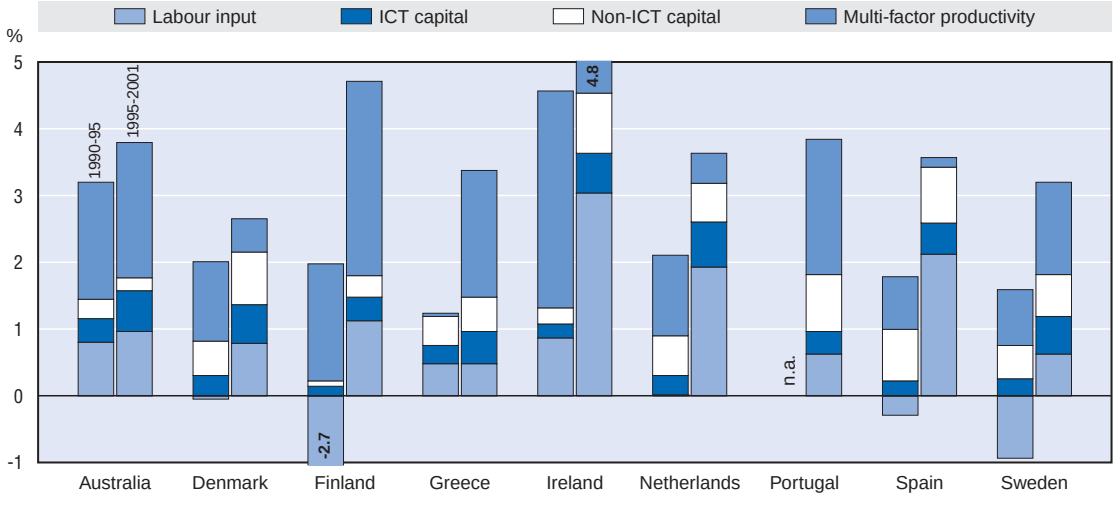
Contributions to growth of GDP, G7 countries, 1990-95 and 1995-2001

In percentage points



Contributions to GDP growth, other OECD countries, 1990-95 and 1995-2001

In percentage points[1]



1. Annual average multi-factor productivity growth in Ireland for 1995-2001 was 4.8%; annual average growth of labour input in Finland over 1990-95 was –2.7%.

Source: OECD, Productivity Database and Database on Capital Services, June 2003.

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D.5. Labour productivity growth by industry

- In many OECD countries, business sector services currently account for the bulk of labour productivity growth. The manufacturing sector remains important in Finland, Hungary, Poland and Korea, countries with rapid productivity growth.
- The growing contribution of business sector services to labour productivity growth is linked to their growing share in total value added and the strong rise in their labour productivity over the past decade. Between the 1980s and the 1990s, average productivity growth rates in these services were substantial.
- A large share of labour productivity growth in the non-agricultural business sector is attributable to knowledge-intensive activities, notably ICT services and high-technology and medium-high-technology manufacturing. In the United States, wholesale and retail trade also contribute significantly to aggregate productivity growth.

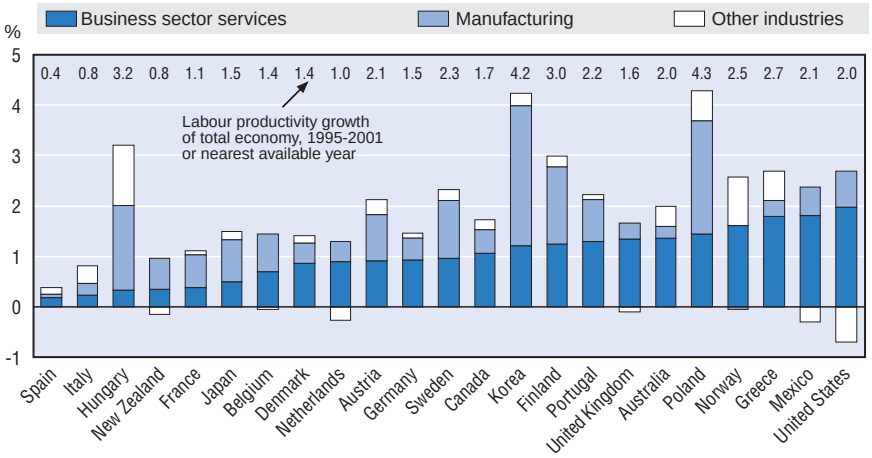
Measuring labour productivity growth by industry

Labour productivity growth can be calculated as the difference between the rate of growth of output or value added and the rate of growth of labour input. Calculating a sector's contribution to aggregate productivity growth requires a number of simple steps. First, the aggregate rate of change in value added is a share-weighted average of the industry-specific rate of change in value added, with weights reflecting the current price share of each industry in value added. On the input side, aggregation of industry-level labour input is achieved by weighting the growth rates of hours worked by industry with each industry's share in total labour compensation. Aggregate labour productivity growth can then be calculated as the difference between aggregate growth in value added and aggregate growth in labour input. An industry's contribution to aggregate labour productivity growth is therefore the difference between its contribution to total value added and total labour input. If value added and labour shares are the same, total labour productivity growth is a simple weighted average of industry-specific labour productivity growth. Similar approaches can be followed when production, instead of value added, is used as the output measure. However, OECD work on the basis of the STAN database has typically focused on value added, since constant price series of value added are more widely available across OECD countries than constant price series of production. Difficulties in measuring output and productivity in services sectors should also be taken into consideration when interpreting the results (see Wölfl, 2003).

See OECD (2001), OECD *Productivity Manual*, OECD, Paris; and A. Wölfl (2003), "Productivity Growth in Service Industries: An Assessment of Recent Patterns and the Role of Measurement", STI *Working Paper* 2003/7, OECD, Paris.

Breakdown of labour productivity growth by industry

Contributions to average annual growth rate, 1995-2001



Note: Business sector services cover wholesale and retail trade, restaurants and hotels (ISIC 50-55); transport, storage and communication (ISIC 60-64); and finance, insurance, real estate and business services (ISIC 65-74).

Source: OECD, STAN database, March 2003.

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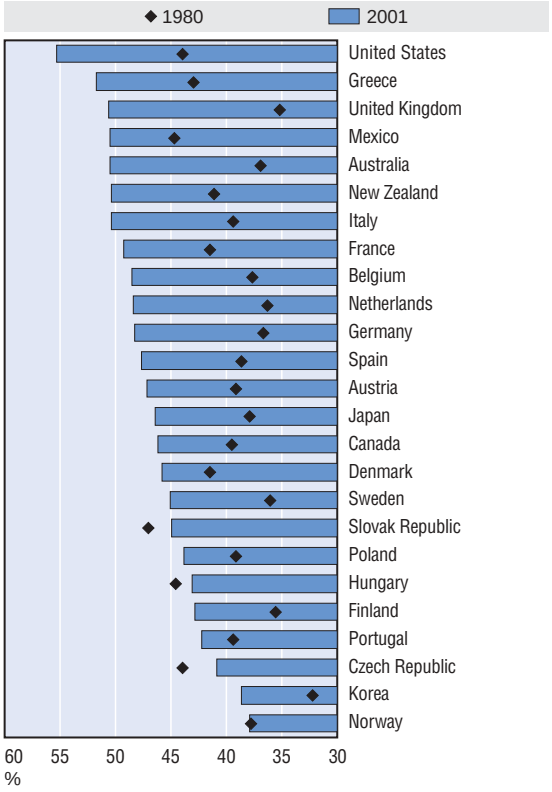
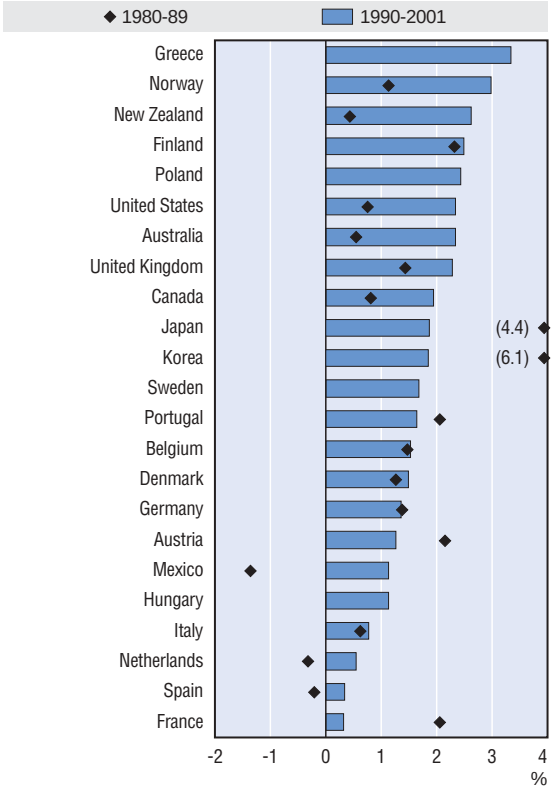
D.5. Labour productivity growth by industry

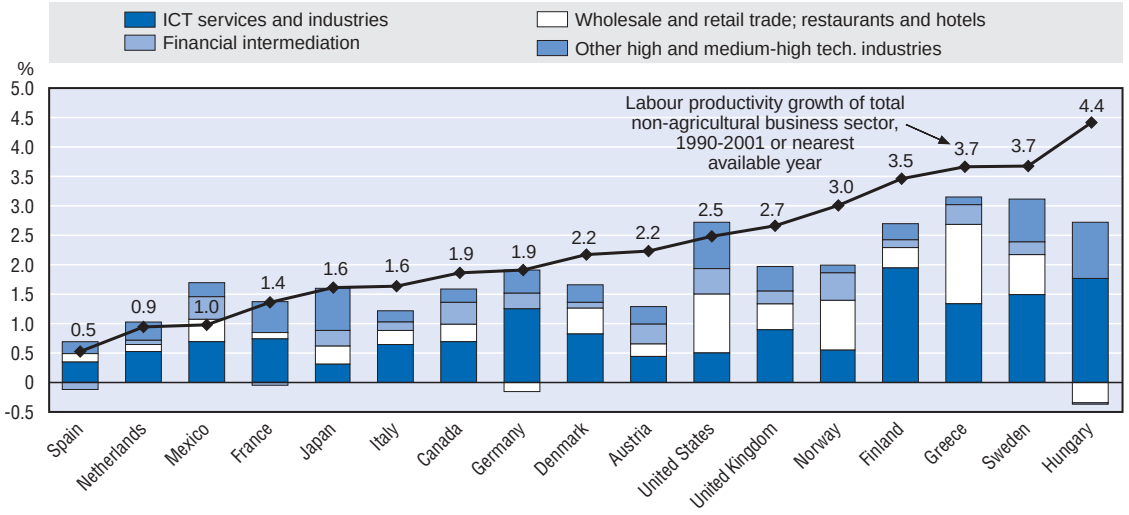
Share of business sector services in total value added, 1980 and 2001



Growth in business sector services labour productivity
Annual average growth rates



Contributions of key sectors to labour productivity growth in the non-agricultural business sector
Contributions to average annual growth rates, 1990-2001



Source: OECD, STAN database, March 2003.

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D.6. Technology- and knowledge-intensive industries

- All industries generate and/or exploit new technology and knowledge to some extent, but some are more technology- and/or knowledge-intensive than others. To gauge the importance of technology and knowledge, it is useful to focus on the leading *producers* of high-technology goods and on the activities (including services) that are intensive *users* of high technology and/or have the relatively highly skilled workforce necessary to benefit fully from technological innovations.
- In 2000, high- and medium-high-technology manufacturing accounted for about 8.5% of total OECD value added, and knowledge-based "market" services (see box) accounted for 19% (including education and health, about 30%).
- In Ireland, high- and medium-high-technology manufacturing continues to be a significant driver of economic growth. It now accounts for about 19% of total value added, significantly above the OECD average. It is also important in Korea and Hungary. Switzerland and Luxembourg's high shares of knowledge-intensive services (over 25% of total value added) are due to their strong financial sectors. In most other countries, business services account for the largest proportion of knowledge-intensive services.
- In the United States and France, growth in real value added of high- and medium-high-technology manufacturing outpaced that of services in the 1990s. In Europe and Japan, services have generally grown more rapidly.

Measuring technology- and knowledge-intensive industries

While there are established methods for classifying manufacturing industries according to technological intensity (see Annex 1), capturing the "knowledge-intensive" services sectors has proved more challenging. Efforts continue in this area as more detailed data for service sectors become available in OECD countries. In the meantime, the classification introduced in the 2001 STI *Scoreboard* is used here. The figures presented opposite reflect the following features:

- Use of an industry breakdown based on ISIC Rev. 3.
- A technology classification of manufacturing industries based on ISIC Rev. 3 R&D intensities in the 1990s (see Annex 1).
- A relatively narrow definition of knowledge-based services, which reflects improved data availability. "Real estate activities" (over 10% of total OECD area value added) are excluded, as a significant proportion consists of "Imputed rent of owner-occupied dwellings".
- Value-added shares are presented in relation to total gross value added.

Based on previous analysis of users of embodied technology (based on input-output tables), recently available (though limited) R&D intensities for services sectors and a preliminary evaluation of the composition of workforce skills by activity, the following ISIC Rev. 3 "market" service activities are considered knowledge-intensive:

- Division 64: Post and telecommunications (these cannot be separated out for most countries).
- Divisions 65-67: Finance and insurance.
- Divisions 71-74: Business activities (not including real estate).

In addition, although not shown in the figures, the value-added shares of the education and health sectors (about 11% of the total for the OECD area) are presented for most countries in Annex Table D.6.1.

Finally, care should be taken when comparing the growth of real value added across countries, particularly for high- and medium-high-technology manufactures, as calculation methods vary. In particular, some countries use quality-adjusted or "hedonic" prices for ICT goods – see the notes in Annex Table D.6.2. For further discussion see "Computer Price Indices and International Growth and Productivity Comparisons", OECD, April 2001.

For more details, see Annex Tables D.6.1 *and* D.6.2.

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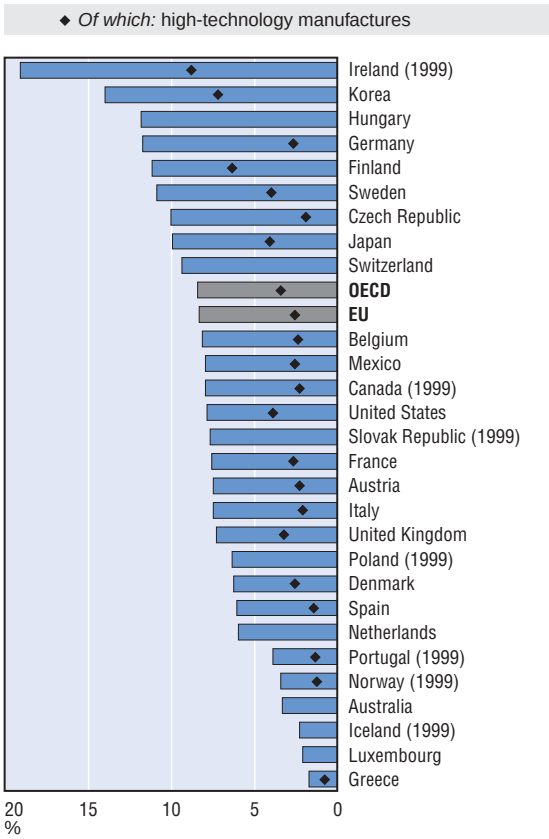
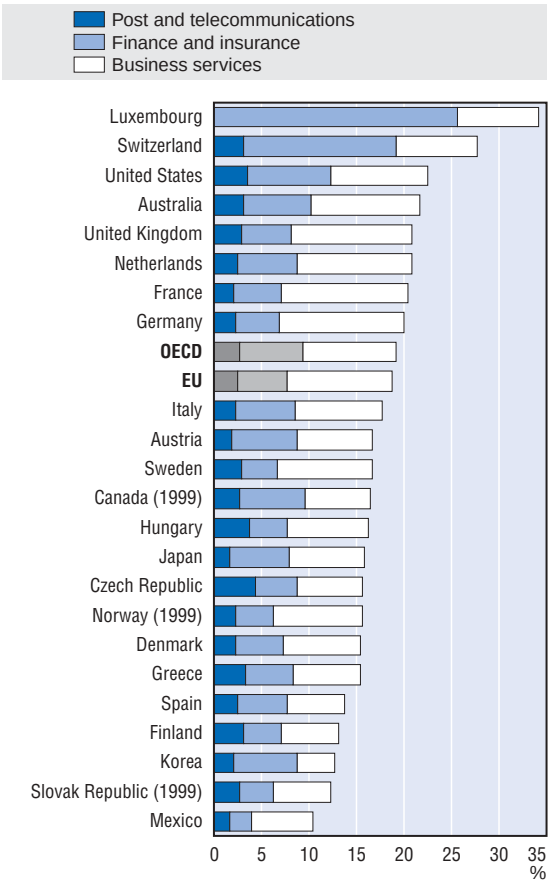
D.6. Technology-and knowledge-intensive industries

Share of total gross value added, 2000

High- and medium-high-technology manufactures

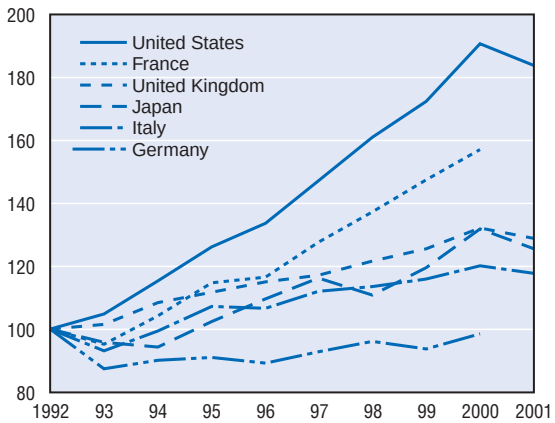


Knowledge-intensive "market" services

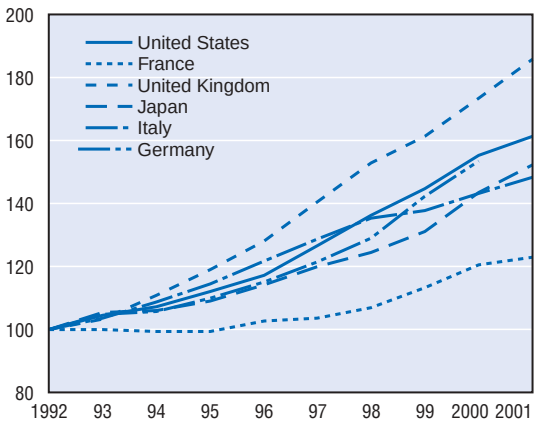


Real value added (1992 = 100)

High- and medium-high-technology manufactures



Knowledge-intensive "market" services



Source: OECD, STAN and National Accounts databases, May 2003.

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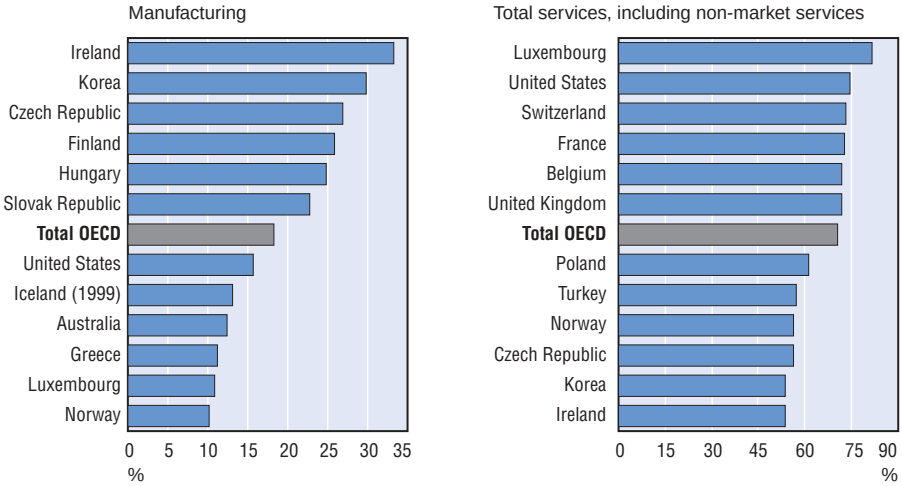
D.7. The structure of OECD economies

- Sectoral shares of value added provide a good perspective on the structure of OECD economies. Some economies are heavily oriented towards services (*e.g.* the United States), while others have a significant manufacturing sector (*e.g.* Ireland and Korea) or a large agricultural sector (Turkey).
- By 2000, services (public sector included) accounted for 70% of OECD value added; manufactures accounted for about 18%. The gap has been widening steadily for many years as demand for services has risen. Moreover, because productivity growth is slow in several services, this tends to increase their share in economic activity.
- Countries that have industrialised very rapidly in recent years or are still at relatively early stages of economic development typically have the largest manufacturing sectors (Finland, Ireland, Korea, eastern European countries). A significant proportion of the goods produced in these countries are high- and medium-high-technology (see D.6).
- Large services sectors in countries such as Belgium, France, Switzerland, the United Kingdom and the United States mainly reflect a high share of value added in finance, insurance, real estate and business services, and a large community, social and personal services sector.
- Agriculture accounts for 2.3% of OECD value added. Only Turkey still has a share of more than 10%. The construction sector is also relatively small in most OECD countries, accounting for only 5.6% of OECD value added. Wholesale and retail trade, restaurants and hotels is a more important economic sector and is often large in countries with a strong tourism industry (*e.g.* Greece, Portugal and Spain).

Structural change in OECD economies

Economic development in OECD economies has long been characterised by a gradual process of structural change. In the initial stages, the share of agriculture in total value added and employment declines and the manufacturing sector grows as economies industrialise. In recent years, many OECD economies have seen a decline in the share of manufacturing in overall economic activity. This is partly due to saturated demand for many manufactured goods but also to the differential in productivity growth between the manufacturing and the services sectors. Since productivity typically grows faster in manufacturing, relative prices decline and the sector's share in value added may drop over time. In contrast, some services sectors may have little scope for productivity growth and therefore experience an increase in relative prices. This typically means that their share in value added will increase.

Share of total gross value added in the top six and bottom six OECD countries, 2000



For more details, see Annex Table D.7.

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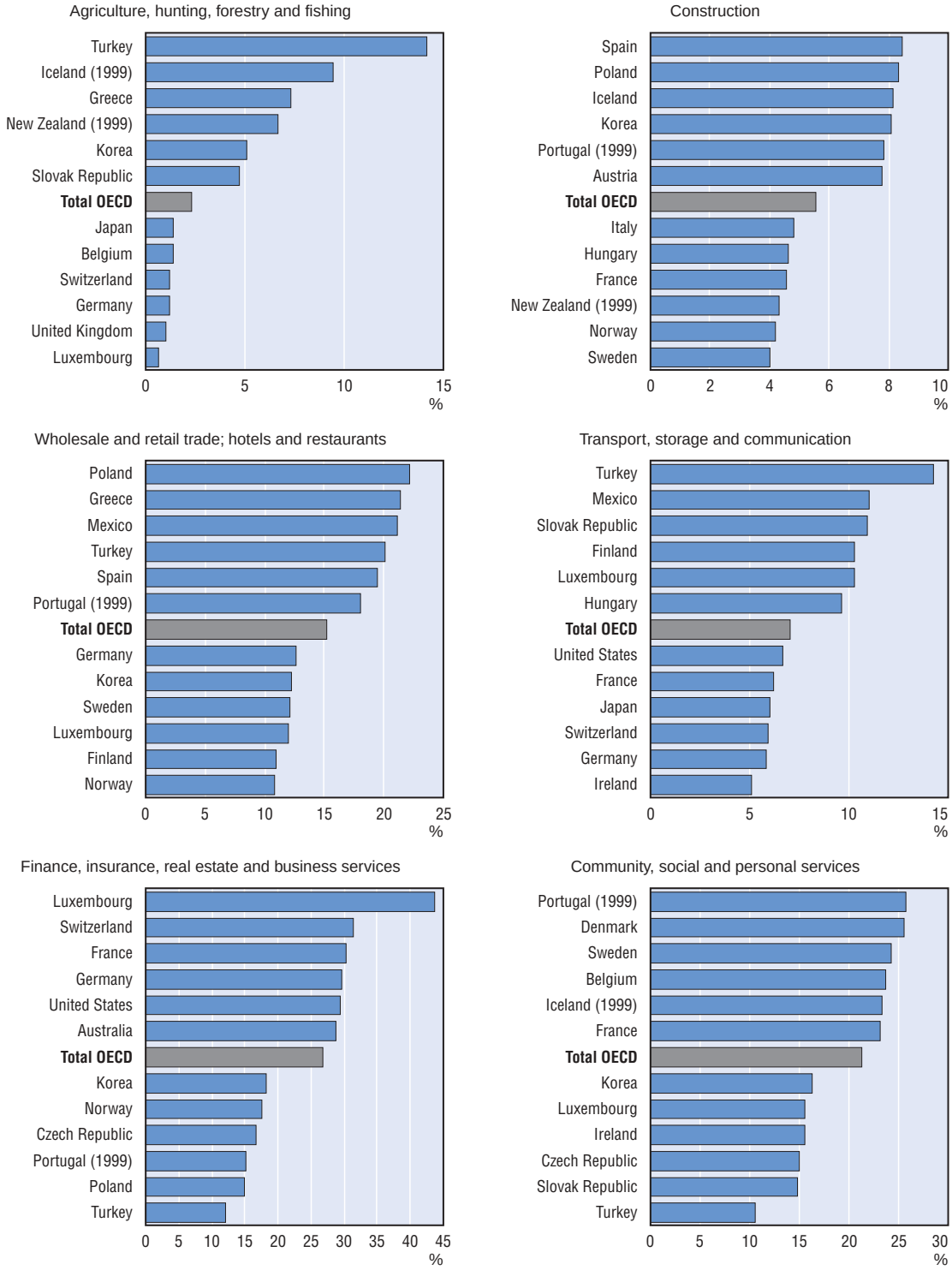
D.7. The structure of OECD economies

Share of total gross value added in the top six and bottom six OECD countries, 2000 *(cont.)*



Source: OECD, STAN and National Accounts databases, May 2003.

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D.8. Services sector value-added embodied in manufactured goods

- OECD economies are increasingly services-oriented. Part of the growth in the services sector's contribution to value added reflects the manufacturing sector's greater demand for services, some of which is due to the outsourcing of service activities previously produced in house. However, these outsourcing-driven increases largely reflect changes in the recording of activity rather than any actual growth in services. In addition, the manufacturing sector increasingly relies on, and exploits, telecommunications, business and computer services, industries that have grown strongly over the past decade.
- Estimates of the value added generated indirectly by the services sector to meet one unit of domestically produced final demand for manufactured goods (embodied services) cover both of these aspects, as well as other structural and compositional changes. Such estimates clearly show the increasing importance of the services sector to manufacturing.
- By the mid-1990s the amount of services embodied in one unit of final demand for manufactured goods was significantly higher than in the early 1970s for all ten countries covered. In the Netherlands, the contribution nearly doubled to 15.7%, albeit from a relatively low starting point (8.2%). The amount of services embodied in manufacturing also grew strongly in Japan, particularly between the mid-1980s and the early 1990s. The rise in embodied services was lowest in Canada, partly because intermediate imports form a significant part of Canada's domestically produced final demand.
- The rise in the use of computer services and telecommunications arguably increases productivity; growth in other services, such as transport and wholesale trade services, is less likely to do so. For example, between the early 1970s and the mid-1990s, the contribution of trade and transport to total intermediate consumption by the manufacturing sector increased from 9.2% to 17% in Australia and from 5.2% to 10% in the Netherlands. This may reflect increased volumes but also relative price increases for these services.
- Services contribute about one-quarter to total intermediate consumption by the manufacturing sector in most large economies, but there are considerable differences in the composition of services. For example, business services represent about one-half in Germany and France but only about one-quarter in most other countries. This may reflect a variety of factors, including differences in the relative prices of services.

Measuring services sector value added embodied in manufactured goods

In an input-output framework, services indirectly embodied in manufactured goods produced for final demand can be shown to be equal to:

$$v*(I-A)^{-1}*y'$$

where v is a $1 \times n$ vector with components v_j (the ratio of value added to output in industry j for service industries and zero otherwise), y' is the $1 \times n$ vector of domestically produced final demand with zero entries for non-manufacturing, and A is an $n \times n$ matrix describing the inter-relationships (or production function) between industries where a_{ij} is the ratio of the inputs from industry i used to make the output of industry j.

Thus, the percentage of final demand in manufactured goods that reflects services sector value added is equal to:

$$v*(I-A)^{-1}*y'/\sum y'$$

The input-output tables used here are based on ISIC Rev. 3 classifications and the latest System of National Accounts, SNA93. Differences in estimates of intermediate consumption of business services also reflect the fact that the capitalisation of software is inconsistent across countries. In the tables for some countries intermediate consumption of business services is higher than it would be if different accounting conventions were used. For example, most expenditure on software in the UK tables is recorded as intermediate consumption whereas in the United States similar expenditure is often capitalised. See also N. Ahmad (2003), "Measuring Investment in Software", STI *Working Paper* 2003-6, OECD, Paris.

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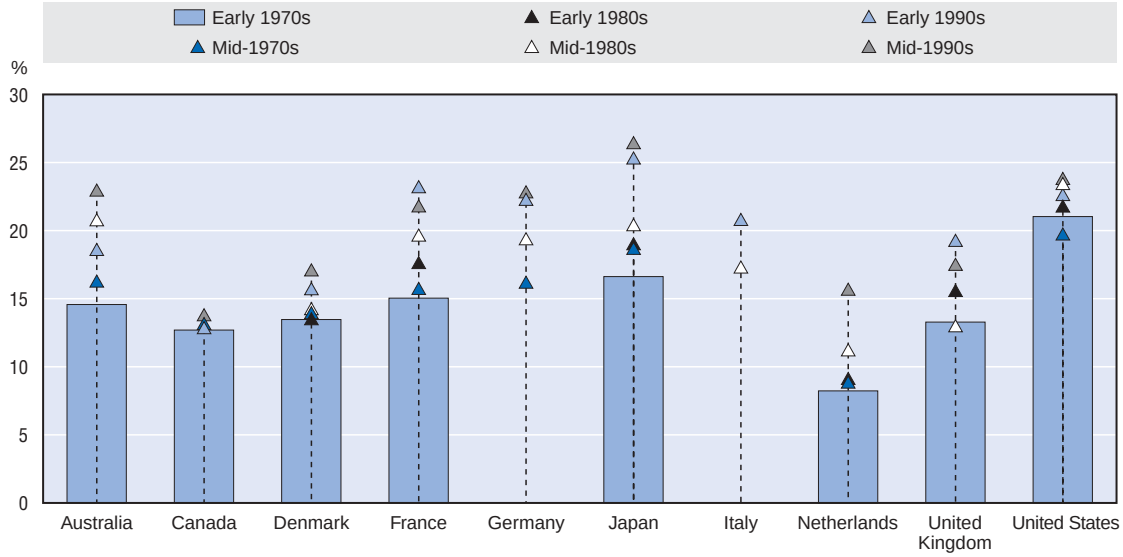
D.8. Services sector value added embodied in manufactured goods

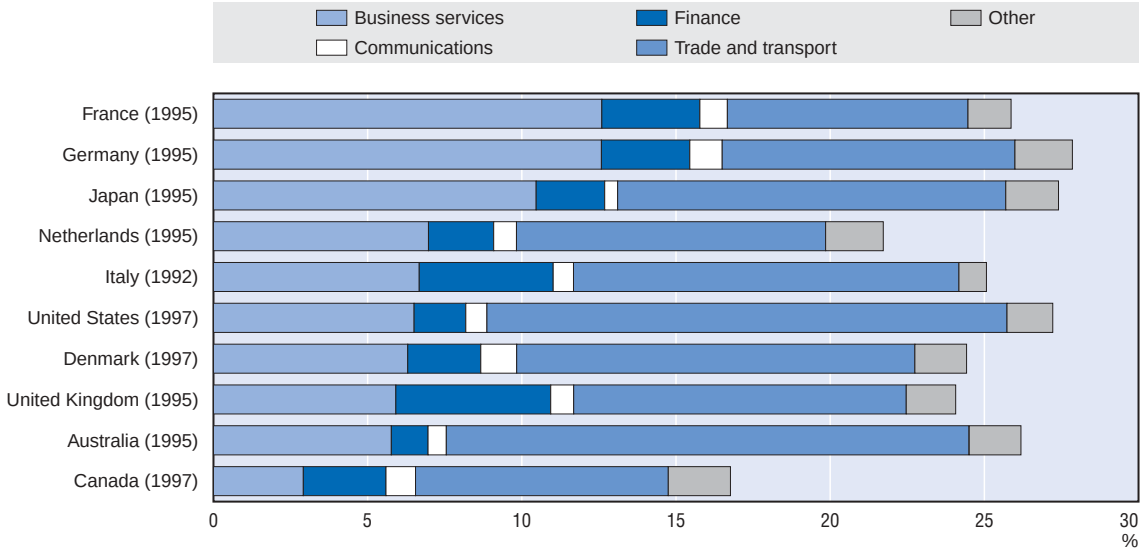
Services sector value added embodied in manufactured goods

Percentage of total value of manufactured goods in final demand



Intermediate consumption of services by the manufacturing sector, late 1990s

Percentage of total intermediate consumption



Source: OECD, Input-Output Database, May 2003.

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D.9.1. International trade by technological intensity

- In spite of the 2001 downturn in ICT trade, high-technology industries continue to be an important component of trade of manufactured goods. International demand for products of these industries has risen fast, as they can have significant positive effects on productivity and competitiveness when used throughout the economy.
- High-technology industries are more oriented towards international trade than less technology-intensive ones. While they still account for quite a small share of total OECD trade, their share is growing faster than the manufacturing average.
- For the period 1992-2001, three high-technology industries – pharmaceuticals, electronic equipment and computers – had the highest growth rates in manufacturing trade in the OECD area.
- High-technology industries represent about one-quarter of total OECD trade. Together with medium-high-technology industries (notably motor vehicles, chemicals and machinery and equipment), high-technology industries already account for the main share of OECD manufacturing trade (almost 65%).

Measuring trade in high-technology industries

The very concept of a "high-technology" industry is subject to debate. Is it one that largely *produces* technology or one that largely *uses* technology? A certain number of potential indicators range from input-related measures (*e.g.* expenditures on research and development, number of scientists and engineers) to output-related measures (*e.g.* number of patents). For such indicators, the choice of cut-off points that separate different technology classes is somewhat arbitrary.

On the basis of methodological work at the OECD, manufacturing industries are classified in four different categories of technological intensity: high technology, medium-high technology, medium-low technology and low technology. For reasons of availability of comparable statistics, this classification is based on indicators of (direct as well as indirect) technological intensity which reflect to some degree "technology-producer" or "technology-user" aspects. These indicators are R&D expenditures divided by value added, R&D expenditures divided by production and R&D expenditures plus technology embodied in intermediate and capital goods divided by production. The level of detail in the industrial breakdown is limited only by the availability of comparable input-output tables and R&D surveys. The indicators were calculated in the aggregate for 1990 for ten OECD countries for which the embodied technology variable is available using purchasing power parities in 1990 USD. Embodied technology intensities appear to be highly correlated with direct R&D intensities; this reinforces the view that the latter largely reflect an industry's technological sophistication.

This classification is particularly useful for analysing industry information on employment or value added by technological intensity, for example. To do likewise for international trade flows – which are defined at product level – requires attributing each product to a specific industry. However, not all products in a "high-technology industry" necessarily have a high technology content. Likewise, some products in industries with lesser technology intensities may well incorporate a high degree of technological sophistication. Because no detailed data are available for services at present, industry and product classifications only concern manufacturing industry.

See T. Hatzichronoglou (1997), "Revision of the High-technology Sector and Product Classification", STI *Working Paper* 1997/2 and Annex 1 for further details.

For more details, see Annex Table D.9.1.

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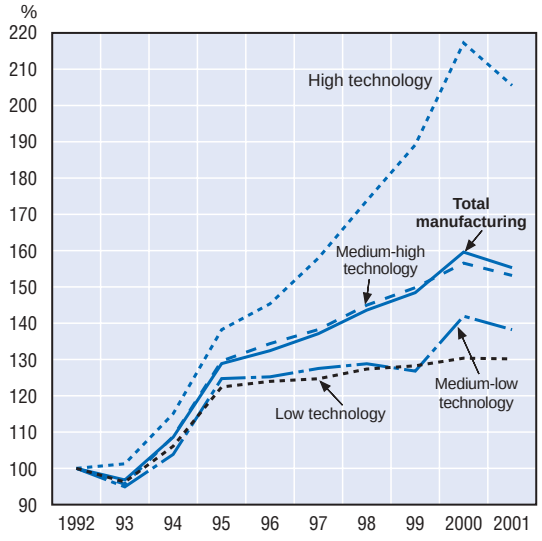
D.9.1. International trade by technological intensity

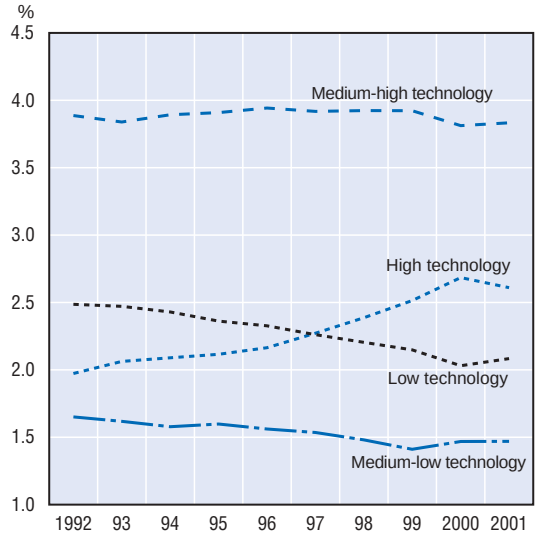
OECD[1] manufacturing trade[2] by technology intensity

1992 = 100



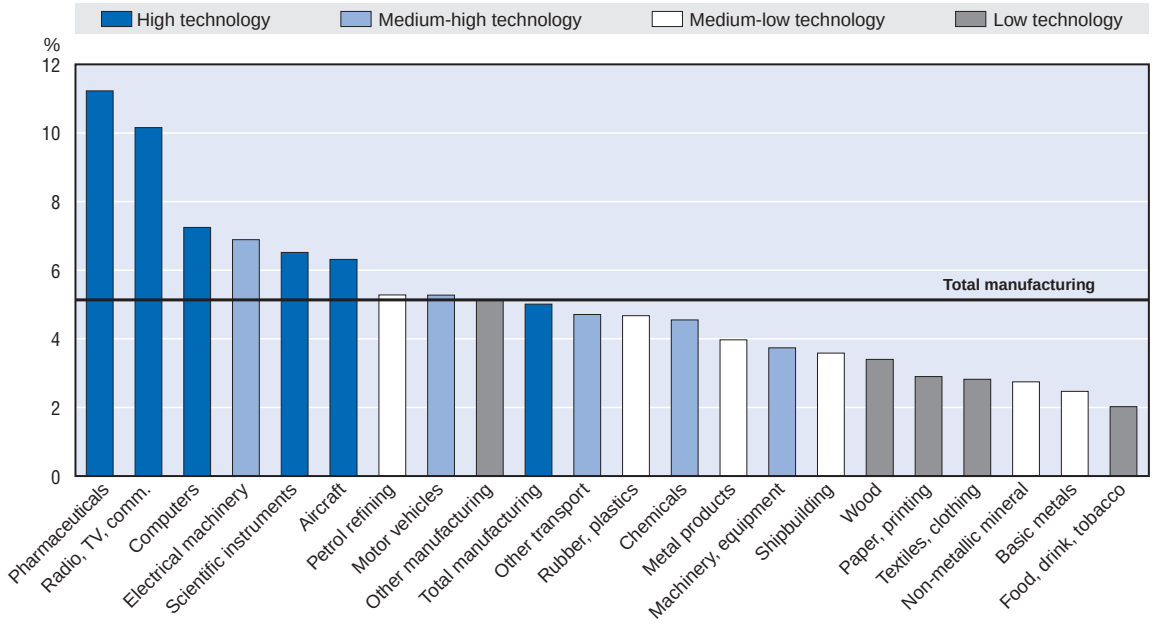
Structure of OECD[1] manufacturing trade[2] by technology intensity

Share in total manufacturing trade



Growth of OECD[1] manufacturing trade[2] by industry and technological intensity

Average annual growth rate, 1992-2001



1. OECD excludes the Czech Republic, Korea and the Slovak Republic.
2. Average value of total OECD exports and total OECD imports.

Source: OECD, STAN database, May 2003.

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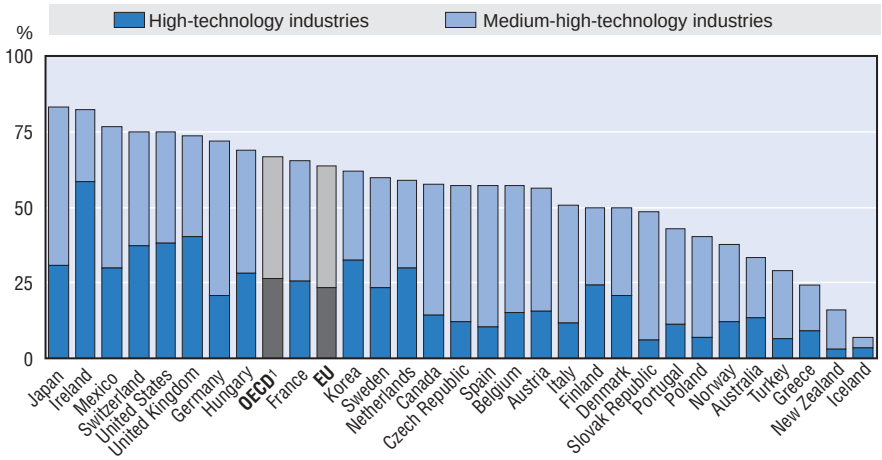
D.9.2. Trade in high- and medium-high-technology industries

- Technology-intensive industries accounted for two-thirds of total OECD manufacturing exports in 2001. Differences among countries are substantial, however; the share of high- and medium-high-technology industries ranges from over 80% in Japan and Ireland to less than 20% in New Zealand and Iceland.
- Manufacturing exports are particularly technology-intensive in Ireland, the United States, the United Kingdom and Korea, where high-technology industries account for a larger share of exports than medium-high-technology industries.
- Technology-intensive exports accounted for much of the growth in trade over the past decade. In all OECD countries, they grew more rapidly than total manufacturing exports. This is especially the case for high-technology exports.
- Technology exports have grown very rapidly in Iceland, Turkey and the eastern European countries but still contribute little to international technology trade. The shares of Mexico, Ireland and Korea in total OECD technology exports have increased considerably at the expense of traditional European and Japanese technology suppliers. With 20% of total OECD exports, the United States has the largest share of the technology market.

Share of high- and medium-high-technology in manufacturing exports, 2001



1. Total OECD excludes Luxembourg and the Slovak Republic.
Source: OECD, STAN database, May 2003.

For more details, see Annex Table D.9.2.

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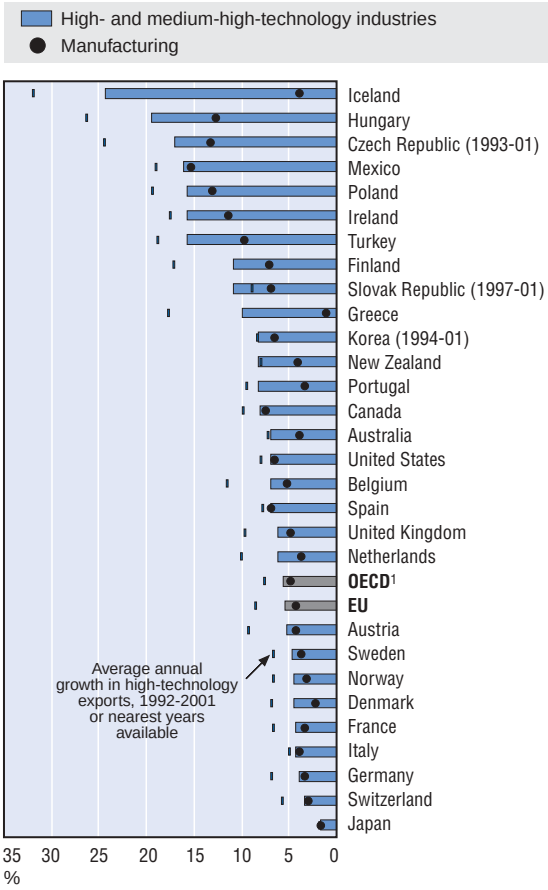
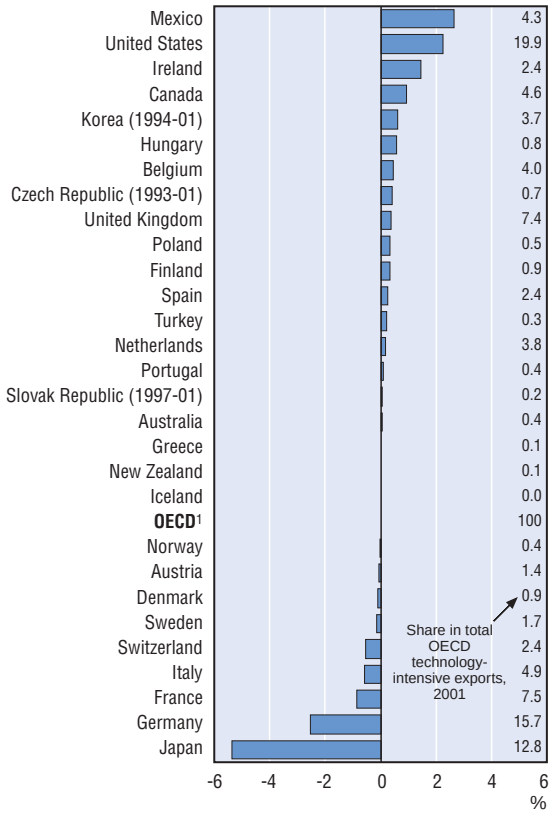
D.9.2. Trade in high- and medium-high-technology industries

Growth of high- and medium-high-technology exports, 1992-2001
Annual average growth rate



Share in total OECD[1] high- and medium-high-technology exports, 1992-2001
Percentage change in market share over the period



1. Total OECD excludes Czech Republic, Luxembourg, Korea and Slovak Republic.
Source: OECD, STAN database, May 2003.

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D.9.3. Revealed comparative advantage by technological intensity

- An assessment of countries' strengths and weaknesses in terms of technological intensity must not focus solely on exports (see D.9.2) but must also gauge the role of imports, as exports may depend heavily on imports in the same industry. Indicators of revealed comparative advantage allow for a better understanding of countries' specialisation profiles. Such indicators are based on the contribution of different industries to the trade balance.
- This indicator shows that few OECD countries are specialised in high- and medium-high-technology manufacturing industries (see Annex 1). In 2001, the trade surplus in these industries represented more than 15% of total manufacturing trade for Japan, over 8% for Switzerland and around 6% for the United States.
- A considerable number of OECD countries still have a strong comparative advantage in medium-low-technology and low-technology industries. The structural surplus in these industries accounted for around 20% of total manufacturing trade in New Zealand and Iceland and for more than 10% in Turkey, Greece and Australia.
- For most OECD countries, these specialisation patterns have changed little over the past decade. There are exceptions, however. Japan's comparative advantage in high-technology industries declined drastically over the 1990s, whereas that of the United Kingdom increased markedly. Comparative disadvantages in Hungary, the Czech Republic and Finland shrunk notably and Mexico's structural deficit shifted to a surplus.

Contribution to the trade balance

The "contribution to the trade balance" makes it possible to identify an economy's structural strengths and weaknesses via the composition of international trade flows. It takes into account not only exports, but also imports, and tries to eliminate business cycle variations by comparing an industry's trade balance with the overall trade balance. It can be interpreted as an indicator of "revealed comparative advantage", as it indicates whether an industry performs relatively better or worse than the manufacturing total, whether the manufacturing total itself is in deficit or surplus.

If there were no comparative advantage or disadvantage for any industry *i*, a country's total trade balance (surplus or deficit) should be distributed across industries according to their share in total trade. The "contribution to the trade balance" is the difference between the actual and this theoretical balance:

$$(X_i - M_i) - (X - M)\frac{(X_i + M_i)}{(X + M)}$$

where $(X_i - M_i)$ = observed industry trade balance,

and $(X - M)\frac{(X_i + M_i)}{(X + M)}$ = theoretical trade balance

A positive value for an industry indicates a structural surplus and a negative one a structural deficit. The indicator is additive and individual industries can be grouped together by summing their respective values: by construction, the sum over all industries is zero. To allow comparisons across industries, the indicator is generally expressed as a percentage of total trade or of GDP.

For more details, see Annex Table D.9.3.

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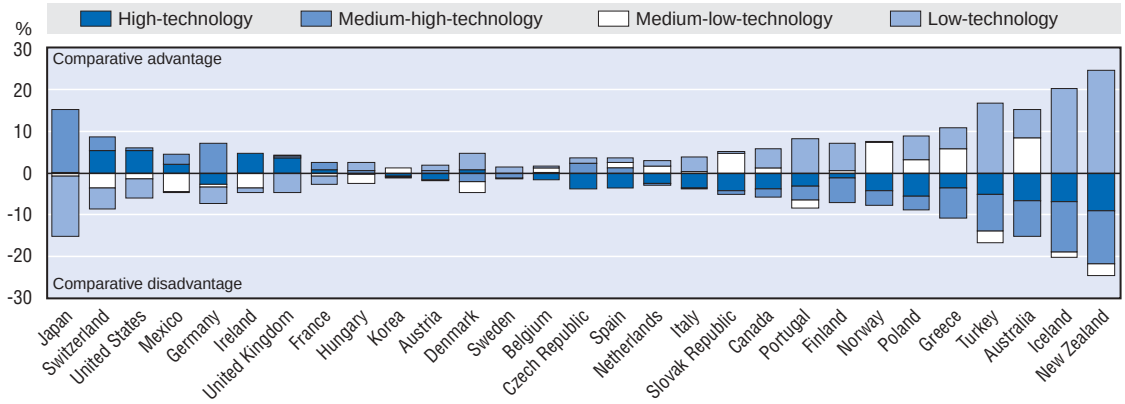
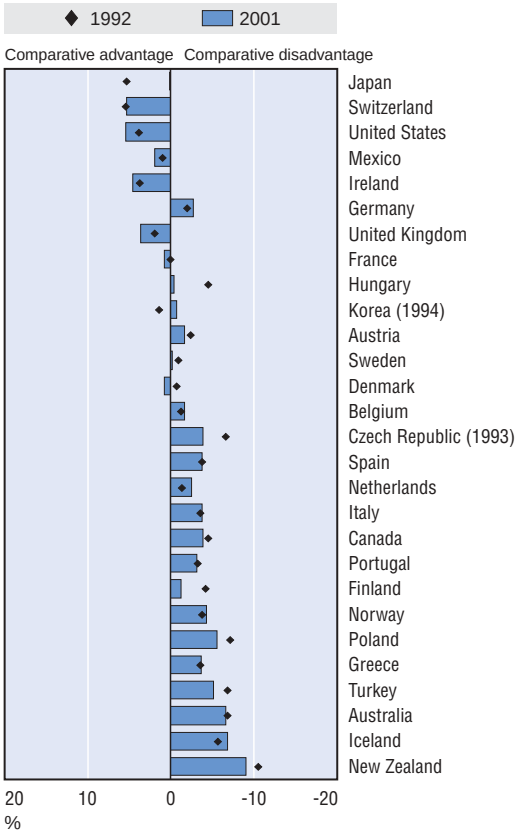
D.9.3. Revealed comparative advantage by technology intensity

Contribution to the manufacturing trade balance, 2001
As a percentage of manufacturing trade

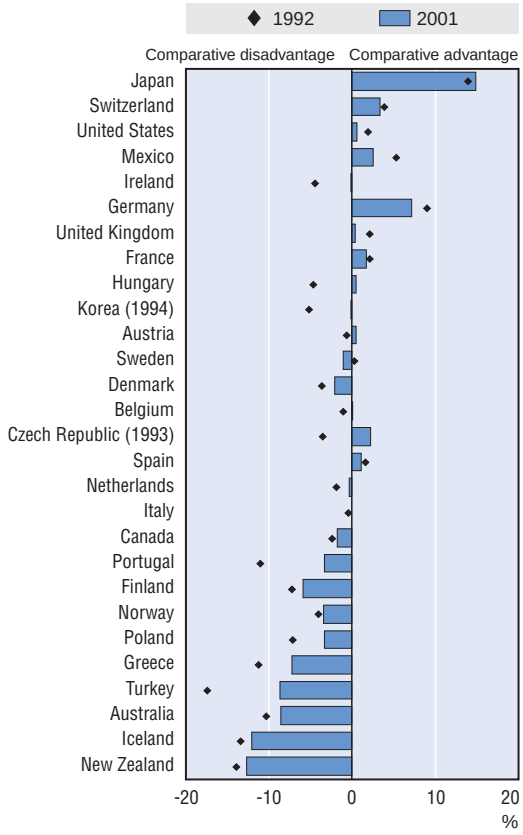


Change in contribution to the manufacturing trade balance between 1992 and 2001
As a percentage of total manufacturing trade

High-technology industries



Medium-high-technology industries



Source: OECD, STAN database, May 2003.

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D.10. Entry, exit and survival of firms

- Firm turnover is a frequent occurrence. Data for nine European countries show that from 12% to 19% of all non-agricultural firms enter or exit the market every year. Entries represented between 7% and 11% of all active enterprises, and exits averaged about 8% in 1999.
- Entry rates are closely correlated with exit rates, although the former exceed the latter in most countries. Entry rates are substantially higher in dynamic services sectors, such as business services or ICT-related industries, than in more mature industries, in manufacturing for example. Average entry rates were highest in Denmark.
- New firms typically start small, and their share in the total stock of firms is therefore considerably higher than their share in total employment. In 1998, employment in new firms ranged from less than one (full-time) person in Finland to just over two persons in Spain.
- Many new firms do not survive very long. In Denmark, almost 20% of all 1998 entries were no longer in existence in 1999. Another 17% did not survive into 2000. Survival rates were considerably higher in Sweden, where 87% of 1998 entries survived into 2000. Once firms survive the initial years, their prospects improve.
- While most firms start small, surviving firms generally grow in size over time in all countries for which data are available. In Spain, employment in new firms that had started in 1998 increased from an initial average of 2.1 persons in 1998 to 3.2 persons in 2000.

Measuring business dynamics

The measurement of enterprise demographics raises a number of methodological issues. The first relates to the coverage of business registers. Business registers record information on firms on the basis of certain criteria, *e.g.* whether the firm submits tax payments to the government. Many OECD countries have several sources for the register, *e.g.* tax declarations (VAT, personal income, corporate, other), social security records, registration at chambers of commerce or other administrative sources. The various sources may not cover the same firms. The coverage of small and newly created firms, in particular, may differ, as size thresholds for compulsory registration (*e.g.* for VAT) differ across countries. Differences in thresholds and the coverage of economic activity in business registers therefore affect the calculation of indicators on enterprise demographics.

In addition, not all firms that are newly recorded in the business register are new entrants. They can be created through mergers and restructuring, takeovers, spin-offs or outsourcing by existing companies, changes in legal forms or names and reactivation of dormant firms. In principle, these should be considered separately from real entries.

A third problem concerns exits, which are typically more difficult to measure than entries. Most business registers do not reliably register them, and many countries do not require removal from the register. In practice, measuring exits often requires verifying annual changes in a firm's economic activity; if production or employment drops to zero or changes very significantly from one year to the next, the firm is likely to have gone out of business. In addition, it is important that mergers, take-overs, restructuring and break-ups should be considered as separate demographic events in counting firm exits.

A fourth issue concerns the statistical unit to measure exit and entry. Business registers in OECD countries cover a variety of statistical units: legal units, enterprise units, local units and establishments. Entry and exit rates can, in principle, be calculated for these different units. The data presented here, based on work by Eurostat and previous work by the OECD Economics Department, mainly focuses on the enterprise as the unit of analysis. However, other studies have examined business turnover using data on establishments; this is particularly useful for examining changes in employment.

The data presented here draw on a harmonised collection of data carried out by Eurostat, covering 1997-2000. The data collection draws on the growing comparability of business registers in the European Union. The data distinguish genuine firm entry and exit, *i.e.* excluding mergers, acquisitions, takeovers and other false entries. In addition, the Eurostat data include all active firms, even those with no employees. More detail on the methodology is available in M. Hult (2003), *Business Demography in 9 Member States*, *Statistics in Focus*, Theme 4 – 9/2003, Eurostat.

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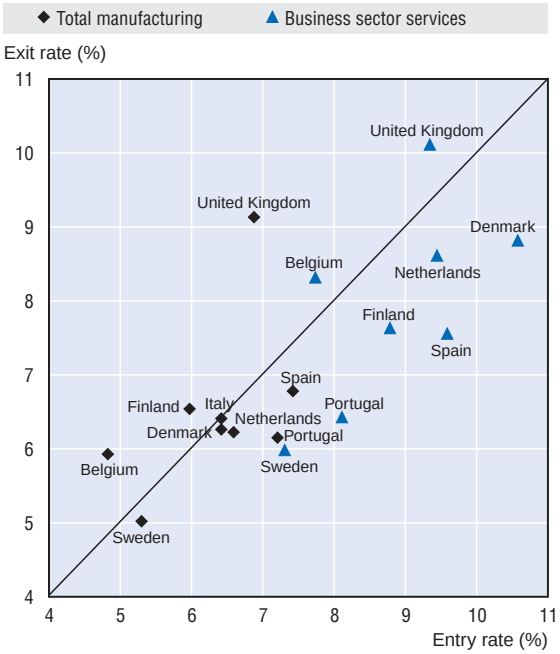
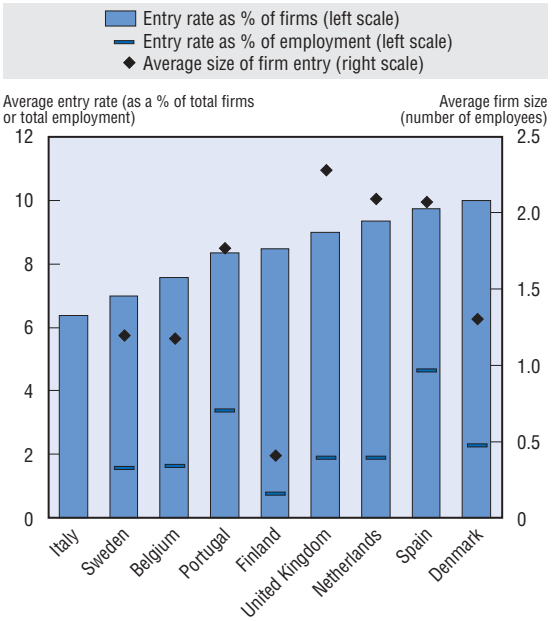
D.10. Entry, exit and survival of firms

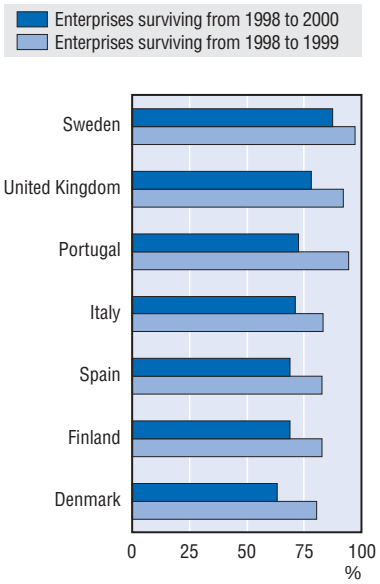
Entry and exit rates in the manufacturing and business services sectors
Average rate over 1997 and 2000



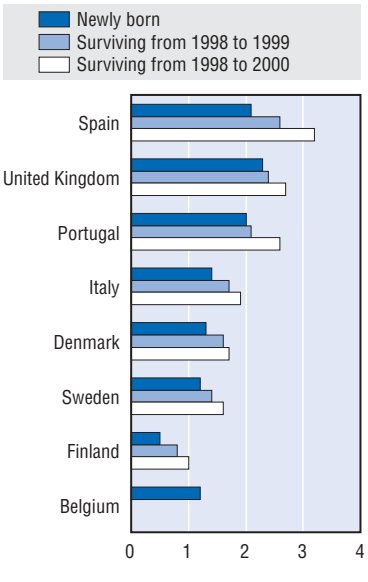
Firm entry rates, job creation and average size of new firms in total non-farm industry[1]
Average rate over 1997 and 2000



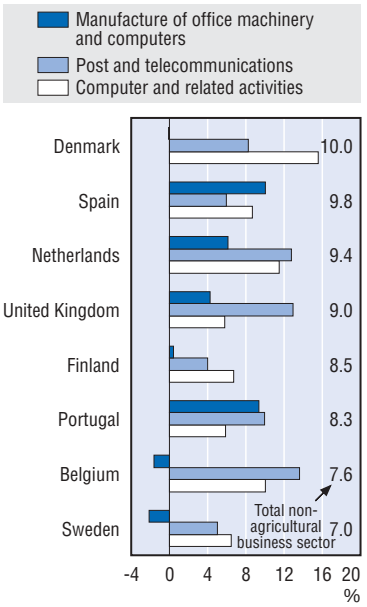
Enterprise survival rates
Percentage of 1998 entries



Average size of firms born in 1998
Average number of employees[1]



Net firm entry in ICT industries
Difference in entry rates compared with entry rates for the total non-agricultural business sector



1. Data on persons employed for Denmark, Finland and the Netherlands are expressed in full-time equivalents.
Source: Eurostat, June 2003.

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Annex I

CLASSIFICATION OF MANUFACTURING INDUSTRIES BASED ON TECHNOLOGY

Annex Table 1.1 presents manufacturing industries classified according to technology intensity using the ISIC Rev. 3 breakdown of activity.

Technological effort is a critical determinant of productivity growth and international competitiveness. However, since it is not spread evenly across the economy, analyses of industry performance and structural change attach much importance to technological criteria. Methodological work carried out at the OECD is used to determine these criteria.

In the past, a technology classification based on ISIC Rev. 2 industry classifications was widely used. The methodology uses three indicators of technology intensity reflecting, to different degrees, "technology-producer" and "technology-user" aspects: *i*) R&D expenditures divided by value added; *ii*) R&D expenditures divided by production; and *iii*) R&D expenditures plus technology embodied in intermediate and investment goods divided by production. These indicators were evaluated for 1990 and for the aggregate of the ten OECD countries for which a measure of embodied technology was available, using 1990 USD purchasing power parities (see T. Hatzichronoglou, "Revision of the High-Technology Sector and Product Classification", STI *Working Paper* 1997/2).

Following the adoption of ISIC Rev. 3 (NACE Rev. 1 in Europe) for collecting and presenting data on industrial activity both in national accounts (in the context of SNA93/ESA95) and industrial surveys, the 2001 Scoreboard used ISIC Rev. 3 R&D expenditure and output data to develop an updated technology classification based on an evaluation of R&D intensities for 13 OECD countries for the period 1991-97. In the absence of updated ISIC Rev. 3 input-output tables (required for estimating embodied technology), only the first two indicators could be calculated. This edition extends the analysis to cover the period 1991-99, although for only 12 OECD countries.

The division of manufacturing industries into high-technology, medium-high-technology, medium-low-technology and low-technology groups was made after ranking the industries according to their average over 1991-99 against aggregate OECD R&D intensities. Industries classified to higher categories have a higher average intensity for both indicators than industries in lower categories. Also considered were: *i*) temporal stability: for adjacent years, industries classified to higher categories have a higher average intensity than those in lower categories (see Annex Table 1.2); and *ii*) country median stability: industries classified to the higher categories have a higher median intensity than those in lower categories.

Points to note:

- This classification confirms that of the 2001 *Scoreboard* and also confirms the classification of "Medical, precision and optical instruments" (ISIC Rev. 3, Division 33) as a high-technology industry. This sector's R&D intensity continues to rise, and its inclusion complements the definition of the ICT sector (see *Measuring the Information Economy*, OECD, 2002) which includes some of its sub-divisions (notably 3312 and 3313).
- The cut-off points are clear except possibly the distinction between the medium-low- and low-technology groups.
- The low-technology group consists of relatively aggregate sectors, owing to limited detailed R&D expenditure data across countries. The few cases in which R&D intensities are available for more detailed (2-digit) breakdowns confirm the allocation of these industries to low technology.
- The classification concerns the OECD area as a whole. For individual countries, allocation to the technology groups may differ. Also, at national level, finer technology classifications may be generated from more detailed underlying data.

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Annex 1.1. **Classification of manufacturing industries based on technology**[1]

	ISIC Rev. 3	1999				1991			
		R&D divided by production		R&D divided by value added		R&D divided by production		R&D divided by value added	
		Aggregate intensity[2]	Median intensity	Aggregate intensity[2]	Median intensity	Aggregate intensity[2]	Median intensity	Aggregate intensity[2]	Median intensity
High-technology industries									
Aircraft and spacecraft	353	10.3	10.4	29.1	27.5	13.9	12.9	34.7	32.1
Pharmaceuticals	2423	10.5	10.1	22.3	25.8	9.4	8.7	20.6	19.7
Office, accounting and computing machinery	30	7.2	4.6	25.8	15.1	10.9	6.4	29.4	15.2
Radio, TV and communciations equipment	32	7.4	7.6	17.9	22.4	7.9	8.2	17.0	21.5
Medical, precision and optical instruments	33	9.7	5.6	24.6	11.9	6.6	6.1	15.6	12.5
Medium-high-technology industries									
Electrical machinery and apparatus, n.e.c.	31	3.6	2.3	9.1	6.7	4.2	2.6	9.3	5.9
Motor vehicles, trailers and semi-trailers	34	3.5	2.8	13.3	11.7	3.7	3.0	14.3	11.9
Chemicals excluding pharmaceuticals	24 excl. 2423	2.9	2.2	8.3	7.1	3.4	2.8	9.8	8.0
Railroad equipment and transport equipment, n.e.c.	352 + 359	3.1	2.8	8.7	7.9	2.9	2.1	7.6	5.4
Machinery and equipment, n.e.c.	29	2.2	2.1	5.8	5.3	1.9	2.0	4.6	4.7
Medium-low-technology industries									
Building and repairing of ships and boats	351	1.0	1.0	3.1	2.9	0.9	0.9	2.8	2.6
Rubber and plastics products	25	1.0	1.1	2.7	3.0	1.0	0.6	2.6	1.5
Coke, refined petroleum products and nuclear fuel	23	0.4	0.3	1.9	2.7	1.2	0.7	5.4	3.8
Other non-metallic mineral products	26	0.8	0.6	1.9	1.3	1.0	0.6	2.4	1.5
Basic metals and fabricated metal products	27-28	0.6	0.5	1.6	1.4	0.7	0.6	2.0	1.6
Low-technology industries									
Manufacturing, n.e.c.; Recycling	36-37	0.5	0.5	1.3	1.2	0.5	0.4	1.2	0.9
Wood, pulp, paper, paper products, printing and publishing	20-22	0.4	0.1	1.0	0.3	0.3	0.1	0.8	0.3
Food products, beverages and tobacco	15-16	0.3	0.3	1.1	1.0	0.3	0.3	1.1	1.1
Textiles, textile products, leather and footwear	17-19	0.3	0.4	0.8	1.0	0.2	0.3	0.7	0.7
Total manufacturing	15-37	2.6	2.2	7.2	6.5	2.5	2.0	7.0	5.7

1. Based on data for 12 OECD countries: United States, Canada, Japan, Denmark, Finland, France, Germany, Ireland, Italy, Spain, Sweden, United Kingdom

2. Aggregate R&D intensities calculated after converting countries' R&D expenditures, value added and production using GDP PPPs

Source: OECD: ANBERD and STAN databases, May 2003

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Annex 1.2. **R&D intensity[1] for aggregate of 12 OECD countries, 1991-1999**

	ISIC Rev.3	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	mean intensity 1991-1999
Aircraft and spacecraft	353	13.9	13.9	13.5	13.9	16.2	14.8	12.8	10.7	10.3	13.3
Pharmaceuticals	2423	9.4	10.1	10.8	10.9	10.6	10.3	11.0	11.1	10.5	10.5
Office, accounting and computing machinery	30	10.9	10.4	9.3	8.8	7.5	9.1	10.4	8.9	7.2	9.2
Radio, TV and communciations equipment	32	7.9	8.3	7.9	7.8	7.7	8.2	8.0	8.6	7.4	8.0
Medical, precision and optical instruments	33	6.6	6.8	7.1	7.7	7.7	7.4	8.0	8.0	9.7	7.7
Electrical machinery and apparatus, n.e.c.	31	4.2	4.0	4.0	3.8	4.0	3.9	3.9	4.0	3.6	3.9
Motor vehicles, trailers and semi-trailers	34	3.7	3.4	3.5	3.4	3.5	3.7	3.5	3.3	3.5	3.5
Chemicals excluding pharmaceuticals	24 excl. 24	3.4	3.3	3.4	3.1	2.8	3.1	2.7	3.1	2.9	3.1
Railroad equipment and transport equipment, n.e.c.	352 + 359	2.9	2.4	2.4	2.7	2.6	3.2	3.5	3.0	3.1	2.9
Machinery and equipment, n.e.c.	29	1.9	2.0	2.0	2.1	2.0	2.1	2.1	2.1	2.2	2.1
Building and repairing of ships and boats	351	0.9	1.0	1.0	0.9	0.9	1.0	0.8	1.0	1.0	1.0
Rubber and plastics products	25	1.0	1.0	0.9	1.0	0.8	0.9	0.9	0.9	1.0	0.9
Coke, refined petroleum products and nuclear fuel	23	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.9	0.4	0.9
Other non-metallic mineral products	26	1.0	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.8	0.9
Basic metals and fabricated metal products	27-28	0.7	0.7	0.7	0.6	0.6	0.7	0.7	0.6	0.6	0.6
Manufacturing, n.e.c.; Recycling	36-37	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.6	0.5	0.5
Wood, pulp, paper, paper products, printing and publishing	20-22	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.3
Food products, beverages and tobacco	15-16	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3
Textiles, textile products, leather and footwear	17-19	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Total manufacturing	**15-37**	**2.5**	**2.5**	**2.5**	**2.4**	**2.4**	**2.6**	**2.6**	**2.6**	**2.6**	**2.5**
High-technology industries		**9.4**	**9.5**	**9.3**	**9.3**	**9.2**	**9.3**	**9.5**	**9.3**	**8.7**	**9.3**
Medium-high-technology industries		**3.1**	**3.0**	**3.1**	**3.0**	**2.9**	**3.1**	**2.9**	**3.0**	**3.0**	**3.0**
Medium-low-technology industries		**0.9**	**0.9**	**0.9**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.7**	**0.8**
Low-technology industries		**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**

1. R&D intensity defined as direct R&D expenditures as a percentage of production (gross output), calculated after converting countries' R&D expenditures and production using GDP PPPs

Source: OECD: ANBERD and STAN databases, May 2003

Annex II

MAIN OECD DATABASES USED

Industrial structure and performance

STAN: The database for **Industrial Analysis** includes annual measures of output, labour input, investment and international trade which allow users to construct a wide range of indicators focused on areas such as productivity growth, competitiveness and general structural change. The industry list provides sufficient details to enable users to highlight high-technology sectors and is compatible with those used in related OECD databases. STAN is primarily based on member countries' annual National Accounts by activity tables and uses data from other sources, such as national industrial surveys/censuses, to estimate any missing detail. Since many of the data points in STAN are estimated, they do not represent the official member country submissions.

The latest version of STAN is based on the International Standard Industrial Classification (ISIC) Rev. 3 and has been expanded to cover all activities (including services) and a wider range of variables – it has effectively been merged with the OECD' s International Sectoral Database (ISDB) which is no longer updated. Further details on STAN are available on the Internet at: *www.oecd.org/sti/stan*.

Publication: STAN is available on line on SourceOECD (*www.sourceoecd.org*). It is updated on a "rolling" basis (*i.e.* new tables are posted as soon as they are ready) rather than published as an annual "snapshot", in order to improve timeliness.

Science and technology

R&D and TBP: The **R&D** database contains the full results of the OECD surveys on **R&D expenditure and personnel** from the 1960s. The **TBP** database presents information on the **technology balance of payments**. These databases serve, *inter alia*, as the raw material for both the ANBERD and MSTI databases.

Publication: OECD (2003), *Basic Science and Technology Statistics*: 2002 *Edition*. Annual on CD-ROM (a printed edition is also available every two years).

MSTI: The **Main Science and Technology Indicators** database provides a selection of the most frequently used annual data on the scientific and technological performance of OECD member countries and seven non-member economies (China, Israel, Romania, Russian Federation, Singapore, Slovenia, Chinese Taipei). The indicators, expressed in the form of ratios, percentages, growth rates, cover resources devoted to R&D, patent families, technology balance of payments and international trade in highly R&D-intensive industries.

Publication: OECD (2003), *Main Science and Technology Indicators* 2003/1. Biannual. Also available on CD-ROM.

ANBERD: The **Analytical Business Enterprise Research and Development** database is an estimated database constructed with a view to creating a consistent data set that overcomes the problems of international comparability and time discontinuity associated with the official business enterprise R&D data provided to the OECD by its member countries. ANBERD contains R&D expenditures for the period 1987-2000, by industry (ISIC Rev. 3), for 19 OECD countries.

Publication: OECD (2002), *Research and Development Expenditure in Industry*, 1987-2000. Annual. Also available on diskette.

Patent database: This database contains patents filed at the largest national patent offices – European Patent Office (EPO); US Patent and Trademark Office (USPTO); Japanese Patent Office (JPO) – and other national or regional offices. Each patent is referenced by: patent numbers and dates (publication, application and priority); names and countries of residence of the applicants and of the inventors; and technological categories, using the national patent classification as well as the International Patent Classification (IPC). The compiled indicators mainly refer to single patent counts in a selected patent office, as well as counts of "triadic" patent families (patents filed at the EPO, the USPTO and the JPO to protect a single invention).

The series are published on a regular basis in OECD, *Main Science and Technology Indicators*.

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Globalisation and international trade

AFA: The **Activities of Foreign Affiliates** database presents detailed data on the performance of foreign affiliates in the manufacturing industry of OECD countries (inward and outward investment). The data indicate the increasing importance of foreign affiliates in the economies of host countries, particularly in production, employment, value added, research and development, exports, wages and salaries. AFA contains 18 variables broken down by country of origin and by industrial sector (based on ISIC Rev. 3) for 18 OECD countries.

Publication: OECD, *Measuring Globalisation: The Role of Multinationals in* OECD *Economies*, 2001 Edition. Vol. I: Manufacturing. Biennial.

FATS: This database gives detailed data on the **activities of foreign affiliates** in the **services** sector of OECD countries (inward and outward investment). The data indicate the increasing importance of foreign affiliates in the economies of host countries and of affiliates of national firms implanted abroad. FATS contains five variables (production, employment, value added, imports and exports) broken down by country of origin (inward investments) or implantation (outward investments) and by industrial sector (based on ISIC Rev. 3) for 19 OECD countries.

Publication: OECD, *Measuring Globalisation: The Role of Multinationals in* OECD *Economies*, 2001 Edition. Vol. II: Services. Biennial.

Bilateral Trade (BTD): This database for industrial analysis includes detailed trade flows by manufacturing industry between a set of OECD *declaring* countries and a selection of *partner* countries and geographical regions. Data are presented in thousands of USD at current prices, and cover the period 1988-2000. The data have been derived from the OECD database *International Trade by Commodities Statistics* (ITCS – formerly *Foreign Trade Statistics* or FTS). Imports and exports are grouped according to the country of origin and the country of destination of the goods. The data have been converted from product classification schemes to an activity classification scheme based on ISIC Rev.3, that matches the classification currently used for the OECD' s STAN, Input-Output tables and ANBERD databases.

Publication: OECD (2003), *Bilateral Trade Database*, 2002. Only available on diskette.

Information and communication technology (ICT)

Telecommunications: This database is produced in association with the biennial *Communications Outlook*. It provides time-series data covering all OECD countries, where available, for the period 1980-2002. It contains both telecommunication and economic indicators.

Publication: OECD (2003), *Telecommunications Database* 2003. Only available on diskette and CD-ROM.

ICT: Work is under way to develop a database on ICT supply and ICT usage statistics. Statistics on employment, value added, production, wages and salaries, number of enterprises, R&D, imports and exports for the ICT sector are been collected following the OECD ICT sector definition.

Publication: OECD (2002), *Measuring the Information Economy*, 2002. Freely available as a Web book with "clickable" access to the data used at: *www.oecd.org/sti/measuring-infoeconomy*.

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Current country coverage of main DSTI databases used in this publication

	Industry	Science and technology					Globalisation			ICT
	STAN	R&D	TBP	MSTI	ANBERD	Patents	AFA	FATS	BTD	Telecom.
Australia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Austria	✓	✓	✓	✓		✓		✓	✓	✓
Belgium	✓	✓	✓	✓	✓	✓		✓	✓	✓
Canada	✓	✓	✓	✓	✓	✓	✓		✓	✓
Czech Republic	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Denmark	✓	✓	✓	✓	✓	✓			✓	✓
Finland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
France	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Germany	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Greece	✓	✓		✓		✓	✓	✓	✓	✓
Hungary	✓	✓	✓	✓		✓	✓	✓	✓	✓
Iceland		✓		✓		✓			✓	✓
Ireland		✓	✓	✓	✓	✓	✓	✓	✓	✓
Italy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Japan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Korea	✓	✓	✓	✓	✓	✓			✓	✓
Luxembourg	✓			✓		✓	✓	✓	✓	✓
Mexico	✓	✓	✓	✓		✓	✓		✓	✓
Netherlands	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
New Zealand	✓	✓	✓	✓		✓			✓	✓
Norway	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Poland	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓		✓	✓	✓	✓	✓
Slovak Republic	✓	✓	✓	✓		✓	✓		✓	✓
Spain	✓	✓	✓	✓	✓	✓	✓		✓	✓
Sweden	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Switzerland		✓	✓	✓		✓			✓	✓
Turkey		✓		✓		✓	✓	✓	✓	✓
United Kingdom	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
United States	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Other OECD databases

ADB: Analytical DataBase (Economics Department).

ANA: Annual National Accounts (Statistics Directorate).

Education database (Directorate for Education, Employment, Labour and Social Affairs).

ITCS: International Trade in Commodities Statistics (Statistics Directorate).

International Direct Investment (Directorate for Financial, Fiscal and Enterprise Affairs).

LFS: Labour Force Statistics (Statistics Directorate).

SSIS: Structural Statistics for Industry and Services (Statistics Directorate).

Services: Value Added and Employment (Statistics Directorate).

Further details on OECD statistics are available on the Internet at: *www.oecd.org/statistics/*

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STATISTICAL ANNEX

Table A.2.1. **Gross domestic expenditure on R&D (GERD)**
As a percentage of GDP

	1981	1985	1991	1995	1996	1997	1998	1999	2000	2001	2002
Canada	1.24	1.44	1.60 [8]	1.72	1.68	1.68	1.79	1.81	1.87	1.94	1.85
Mexico[1]	..	..	0.22	0.31	0.31	0.34	0.38	0.43	..	..	..
United States	2.34	2.76	2.72	2.51	2.55	2.58	2.60	2.65	2.72	2.82	2.82
Australia[2]	0.95	1.24	1.52	..	1.66	..	1.51	..	1.53	..	..
Japan[3]	2.11	2.54	2.75	2.69	2.77 [8]	2.83	2.94	2.94	2.98	3.09	..
Korea	..	..	1.92	2.50	2.60	2.69	2.55	2.47	2.65	2.96	..
New Zealand	0.99	..	0.98	0.96 [8]	..	1.11	..	1.03	..	..	..
Austria	1.13	1.24	1.47	1.56 [8]	1.60	1.71	1.78	1.85	1.84	1.90	1.94
Belgium	..	1.62 [8]	1.62 [8]	1.72 [8]	1.80	1.87	1.90	1.96	..	..	..
Czech Republic	..	..	2.02	1.01 [8]	1.04	1.16	1.24	1.24	1.33	1.30	..
Denmark	1.06	1.21	1.64 [8]	1.84	1.85	1.94	2.06	2.19	..	..	..
Finland	1.17	1.55	2.03 [8]	2.28	2.54	2.71	2.88	3.23	3.40	3.40	..
France	1.93	2.22	2.37	2.31	2.30	2.22 [8]	2.17	2.18	2.18 [8]	2.20	..
Germany[4]	2.43	2.68	2.53 [8]	2.26 [8]	2.26	2.29	2.31	2.44		2.49	2.50
Greece[5]	0.17	0.27	0.36 [8]	0.49 [8]	..	0.51	..	0.67	..	..	..
Hungary	..	..	1.06	0.73 [8]	0.65	0.72	0.68	0.69	0.80	0.95	..
Iceland	0.64	0.74	1.18	1.57	..	1.88	2.07	2.39	2.77	3.06	3.04
Ireland	0.68	0.77	0.93	1.28	1.32	1.29	1.25	1.22	1.15	1.17	..
Italy	0.88	1.12	1.23 [8]	1.00	1.01	1.05 [8]	1.07	1.04	1.07	..	..
Netherlands	1.79	1.99 [8]	1.97 [8]	1.99 [8]	2.01 [8]	2.04	1.94	2.02	1.94	..	..
Norway	1.17	1.48 [8]	1.64	1.70 [8]	..	1.64	..	1.65	..	1.62	..
Poland	..	..	..	0.69 [8]	0.71	0.71	0.72	0.75	0.70	0.67	..
Portugal[6]	0.30	0.38	0.61	0.57 [8]	..	0.62	0.69	0.75	0.79	0.83	0.78
Slovak Republic	..	..	2.16	0.94 [8]	0.94	1.09 [8]	0.79	0.66	0.67	0.65	..
Spain	0.41	0.53	0.84	0.81 [8]	0.83	0.82	0.89	0.88	0.94	0.96	..
Sweden	2.17	2.71	2.70	3.35 [8]	..	3.54	..	3.65	..	4.27	..
Switzerland[2]	2.18	2.82 [8]	2.66 [8]	..	2.73	..	..	..	2.63	..	..
Turkey	..	..	0.53	0.38	0.45	0.49	0.50	0.63	0.64	..	..
United Kingdom	2.38	2.24 [8]	2.07	1.95 [8]	1.88	1.81	1.80	1.88	1.85	1.90	..
European Union	1.69	1.86	1.90 [8]	1.80 [8]	1.80	1.80	1.81	1.86	1.89	1.93	..
Total OECD[7]	1.95	2.26	2.23 [8]	2.10 [8]	2.13	2.15	2.17	2.20	2.25	2.33	..

1. 1993 instead of 1991.
2. 1986 instead of 1985; 1992 instead of 1991.
3. Adjusted by OECD up to 1995.
4. Figures for Germany from 1991 onwards refer to unified Germany.
5. 1986 instead of 1985.
6. 1982 instead of 1981; 1986 instead of 1985; 1992 instead of 1991.
7. Includes Mexico and Korea from 1991, and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
8. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.2.2. **Gross domestic expenditure on R&D (GERD)**

	Millions of 1995 PPP dollars										Average annual growth rate (1995-2001)	
	1981	1985	1991	1995	1996	1997	1998	1999	2000	2001		
Canada	6 041.0	7 768.4	9 689.8 [8]	11 630.7	11 501.2	12 045.8	13 293.3	14 198.8	15 353.8	16 122.4		5.6
Mexico[1]	..	..	1 395.4	1 923.1	2 024.8	2 404.6	2 766.1	3 262.8	..	..	1995-1999	14.1
United States	114 529.7	153 685.9	176 602.8	184 077.1	194 022.5	204 648.1	215 528.3	228 604.2	243 258.1	252 938.5		5.4
Australia[2]	2 418.6	3 628.0	5 265.2	..	6 728.0	..	6 733.7	..	7 229.1	..	1996-2000	1.8
Japan[3]	39 655.3	54 613.5	77 592.3	78 668.4	83 979.6 [8]	87 457.3	89 725.2	90 211.8	93 700.5	96 532.3	1996-2001	2.8
Korea	..	..	7 565.3	12 923.4	14 334.0	15 567.4	13 784.7	14 797.4	17 380.2	19 950.3		7.5
New Zealand	460.7	..	524.5	606.2 [8]	..	736.5	..	720.0	..	..	1995-1999	4.4
Austria	1 386.6	1 648.8	2 368.2	2 685.3	2 823.9	3 060.1	3 315.6	3 541.8	3 634.9	3 787.6		5.9
Belgium	..	2 860.7 [8]	3 392.1 [8]	3 807.4 [8]	4 054.3	4 346.4	4 507.6	4 801.1	..	..	1995-1999	6.0
Czech Republic	..	..	2 391.1	1 293.3 [8]	1 382.8	1 532.8	1 626.6	1 633.9	1 811.1	1 822.6		5.9
Denmark	964.9	1 239.9	1 809.0	2 203.1	2 278.9	2 456.4	2 672.4	2 913.1	..	..	1995-1999	7.2
Finland	878.6	1 314.7	1 902.2 [8]	2 203.6	2 547.3	2 897.7	3 228.5	3 745.4	4 151.3	4 185.2		11.3
France	17 406.6	21 520.6	27 235.8	27 722.6	27 860.3	27 427.8 [8]	27 724.2	28 752.7	29 916.5 [8]	30 703.9	1997-1999	2.4
Germany[4]	27 786.8	32 522.7	42 019.0 [8]	39 451.5 [8]	39 728.4	40 894.2	42 134.5	45 253.1	47 653.3	47 827.0		3.3
Greece[5]	199.3	322.2	469.8 [8]	652.0 [8]	..	720.2	..	1 026.1	..	..	1995-1999	12.0
Hungary	..	..	976.0	680.4 [8]	611.8	710.4	700.8	736.5	904.7	1 111.7		8.5
Iceland	29.0	36.4	67.4	91.7	..	120.7	140.3	168.3	205.6	235.2		17.0
Ireland	254.5	316.1	494.0	833.9	929.6	1 006.5	1 067.6	1 157.6	1 197.6	1 287.2		7.5
Italy	7 668.3	10 548.5	13 449.5	11 522.8	11 735.8	12 500.4 [8]	12 909.2	12 798.7	13 556.5	..	1997-2000	2.7
Netherlands	4 220.3	5 007.0 [8]	5 963.1 [8]	6 528.9 [8]	6 816.2 [8]	7 170.4	7 112.9	7 712.4	7 647.3	..	1996-2000	2.9
Norway	923.5	1 312.0 [8]	1 490.0	1 739.6 [8]	..	1 910.6	..	2 025.6	..	2 255.8		4.4
Poland	..	..	..	1 875.6 [8]	2 045.5	2 183.7	2 328.0	2 498.5	2 437.4	2 367.7		4.0
Portugal[6]	279.9	373.2	804.4	774.6	..	908.5	1 055.8	1 199.3	1 305.2	1 382.8		10.1
Slovak Republic	..	..	967.0	451.7 [8]	475.5	584.3 [8]	441.4	374.2	385.5	388.7	1997-2001	-9.7
Spain	1 694.1	2 362.3	4 774.9	4 838.7 [8]	5 072.3	5 197.1	5 925.0	6 110.0	6 760.1	7 066.8		6.5
Sweden	3 072.0	4 224.4	4 710.7	6 095.4 [8]	..	6 692.0	..	7 472.2	..	9 232.7		7.2
Switzerland[2]	3 283.7	4 553.8 [8]	4 770.9 [8]	..	4 949.7	..	..	..	5 203.1	..	1996-2000	1.3
Turkey	..	..	1 582.8	1 321.3	1 680.0	1 966.3	2 055.8	2 482.3	2 703.1	..	1995-2000	15.4
United Kingdom	18 174.6	19 211.2 [8]	20 576.7	21 460.8 [8]	21 228.3	21 098.1	21 609.7	23 084.2	23 416.5	24 558.1		2.3
European Union	86 654.5	103 448.7	129 898.2 [8]	130 823.8 [8]	132 999.7	136 375.7	141 187.4	149 535.0	157 060.0	162 813.3		3.7
Total OECD[7]	254 843.8	329 650.9	415 725.2 [8]	439 619.0 [8]	459 299.1	479 952.3	497 903.8	523 127.0	554 856.0	578 749.4		4.7

1. 1993 instead of 1991.
2. 1986 instead of 1985; 1992 instead of 1991.
3. Adjusted by OECD up to 1995.
4. Figures for Germany from 1991 onwards refer to unified Germany.
5. 1986 instead of 1985.
6. 1982 instead of 1981; 1986 instead of 1985; 1992 instead of 1991..
7. Includes Mexico and Korea from 1991, and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
8. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

Table A.3.1. **R&D expenditure by source of funds**

Percentages

	Business enterprise						Government						Other national sources						Abroad					
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001
Canada	38.2	45.7	48.1	44.3	42.3	41.9	45.7	35.9	32.0	31.5	30.8	31.3	6.7	6.9	7.7	8.6	8.8	9.0	9.4	11.6	12.3	15.6	18.1	17.8
Mexico	..	17.6	16.9	23.6	..	..	..	66.2	71.1	61.3	..	..	..	9.5	9.5	9.8	..	..	..	6.7	2.5	5.3	..	..
United States	57.2 [8]	60.2 [8]	64.0 [8]	66.9 [8]	69.3 [8]	68.3 [8]	38.9 [8]	35.4 [8]	31.5 [8]	28.5 [8]	26.0 [8]	26.9 [8]	3.9 [8]	4.4 [8]	4.4 [8]	4.6 [8]	4.7 [8]	4.8 [8]	..	..	..	..	..	..
Australia[1]	..	47.8	45.7	..	45.9	..	..	45.8	47.1	..	46.1	..	..	4.4	4.7	..	4.7	..	..	2.1	..	2.5	3.3	..
Japan[2]	77.4 [7]	72.3 [7]	74.0 [9]	72.2	72.4	73.0	16.4 [8]	20.9 [8]	18.2 [9]	19.6	19.6	18.5	6.1 [8]	6.7 [8]	7.5 [9]	7.8	7.6	8.1	0.1 [8]	0.1 [8]	0.3 [9]	0.4	0.4	0.4
Korea	..	76.3 [8]	72.5 [8]	70.0 [8]	72.4 [8]	72.5 [8]	..	19.0 [8]	22.9 [8]	24.9 [8]	23.9 [8]	25.0 [8]	..	4.7 [8]	4.5 [8]	5.1 [8]	3.6 [8]	2.1 [8]	..	0.0 [8]	0.1 [8]	0.1 [8]	0.1 [8]	0.5 [8]
New Zealand	27.4	33.7 [9]	30.5	34.1	..	..	61.8	52.3 [9]	52.3	50.6	..	..	8.2	10.1 [9]	12.0	11.0	..	..	2.5	3.9 [9]	5.2	4.3	..	..
Austria	50.3	45.3	43.3	40.3	40.2	39.4	46.5	47.3	41.0	39.7	39.9	41.3	0.3	0.4	0.4	0.4	0.4	0.3	3.0	7.1	15.3	19.7	19.6	18.9
Belgium	64.8	67.1 [9]	67.6	66.2	..	..	31.3	23.1 [9]	22.2	23.2	..	..	1.0	2.3 [9]	3.4	3.3	..	..	3.0	7.5 [9]	6.8	7.3	..	..
Czech Republic	..	63.1	59.8	52.6	51.2	52.5	..	32.3 [8]	30.8 [8]	42.6 [9]	44.5	43.6	..	1.3 [7]	7.5 [7]	0.8 [9]	1.1	1.7	..	3.3	1.9	4.0	3.1	2.2
Denmark	51.4	45.2	53.4	59.0	..	..	39.7	39.6	36.1	31.2	..	..	4.6	4.3	4.1	3.3	..	..	4.4	11.0	6.4	5.4	..	..
Finland	56.3	59.5	62.9	67.0 [9]	70.3	70.8	40.9	35.1	30.9	29.2	26.2	25.5	1.5	1.0	0.9	0.9	0.9	1.2	1.3	4.5	5.4	3.0 [9]	2.7	2.5
France	42.5	48.4 [9]	51.6 [9]	54.1	52.5 [9]	..	48.8	41.9 [9]	38.8 [9]	36.9	38.7 [9]	..	0.7	1.7 [9]	1.6 [9]	1.9	1.6 [9]	..	8.0	8.0	7.9 [9]	7.0	7.2 [9]	..
Germany[3]	61.9	61.1 [9]	61.4	65.0	65.8	66.0	35.7	36.8 [9]	35.9	32.6	31.6	31.5	0.5	0.3 [9]	0.3	0.4	0.4	0.4	1.9	1.8 [9]	2.4	2.1	2.2	2.1
Greece	21.8	25.5 [9]	21.6	24.2	..	..	57.7	53.9 [9]	54.2	48.7	..	..	0.7	2.5 [9]	1.6	2.5	..	..	19.9	18.2 [9]	22.6	24.7	..	..
Hungary	56.0	38.4 [9]	36.6	38.5	37.8	34.8	40.0	53.1 [9]	54.8	53.2	49.5	53.6	0.1	0.5 [9]	0.5	0.3	0.3	0.4	1.8	4.9 [9]	4.3	5.6	10.6	9.2
Iceland	24.5	34.6	42.0	43.4	..	46.2	69.7	57.3	50.9	41.2	..	34.0	1.7	3.7	0.9	1.5	..	1.6	4.1	4.4	6.2	13.9	..	18.3
Ireland	60.6	72.3	67.3	62.7	66.0	..	27.9	22.5	24.3	23.6	22.6	..	2.2	1.9	1.7	2.1	2.6 [c]	..	9.4	8.5	6.7	11.7	8.9	..
Italy	44.4	41.7	43.0	..	..	..	49.6	53.0	50.8	..	..	..	..	..	..	..	..	..	6.1	5.3	6.2	..	..	..
Netherlands	47.8	46.0 [9]	45.6 [9]	49.7	50.1	..	48.6	42.2 [9]	39.1 [9]	35.8	35.9	..	1.8	2.6 [9]	2.6 [9]	3.4	2.6	..	1.9	9.3 [9]	12.8 [9]	11.2	11.4	..
Norway	44.5	49.9 [9]	49.4	49.5	..	51.7	49.5	44.0 [9]	42.9	42.6	..	39.8	1.3	1.2 [9]	1.2	1.6	..	1.4	4.6	4.9 [9]	6.5	6.4	..	7.1
Poland	..	36.0 [9]	35.1	38.1	32.6	30.8	..	60.2 [9]	61.7	58.5	63.4	64.8	..	2.1 [9]	1.6	1.7	2.1	2.0	..	1.7 [9]	1.6	1.7	1.8	2.4
Portugal[4]	20.2	19.5	21.2	21.3	27.5	32.4	59.4	65.3 [9]	68.2 [9]	69.7	65.0	61.2	5.4	3.3	4.4	3.7	2.8	2.1	15.0	11.9 [9]	6.1 [9]	5.3	4.8	4.4
Slovak Republic	68.3	60.4 [9]	63.6 [7,9]	49.9 [7]	54.4 [7]	56.1 [7]	31.7	37.8 [9]	34.5 [9]	47.9	42.6	41.3	..	0.1 [9]	0.1 [7,9]	0.0 [7]	0.7 [7]	0.8 [7]	..	1.6 [9]	1.9 [7,9]	2.3 [7]	2.3 [7]	1.9 [7]
Spain	48.1	44.5 [9]	44.7	48.9	49.7	47.2	45.7	43.6 [9]	43.6	40.8	38.6	39.9	0.6	5.2 [9]	4.9	4.7	6.8	5.3	5.6	6.7 [9]	6.7	5.6	4.9	7.7
Sweden	61.9	65.5 [9]	67.9	67.8	..	71.9	34.0	28.8 [9]	25.8 [9]	24.5	..	21.0	2.7	2.2 [9]	2.8 [9]	4.2	..	3.8	1.5	3.4 [9]	3.5	3.5	..	3.4
Switzerland[b]	67.4	67.5	..	..	69.1	..	28.4	26.9	..	..	23.2	..	2.3	2.5	..	..	3.4	..	1.9	3.1	..	..	4.3	..
Turkey	28.5	32.9	41.8	43.3	42.9	..	70.1	62.4	53.7	47.7	50.6	..	1.3	2.7	2.7	4.2	5.3	..	0.2	2.0	1.8	4.8	1.2	..
United Kingdom	49.6	48.2 [9]	50.0	48.5	49.3	46.2	35.0	32.8 [9]	30.7	29.2	28.9	30.2	3.5	4.5 [9]	4.8	5.0	5.5	5.7	11.9	14.5 [9]	14.6	17.3	16.3	18.0
European Union	51.9	52.6 [9]	53.8	55.5	56.2	..	41.2	38.8 [9]	37.1	35.0	34.5	..	1.3	1.8 [9]	2.0	2.2	2.2	1.5	5.7	6.8 [9]	7.2	7.3	7.1	..
Total OCDE[b]	58.8	59.7 [9]	62.0	63.0	64.3	63.6	35.6	33.8 [9]	31.1	29.7	28.4	28.9	3.5	4.1 [9]	4.4	4.5	4.5	4.6	..	..	..	..	..	..

1. 1996 instead of 1995; 1998 instead of 1997.
2. Adjusted by OECD up to 1995.
3. Figures for Germany and zone totals refer to unified Germany.
4. 1992 instead of 1991.
5. 1992 instead of 1991; 1996 instead of 1995.
6. Includes Czech Republic, Hungary, Poland and Slovak Republic from 1995.
7. Overestimated.
8. Underestimated
9. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.3.2. **Financing of expenditures on R&D by source as a percentage of GDP**

	Business enterprise						Government						Other national sources						Abroad					
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001
Canada	0.61	0.79	0.81	0.80	0.79	0.81	0.73	0.62	0.54	0.57	0.58	0.61	0.11	0.12	0.13	0.16	0.16	0.17	0.15	0.20	0.21	0.28	0.34	0.35
Mexico	0.10 [8]	0.05 [10]	0.06	0.10	..	..	0.21 [9]	0.20 [10]	0.25	0.26	..	..		0.03	0.03	0.04	..	..		0.02	0.01	0.02	..	..
United States	1.56 [9]	1.51 [9]	1.65 [9]	1.77 [9]	1.88 [9]	1.92 [9]	1.06 [9]	0.89 [9]	0.81 [9]	0.76 [9]	0.71 [9]	0.76 [9]	0.11 [9]	0.11 [9]	0.11 [9]	0.12 [9]	0.13 [9]	0.14 [9]	0.00	0.00	0.00	0.00	0.00	0.00
Australia[1]	0.67	0.79	0.69	..	0.70	..	0.76	0.76	0.71	..	0.71	..	0.06	0.07	0.07	..	0.07	..	0.03	0.03	0.04	..	0.05	..
Japan[2]	2.13 [8]	1.94 [8]	2.10 [10]	2.12	2.16	2.25	0.45	0.56	0.52 [10]	0.58	0.58	0.57	0.17 [8]	0.18	0.21 [10]	0.23	0.23	0.25	0.00	0.00	0.01	0.01	0.01	0.01
Korea		1.91 [9]	1.95 [9]	1.73 [9]	1.92 [9]	2.14 [9]	..	0.48 [9]	0.62 [9]	0.61 [9]	0.64 [9]	0.74 [9]		0.12 [9]	0.12 [9]	0.13 [9]	0.10 [9]	0.06 [9]		0.00 [9]	0.00 [9]	0.00 [9]	0.00 [9]	0.01 [9]
New Zealand	0.27	0.32	0.34	0.35	..	..	0.61	0.50 [10]	0.58	0.52	..	..	0.08	0.10	0.13	0.11	..	..	0.02	0.04	0.06	0.04	..	..
Austria	0.74	0.70 [10]	0.74	0.75	0.74	0.75	0.68	0.74 [10]	0.70	0.74	0.73	0.79	0.00	0.01	0.01	0.01	0.01	0.01	0.04	0.11	0.26	0.36	0.36	0.36
Belgium	1.05	1.15 [10]	1.26	1.30	..	..	0.51	0.40 [10]	0.41	0.45	..	..	0.02	0.04 [10]	0.06	0.07	..	..	0.05	0.13 [10]	0.13	0.14	..	..
Czech Republic	..	0.64	0.69	0.65	0.68	0.68	0.59 [9]	0.33 [9,10]	0.36 [9]	0.53 [10]	0.59	0.57		0.01 [8]	0.09 [8]	0.01 [10]	0.02	0.02		0.03	0.02	0.05	0.04	0.03
Denmark	0.84	0.83	1.04	1.29	..	..	0.65	0.73	0.70	0.68	..	..	0.08	0.08	0.08	0.07	..	..	0.07	0.20	0.12	0.12	..	..
Finland	1.14	1.36	1.71	2.16 [10]	2.39	2.41	0.83	0.80	0.84	0.94	0.89	0.87	0.03	0.02	0.02	0.03	0.03	0.04	0.03	0.10	0.15	0.10 [10]	0.09	0.08
France	1.01	1.12 [10]	1.15 [10]	1.18	1.15 [10]	..	1.16	0.97 [10]	0.86 [10]	0.80	0.84 [10]	..	0.02	0.04	0.04	0.04	0.04 [10]	..	0.19	0.19	0.18	0.15	0.16 [10]	..
Germany[3]	1.57	1.38	1.41	1.58	1.64	1.64	0.90	0.83 [10]	0.82	0.79	0.79	0.78	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.04 [10]	0.06	0.05	0.05	0.05
Greece	0.08	0.12 [10]	0.11	0.16	..	..	0.21	0.26 [10]	0.27	0.33	..	..	0.00	0.01	0.01	0.02	..	..	0.07	0.09	0.11	0.17	..	..
Hungary	0.59	0.28 [10]	0.26	0.26	0.30	0.33	0.42	0.39 [10]	0.40	0.37	0.40	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.03	0.04	0.09	0.09
Iceland	0.29	0.54	0.79	1.04	..	1.41	0.82	0.90	0.96	0.99	..	1.04	0.02	0.06	0.02	0.04	..	0.05	0.05	0.07	0.12	0.33	..	0.56
Ireland	0.56	0.92	0.86	0.77	0.76	..	0.26	0.29	0.31	0.29	0.26	..	0.02	0.02	0.02	0.03	0.03	..	0.09	0.11	0.09	0.14	0.10	..
Italy[4]	0.54	0.42	0.43	..	..	..	0.61	0.53	0.51	..	..	..	..	..	..	..	..	..	0.07	0.05	0.06	..	..	..
Netherlands	0.94	0.91 [10]	0.93 [10]	1.00	0.97	..	0.96	0.84 [10]	0.80	0.72	0.70		0.03	0.05	0.05	0.07	0.05	..	0.04	0.19	0.26	0.23	0.22	..
Norway	0.73	0.85 [10]	0.81	0.82	..	0.84	0.81	0.75	0.70	0.70	..	0.64	0.02	0.02	0.02	0.03	..	0.02	0.08	0.08	0.11	0.10	..	0.12
Poland	..	0.25	0.25	0.28	0.23	0.21	..	0.42 [10]	0.44	0.44	0.44	0.44	..	0.01	0.01	0.01	0.01	0.01	..	0.01	0.01	0.01	0.01	0.02
Portugal[5]	0.12	0.11 [10]	0.13	0.16	0.22	0.27	0.36	0.37 [10]	0.42 [10]	0.53	0.51	0.50	0.03	0.02	0.03	0.03	0.02	0.02	0.09	0.07 [10]	0.04 [10]	0.04	0.04	0.04
Slovak Republic	1.48	0.57 [10]	0.69	0.33	0.36	0.37	0.68	0.36 [10]	0.38 [9,10]	0.32 [9]	0.29 [9]	0.27 [9]	..	0.00	0.00	0.00	0.00	0.01	..	0.02	0.02	0.01	0.02	0.01
Spain	0.40	0.36 [10]	0.37	0.43	0.47	0.45	0.38	0.35 [10]	0.36	0.36	0.36	0.38	0.01	0.04	0.04	0.04	0.06	0.05	0.05	0.05	0.06	0.05	0.05	0.07
Sweden	1.67 [9]	2.19 [9,10]	2.40 [9]	2.47 [9]		3.07 [9]	0.92 [9]	0.96 [9,10]	0.91 [9,10]	0.89 [9]	..	0.90 [9]	0.07 [9]	0.07 [9]	0.10 [9]	0.15 [9]	..	0.16 [9]	0.04 [9]	0.11 [9,10]	0.12 [9]	0.13 [9]		0.14 [9]
Switzerland[6]	1.79	1.84	..	..	1.82	..	0.75	0.74	..	..	0.61	..	0.06	0.07	..	..	0.09	..	0.05	0.08	..	..	0.11	..
Turkey	0.15	0.13	0.21	0.27	0.28	..	0.37	0.24	0.26	0.30	0.32	..	0.01	0.01	0.01	0.03	0.03	..	0.00	0.01	0.01	0.03	0.01	..
United Kingdom	1.03	0.94 [10]	0.90	0.91	0.91	0.88	0.72	0.64 [10]	0.55	0.55	0.53	0.57	0.07	0.09	0.09	0.09	0.10	0.11	0.25	0.28 [10]	0.26	0.32	0.30	0.34
European Union	0.99	0.95 [10]	0.97	1.03	1.06	..	0.78	0.70 [10]	0.67	0.65	0.65	..	0.01	0.01 [10]	0.01	0.01	0.01	..	0.11	0.12 [10]	0.13	0.14	0.13	..
Total OECD[7]	1.31	1.25 [10]	1.33	1.39	1.44	1.48	0.79	0.71 [10]	0.67	0.65	0.64	0.67	0.05	0.06 [10]	0.07	0.07	0.07	0.06	..	..	..	..	..	..

1. 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
2. Adjusted by OECD up to 1995.
3. Figures for Germany and zone totals refer to unified Germany.
4. 1996 instead of 1995.
5. 1992 instead of 1991.
6. 1992 instead of 1991; 1996 instead of 1995.
7. Includes Czech Republic, Hungary, Poland and Slovak Republic from 1995.
8. Overestimated.
9. Underestimated.
10. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

Table A.3.3. **R&D expenditures by main sectors of performance**

Percentages

	Business enterprise						Higher education						Government						Private non-profit					
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001
Canada	49.7	58.1	59.7	58.6	58.3	57.5	30.6	26.8	26.5	29.1	29.5	30.3	18.7	14.4	13.2	12.0	11.9	11.9	1.0	0.7	0.6	0.4	0.3	0.3
Mexico	..	20.8	19.7	25.5	..	..	..	45.8	39.9	26.3	..	..	..	33.0	38.8	45.0	..	..	..	0.4	1.6	3.1	..	..
United States	72.5 [9]	71.8 [9]	74.1 [9]	74.9 [9]	75.3 [9]	74.4 [9]	14.5 [9]	15.2 [9]	14.3 [9]	13.9 [9]	13.9 [9]	14.2 [9]	9.8 [9]	9.4 [9]	8.2 [9]	7.5 [9]	6.8 [9]	7.0 [9]	3.3 [9]	3.6 [9]	3.5 [9]	3.8 [9]	4.1 [9]	4.5
Australia[1]	44.2	48.2	45.8	..	47.1	..	26.2	26.3	28.6	..	27.1	..	28.1	23.5	23.2	..	23.1	..	1.6	2.1	2.5	..	2.8	..
Japan[2]	75.4 [8]	70.3	72.0 [10]	70.7	71.0	73.7	12.1 [9]	14.5 [9]	14.3 [10]	14.8	14.5	14.5	8.1 [9]	10.4 [9]	8.8 [10]	9.9	9.9	9.5	4.4 [9]	4.8 [9]	4.9 [10]	4.6	4.6	2.3
Korea	..	73.7 [9]	72.6 [9]	71.4 [9]	74.1 [9]	76.2 [9]	..	8.2 [9]	10.4 [9]	12.0 [9]	11.3 [9]	10.4 [9]	..	17.0 [9]	15.8 [9]	14.5 [9]	13.3 [9]	12.4 [9]	..	1.2 [9]	1.2 [9]	2.2 [9]	1.4 [9]	1.1
New Zealand	26.8	27.0 [10]	28.2	29.7	..	..	28.6	30.7 [10]	36.4	34.3	..	..	44.6	42.2 [10]	35.3	36.0	..	..	..	..	..	..	..	..
Austria[3]	55.9	..	63.6	..	..	..	35.0	..	29.7	..	..	..	8.9	..	6.4	..	..	..	0.3	..	0.3	..	..	..
Belgium	66.5	71.3 [10]	71.6	71.6	..	..	26.2	23.9 [10]	23.8	23.9	..	..	6.1	3.5 [10]	3.3	3.3	..	..	1.2	1.4 [10]	1.3	1.2	..	..
Czech Republic	69.4	65.1 [10]	62.8	62.9	60.0	60.2	1.6	8.5 [10]	9.1	12.3	14.2	15.7	29.0	26.5 [10]	26.6	24.3	25.3	23.7	..	0.1	1.4	0.6	0.5	0.5
Denmark	58.5	57.4	61.5	64.9	..	..	22.6	24.5	22.2	19.4	..	..	17.7	17.0	15.4	14.5	..	..	1.2	1.1	1.0	1.1	..	..
Finland	57.0	63.2	66.0	68.2	70.9	71.1	22.1	19.5	20.0 [10]	19.7	17.9	18.1	20.2	16.7 [10]	13.6	11.4	10.6	10.2	0.7	0.6	0.5	0.7	0.7	0.6
France	61.5	61.0 [10]	62.5 [10]	63.2	62.5 [10]	62.4	15.1	16.7	17.4 [10]	17.2	18.8 [10]	18.5	22.7	21.0 [10]	18.7 [10]	18.1	17.3 [10]	17.7	0.8	1.3 [10]	1.4 [10]	1.5	1.4 [10]	1.4
Germany[4]	69.5	66.4 [10]	67.5	69.8	70.3	70.5	16.2	18.2 [10]	17.9	16.5	16.1	16.0	14.0	15.4 [10]	14.6	13.8	13.6	13.4	0.4	..	..	..	..	..
Greece	26.1	29.5 [10]	25.6	28.5	..	..	33.8	44.3 [10]	50.6	49.5	..	..	40.1	25.5 [10]	23.4	21.7	..	..	..	0.7 [10]	0.4	0.3	..	..
Hungary	41.4	43.4 [10]	41.5	40.2	44.3	40.1	20.3	24.8 [10]	23.0	22.4	24.0	25.7	24.5	25.6 [10]	25.1	32.3	26.1	25.9	..	..	..	..	..	..
Iceland	21.8	31.9	40.6	46.7	56.4	58.9	29.4	27.5	28.3	20.9	16.2	18.8	44.5	37.5	29.8	30.2	25.5	20.1	4.4	3.2	1.3	2.2	1.9	2.3
Ireland	63.6	70.0	71.0	71.4	71.9	68.5	23.2	20.4	20.7	22.7	20.1	..	11.6	9.0 [10]	7.6	5.8	8.1	9.5	1.7	0.8	0.7	..	..	..
Italy	55.8	53.4	49.8 [10]	49.3	50.1	..	21.5	25.5	30.8 [10]	31.5	31.0	..	22.7	21.1	19.4 [10]	19.2	18.9	..	..	..	..	..	..	..
Netherlands	49.7	52.1 [10]	54.6 [10]	56.4	57.1	..	29.7	28.8 [10]	27.3 [10]	26.2	29.2 [10]	..	18.3	18.1 [10]	17.1 [10]	16.5	13.0 [10]	..	2.3	1.0 [10]	1.0 [10]	0.9	0.8	..
Norway	54.6	56.7 [10]	56.9	56.0	..	59.7	26.7	26.0 [10]	26.6	28.6	..	25.7	18.8	17.3 [10]	16.4	15.4	..	14.6	..	..	..	..	..	..
Poland	..	38.7 [10]	39.4	41.3	36.1	35.8	..	26.3 [10]	28.6	27.8	31.5	32.7	..	35.0 [10]	32.0	30.8	32.3	31.3	..	0.1	..	0.1	0.1	0.2
Portugal[5]	21.7	20.9 [10]	22.5	22.7	28.2	32.6	43.0	37.1 [10]	40.0	38.6	37.2	36.1	22.1	27.0	24.2	27.9	24.3	21.4	13.2	15.0 [10]	13.3	10.8	10.3	10.0
Slovak Republic	74.6	53.9 [10]	75.6 [8,10]	62.6 [8]	65.8 [8]	67.3 [8]	3.9	5.9 [10]	6.7 [8,10]	9.9 [8]	9.5 [8]	9.0 [8]	21.5	40.2 [10]	17.7 [8,10]	27.5 [8]	24.7 [8]	23.7 [8]	..	..	0.0 [10]	0.0	0.0	0.0
Spain	56.0	48.2 [10]	48.8	52.0	53.7	52.4	22.2	32.0 [10]	32.7	30.1	29.6	30.9	21.3	18.6 [10]	17.4	16.9	15.8	15.9	0.5	1.1 [10]	1.1	1.0	0.9	0.8
Sweden	68.5	74.3 [10]	74.9	75.1	..	77.6	27.4 [8]	21.9 [10]	21.4 [8,10]	21.4 [8]	..	19.4 [8]	4.1 [8,9]	3.7 [10]	3.5 [8,9]	3.4 [8,9]	..	2.8 [8,9]	0.1 [8,9]	0.2 [8,10]	0.1 [8]	0.1 [8]	..	0.1
Switzerland[6]	70.1	70.7	..	..	73.9	..	25.0	24.3	..	..	22.9	..	3.7	2.5	..	..	1.3 [9,10]	..	1.2	2.5	..	..	1.9	..
Turkey	21.1	23.6	32.3	38.1	33.4	..	71.1	69.0	57.2	55.3	60.4	..	7.9	7.4	10.5	6.7	6.2	..	..	..	..	..	..	..
United Kingdom	67.1	65.0 [10]	65.2	66.8	65.6	67.4 [10]	16.7	19.2 [10]	19.7	19.6	20.8	21.4	14.5	14.6 [10]	13.8	12.2	12.2	9.7 [10]	1.8	1.3 [10]	1.3	1.4	1.5	1.4
European Union	63.5	62.2 [10]	62.9	64.2	64.5	64.5	18.7	20.8 [10]	21.5	20.9	21.2	..	17.0	16.2 [10]	14.8	14.1	13.5	13.1	0.9	0.9 [10]	0.9	0.9	0.9	0.8
Total OECD[7]	68.9	67.3 [10]	68.9	69.3	69.6	69.6	16.2	17.5 [10]	17.2	17.1	17.1	17.3	12.4	12.5 [10]	11.2	10.8	10.4	10.4	2.6	2.8 [10]	2.8	2.8	2.9	2.7

1. 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
2. Adjusted by OECD up to 1995.
3. 1993 instead of 1991; 1998 instead of 1997.
4. Figures for Germany and zone totals refer to unified Germany.
5. 1992 instead of 1991.
6. 1992 instead of 1991; 1996 instead of 1995.
7. Includes Czech Republic, Hungary, Poland and Slovak Republic from 1995.
8. Overestimated.
9. Underestimated.
10. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.4.1.1. **Business enterprise expenditure on R&D (BERD)**

	Millions of 1995 PPP dollars						As a percentage of OECD total						Average annual growth rate (1995-2000)	
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001		
Canada	4 817.9	6 757.4	7 195.1	8 315.2	8 953.1	9 268.0 [6]	1.6	2.3	2.2	2.2	2.2	2.2		5.4
Mexico	539.9	399.1 [6]	474.5	833.3	..	..	0.2	0.1	0.1	0.2	..	..	1995-1999	20.2
United States	127 943.8	132 103.0	151 557.2	171 134.9	183 043.8	188 122.8	45.8	44.7	45.7	47.4	47.4	46.7		6.1
Australia	1 942.0	3 384.9	3 183.2	3 014.1	3 402.7	..	0.7	1.1	0.9	0.8	0.9	..	1995-2000	0.1
Japan	58 495.2	55 288.9	63 008.6 [6]	63 792.1	66 491.1	71 119.1	19.8	18.7	19.0	17.0	16.6	17.0	1996-2001	3.6
Korea	..	9 528.1	11 299.9	10 564.2	12 869.8	15 198.9	..	3.2	3.4	2.9	3.3	3.8		8.1
New Zealand	140.7	163.8	207.9	213.9	..	..	0.0	0.1	0.1	0.1	..	..	1995-1999	6.9
Austria[1]	..	..	2 107.2	..	..	..	..	..	0.6	..	..	..	1993-1998	9.2
Belgium	2 255.5	2 713.3 [6]	3 112.5	3 438.2	3 701.5	..	0.7	0.9	0.9	0.9	0.9	..	1995-2000	6.4
Czech Republic	1 659.7	841.6 [6]	962.6	1 026.9	1 086.0	1 096.8	0.5	0.3	0.3	0.3	0.3	0.3		4.5
Denmark	1 059.0	1 264.3	1 509.4	1 891.4	..	..	0.4	0.4	0.5	0.5	..	..	1995-1999	10.6
Finland	1 084.3	1 393.1	1 912.0	2 553.0	2 943.5	2 975.6	0.4	0.5	0.6	0.7	0.8	0.7		13.5
France	16 744.9	16 905.5 [6]	17 151.8 [6]	18 165.1	18 700.2	19 171.1	6.0	5.7	5.1	5.0	4.9	4.9	1997-2001	2.8
Germany[2]	29 197.1	26 212.6	27 584.6	31 573.0	33 514.2	33 732.0	9.7	8.9	8.4	8.9	9.0	8.5		4.3
Greece	122.6	192.2	184.0	292.3	..	..	0.0	0.1	0.1	0.1	..	..	1995-1999	11.0
Hungary	404.0	295.5	294.8	296.3	400.9	445.7	0.1	0.1	0.1	0.1	0.1	0.1		7.1
Iceland	14.7	29.2	49.0	78.5	115.9	138.5	0.0	0.0	0.0	0.0	0.0	0.0		29.6
Ireland	314.0	583.3	714.7	826.9	860.5	881.6	0.1	0.2	0.2	0.2	0.2	0.2		7.1
Italy	7 505.5	6 154.1	6 229.4	6 312.7	6 787.9	7 275.2	2.6	2.1	1.9	1.8	1.8	1.9		2.8
Netherlands	2 961.5	3 402.8 [6]	3 912.4 [6]	4 347.1	4 363.1	4 318.9	1.0	1.2	1.2	1.2	1.1	1.1	1996-2001	3.8
Norway	813.1	986.6 [6]	1 087.5	1 133.4	..	1 347.3	0.3	0.3	0.3	0.3	..	0.4		5.3
Poland	..	726.5 [6]	860.9	1 032.6	879.6	848.4	..	0.2	0.2	0.3	0.2	0.2		2.6
Portugal[3]	174.6	162.0 [6]	204.1	272.0	367.5	450.2	0.1	0.1	0.1	0.1	0.1	0.1		18.6
Slovak Republic	721.6	243.5 [6]	441.7 [6]	234.1	253.7	261.7	0.2	0.1	0.1	0.1	0.1	0.1	1997-2001	-12.3
Spain	2 673.8	2 333.7	2 536.0	3 176.6	3 627.7	3 700.7	1.0	0.8	0.8	0.9	1.0	1.0		8.0
Sweden	3 225.9	4 526.0 [6]	5 015.1	5 613.4	..	7 166.8	1.1	1.5	1.5	1.5	..	1.7		8.0
Switzerland[4]	3 343.3	3 498.0	..	..	3 845.7	..	1.1	1.1	..	..	1.0	..	1996-2000	2.4
Turkey	333.8	311.9	634.6	944.5	903.9	..	0.1	0.1	0.2	0.2	0.2	..	1995-2000	23.7
United Kingdom	13 797.5	13 940.7 [6]	13 755.2	15 411.4	15 362.2	16 553.0 [6]	5.0	4.7	4.4	4.5	4.2	4.4	1995-2000	2.0
European Union	82 467.0	81 353.4 [6]	85 701.3	96 085.0	101 289.5	105 121.2	28.5	27.5	26.2	27.0	26.9	26.7		4.4
Total OECD[5]	286 111.2	295 831.9 [6]	330 512.9	362 431.2	386 216.1	403 243.6	100.0	100.0	100.0	100.0	100.0	100.0		5.3

1. 1998 instead of 1997.
2. Figures for Germany refer to unified Germany.
3. 1992 instead of 1991.
4. 1992 instead of 1991; 1996 instead of 1995.
5. Includes Czech Republic, Hungary, Poland and Slovak Republic from 1995.
6. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

Table A.4.1.2. **Business enterprise expenditure on R&D (BERD) as a percentage of value added in industry**

	1981	1985	1991	1995	1996	1997	1998	1999	2000	2001
Canada	0.8	1.0	1.1	1.4	1.3	1.4	1.5	1.4	1.5	1.5
Mexico	..	..	0.1	0.1 [6]	0.1	0.1	0.2	0.2	..	..
United States	2.3	2.8	2.8	2.6	2.6	2.7	2.7	2.7	2.8	2.9
Australia	0.3	0.5	0.8	1.2	1.1	1.0	0.9	0.9	1.0	..
Japan	1.8	2.5	2.8	2.7	2.8 [6]	2.9	3.0	3.0	3.1	3.3
Korea	..	..	..	2.2	2.3	2.4	2.2	2.2	2.4	2.8
New Zealand	0.3	..	0.4	0.3	..	0.4	..	0.4	..	..
Austria	0.9	1.0	..	..	..	..	1.6	..	..	..
Belgium	1.5	1.7	1.6	1.8 [6]	1.9	2.0	2.0	2.1	2.2	..
Czech Republic	..	..	1.8	0.9 [6]	0.8	1.0	1.1	1.0	1.1	1.0
Denmark	0.9	1.1	1.5	1.7	1.8	1.9	2.2	2.3	..	..
Finland	0.9	1.3	1.8	2.2	2.5	2.7	2.9	3.3	3.5	3.5
France	1.6	1.9	2.1	2.1	2.1	2.1 [6]	2.0	2.1	2.0	2.0
Germany[1]	2.3	2.7	2.5 [6]	2.1 [6]	2.1	2.2	2.2	2.4	2.5	2.5
Greece[2]	0.0	0.1	0.1	0.2	0.2	0.2	..	0.3	..	..
Hungary	..	..	0.6	0.5 [6]	0.4	0.4	0.4	0.4	0.5	0.6
Iceland	0.1	0.2	0.4	0.8	..	1.2	1.2	1.8	2.5	2.8
Ireland	0.4	0.5	0.8	1.3	1.3	1.3	1.2	1.2	1.1	1.1
Italy	0.6	0.8	1.0 [6]	0.7 [6]	0.8	0.7	0.7	0.7	0.8	0.8
Netherlands	1.4	1.6	1.4	1.5 [6]	1.6 [6]	1.6	1.5	1.7	1.6	1.6
Norway	0.9	1.3 [6]	1.3	1.5 [6]	..	1.4	..	1.4	..	1.4
Poland	..	..	..	0.4 [6]	0.4	0.4	0.4	0.4	0.4	0.3
Portugal[3]	0.1	0.1	0.2	0.2 [6]	..	0.2	0.2	0.3	0.4	0.4
Slovak Republic	..	..	..	0.7 [6]	0.7	1.1 [6]	0.7	0.6	0.6	0.6
Spain	0.2	0.4	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.7
Sweden	2.2	2.9	3.0	3.8 [6]	..	4.1	..	4.3	..	5.2
Switzerland[4]	1.6	2.6 [6]	2.9 [6]	..	3.1	..	..	..	3.1	..
Turkey	..	..	0.1	0.1	0.1	0.2	0.2	0.3	0.3	..
United Kingdom	2.1	2.0	2.0 [6]	1.8 [6]	1.8	1.7	1.7	1.8	1.8	1.9 [6]
European Union	1.4	1.7	1.7 [6]	1.6 [6]	1.6	1.6	1.6	1.7	1.8	1.8
Total OECD[5]	1.7	2.1	2.2 [6]	2.0 [6]	2.1	2.1	2.1	2.2	2.2	2.3

1. Figures for Germany from 1991 onwards refer to unified Germany.
2. 1986 instead of 1985.
3. 1982 instead of 1981; 1986 instead of 1985; 1992 instead of 1991.
4. 1986 instead of 1985; 1992 instead of 1991.
5. Includes Mexico and Korea from 1991 and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
6. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.5.1. **R&D expenditures by main sectors of performance as a percentage of GDP**

	Business enterprise							Higher education							Government						
	1991	1995	1997	1998	1999	2000	2001	1991	1995	1997	1998	1999	2000	2001	1991	1995	1997	1998	1999	2000	2001
Canada	0.79	1.00	1.01	1.07	1.06	1.09	1.11	0.49	0.46	0.45	0.49	0.53	0.55	0.59	0.30	0.25	0.22	0.22	0.22	0.22	0.23
Mexico	0.09 [7]	0.06 [9]	0.07	0.11	0.11	..	..	..	0.14	0.14	0.12	0.11	..	..	0.15 [8]	0.10 [9]	0.13	0.14	0.19	..	..
United States	1.97 [8]	1.80 [8]	1.91 [8]	1.94 [8]	1.98 [8]	2.04 [8]	2.10 [8]	0.39 [8]	0.38 [8]	0.37 [8]	0.36 [8]	0.37 [8]	0.38 [8]	0.40 [8]	0.27 [8]	0.24 [8]	0.21 [8]	0.20 [8]	0.20 [8]	0.18 [8]	0.20 [8]
Australia[1]	0.67	0.8	0.75	0.69	0.65	0.72	..	0.40	0.44	..	0.43	..	0.41	..	0.43	0.39	..	0.35	..	0.35	..
Japan[2]	2.08 [7]	1.89 [7]	2.04 [9]	2.09	2.08	2.11	2.28	0.33	0.39	0.40 [9]	0.44	0.44	0.43	0.45	0.22	0.28	0.25	0.27	0.29	0.29	0.29
Korea	..	1.84	1.95	1.79	1.76	1.96	2.25	..	0.20 [8]	0.28 [8]	0.28 [8]	0.30 [8]	0.30 [8]	0.31 [8]	..	0.42 [8]	0.42 [8]	0.45 [8]	0.36 [8]	0.35 [8]	0.37 [8]
New Zealand	0.26	0.26	0.31	..	0.31	..	..	0.28	0.29 [9]	0.40	..	0.35	..	..	0.44	0.41	0.39	..	0.37	..	..
Austria[3]	0.82	..	..	1.13	..	..	..	0.51	..	..	0.53	..	..	..	0.13 [9]	..	..	0.11	..	..	..
Belgium	1.08	1.22 [9]	1.34	1.35	1.40	1.46	..	0.43	0.41 [9]	0.44	0.46	0.47	..	..	0.10	0.06 [9]	0.06	0.07	0.06	..	..
Czech Republic	1.40	0.66 [9]	0.73	0.80	0.78	0.80	0.78	0.03	0.09 [9]	0.11	0.12	0.15	0.19	0.20	0.58	0.27 [9]	0.31	0.32	0.30	0.34	0.31
Denmark	0.96	1.05	1.19	1.33	1.42	..	..	0.37	0.45	0.43	0.41	0.43	0.45	..	0.29	0.31	0.30	0.30	0.32	0.29	..
Finland	1.16	1.44	1.79	1.94	2.20	2.41	2.42	0.45	0.45	0.54 [9]	0.57	0.64	0.61	0.61	0.41	0.38 [9]	0.37	0.36	0.37	0.36	0.35
France	1.46	1.41 [9]	1.39 [9]	1.35	1.38	1.37	1.37	0.36	0.39	0.39 [9]	0.38	0.37	0.41 [9]	0.41	0.54	0.48 [9]	0.41 [9]	0.40	0.40	0.38 [9]	0.39
Germany[4]	1.76	1.50	1.54	1.57	1.70	1.75	1.76	0.41	0.41	0.41	0.40	0.40	0.40	0.40	0.35	0.35 [7]	0.34 [7]	0.34 [7]	0.34 [7]	0.34 [7]	0.33 [7]
Greece	0.09	0.14 [9]	0.13	..	0.19	..	..	0.12	0.22 [9]	0.26	..	0.33	..	..	0.15	0.12 [9]	0.12	..	0.15	..	..
Hungary	0.44	0.32 [9]	0.30	0.26	0.28	0.36	0.38	0.22	0.18 [9]	0.17	0.17	0.15	0.19	0.24	0.26	0.19 [9]	0.18	0.21	0.22	0.21	0.25
Iceland	0.26	0.50	0.76	0.76	1.12	1.56	1.80	0.35	0.43	0.53	0.52	0.50	0.45	0.58	0.52	0.59	0.56	0.77	0.72	0.71	0.61
Ireland	0.59	0.89	0.91	0.90	0.87	0.83	0.80	0.22	0.26	0.27	0.26	0.28	0.23	..	0.11	0.11 [9]	0.10	0.09	0.07	0.09	0.11
Italy	0.68	0.53	0.52	0.52	0.51	0.53	0.56	0.26	0.25	0.32 [9]	0.34	0.33	0.33	..	0.28	0.21	0.20	0.22	0.20	0.20	0.22
Netherlands	0.98	1.04 [9]	1.11 [9]	1.05	1.14	1.11	1.08	0.58	0.57 [9]	0.56	0.53	0.53	0.57 [9]	..	0.36	0.36 [9]	0.35	0.34	0.33	0.25 [9]	0.26
Norway	0.89	0.96 [9]	0.93	..	0.92	..	0.97	0.44	0.44	0.44	..	0.47	..	0.42	0.31	0.29	0.27	..	0.25	..	0.24
Poland	..	0.27 [9]	0.28	0.30	0.31	0.25	0.24	..	0.18	0.20	0.20	0.21	0.22	0.22	..	0.24 [9]	0.23	0.22	0.23	0.23	0.21
Portugal[5]	0.13	0.12 [9]	0.14	0.16	0.17	0.22	0.27	0.26	0.21 [9]	0.25	0.27	0.29	0.29	0.30	0.13	0.15 [9]	0.15	0.18	0.21	0.19	0.18
Slovak Republic	1.61	0.51 [9]	0.83 [9]	0.52	0.42	0.44	0.44	0.08	0.06 [9]	0.07	0.07	0.07	0.06	0.06	0.46	0.38 [9]	0.19 [9]	0.20	0.18	0.17	0.15
Spain	0.47	0.39 [9]	0.40	0.47	0.46	0.50	0.50	0.19	0.26 [9]	0.27	0.27	0.27	0.28	0.30	0.18	0.15 [9]	0.14	0.15	0.15	0.15	0.15
Sweden	1.85 [8]	2.48 [8,9]	2.65 [8]	..	2.74 [8]	..	3.31 [8]	0.74	0.73 [8,9]	0.76 [9]	..	0.78	..	0.83	0.11 [8]	0.12 [9]	0.13 [8]	..	0.12 [8]	..	0.12 [8]
Switzerland[1]	1.86	1.93	..	..	..	1.95	..	0.66	0.66	..	0.63	..	0.60	..	0.10	0.07	..	0.05 [8]	..	0.03 [8,9]	..
Turkey	0.11	0.09	0.16	0.16	0.24	0.21	..	0.38	0.26	0.28	0.30	0.35	0.39	..	0.04	0.03	0.05	0.04	0.04	0.04	..
United Kingdom	1.39	1.27 [9]	1.18	1.18	1.25	1.21	1.28 [9]	0.34	0.37 [9]	0.36	0.35	0.37	0.38	0.41	0.30	0.28	0.25	0.24	0.23	0.22	0.18 [9]
European Union	1.21	1.12 [9]	1.13	1.14	1.19	1.22	1.24	0.36	0.37 [9]	0.39	0.39	0.39	0.40	..	0.32	0.29 [9]	0.27	0.27	0.26	0.26	0.25
Total OECD[6]	1.53	1.41 [9]	1.48	1.49	1.53	1.56	1.62	0.36	0.37 [9]	0.37	0.37	0.38	0.38	0.40	0.28	0.26 [9]	0.24	0.24	0.24	0.23	0.24

1. 1992 instead of 1991; 1996 instead of 1995.
2. Adjusted by OECD up to 1995.
3. 1993 instead of 1991.
4. Figures for Germany and zone totals refer to unified Germany.
5. 1992 instead of 1991.
6. Includes Czech Republic, Hungary and Poland from 1995.
7. Overestimated.
8. Underestimated
9. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

Table A.5.2. **Researchers[1] per 10 000 labour force by sector of employment**

	Business enterprise						Government						Higher education					
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001	1991	1995	1997	1999	2000	2001
Canada	20.9	33.1	33.9	31.4	..	..	5.8	5.2	4.8	4.7	..	..	19.9	20.8	22.3	21.1	..	..
Mexico[2]	0.3	0.6	0.7	0.9	..	..	1.7	1.8	1.7	2.0	..	..	2.4	3.3	3.4	2.8	..	..
United States	60.4	58.9	66.7	72.1	72.9	..	4.5 [10]	4.0 [10]	3.6 [10]	3.4 [10]	..	..	10.8	13.5 [11]	13.0	13.2	..	..
Australia[3]	16.2	16.7	15.8	16.4	16.3	..	11.2	9.9	9.4	..	9.2	..	32.5	38.8	40.9	..	40.7	..
Japan[4]	52.4 [9]	57.6 [9]	59.6 [11]	64.0	62.3	63.8	4.6	4.6	4.5	4.6	4.6	5.0	16.5	18.2 [9]	25.7 [11]	26.3	26.5	29.7
Korea	..	32.2	32.3	30.3	32.8	45.2	..	6.1 [10]	5.7 [10]	5.4 [10]	5.3 [10]	5.4 [10]	..	9.3 [10]	9.0 [10]	10.0 [10]	10.8 [10]	10.4 [10]
New Zealand	8.3	8.8	9.1	11.3	..	..	9.3	8.4	9.4	8.6	..	..	11.4	16.9 [11]	25.7	26.5	..	..
Austria[5]	18.7	..	30.1	..	..	..	2.4	..	2.5	..	..	..	13.0	..	15.3	..	..	..
Belgium	20.8	28.2 [11]	31.9	37.7	41.2		1.9	2.3 [11]	2.6	2.8	..	..	20.0	23.2 [11]	23.7	27.9	..	..
Czech Republic	..	9.5	9.9	11.1	10.7	11.1	..	8.3	8.9	8.2	8.5	9.4	..	5.2	5.5	6.5	7.3	8.2
Denmark	17.7	23.9	26.3	31.7	..	..	8.8	12.8	12.9	13.7	12.7		14.2	19.7	21.5	20.0	20.4	..
France	23.9	26.3 [11]	27.9 [11]	28.6	30.5	..	10.4	10.7 [11]	9.4 [11]	9.6	9.8 [11]	..	16.9	21.2	21.3 [11]	21.5	23.2 [11]	..
Germany[6]	35.6	32.9	33.3	37.4	38.2	38.4	9.4	9.5	9.4	9.4	9.4	9.3	15.7 [11]	16.4	16.5	16.6	16.7	17.0
Greece	2.6	3.7	4.2	5.0	..	..	4.9	4.7	4.6	4.5	..	..	8.3	14.3 [11]	16.6	23.5		
Hungary[7]	8.2	7.1	7.6	8.0	9.5	9.9	8.5	8.6	9.8	11.1	11.3	11.4	10.5	9.9	10.5	11.6	14.2	14.5
Iceland	11.9	24.1	32.1	40.0	..	52.4	20.6	21.7	26.4	26.9		26.1	15.3	25.5	31.2	30.6		31.6
Ireland	15.7	23.2	28.1	31.3	32.3	33.5	2.6	1.9 [11]	2.0	1.8	4.2 [11]	4.3	18.3	13.1 [11]	14.6	13.5	12.3	..
Italy	12.0	11.9	12.0	11.1	11.0	..	5.1	6.1	5.9	5.8	6.0		13.4	15.1	10.6 [11]	10.7	10.8	..
Netherlands[2]	16.0	17.9 [11]	22.5 [11]	24.4	24.8	27.2	10.2	10.6 [11]	10.2	10.1	7.4 [11]	8.0	17.9	16.8	16.2	15.7	19.4 [11]	..
Norway	..	..	40.9	41.7	..	46.5	..	..	13.3	13.0	..	13.1	19.5	22.8	22.3	23.7		24.0
Poland	..	6.5	6.4	6.0	5.6	5.5	..	6.5	6.8	6.3	6.4	6.1	..	16.3	19.1	20.4	19.7	21.1
Portugal[7]	2.1	2.3 [11]	2.5	4.0	4.6	5.2	4.2	5.8 [11]	6.0	6.8	7.0	7.1	11.3	12.3 [11]	15.4	16.3	16.7	17.0
Slovak Republic	..	8.5	13.4 [11]	9.8	9.3	8.5	..	14.8 [11]	9.8 [11]	9.4	9.7	9.2	..	16.0	16.4	16.5	19.2	18.4
Spain	7.3	6.6	7.1	8.7	11.6	10.6	5.1	5.1	6.2	6.9	7.1	7.5	13.1	16.9	18.2	19.4	23.4	26.3
Sweden	29.3 [10]	43.4 [11]	47.9	52.1	..	62.5	3.8 [10]	6.2 [11]	5.6	5.5	..	5.1	25.2	27.0 [11]	30.9	33.4		35.5
Switzerland[3]	24.8	31.6	..	..	40.3	..	1.6 [10]	1.4	1.1 [10]	..	1.0 [10,11]	..	18.4	21.7	22.5	..	22.7	..
Turkey	0.6	1.0	1.4	1.4	1.6	..	0.9	0.8	1.0	0.9	1.1	..	4.1	5.4	6.0	6.2	7.5	..
United Kingdom	27.8	28.8 [11]	28.7	31.6	29.2	31.6 [11]	5.2	4.8 [11]	4.3	5.1	5.1	3.4 [11]	10.1	16.5 [11]	16.5	..	..	..
European Union	22.1	23.1 [11]	24.5	26.8	27.6	14.6	7.1	7.4 [11]	7.2 [11]	7.4	7.4	3.9	14.4 [11]	17.4	17.4 [11]	18.3	..	9.9
Total OECD[8]	35.0	34.5 [11]	37.3	39.9	40.2	8.1	5.3	5.4 [11]	5.2	5.2	..	1.9	12.9 [11]	15.0 [11]	16.0	16.5	..	4.6

1. Or university graduates.
2. 1993 instead of 1991.
3. 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
4. Adjusted by OECD up to 1995.
5. 1993 instead of 1991;1998 instead of 1997.
6. Figures for Germany and zone totals refer to unified Germany.
7. 1992 instead of 1991.
8. Includes Czech Republic, Hungary, Korea, Poland and Slovak Republic from 1995.
9. Overestimated.
10. Underestimated
11. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.6.3.1. **Basic research as a percentage of total R&D activities and as a percentage of GDP[1]**

	As a percentage of all R&D activities							As a percentage of GDP						
	1991	1995	1997	1998	1999	2000	2001	1991	1995	1997	1998	1999	2000	2001
Mexico	..	35.8	23.2	..	..	..	..	..	0.09	0.07	..	..	..	..
United States	16.9	16.1	17.3	18.6	19.2	20.5	20.9	0.46	0.40	0.44	0.48	0.51	0.56	0.59
Australia[2]	28.4	25.8	..	26.7	..	25.9	..	0.43	0.43	..	0.40	..	0.40	..
Japan	12.3	14.2	12.0 [9]	12.0	12.3	12.4	12.2	0.36	0.41	0.34 [9]	0.35	0.36	0.37	0.38
Korea	..	12.5	13.3	14.0	13.6	12.6	12.6	..	0.31	0.36	0.36	0.34	0.33	0.37
Austria[3]	21.3	..	..	17.0 [9]	..	..	..	0.31	..	..	0.27 [9]	..	..	..
Czech Republic	..	17.0	18.0	17.7	20.5	36.6	40.3	..	0.17	0.21	0.22	0.25	0.49	0.53
Denmark	..	..	..	..	22.1	..	..	..	..	..	..	0.43	..	..
France	20.3	22.2	22.0 [9]	25.1	24.4	23.6 [9]	..	0.48	0.51	0.49 [9]	0.54	0.53	0.52 [9]	..
Germany[4,5]	20.9	20.7		..	..	..	..	0.47	0.44	..	..	..	..	..
Hungary[6]	25.0	27.9 [9]	27.6	29.9	29.9	29.3	30.3	0.23	0.18 [9]	0.17	0.17	0.17	0.19	0.24
Iceland	24.9	24.4	21.4	..	17.8	..	15.2	0.29	0.38	0.40	..	0.43	..	0.47
Ireland[4]	10.5	12.0	..	..	..	..	..	0.08	0.12	..	..	..	..	..
Italy[7]	20.3	22.1	22.2	..	..	..	..	0.25	0.22	0.22	..	..	..	..
Netherlands	14.0	9.6 [9]	..	..	..	..	..	0.28	0.19 [9]	..	..	..	..	..
Norway	14.8	16.1	16.3	..	16.6	..	16.6	0.22	0.25	0.24	..	0.25	..	0.25
Poland	..	36.4 [9]	33.9	34.5	36.2	38.5	37.9	..	0.22 [9]	0.20	0.20	0.22	0.22	0.20
Portugal[6]	23.8	24.9 [9]	29.6 [9]	28.6	27.8	..	..	0.15	0.14 [9]	0.16 [9]	0.17	0.18	..	..
Slovak Republic	..	24.3	19.5 [9]	24.8	28.8	24.9	25.7	..	0.20	0.19 [9]	0.17	0.17	0.15	0.16
Spain	18.3	25.3 [9]	22.8	..	22.0	20.5	20.2	0.13	0.17 [9]	0.15	..	0.16	0.16	0.15
Switzerland[8]	..	30.1	..	..	..	28.0	..	..	0.82	..	..	..	0.74	..

1. No corresponding data are available during the 1990s for Belgium, Canada, Finland, Greece, New Zealand, Sweden, Turkey and United Kingdom.
2. 1992 instead of 1991; 1996 instead of 1995.
3. 1993 instead of 1991.
4. 1993 instead of 1995.
5. Figures for Germany refer to unified Germany.
6. 1992 instead of 1991.
7. 1996 instead of 1997.
8. 1996 instead of 1995.
9. Break in series from previous year for which data are available.

Source: OECD, R&D database, May 2003.

Table A.6.3.2. **Basic research by main sectors of performance**

As a percentage of GDP

	Business enterprise				Government				Higher education				Private non-profit			
	1995	1997	1999	2001	1995	1997	1999	2001	1995	1997	1999	2001	1995	1997	1999	2001
Mexico	0.00	0.00	0.00	..	0.04	0.03			0.05	0.04	0.05	..	0.00	0.00	0.01	..
United States	0.08	0.13	0.17	0.20	0.04 [7]	0.03 [7]	0.04 [7]	0.04 [7]	0.24	0.24	0.26	0.28	0.04	0.04	0.05	0.06
Australia[1]	0.04	0.02	0.05	..	0.11	0.10	0.10	..	0.26	0.25	0.23	..	0.02	0.02	0.03	..
Japan	0.13	0.13 [9]	0.12	0.13	0.06	0.05	0.07	0.08	0.21 [8]	0.14 [9]	0.15	0.15	0.02	0.02	0.02	0.01
Korea[2]	0.15	0.16	0.13	0.17	0.07	0.09	0.09	0.08	0.11	0.11	0.10	0.12	0.01	0.01	0.01	0.00
Austria[3]	..	0.04 [9]	..	..	..	0.02 [7,9]	..	..	..	0.21 [9]	..	..	..	0.00 [9]	..	..
Czech Republic	0.01	0.01	0.01	0.22	0.13	0.15	0.15 [8]	0.20	0.04	0.05	0.09	0.10	..	0.00	0.00	0.00
Denmark[4]	..	..	0.06 [9]	..	0.08	0.08 [9]	0.10	0.06	0.25	0.27 [9]	0.27	0.28	0.01	0.01 [9]	0.01	0.01
France[4]	0.06	0.06 [9]	0.06	0.06	0.11	0.08 [9]	0.13	0.09 [9]	0.33	0.33	0.32	0.36 [9]	0.01	0.01	0.01	0.01
Germany[5]	0.07	0.08	0.08	..	..	..	..	..	..	..	..	..	..	..	..	..
Hungary	0.01	0.01	0.00	0.01	0.10	0.09	0.11	0.11	0.07	0.07	0.06	0.11	..	..	..	..
Iceland	..	..	0.00	0.00	0.12	0.12	0.16	0.15	0.24	0.27	0.24	0.27	0.02	0.01	0.03	0.05
Ireland	..	0.03	0.05	0.04	..	..	..	..	..	0.11	0.10	..	..	..	..	..
Italy[6]	0.02	0.01	0.02	0.03	0.08	0.08	0.08	0.06	0.13	0.13	..	..	..	..	..	..
Norway	0.02	0.02	0.02	0.03	0.04	0.04	0.03	0.04	0.19	0.18	0.19	0.18	..	..	..	..
Poland	0.01 [8]	0.01 [8]	0.01 [8]	0.01 [8]	0.11 [8]	0.10 [8]	0.11 [8]	0.09 [8]	0.10 [8]	0.09 [8]	0.10 [8]	0.10 [8]	..	0.00	0.00	0.00
Portugal	0.00	0.00 [9]	0.00	0.01	0.01	0.01 [9]	0.01	..	0.10	0.12 [9]	0.13	..	0.03	0.02 [9]	0.03	..
Slovak Republic	0.03	0.03 [9]	0.03	0.03	0.13	0.10 [9]	0.09	0.08	0.04	0.06	0.05	0.05	..	..	..	..
Spain	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.11	0.10	0.10	0.10	0.00	0.00	0.00	0.00
Sweden	..	..	..	..	0.08 [7]	0.07	0.07 [7]	0.09 [7]	..	..	..	..	..	..	..	..
Switzerland[1]	0.19	..	0.21	..	0.00	0.00	0.00	..	0.57	0.53	0.49	..	0.06	..	0.04	..
Turkey[3]	0.01	0.01	0.01	..	0.00	0.01	0.01	..	..	..	..	..	..	..	..	..
United Kingdom	0.05	0.05	0.06	0.05 [9]	0.04	0.03	0.03	0.03 [9]	..	..	..	..	..	..	..	..

1. 1996 instead of 1995; 1998 instead of 1997; 2000 instead of 1999.
2. 1996 instead of 1995.
3. 1998 instead of 1997.
4. 2000 instead of 2001
5. Figures for Germany and zone totals refer to unified Germany.
6. 1996 instead of 1997.
7. Understimated.
8. Overestimated.
9. Break in series from previous year for which data are available.

Source: OECD, R&D database, May 2003.

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Table A.9.2.1. **Researchers[1] per thousand total employment**

	1991	1995	1997	1998	1999	2000	2001
Canada	5.1	6.5	6.6	6.2	6.1	..	..
Mexico[2]	0.4	0.6	0.6	0.5	0.6	..	..
United States	7.7	7.6 [8]	8.2	..	8.6	..	..
Australia[3]	6.8	7.2	..	7.2	..	7.2	..
Japan[4]	7.5	8.3	9.2 [8]	9.7	9.9	9.7	10.2
Korea	..	4.9	4.9	4.6	5.0	5.2	6.4
New Zealand	5.0	5.7 [8]	7.5	..	7.6	..	..
Austria[2]	3.3	..	..	4.7	..	..	..
Belgium	4.8	6.1 [8]	6.6	7.1	7.5	..	..
Czech Republic	..	..	..	..	..	..	..
Denmark	4.6	6.1	6.5	..	6.8	..	..
Finland	6.0	8.2	12.3 [8]	13.9	14.5	15.1	15.8
France	5.7	6.7	6.8 [8]	6.7	6.8	7.1 [8]	..
Germany[5]	6.3	6.2	6.3	6.3	6.7	6.7	6.7
Greece	1.7	2.5 [8]	2.9	..	3.7	..	..
Hungary	3.2	2.9	3.1	3.2	3.3	3.8	3.8
Ireland	4.4	4.5	5.0	5.1	4.9	5.0 [8]	..
Italy	3.3	3.4	3.0 [8]	2.9	2.9	2.9	..
Netherlands[2]	4.6	4.8 [8]	5.0 [8]	5.1	5.1	5.2	..
Norway	6.6	7.5 [8]	7.9	..	8.0	..	8.5
Poland	..	3.4	3.6	3.6	3.7	3.7	3.8
Portugal[6]	2.1	2.6 [8]	3.0	3.1	3.3	3.4	3.5
Slovak Republic	..	4.5	4.6 [8]	4.6	4.3	4.7	4.5
Spain	2.9	3.5	3.8	4.1	4.1	4.9	5.0
Sweden	5.9	8.2 [8]	9.2	..	9.6	..	10.6
Turkey	0.6	0.8	0.9	0.9	0.9	1.1	..
United Kingdom	4.6	5.3 [8]	5.2	5.5	..	..	..
European Union	4.7	5.2 [8]	5.3 [8]	5.5	5.6	5.8	..
Total OECD[7]	5.6	5.8 [8]	6.1	6.3	6.4	6.5	..

1. Or university graduates.
2. 1993 instead of 1991.
3. 1992 instead of 1991; 1996 instead of 1995.
4. Adjusted by OECD up to 1995.
5. Figures for Germany from 1991 onwards refer to unified Germany.
6. 1992 instead of 1991.
7. Includes Mexico from 1991, and Czech Republic, Hungary, Korea, Poland, Czech Republic and Slovak Republic from 1995.
8. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.9.2.2. **Estimates of the share of OECD gross domestic expenditure on R&D (GERD) and of total number of researchers[1] by OECD country/zone**

Percentage

	Share of GERD[2]						Share of researchers[2]					
	1991	1995	1997	1999	2000	2001	1991	1995	1997	1998	1999	2000
Canada	2.3	2.6	2.5	2.6	2.7	2.7	2.8	3.1	3.0	2.8	2.8	..
Mexico	..	0.4	0.5	0.6	..	..	..	0.7	0.7	0.7	0.7	..
United States	43.5	41.9	42.5	43.8	43.9	43.7	41.0	36.8 [10]	37.8		38.3	..
Australia[3]	1.2	1.4	1.3	..	1.3	..	2.1	2.1	..	2.0		2.0
Japan[4]	18.0	17.9	18.1 [10]	16.7	16.3	16.1	20.5	19.6	20.4 [10]	20.5	20.0	19.2
Korea	1.9	2.9	3.2	2.8	3.1	3.4		3.6	3.3	2.9	3.0	3.2
New Zealand	0.1	0.1 [10]	0.2	0.1	..	..	0.2	0.2 [10]	0.3		0.3	..
Austria	0.6	0.6	0.7	0.7	0.7	0.7	..	..	..	0.6	..	..
Belgium	0.8	0.9 [10]	0.9	0.9			0.8	0.8 [10]	0.8	0.9	0.9	..
Czech Republic	0.5	0.3 [10]	0.3	0.3	0.3	0.3	..	0.4 [10]	0.4	0.4	0.4	0.4
Denmark	0.4	0.5	0.5	0.6	..	..	0.5	0.6	0.6		0.6	
Finland	0.4	0.5	0.6	0.7	0.7	0.7	0.6	0.6	0.9 [10]	1.0	1.0	1.0
France	6.8	6.3	5.6 [10]	5.4	5.4 [10]	5.4	5.4	5.4	5.0 [10]	4.9	4.9	5.1 [10]
Germany[5]	9.6	9.0 [10]	8.6	8.8	8.9	8.4	10.1	8.2	7.7	7.5	7.7	7.7
Greece	0.1	0.1 [10]	0.1	0.2			0.3	0.3 [10]	0.4	..	0.4	..
Hungary	0.2	0.2 [10]	0.1	0.1	0.2	0.2	0.6	0.4	0.4	0.4	0.4	0.4
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	..
Ireland	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3 [10]
Italy	3.3	2.6	2.6 [10]	2.6	2.6	..	3.1	2.7	2.1 [10]	2.1	2.0	2.0
Netherlands	1.4	1.5 [10]	1.5 [10]	1.5	1.4	..	..	1.2 [10]	1.2 [10]	1.2	1.2	1.2
Norway	0.4	0.4 [10]	0.4	0.4	..	0.4	0.6	0.6 [10]	0.6		0.6	..
Poland	..	0.4 [10]	0.4	0.5	0.4	0.4	..	1.8	1.8	1.8	1.7	1.6
Portugal[6]	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4 [10]	0.4	0.5	0.5	0.5
Slovak Republic	0.2	0.1 [10]	0.1 [10]	0.1	0.1	0.1	..	0.3	0.3 [10]	0.3	0.3	0.3
Spain	1.2	1.1	1.1	1.2	1.3	1.3	1.7	1.7	1.8	1.9	1.9	2.3
Sweden	1.1	1.4 [10]	1.4	1.4	..	1.5	1.1	1.2 [10]	1.2		1.2	..
Switzerland[7]	1.1	1.0	..	..	0.9	..	0.7	0.7 [10]	..	..	..	0.8
Turkey	0.4	0.3	0.4	0.4	0.4	..	0.5	0.6	0.6	0.6	0.6	0.7
United Kingdom	5.1	4.9 [10]	4.7	4.7	4.5	4.6	5.3	5.2 [10]	4.7	5.0	..	..
European Union	30.9	29.8 [10]	28.7	29.2	29.1	28.9	31.1	29.0 [10]	27.6 [10]	27.8	28.1	28.8
Total OECD[8,9]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1. Or university graduates.
2. Based on OECD estimates for missing data.
3. 1992 instead of 19991; 1996 instead of 1995; 1997 instead of 1998.
4. Adjusted by OECD up to 1995.
5. Figures for Germany from 1991 onwards refer to unified Germany.
6. 1992 instead of 1991.
7. 1992 instead of 1991; 1996 instead of 1995.
8. Korea included in expenditures from 1991 and in researchers from 1995.
9. Includes Mexico from 1991, and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
10. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2003.

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Table A.11.1. **EPO[1] patent applications by priority year and by inventor's country of residence**

	1991	1995	1999	Average annual growth rate 1991-99	Share in OECD applications to the EPO			Number of EPO patent applications per million population		
					1991	1995	1999	1991	1995	1999
Canada	548	805	1,493	13.3	0.93	1.19	1.50	19.6	27.4	48.9
Mexico	14	24	40	14.1	0.02	0.04	0.04	0.2	0.3	0.4
United States	17,401	21,005	28,109	6.2	29.45	30.98	28.32	68.7	78.9	100.7
Australia	399	487	885	10.5	0.67	0.72	0.89	22.9	26.8	46.4
Japan	11,804	12,191	17,454	5.0	19.98	17.98	17.58	95.3	97.1	137.8
Korea	168	453	972	24.6	0.28	0.67	0.98	3.9	10.0	20.9
New Zealand	44	64	135	15.2	0.07	0.09	0.14	12.5	17.5	35.5
Austria	655	670	1,043	6.0	1.11	0.99	1.05	83.9	83.2	128.9
Belgium	596	803	1,277	10.0	1.01	1.18	1.29	59.6	79.3	124.9
Czech Republic	28	19	60	9.9	0.05	0.03	0.06	2.7	1.8	5.8
Denmark	364	486	802	10.4	0.62	0.72	0.81	70.7	92.9	150.7
Finland	417	698	1,367	16.0	0.71	1.03	1.38	83.1	136.6	264.6
France	4,961	5,115	7,050	4.5	8.40	7.54	7.10	84.9	86.1	116.9
Germany	11,285	12,953	20,397	7.7	19.10	19.10	20.55	141.1	158.6	248.5
Greece	25	27	48	8.7	0.04	0.04	0.05	2.4	2.5	4.4
Hungary	56	54	107	8.4	0.09	0.08	0.11	5.4	5.3	10.5
Iceland	10	10	35	16.5	0.02	0.01	0.04	39.7	38.0	125.6
Ireland	64	96	216	16.5	0.11	0.14	0.22	18.1	26.6	57.5
Italy	2,285	2,468	3,638	6.0	3.87	3.64	3.67	40.3	43.1	63.1
Luxembourg	30	32	60	9.0	0.05	0.05	0.06	77.4	79.0	138.5
Netherlands	1,439	1,724	2,873	9.0	2.43	2.54	2.89	95.5	111.5	181.7
Norway	173	235	356	9.4	0.29	0.35	0.36	40.6	54.0	79.7
Poland	19	13	32	6.4	0.03	0.02	0.03	0.5	0.3	0.8
Portugal	10	14	36	16.7	0.02	0.02	0.04	1.1	1.4	3.5
Slovak Republic	0	7	15	..	0.00	0.01	0.02	0.0	1.3	2.9
Spain	322	386	714	10.5	0.55	0.57	0.72	8.3	9.9	18.0
Sweden	923	1,514	2,119	11.0	1.56	2.23	2.13	107.1	171.5	239.2
Switzerland	1,593	1,679	2,424	5.4	2.70	2.48	2.44	234.3	238.5	339.2
Turkey	4	5	22	22.8	0.01	0.01	0.02	0.1	0.1	0.3
United Kingdom	3,452	3,769	5,492	6.0	5.84	5.56	5.53	60.1	65.0	93.8
European Union	26,827	30,755	47,130	7.3	45.40	45.36	47.48	73.0	82.4	125.0
OECD Total	59,089	67,806	99,268	6.7	100.00	100.00	100.00	56.0	62.2	88.4
World	60,020	68,993	101,731	6.8						

1. European Patent Office.

Source : OECD, Patent database, May 2003.

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Table A.11.2. **"Triadic"[1] patent families by priority year and by inventor's country of residence**

	1991	1995	1998	Average annual growth rate 1991-98	Share in OECD's "triadic" patent families			Number of patents in "triadic" patent families per million population		
					1991	1995	1998	1991	1995	1998
Canada	294	379	511	8.2	0.97	1.09	1.27	10.5	12.9	16.9
Mexico	6	11	12	10.5	0.02	0.03	0.03	0.1	0.1	0.1
United States	10,692	12,070	14,401	4.3	35.20	34.75	35.69	42.2	45.3	52.2
Australia	165	222	271	7.4	0.54	0.64	0.67	9.5	12.2	14.4
Japan	8,924	9,326	10,230	2.0	29.38	26.85	25.35	72.0	74.3	80.9
Korea	90	326	355	21.6	0.30	0.94	0.88	2.1	7.2	7.7
New Zealand	20	21	37	9.4	0.06	0.06	0.09	5.6	5.8	9.7
Austria	179	214	260	5.5	0.59	0.62	0.64	22.9	26.6	32.2
Belgium	239	366	380	6.9	0.79	1.05	0.94	23.9	36.1	37.2
Czech Republic	10	3	10	-0.4	0.03	0.01	0.02	1.0	0.3	0.9
Denmark	113	184	220	10.0	0.37	0.53	0.54	21.9	35.1	41.4
Finland	170	314	386	12.4	0.56	0.90	0.96	33.9	61.4	74.9
France	1,793	1,923	2,044	1.9	5.90	5.54	5.07	30.7	32.4	34.0
Germany	3,742	4,757	5,736	6.3	12.32	13.69	14.21	46.8	58.3	69.9
Greece	6	1	11	9.2	0.02	0.00	0.03	0.6	0.1	1.0
Hungary	21	24	24	1.9	0.07	0.07	0.06	2.0	2.3	2.3
Iceland	3	5	11	20.4	0.01	0.01	0.03	11.6	18.7	40.2
Ireland	28	33	43	6.5	0.09	0.09	0.11	7.9	9.1	11.7
Italy	670	598	713	0.9	2.21	1.72	1.77	11.8	10.4	12.4
Luxembourg	9	13	19	11.0	0.03	0.04	0.05	23.4	31.7	44.3
Netherlands	589	736	782	4.1	1.94	2.12	1.94	39.1	47.6	49.8
Norway	61	88	117	9.7	0.20	0.25	0.29	14.3	20.3	26.4
Poland	10	3	10	0.5	0.03	0.01	0.02	0.3	0.1	0.3
Portugal	4	2	6	6.0	0.01	0.01	0.02	0.4	0.2	0.6
Slovak Republic		2	5	..	0.00	0.01	0.01	0.0	0.4	0.9
Spain	75	87	105	5.1	0.25	0.25	0.26	1.9	2.2	2.7
Sweden	411	734	951	12.7	1.35	2.11	2.36	47.7	83.1	107.4
Switzerland	730	745	848	2.2	2.40	2.15	2.10	107.4	105.8	119.2
Turkey	1	2	4	40.2	0.00	0.01	0.01	0.0	0.0	0.1
United Kingdom	1,321	1,548	1,851	4.9	4.35	4.46	4.59	23.0	26.7	31.7
European Union	9,349	11,511	13,507	5.4	30.78	33.13	33.47	25.4	30.9	35.9
OECD Total	30,376	34,740	40,353	4.1	100.00	100.00	100.00	28.8	31.9	36.2
World	30,677	35,161	40,977	4.2						

1. Patents filed all together to the European Patent Office (EPO), the US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO).

Source : OECD, Patent database, May 2003.

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Table C.2.1. **Trade-to-GDP ratio**[1]

Percentages

	Goods							Services							Goods and services						
					Average annual growth							Average annual growth							Average annual growth		
	1990	1995	2000	2001	1990-95	1995-2001	1990-2001	1990	1995	2000	2001	1990-95	1995-2001	1990-2001	1990	1995	2000	2001	1990-95	1995-2001	1990-2001
Canada	21.9	31.0	37.6	35.6	7.2	2.3	4.5	4.1	5.1	5.8	5.7	4.4	1.7	2.9	26.0	36.1	43.4	41.3	6.8	2.2	4.3
Mexico	15.7	26.6	29.4	26.5	11.1	0.0	4.9	3.5	3.4	2.7	2.4	-0.6	-5.5	-3.3	19.2	30.0	32.1	28.9	9.3	-0.6	3.8
United States	7.7	9.0	10.2	9.3	3.2	0.5	1.7	2.3	2.4	2.6	2.4	1.3	-0.1	0.5	10.0	11.5	12.8	11.7	2.8	0.4	1.5
Australia	12.7	14.8	17.1	17.0	3.2	2.3	2.7	3.9	4.5	4.7	4.5	2.9	0.1	1.4	16.6	19.3	21.8	21.5	3.1	1.8	2.4
Japan	8.1	6.9	8.4	8.4	-3.3	3.5	0.3	2.1	1.8	2.0	2.1	-2.9	2.7	0.1	10.2	8.6	10.4	10.5	-3.2	3.3	0.3
Korea	25.7	25.9	36.3	34.2	0.2	4.7	2.6	3.9	5.0	6.9	7.3	4.8	6.7	5.8	29.6	30.9	43.2	41.6	0.8	5.1	3.1
New Zealand	20.1	21.5	26.8	26.1	1.3	3.3	2.4	6.7	7.5	8.7	8.5	2.5	1.9	2.2	26.8	29.0	35.5	34.6	1.6	2.9	2.3
Austria	27.1	26.0	34.6	35.6	-0.9	5.4	2.5	11.6	12.7	16.0	17.0	1.9	4.9	3.5	38.7	38.7	50.6	52.6	0.0	5.3	2.8
Belgium-Luxembourg	52.5	51.0	66.1	65.5	-0.6	4.2	2.0	13.2	11.6	18.5	19.0	-2.5	8.5	3.3	65.7	62.7	84.6	84.5	-0.9	5.1	2.3
Czech Republic	..	44.8	59.4	61.1	..	5.3	..	..	11.2	11.9	11.1	..	-0.1	..	..	56.0	71.4	72.2	..	4.3	..
Denmark	25.2	26.1	29.9	29.6	0.7	2.1	1.5	8.6	8.1	14.7	15.9	-1.2	11.8	5.7	33.9	34.3	44.6	45.4	0.2	4.8	2.7
Finland	19.1	26.6	32.4	30.2	6.8	2.1	4.2	4.5	6.6	6.1	5.7	7.9	-2.3	2.3	23.6	33.1	38.5	35.9	7.0	1.3	3.9
France	17.7	17.6	22.6	22.1	-0.2	3.9	2.0	5.7	4.8	5.5	5.5	-3.1	2.0	-0.3	23.4	22.4	28.1	27.6	-0.8	3.5	1.5
Germany	22.5	20.0	27.9	28.4	-2.4	6.0	2.1	4.3	4.3	5.9	6.1	-0.4	6.2	3.2	26.9	24.2	33.8	34.5	-2.1	6.0	2.3
Greece	13.7	11.2	17.9	17.2	-4.0	7.5	2.1	5.7	5.9	13.5	13.2	0.9	14.3	8.0	19.4	17.1	31.4	30.5	-2.5	10.1	4.2
Hungary	..	31.5	57.1	56.2	..	10.1	..	..	9.8	11.5	12.8	..	4.5	..	..	41.4	68.6	69.0	..	8.9	..
Iceland	24.6	24.6	25.5	26.9	0.0	1.4	0.8	8.9	9.6	13.2	14.2	1.6	6.7	4.3	33.5	34.3	38.7	41.0	0.4	3.0	1.9
Ireland	45.2	56.6	64.0	61.9	4.6	1.5	2.9	9.1	12.3	24.0	26.9	6.1	13.9	10.3	54.3	68.9	88.1	88.7	4.9	4.3	4.6
Italy	15.5	19.6	21.9	21.5	4.7	1.6	3.0	4.4	5.3	5.2	5.3	4.0	-0.2	1.7	19.9	24.9	27.1	26.7	4.6	1.2	2.7
Netherlands	42.1	44.3	52.7	50.5	1.0	2.2	1.7	10.0	11.2	14.2	14.1	2.2	3.9	3.1	52.2	55.5	67.0	64.6	1.2	2.6	2.0
Norway	26.1	25.7	28.5	27.6	-0.3	1.2	0.5	10.8	9.1	9.5	9.8	-3.4	1.3	-0.9	36.9	34.8	38.1	37.5	-1.2	1.2	0.1
Poland	23.8	20.4	26.7	25.8	-3.1	4.0	0.7	5.1	7.0	6.1	5.3	6.5	-4.5	0.3	28.9	27.4	32.8	31.1	-1.1	2.2	0.7
Portugal	27.7	26.6	30.2	29.0	-0.8	1.5	0.4	6.4	6.9	7.1	6.9	1.7	-0.1	0.7	34.1	33.5	37.3	35.9	-0.4	1.2	0.5
Slovak Republic	..	45.5	62.5	..	..	..	..	..	11.0	10.2	..	..	..	..	..	56.5	72.8	..	..	..	..
Spain	13.8	17.6	23.8	22.9	5.0	4.5	4.7	4.3	5.3	7.6	7.8	4.1	6.8	5.6	18.1	22.9	31.4	30.7	4.8	5.0	4.9
Sweden	22.4	28.9	33.3	31.6	5.2	1.5	3.2	6.3	6.6	9.1	10.3	1.1	7.6	4.6	28.7	35.6	42.4	41.8	4.4	2.7	3.5
Switzerland	35.7	31.1	39.1	38.7	-2.7	3.7	0.7	6.6	6.7	9.3	8.7	0.3	4.6	2.6	42.3	37.8	48.3	47.4	-2.3	3.9	1.0
Turkey	11.8	16.9	21.0	25.2	7.4	6.9	7.1	3.7	5.8	7.4	7.9	9.5	5.3	7.2	15.5	22.7	28.4	33.1	7.9	6.5	7.1
United Kingdom	20.1	22.2	21.4	20.9	2.0	-1.0	0.3	5.3	6.4	7.5	7.3	3.6	2.3	2.9	25.4	28.5	28.9	28.1	2.3	-0.2	0.9
European Union	21.5	22.7	27.8	27.5	1.1	3.2	2.2	5.6	6.0	7.8	8.0	1.2	4.9	3.2	27.1	28.7	35.6	35.4	1.1	3.6	2.5
Total OECD[2]	14.7	15.4	18.0	17.4	0.8	2.1	1.5	3.8	3.9	4.5	4.5	0.4	2.5	1.5	18.6	19.3	22.5	22.0	0.7	2.2	1.5

1. Average of imports and exports as a share of nominal GDP.
2. Excludes the Czech Republic, Hungary and the Slovak Republic in 1990 and in growth rates, as well as the Slovak Republic in 2001.

Source: IMF, Balance of Payments Statistics and OECD ANA database, July 2003.

Table C.2.2.1. **Export ratio by industry**[1]

	Total manufacturing		High-technology industries												Medium-high-technology industries											
			Total		Aircraft and spacecraft		Pharmaceuticals		Office, accounting and computing machinery		Radio, television and communication equipment		Medical, precision and optical instruments		**Total**		Electrical machinery and apparatus, n.e.c.		Motor vehicles, trailers and semi-trailers		Chemicals excluding pharmaceuticals		Railroad equipment and transport equipment, n.e.c.		Machinery and equipment, n.e.c.	
	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
Canada[2]	38	55	58	79	83	89	8	29	108	137	41	56	..	..	57	75	31	81	77	82	34	54	36	44	40	73
United States	12	16	23	31	33	46	8	12	44	43	21	32	14	24	19	21	22	32	17	16	17	21	11	10	23	25
Japan[3]	12	16	25	29	13	27	4	5	31	35	25	27	42	65	18	25	15	23	23	28	13	20	..	..	17	24
Australia	16	21	29	41	38	40	13	26	162	116	13	25	33	67	12	20	11	25	10	17	11	18	6	5	17	26
Austria	45	60	56	89	..	..	55	91	1082	235	35	61	74	94	71	92	83	90	93	125	56	77	26	66	70	80
Denmark[4]	55	63	100	103	..	..	87	80	238	273	88	118	96	98	73	76	54	65	111	115	60	75	180	217	72	71
Finland	34	46	57	55	7	10	36	50	72	88	60	53	69	64	43	58	43	83	97	156	36	47	16	20	40	47
France	28	37	42	57	70	58	22	42	60	110	40	66	28	37	41	49	35	49	41	43	47	58	33	41	39	52
Germany	32	42	54	85	103	119	45	72	46	111	53	85	49	67	41	50	24	34	46	51	46	56	49	30	43	53
Italy	22	32	29	45	48	68	11	31	78	77	24	48	30	46	33	45	18	25	40	49	21	32	30	39	43	57
Norway	38	40	65	64	35	156	65	51	191	136	57	67	53	42	52	62	28	38	98	77	67	86	10	28	45	52
Portugal	27	38	40	62	..	..	10	23	159	128	48	75	59	60	35	66	54	94	53	85	21	34	29	27	31	51
Spain	18	29	26	48	117	83	11	28	48	65	24	66	20	37	33	48	21	37	48	61	19	35	7	40	31	43
Sweden	38	51	63	69	48	82	61	74	91	113	62	69	59	50	48	60	44	90	51	52	41	68	14	33	51	62
United Kingdom	31	37	59	76	78	71	42	61	70	101	50	80	50	59	45	50	34	46	45	48	46	53	20	20	50	52
EU[5] (excl. intra-EU)	11	16	21	31	47	42	15	26	15	30	17	29	20	29	15	20	10	18	11	15	16	22	14	12	20	27
EU[6]	29	39	48	68	77	76	29	52	60	103	44	70	43	55	40	50	26	40	43	50	40	51	31	36	44	55
OECD[7]	20	26	32	43	46	57	17	28	46	57	28	40	28	41	29	36	22	34	32	35	26	34	33	32	31	38

1. Exports as a percentage of production. Values greater than 100 can occur when exports exceed production because of the inclusion of re-exports - products that are imported and then re-exported without any further transformation.
2. Medical, precision and optical instruments is included in Manufacturing, n.e.c. and recycling.
3. Railroad equipment and transport equipment, n.e.c. is included in Motor vehicles.
4. Aircraft and spacecraft is included in Railroad equipment and transport equipment, n.e.c.
5. Excludes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
6. Includes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
7. Calculated with the above countries.

Source: OECD, STAN and Bilateral Trade database, May 2003.

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Table C.2.2.1. **Export ratio by industry**[1] *(cont.)*

	Medium-low-technology industries														Low-technology industries											
	Total		Coke, refined petroleum products and nuclear fuel		Rubber and plastic products		Other non-metallic mineral products		Building and repairing of ships and boats		Basic metals		Fabricated metal products, except machinery and equipment		**Total**		Manufacturing, n.e.c. and recycling		Wood and products of wood and cork		Pulp, paper, paper products, printing and publishing		Food products, beverages and tobacco		Textiles, textile products, leather and footwear	
	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
Canada[2]	29	39	22	25	24	43	15	34	8	67	53	52	13	29	26	40	19	56	54	68	42	43	12	22	9	39
United States	6	7	5	5	7	10	6	6	8	8	10	10	4	6	6	7	8	13	6	4	5	6	5	6	7	12
Japan[3]	6	8	1	1	14	16	5	6	54	58	6	9	4	5	3	3	5	8	0	0	2	2	1	1	6	8
Australia	19	23	17	26	4	7	2	4	14	49	40	46	5	4	13	16	8	12	10	10	3	4	17	22	15	26
Austria	38	42	5	14	62	64	25	23	35	393	55	59	35	36	30	43	32	48	37	40	43	49	8	21	62	88
Denmark[4]	40	43	38	35	53	56	29	26	40	68	54	71	34	34	49	55	58	58	40	41	19	17	53	59	81	150
Finland	31	37	24	37	29	32	12	23	51	63	47	51	18	21	29	39	19	26	41	47	48	53	4	9	33	44
France	20	23	15	14	25	31	16	19	16	17	42	39	11	14	19	25	18	23	12	17	12	16	19	24	30	45
Germany	23	28	14	22	26	34	17	19	36	53	36	44	15	19	20	24	27	30	10	13	16	20	13	16	46	70
Italy	16	21	13	14	22	29	17	23	15	51	22	24	11	15	18	26	33	45	5	8	9	13	9	15	29	39
Norway	55	44	62	82	34	32	13	10	55	26	81	76	26	20	19	23	21	25	17	18	23	24	17	23	34	43
Portugal	16	24	18	18	14	33	18	19	8	10	15	47	17	26	28	31	25	21	41	39	20	24	9	12	47	53
Spain	16	21	24	17	17	29	10	18	38	46	26	29	9	12	9	18	10	21	6	10	8	13	7	15	14	28
Sweden	35	42	43	51	42	52	14	27	39	26	49	56	23	27	26	36	32	42	26	44	39	45	6	13	53	102
United Kingdom	21	23	24	26	21	22	16	16	15	22	34	41	12	14	15	17	25	22	3	6	11	11	13	15	29	38
EU[5] (excl. intra-EU)	7	10	8	10	7	11	6	9	18	30	11	14	4	7	6	9	10	14	3	6	5	6	5	6	11	18
EU[6]	21	26	18	20	25	33	16	20	26	38	34	39	13	17	19	25	26	32	13	19	16	20	14	19	32	46
OECD[7]	14	16	9	10	18	21	11	13	29	34	18	22	9	11	12	15	13	19	11	14	10	12	9	11	20	29

1. Exports as a percentage of production. Values greater than 100 can occur when exports exceed production because of the inclusion of re-exports - products that are imported and then re-exported without any further transformation.
2. Medical, precision and optical instruments is included in Manufacturing, n.e.c. and recycling.
3. Railroad equipment and transport equipment, n.e.c. is included in Motor vehicles.
4. Aircraft and spacecraft is included in Railroad equipment and transport equipment, n.e.c.
5. Excludes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
6. Includes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
7. Calculated with the above countries.

Source: OECD, STAN and Bilateral Trade database, May 2003.

Table C.2.2.2. **Import penetration by industry**[1]

	Total manufacturing		High-technology industries												Medium-high-technology industries											
			Total		Aircraft and spacecraft		Pharmaceuticals		Office, accounting and computing machinery		Radio, television and communication equipment		Medical, precision and optical instruments		Total		Electrical machinery and apparatus, n.e.c.		Motor vehicles, trailers and semi-trailers		Chemicals excluding pharmaceuticals		Railroad equipment and transport equipment, n.e.c.		Machinery and equipment, n.e.c.	
	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
Canada[2]	40	55	71	86	80	87	27	57	104	114	55	67	..	..	62	76	58	91	76	77	37	61	34	37	65	84
United States	15	21	21	32	13	25	7	15	48	56	31	35	12	21	21	26	25	40	31	30	10	17	18	19	19	24
Japan[3]	7	10	9	18	47	52	7	9	9	25	5	12	22	52	4	7	4	10	3	4	8	11	..	..	4	7
Australia	24	34	66	75	78	76	32	49	110	103	48	70	68	85	35	49	36	54	30	46	29	40	36	44	48	63
Austria	48	62	68	93	..	..	61	93	146	125	42	66	81	96	75	92	78	89	96	123	67	83	30	55	70	77
Denmark[4]	54	62	100	104	..	..	76	58	131	133	89	116	95	97	76	79	59	65	105	105	75	81	126	171	65	65
Finland	29	35	69	47	60	75	56	72	86	93	64	31	74	58	50	59	42	81	98	124	47	53	27	40	41	40
France	29	35	43	54	61	44	18	37	70	107	47	63	32	41	39	46	30	44	35	37	44	54	38	47	43	52
Germany	29	36	57	85	103	120	36	60	59	105	59	85	40	57	29	35	17	28	35	34	36	48	45	40	25	33
Italy	21	28	40	55	51	69	17	33	83	89	43	61	42	54	31	41	15	21	48	58	36	44	23	30	24	34
Norway	45	47	83	82	68	108	74	63	118	108	76	83	74	58	65	75	50	54	99	94	63	82	37	73	66	71
Portugal	35	47	68	82	..	..	34	57	105	102	64	82	89	87	63	79	58	93	79	91	45	62	60	54	67	75
Spain	24	34	52	68	106	91	18	42	73	83	52	81	58	66	40	54	32	41	41	61	34	46	30	40	50	57
Sweden	35	44	62	59	51	83	43	52	95	103	57	50	59	48	45	56	49	90	40	43	52	77	25	38	45	52
United Kingdom	33	41	58	76	69	67	30	55	74	101	56	81	49	58	44	52	35	48	49	58	43	49	32	43	47	50
EU[5] (excl. intra-EU)	10	14	27	35	46	44	11	15	37	51	29	36	23	31	9	13	8	17	6	10	11	13	19	22	10	15
EU[6]	29	37	52	69	75	73	25	46	71	102	53	70	43	55	35	45	23	37	39	47	40	50	35	41	34	44
OECD[7]	19	26	30	43	37	49	16	27	48	65	28	38	26	38	25	32	20	33	28	34	24	31	30	31	24	31

1. Imports as a percentage of domestic demand (estimated as production minus exports plus imports). Values greater than 100 can occur when exports exceed production because of the inclusion of re-exports - products that are imported and then re-exported without any further transformation.
2. Medical, precision and optical instruments is included in Manufacturing, n.e.c. and recycling.
3. Railroad equipment and transport equipment, n.e.c. is included in Motor vehicles.
4. Aircraft and spacecraft is included in Railroad equipment and transport equipment, n.e.c.
5. Excludes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
6. Includes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
7. Calculated with the above countries.

Source: OECD, STAN and Bilateral Trade database, May 2003.

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Table C.2.2.2. **Import penetration by industry**[1] *(cont.)*

	Medium-low-technology industries														Low-technology industries											
	Total		Coke, refined petroleum products and nuclear fuel		Rubber and plastic products		Other non-metallic mineral products		Building and repairing of ships and boats		Basic metals		Fabricated metal products, except machinery and equipment		**Total**		Manufacturing, n.e.c. and recycling		Wood and products of wood and cork		Pulp, paper, paper products, printing and publishing		Food products, beverages and tobacco		Textiles, textile products, leather and footwear	
	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999	1991	1999
Canada[2]	25	36	10	13	34	46	27	41	12	53	35	42	23	36	20	30	32	57	15	19	20	25	12	19	37	58
United States	10	12	10	11	9	11	10	12	2	6	15	19	6	8	11	15	26	35	8	12	4	5	5	6	27	38
Japan[3]	6	6	12	9	4	4	3	4	7	3	7	7	2	3	8	11	6	8	16	23	2	3	9	10	13	28
Australia	14	20	16	15	22	29	10	12	22	50	14	23	10	13	14	19	25	36	13	12	14	16	7	9	30	48
Austria	37	43	26	34	59	66	21	26	40	418	50	53	34	37	31	42	39	53	20	23	33	38	11	23	70	91
Denmark[4]	45	45	49	41	51	55	25	27	40	41	77	81	31	33	38	49	36	46	48	50	28	29	30	40	85	135
Finland	26	26	26	28	37	34	15	19	27	11	33	34	19	17	13	18	29	33	6	8	8	9	6	15	55	66
France	22	23	22	17	26	30	16	18	11	14	43	41	11	13	22	26	27	31	17	21	18	20	16	19	38	54
Germany	22	24	29	28	22	27	17	17	18	32	37	42	12	14	27	29	31	36	20	19	17	17	16	18	62	79
Italy	16	17	18	16	15	19	7	8	15	19	36	38	5	6	14	18	11	16	14	17	11	15	16	18	13	21
Norway	53	40	39	55	60	61	26	23	54	25	74	67	46	38	24	28	48	48	17	25	20	23	10	14	80	85
Portugal	27	36	29	28	31	51	10	14	8	14	62	79	23	33	21	28	33	32	9	18	17	25	16	24	28	38
Spain	17	20	28	16	19	31	8	10	13	29	26	35	12	14	13	20	15	22	13	18	14	17	10	16	19	30
Sweden	35	37	45	45	49	53	24	32	66	14	39	49	20	21	21	28	38	41	7	13	12	15	13	22	81	101
United Kingdom	23	24	20	20	24	25	17	17	15	8	40	48	14	15	24	27	35	34	29	31	18	16	18	21	44	58
EU[5] (excl. intra-EU)	7	8	11	9	5	8	3	4	10	13	14	16	3	5	8	11	12	16	8	10	4	4	5	5	17	28
EU[6]	21	24	25	21	23	29	13	15	19	19	38	42	11	14	21	26	25	31	18	20	16	18	16	20	36	49
OECD[7]	14	16	16	14	17	20	10	13	16	14	20	24	8	11	15	19	18	26	14	17	9	10	11	13	30	42

1. Imports as a percentage of domestic demand (estimated as production minus exports plus imports). Values greater than 100 can occur when exports exceed production because of the inclusion of re-exports - products that are imported and then re-exported without any further transformation.
2. Medical, precision and optical instruments is included in Manufacturing, n.e.c. and recycling.
3. Railroad equipment and transport equipment, n.e.c. is included in Motor vehicles.
4. Aircraft and spacecraft is included in Railroad equipment and transport equipment, n.e.c.
5. Excludes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
6. Includes intra-EU trade. European Union includes Austria, Denmark, Finland, France, Germany, Italy, Portugal, Spain, Sweden and United Kingdom.
7. Calculated with the above countries.

Source: OECD, STAN and Bilateral Trade database, May 2003.

Table C.3.1. **Outward and inward foreign direct investment flows**

Billion USD

	Outward flows												Inward flows											
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Australia	1.0	1.2	5.1	1.9	2.8	3.3	7.1	6.4	3.4	-3.0	5.1	11.6	8.1	4.3	5.7	4.3	5.0	12.0	6.2	7.6	6.0	5.7	11.5	4.4
Austria	1.7	1.3	1.7	1.2	1.3	1.1	1.8	2.0	2.8	3.3	5.6	3.0	0.7	0.4	1.4	1.1	2.1	1.9	4.5	2.6	4.7	3.0	8.5	5.9
Belgium-Luxembourg	6.3	6.3	11.4	4.9	1.4	11.6	8.0	7.3	28.8	121.7	229.4	66.4	8.0	9.4	11.3	10.8	8.5	10.7	14.1	12.0	22.7	133.1	234.8	50.5
Canada	5.2	5.8	3.5	5.7	9.3	11.5	13.1	23.1	34.1	15.6	47.3	35.6	7.6	2.9	4.8	4.7	8.2	9.3	9.6	11.5	22.7	24.5	66.0	27.4
Czech Republic	..	..	..	0.1	0.1	0.0	0.2	0.0	0.1	0.1	0.0	0.1	..	..	..	0.7	0.9	2.6	1.4	1.3	3.7	6.3	5.0	4.9
Denmark	1.5	1.9	2.2	1.4	4.2	3.0	2.5	4.4	4.2	17.0	27.7	9.6	1.1	1.6	1.0	1.7	5.0	4.1	0.8	2.8	6.7	16.1	35.5	7.2
Finland	2.8	-0.1	-0.8	1.4	4.4	1.5	3.6	5.3	18.7	6.7	23.9	8.4	0.8	-0.2	0.4	0.9	1.5	1.0	1.1	2.1	12.0	4.6	9.1	3.4
France	34.8	23.9	31.3	20.6	24.4	15.8	30.4	35.5	45.7	119.5	169.5	83.2	13.2	15.2	21.8	20.8	15.8	23.7	22.0	23.0	29.5	46.6	43.2	52.5
Germany	24.2	23.7	19.7	15.3	17.3	39.1	50.8	42.7	89.9	109.4	53.0	42.7	2.5	4.1	2.6	1.9	1.9	12.0	6.4	12.8	23.6	54.6	207.7	31.5
Greece	..	..	..	..	..	..	..	..	..	0.5	2.1	0.6	1.0	1.1	1.1	1.0	1.0	1.1	1.1	1.0	..	0.6	1.1	1.6
Hungary	..	..	0.0	0.0	0.0	0.0	0.0	0.4	0.5	0.3	0.5	0.3	..	1.5	1.5	2.3	1.1	4.5	2.3	2.2	2.0	2.0	1.6	2.4
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.4	..	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	..
Ireland	0.4	0.2	0.2	0.2	0.4	0.8	0.7	1.0	5.0	6.1	4.0	5.4	0.6	1.4	1.4	1.1	0.8	1.4	2.6	2.7	11.0	18.6	22.8	9.9
Italy	7.4	7.5	4.1	7.3	5.2	7.0	8.7	10.4	12.4	6.7	12.1	21.8	6.4	2.4	3.1	3.7	2.2	4.8	3.5	3.7	2.6	6.9	13.2	14.9
Japan	50.5	31.6	17.4	13.8	18.1	22.5	23.4	26.1	24.6	22.3	31.5	38.5	1.8	1.3	2.8	0.1	0.9	0.0	0.2	3.2	3.3	12.3	8.2	6.2
Korea	1.1	1.5	1.2	1.3	2.5	3.6	4.7	4.4	4.7	4.2	5.0	2.6	0.8	1.2	0.7	0.6	0.8	1.8	2.3	2.8	5.4	9.3	9.3	3.2
Mexico	..	..	..	..	..	..	..	..	..	..	..	3.7	2.6	4.8	4.4	4.4	11.0	9.5	9.2	12.8	11.9	12.5	14.2	24.7
Netherlands	13.7	12.8	12.8	10.0	17.6	20.0	31.7	24.0	36.8	57.0	69.5	39.7	10.7	5.6	6.2	6.4	7.1	12.2	16.6	11.1	37.6	41.2	57.4	51.2
New Zealand	1.6	0.7	-0.8	1.3	1.7	-0.3	-1.5	0.0	0.9	0.8	0.9	0.3	1.7	1.3	2.1	2.3	2.5	3.7	2.2	2.6	1.2	1.4	3.3	1.7
Norway	1.5	1.8	-0.1	0.7	2.2	2.9	5.9	5.0	3.2	6.0	8.5	-1.1	1.0	-0.4	-0.7	1.0	2.7	2.4	3.2	3.9	4.4	8.1	5.8	2.2
Poland	..	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	-0.1	0.1	0.3	0.7	1.7	1.9	3.7	4.5	4.9	6.4	7.3	9.3	5.7
Portugal	0.2	0.5	0.7	0.1	0.3	0.7	1.0	2.2	3.9	3.0	7.7	7.9	2.6	2.4	1.9	1.5	1.3	0.7	1.7	2.5	3.2	1.2	6.5	5.9
Slovak Republic	..	..	..	0.1	0.0	0.0	0.0	0.1	0.1	-0.4	0.0	..	..	..	..	0.2	0.3	0.2	0.4	0.2	0.6	0.4	2.1	..
Spain	3.5	4.4	2.2	3.2	4.1	4.2	5.6	12.4	19.1	41.8	53.9	27.7	14.0	12.5	13.3	9.7	9.2	6.3	6.8	6.4	11.9	15.5	36.9	21.5
Sweden	14.6	7.3	0.4	1.5	6.7	11.4	5.1	12.1	22.7	19.6	40.0	7.0	2.0	6.4	0.0	3.7	6.3	14.9	5.5	10.3	19.4	59.4	22.1	13.1
Switzerland	7.2	6.5	6.1	8.8	10.8	12.2	16.2	17.7	18.8	33.3	42.7	11.1	6.0	3.2	1.2	0.9	4.1	3.6	4.4	7.3	9.6	12.3	20.0	8.6
Turkey	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.3	0.4	0.6	0.9	0.5	0.7	0.8	0.8	0.6	0.6	0.9	0.7	0.8	0.9	0.8	1.0	3.3
United Kingdom	20.1	16.8	19.7	27.3	34.9	45.3	34.8	62.4	122.1	201.6	266.2	34.2	33.5	16.5	16.6	16.5	10.7	21.7	27.4	37.4	74.7	89.5	119.9	63.1
United States	37.2	37.9	48.3	84.0	80.2	98.8	91.9	104.8	142.6	188.9	178.3	127.8	48.5	23.2	19.8	51.4	46.1	57.8	86.5	105.6	179.0	289.4	307.7	130.8
European Union[1]	131.2	106.4	105.6	94.3	122.0	161.5	184.7	221.7	412.0	714.0	964.5	357.6	97.2	78.6	82.2	80.8	73.5	116.7	114.1	130.4	259.6	491.0	818.7	332.3
OECD Total[1]	236.4	193.5	186.4	212.0	249.8	316.1	345.7	410.1	645.9	982.8	1285.8	588.5	176.1	122.8	126.0	156.2	159.7	228.7	247.3	297.4	517.0	883.3	1284.0	557.9

1. Excluding missing countries.

Source: IMF, Balance of Payments Statistics.

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Table C.4.1. **Share of affiliates under foreign control in manufacturing employment and turnover[1]**

	Employment								Turnover[1]							
	Share of affiliates							Average annual growth rate 1995-00	Share of affiliates							Average annual growth rate 1995-00
	1995	1996	1997	1998	1999	2000	2001		1995	1996	1997	1998	1999	2000	2001	
Canada[2]	..	..	..	..	..	..	..	..	51.2	50.9	49.6	50.3	51.4	..	..	4.1
United States	12.3	12.4	12.0	13.5	14.0	14.3	..	3.1	16.4	16.8	17.6	21.1	22.2	23.0	..	9.9
Japan[2]	0.7	0.8	..	..	..	..	..	..	1.3	1.2	1.6	1.8	2.5	..	..	17.9
Austria	17.9	..	19.0	18.6	..	19.6	..	1.1	23.3	..	26.3	26.1	..	27.1	..	6.7
Belgium	..	18.1	19.1	..	..	..	..	..	..	46.2	47.5	..	..	..	..	..
Czech Republic[3]	..	..	10.7	13.2	16.2	24.9		12.1	..	..	17.8	21.7	27.1	39.5		9.5
Denmark	..	..	..	11.4	10.2	..	..	..	..	..	..	11.7	12.0	..	..	..
Finland[4]	9.7	11.3	12.4	13.8	15.9	15.9	17.2	10.4	10.1	12.7	13.7	14.3	16.2	14.4	16.2	12.7
France[3]	25.1	25.8	27.4	27.8	29.5	..	..	5.4	31.0	31.2	32.0	31.7	33.3	..	..	7.8
Germany	7.2	7.0	6.7	6.0	6.2	4.2		-11.4	13.1	12.8	12.5	10.8	10.1	5.9	..	-11.1
Hungary	37.4	35.6	41.2	45.0	46.5	47.2		5.8	56.6	62.4	66.1	70.1	73.0	73.7	..	23.6
Ireland	47.1	47.0	47.8	47.5	49.1	48.1		3.4	65.2	66.4	69.2	72.3	75.9	78.2	..	16.2
Italy[2]	12.3	..	13.4	..	13.8	..	..	2.9	20.6	..	21.8	..	22.4	..	..	3.5
Luxembourg[2]	41.2	41.8	42.7	46.3	41.4	..	..	-0.1	46.5	48.4	49.4	52.4	52.9	..	..	3.1
Netherlands[2]	20.1	19.0	19.7	21.9	18.9	..	..	0.0	30.3	29.7	30.4	32.1	30.8	..	..	3.1
Norway[2]	15.0	14.3	14.2	17.4	19.9	..	..	12.9	19.5	18.9	19.9	23.9	27.5	..	..	18.2
Poland[3]	..	..	12.5	14.8	18.6	20.9	..	9.7	..	..	19.4	26.1	33.8	34.7	..	21.9
Portugal[5]	..	7.9	8.3	8.8	8.9	10.1	..	3.5	..	15.0	15.4	16.4	15.9	17.4	..	3.3
Spain	..	..	..	..	16.5	16.8	..	..	..	..	..	..	29.9	29.7	..	..
Sweden	19.9	19.9	19.0	21.1	24.1	29.1	..	11.0	21.6	20.8	19.6	21.9	29.0	34.3	..	16.9
Turkey	5.6	5.6	5.3	5.5	5.9	5.7	..	3.4	12.4	12.8	12.3	11.6	13.2	14.0	..	4.7
United Kingdom[2]	16.3	19.2	17.8	..	20.4	..	..	4.5	30.6	33.2	31.4	..	36.1	..	..	11.6

1. Production instead of turnover for Canada and Ireland. National currency, 1995 prices.
2. 1995-99.
3. 1997-00.
4. 1996-01.
5. 1996-00.

Source : OECD, AFA and FATS databases, May 2003.

Table C.5.4. **Technology balance of payments**

	Million USD						As a percentage of GDP						Receipts/payments ratio (%)	
	Receipts		Payments		Balance		Receipts		Payments		Balance			
	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001	1990	2001
Canada[1]	845.8	2 583.7	846.6	1 299.6	- 0.9	1 284.1	0.15	0.37	0.15	0.18	0.00	0.18	100	199
Mexico	74.7	40.8	386.8	418.5	- 312.1	- 377.7	0.03	0.01	0.15	0.07	-0.12	-0.06	19	10
United States	16 634.0	38 668.0	3 135.0	16 359.0	13 499.0	22 309.0	0.29	0.39	0.05	0.16	0.23	0.22	531	236
Australia[2]	104.6	103.0	292.0	224.9	- 187.4	- 121.9	0.03	0.03	0.09	0.06	-0.06	-0.03	36	46
Japan[1]	2 343.7	9 816.3	2 568.6	4 113.5	- 224.8	5 702.8	0.08	0.21	0.09	0.09	-0.01	0.12	91	239
Korea[3]	21.8	193.0	1 087.0	2 686.0	- 1 065.2	-2 493.0	0.01	0.05	0.43	0.66	-0.42	-0.61	2	7
New Zealand[3]	21.5	7.9	20.3	3.7	1.2	4.2	0.05	0.01	0.05	0.01	0.00	0.01	106	214
Austria[1,4]	89.9	2 429.5	284.8	2 425.8	- 194.9	3.7	0.06	1.29	0.18	1.29	-0.12	0.00	32	100
Belgium-Luxembourg	1 885.4	5 632.2	2 522.5	4 466.2	- 637.1	1 166.0	0.96	2.45	1.28	1.95	-0.32	0.51	75	126
Czech Republic	..	172.2	..	92.9	..	79.2	..	0.30	..	0.16	..	0.14	..	185
Denmark[3]	..	1 657.3	..	1 055.3	..	602.0	..	0.95	..	0.61	..	0.35	..	157
Finland	49.9	572.7	315.4	526.2	- 265.4	46.5	0.04	0.47	0.23	0.43	-0.19	0.04	16	109
France	1 896.1	3 196.4	2 507.4	2 695.3	- 611.4	501.1	0.16	0.24	0.21	0.21	-0.05	0.04	76	119
Germany	6 334.8	13 896.2	6 941.2	20 606.7	- 606.4	-6 710.5	0.42	0.75	0.46	1.11	-0.04	-0.36	91	67
Greece	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hungary[3]	..	216.1	..	503.7	..	- 287.6	..	0.45	..	1.05	..	-0.60	..	43
Iceland	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ireland	..	343.6	..	8 766.9	..	-8 423.3	..	0.33	..	8.49	..	-8.15	..	4
Italy[4]	705.5	2 683.7	1 226.1	3 439.8	- 520.6	- 756.2	0.06	0.25	0.11	0.32	-0.05	-0.07	58	78
Netherlands	4 209.2	..	4 057.1	..	152.1	..	1.48	..	1.43	..	0.05	..	104	..
Norway[1]	450.6	1 057.1	545.0	1 283.8	- 94.4	- 226.8	0.39	0.64	0.47	0.77	-0.08	-0.14	83	82
Poland[1]	..	136.0	..	813.4	..	- 677.4	..	0.09	..	0.52	..	-0.43	..	17
Portugal	..	272.9	..	580.8	..	- 307.8	..	0.25	..	0.53	..	-0.28	..	47
Slovak Republic	..	30.4	..	64.9	..	- 34.4	..	0.15	..	0.32	..	-0.17	..	47
Spain[2,4]	400.1	190.4	2 176.4	1 025.7	- 1 776.3	- 835.3	0.08	0.03	0.44	0.17	-0.36	-0.14	18	19
Sweden	208.1	..	75.3	..	132.8	..	0.19	..	0.07	..	0.12	..	276	..
Switzerland	1 867.5	3 263.8	733.6	1 956.6	1 133.9	1 307.2	0.82	1.32	0.32	0.79	0.50	0.53	255	167
Turkey	..	..	..	..	..	..	..	..	..	..	..	..	..	..
United Kingdom[4]	2 063.9	16 375.4	2 728.2	7 862.4	- 664.3	8 513.0	0.21	1.15	0.28	0.55	-0.07	0.60	76	208
European Union[1,5]	27 747.6	53 992.6	30 314.1	58 634.1	- 2 566.5	-4 641.5	0.43	0.71	0.61	0.77	-0.18	-0.06	92	92
OECD Total[1,5,6]	50 111.6	110 262.1	39 929.1	87 089.5	10 182.6	23 172.6	0.29	0.45	0.31	0.35	-0.01	0.09	126	127

1. 2000 instead of 2001.
2. 1998 instead of 2001.
3. 1999 instead of 2001.
4. Break in series between the two years shown.
5. Including intra-zone flows. Excluding Denmark and Greece. Data partially estimated.
6. Excluding Czech Republic, Hungary, Iceland, Poland, Slovak Republic and Turkey.

Source: OECD, TBP database, May 2003.

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Table D.1. **Breakdown of GDP[1] per capita into its components, 2002**

	GDP per capita (US = 100)	Effect of (%): Working-age population (15-64 years) to total population	Labour force to working-age population	Unemployment	Working hours	Total effect of labour force participation	GDP per hour worked (US = 100)	GDP per person employed (US = 100)
	(1)	(2)	(3)	(4)	(5)	(6) (2) + (3) + (4) + (5)	(7) (1) - (6)	(8) (1) - (2) - (3) - (4)
Canada	85	3	2	-2	-2	1	84	82
Mexico	26	-2	-5	1	1	-5	31	32
United States	100	0	0	0	0	0	100	100
Australia	76	0	0	0	0	0	76	77
Japan	74	1	2	0	-1	2	72	72
Korea	48	3	-6	1	12	11	37	49
New Zealand	61	-1	1	0	0	0	61	61
Austria	80	2	-4	1	-15	-16	96	81
Belgium	78	-1	-12	-4	-16	-33	111	95
Czech Republic	44	2	-2	-1	4	3	41	44
Denmark	83	0	4	1	-16	-12	95	78
Finland	75	0	0	-3	-6	-9	84	78
France[2]	77	-2	-6	-3	-15	-27	103	88
Germany	75	1	-4	-2	-21	-26	101	80
Greece	49	1	-12	-3	4	-10	59	63
Hungary	40	1	-11	0	-1	-11	51	50
Iceland	79	-2	10	2	0	10	69	69
Ireland	89	1	-9	2	-8	-14	103	94
Italy	75	1	-16	-3	-11	-30	105	94
Luxembourg	141	1	31	4	-11	26	116	105
Netherlands	82	1	0	2	-28	-24	106	78
Norway	103	-2	6	2	-34	-29	131	97
Poland	29	1	-5	-6	.	-10	.	39
Portugal	50	1	1	0	-3	-1	51	48
Slovak Republic	36	2	-3	-6	4	-4	39	43
Spain	62	2	-9	-4	0	-12	74	73
Sweden	74	-2	2	0	-11	-11	85	74
Switzerland[3]	82	1	10	2	-12	1	81	68
Turkey[3]	17	0	-8	-1	.	-10	.	27
United Kingdom	74	-1	0	1	-5	-6	79	74
European Union	73	0	-6	-2	-11	-19	91	80
Total OECD[4]	75	0	-3	0	-2	-6	81	78

1. GDP converted to common currency by 2002 OECD purchasing power parities (PPP).
2. Includes overseas departments.
3. GDP estimates for Switzerland and Turkey are based on the SNA68.
4. Excludes Poland and Turkey.

Source : OECD, GDP from National Accounts database; population, working-age population, labour force and employment from Labour Force database; hours worked from OECD Employment Outlook.

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Table D.2. **Income and productivity levels in the OECD, 1950-2002**

	GDP per capita, United States = 100						GDP per hour worked, United States = 100					
	1950	1973	1980	1990	1995	2002	1950	1973	1980	1990	1995	2002
Canada	81	86	91	85	82	85	85	86	88	85	86	84
Mexico	27	31	35	28	25	26	31	42	..	37	32	31
United States	100	100	100	100	100	100	100	100	100	100	100	100
Australia	77	76	75	70	74	76	72	69	72	71	73	76
Japan	20	67	71	81	81	74	15	47	55	68	72	72
Korea	9	15	20	33	42	48	7	10	16	26	32	37
New Zealand	94	79	68	61	61	61		81	71	65	63	61
Austria	42	73	81	80	81	80						96
Belgium	60	76	81	79	79	78	59	85	102	110	113	111
Czech Republic	50	57	58	50	45	44	..	..	..	..	39	41
Denmark	80	91	87	82	84	83	60	81	89	94	97	95
Finland	46	69	74	77	69	75	35	60	64	74	80	84
France[1]	55	78	82	80	78	77	46	77	88	103	106	103
Germany	42	74	78	78	80	75	39	76	88	94	104	101
Greece	24	56	57	47	46	49	..	..	..	56	55	59
Hungary	39	51	43	42	35	40	..	..	..	..	48	51
Iceland	..	72	87	82	75	79	..	59	74	73	67	69
Ireland	38	43	49	54	63	89	..	46	58	74	83	103
Italy	41	70	78	78	78	75	43	83	97	104	115	105
Luxembourg	..	98	92	115	123	141	..	..	..	..	..	116
Netherlands	67	83	84	80	81	82	59	92	106	112	113	106
Norway	63	74	91	91	101	103	57	79	101	115	128	131
Poland	29	36	35	25	26	29	..	..	..	..	..	..
Portugal	22	44	43	47	48	50	19	40	..	44	50	51
Slovak Republic	38	43	44	38	32	36	..	..	..	..	34	39
Spain	28	57	56	58	59	62	25	56	69	82	87	74
Sweden	69	78	78	75	71	74	58	79	83	81	84	85
Switzerland[2]	100	114	106	99	89	82	86	96	101	95	86	81
Turkey[2]	15	17	17	18	18	17	..	..	..	..	..	..
United Kingdom	72	72	69	71	73	74	61	64	70	74	80	79

1. Includes overseas departments.
2. GDP estimates for Switzerland and Turkey are based on the SNA68.

Source: 2002 levels from Annex Table D.1; GDP, employment and productivity from OECD productivity database; hours worked from *OECD Employment Outlook*, various issues; population from OECD Labour Force Statistics, earlier years based on Angus Maddison (2001), *The World Economy: A Millennial Perspective*, Development Centre Studies, OECD, Paris.

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Table D.6.1. **Share of value added in total gross value added[1], current prices**

Percentages

		Technology and knowledge-based industries							
		High technology manufactures	Medium-high technology manufactures	Post and telecommuni-cations services	Finance and insurance services	Business activities (excluding real estate activities) [2]	Total with 'market' sevices	Education and health	Total
	ISIC Rev.3	2423, 30, 32, 33, 353	24less2423, 29, 31, 34, 352, 359	64	65-67	71-74		80, 85	
Canada	1999	2.1	5.8	2.8	6.9	6.9	24.4	11.1	35.5
Mexico	2000	2.4	5.6	1.7	2.3	6.5	18.4	8.9	27.3
United States	2000	3.7	4.2	3.5	8.8	10.3	30.4	11.5	41.9
Australia	2000	3.3 [3]	→	3.1	7.1	11.5	25.0	10.9	35.9
Japan	2000	3.9	6.0	1.6	6.4	7.8	25.7	..	..
Korea	2000	7.0	7.0	2.1	6.6	4.0	26.8	7.6	34.4
Austria	2000	2.1	5.4	2.0	6.8	7.9	24.2	9.8	34.0
Belgium	2000	2.2	5.9	1.6	5.9	..	..	12.9	..
Czech Republic	2000	1.7	8.3	4.3	4.5	6.9	25.7	7.1	32.8
Denmark	2000	2.3	3.9	2.4	5.0	8.1	21.7	15.2	36.9
Finland	2000	6.1	5.0	3.2	3.8	6.1	24.3	12.2	36.5
France	2000	2.4	5.1	2.2	5.0	13.4	28.0	11.4	39.4
Germany	2000	2.4	9.3	2.3	4.5	13.2	31.7	10.2	41.9
Greece	2000	0.5	1.2	3.3	5.0	7.0	17.1	10.1	27.2
Hungary	2000	11.8 [3,4]	→	3.8	3.9	8.6	28.1	9.2	37.3
Iceland	1999	2.3 [3,4]	→	..	6.5	..	..	13.3	..
Ireland	1999	8.6	10.4	..	4.5	..	..	8.3	..
Italy	2000	1.9	5.6	2.3	6.2	9.1	25.0	9.7	34.7
Luxembourg	2000	2.1 [3,4]	→	..	25.6	8.6	36.3 [5]	7.2	43.5 [5]
Netherlands	2000	6.0 [3,4]	→	2.4	6.4	12.0	26.8	11.5	38.3
Norway	1999	1.0	2.4	2.2	3.9	9.4	19.0	13.6	32.6
Poland	1999	6.4 [3,4]	→	2.1	2.2	..	..	8.4	..
Portugal	1999	1.1	2.8	2.9	6.4	..	..	12.7	..
Slovak Republic	1999	7.7 [3,4]	→	2.7	3.6	6.0	20.0	7.4	27.5
Spain	2000	1.2	4.8	2.6	5.2	5.9	19.8	10.2	29.9
Sweden	2000	3.7	7.1	2.8	3.8	10.0	27.4	14.8	42.2
Switzerland	2000	9.3 [3,4]	→	3.0	16.1	8.5	37.0	5.8	42.8
United Kingdom	2000	3.0	4.3	2.9	5.2	12.7	28.2	12.1	40.2
European Union	2000	2.3	6.0	2.4	5.3	11.0	27.0	11.0	38.0
Total OECD[6]	2000	3.2	5.2	2.7	6.7	9.6	27.4	..	..

1. Value added measured at basic prices except for United States, Japan, Korea and Iceland - estimated at factor costs

2. Business services includes renting of machinery and equipment (71); computer-related services (72); research and development (73); and other services (74) such as legal, accounting, market research and management consultancy activities, architectural, engineering and other technical activities.

3. Includes medium-high technology manufactures

4. Includes "Shipbuilding" (ISIC 351)

5. Not including "Post and telecommunications" (64)

6. OECD does not include Poland and Turkey

Sources: OECD, STAN database, 2003; *National Accounts of OECD countries Vol. II,* 2003; Secretariat estimates

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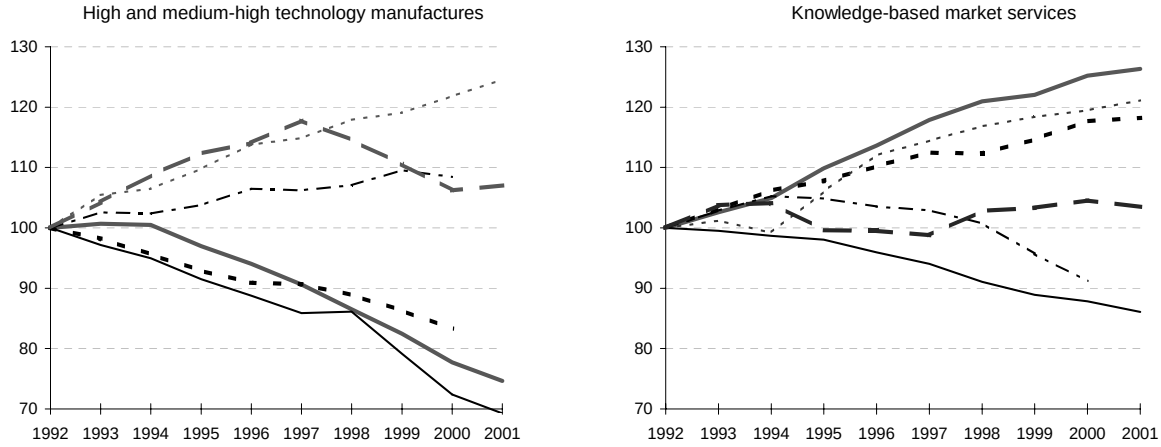
Table D.6.2. **Real value added in knowledge-based industries**
1995=100

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Real value added										
High and Medium-high technology manufactures										
United States[1]	79.2	83.1	91.4	100.0	105.9	116.6	127.6	136.5	151.0	145.7
Japan[2]	97.6	93.4	92.2	100.0	107.1	113.4	108.3	116.7	128.7	122.4
Germany[2]	109.7	96.0	99.1	100.0	98.1	102.0	105.7	102.9	108.2	..
France[3]	87.1	83.2	90.9	100.0	101.6	111.2	119.6	128.6	136.8	..
Italy[2]	93.1	86.8	92.6	100.0	99.4	104.3	105.6	108.1	111.9	109.7
United Kingdom[2]	89.4	90.8	96.8	100.0	103.0	104.9	108.7	112.3	118.1	115.1
Knowledge-based market services										
United States[1]	89.3	93.2	95.7	100.0	104.7	113.2	121.8	129.4	138.8	144.1
Japan[2]	87.3	90.5	94.9	100.0	106.1	112.4	118.2	120.2	125.1	132.9
Germany[2]	90.9	95.3	96.1	100.0	104.6	110.4	117.3	129.5	139.5	..
France[3]	100.8	100.7	100.0	100.0	103.4	104.4	107.7	114.1	121.4	124.0
Italy[2]	91.8	96.7	97.4	100.0	104.7	110.0	114.2	120.4	131.5	136.1
United Kingdom[2]	84.0	86.8	93.2	100.0	107.4	118.0	128.3	135.4	145.7	155.9
Implicit deflators										
High and Medium-high technology manufactures										
United States[4]	103.1	103.8	103.6	100.0	97.0	93.4	89.2	85.0	80.1	77.0
Japan[4]	109.3	106.2	103.8	100.0	97.0	93.9	94.1	86.5	79.2	75.7
Germany	96.3	98.8	98.6	100.0	102.6	102.4	103.2	105.6	104.5	..
France[4]	107.6	105.7	102.9	100.0	97.8	97.6	95.7	92.9	89.6	..
Italy	91.1	96.0	97.0	100.0	103.7	104.6	107.4	108.4	110.9	113.4
United Kingdom	89.1	92.8	96.8	100.0	101.6	104.9	102.0	98.5	94.6	95.3
Knowledge-based market services										
United States	91.0	93.4	95.5	100.0	103.4	107.3	110.1	111.1	114.0	115.0
Japan	102.0	101.5	100.6	100.0	97.8	95.9	92.9	90.7	89.6	87.8
Germany	95.4	98.1	100.4	100.0	98.8	98.2	96.1	91.3	87.0	..
France	92.8	95.7	98.6	100.0	102.3	104.3	104.2	106.4	109.2	109.7
Italy	94.3	95.5	93.6	100.0	105.7	108.0	110.2	111.7	112.7	114.3
United Kingdom	100.4	104.2	104.5	100.0	99.9	99.2	103.3	103.7	105.0	103.9

1. Based on annually re-weighted chained Fisher volumes.
2. Based on fixed-weight Laspeyres volumes with 1995 base year.
3. Based on annually re-weighted chained Laspeyres volumes
4. Quality adjusted (or hedonic) prices used for certain ICT goods

Implicit value added deflators (1991 = 100)



Source: OECD STAN database, May 2003.

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Table D.7. **Share of value added in total gross value added[1], current prices**

Percentages

		Aggregate sectors								
		Agriculture, hunting, forestry and fishing	Mining and quarrying	Total manufacturing	Electricity, gas and water	Construction	Wholesale and retail trade; hotels and restaurants	Transport, storage and communication	Finance, insurance, real estate and business services	Community, social and personal services
	ISIC Rev. 3	01-05	10-14	15-37	40-41	45	50-55	60-64	65-74	75-99
Canada	1999	2.5	3.8	19.7	2.9	5.2	13.8	7.0	25.4	19.8
Mexico	2000	4.0	1.4	20.1	1.1	5.0	21.2	11.0	18.3	17.8
United States	2000	1.6	1.3	15.8	1.9	4.9	16.0	6.7	29.4	22.5
Australia	1999/2000[2]	3.5	4.6	12.4	2.5	6.7	13.8	8.5	28.7	19.4
Japan[3]	2000	1.4	0.1	19.5	3.5	7.3	12.8	6.0	26.9	22.5
Korea	2000	5.1	0.4	29.8	2.8	8.1	12.3	7.0	18.3	16.2
New Zealand	1998/1999[4]	6.7	1.2	16.2	2.7	4.3	15.4	7.7	28.0	17.8
Austria	2000	2.2	0.4	20.7	2.3	7.8	16.9	6.9	22.9	20.0
Belgium	2000	1.4	0.2	19.0	2.6	5.0	13.1	6.8	28.1	23.8
Czech Republic	2000	4.3	1.4	26.9	3.9	7.1	16.5	8.1	16.6	15.1
Denmark	2000	2.7	2.9	15.9	1.9	5.2	13.8	8.1	23.8	25.6
Finland	2000	3.6	0.2	25.8	1.7	5.6	11.0	10.3	21.2	20.6
France	2000	2.8	0.2	17.8	2.0	4.6	13.0	6.2	30.3	23.1
Germany	2000	1.2	0.3	22.2	1.8	5.1	12.6	5.9	29.7	21.3
Greece	2000	7.3	0.6	11.3	1.9	7.2	21.4	7.9	22.5	19.9
Hungary	2000	4.2	0.3	24.8	3.6	4.6	12.7	9.6	20.8	19.3
Iceland	1999	9.5	0.1	13.2	3.4	8.2	14.7	7.7	19.9	23.4
Ireland	2000	3.8	0.7	33.3	1.2	7.3	12.6	5.1	20.5	15.5
Italy	2000	2.8	0.5	20.6	2.1	4.8	16.7	7.2	26.1	19.1
Luxembourg	2000	0.7	0.1	10.8	1.1	5.7	11.9	10.3	43.8	15.5
Netherlands	2000	2.7	2.6	16.3	1.5	5.7	15.2	7.1	26.4	22.5
Norway	2000	2.0	24.8	10.2	2.2	4.2	10.8	8.1	17.6	20.0
Poland	2000	3.8	2.8	20.6	3.3	8.3	22.1	6.8	14.8	17.5
Portugal	1999	3.9	0.4	19.1	3.0	7.8	18.0	6.8	15.1	25.8
Slovak Republic	2000	4.7	0.9	22.8	4.0	5.4	16.7	10.9	19.9	14.9
Spain	2000	3.5	0.4	18.1	2.2	8.4	19.4	8.1	19.3	20.6
Sweden	2000	1.9	0.2	22.2	2.4	4.0	12.1	8.3	24.6	24.3
Switzerland	2000	1.2	0.2	17.8	2.4	5.2	15.2	5.9	31.5	20.7
Turkey	2000	14.2	1.2	19.3	3.0	5.2	20.1	14.3	12.1	10.6
United Kingdom	2000	1.0	2.9	17.5	1.8	5.0	14.9	7.9	27.4	21.6
European Union	2000	2.2	0.9	19.5	2.0	5.4	14.8	7.0	26.8	21.4
Total OECD	2000	2.3	1.2	18.3	2.3	5.6	15.3	7.0	26.7	21.3

1. Value added measured at basic prices except for Japan, Korea and United States -- measured at factor costs; and Turkey -- measured at producer's prices.
2. Fiscal year 1st July 1999 to 30th June 2000.
3. For Japan, Hotels and restaurants (ISIC 55) is included in Community, social and personal services (ISIC 75-99)
4. Fiscal year 1st April 1998 to 31st March 1999.

Source: OECD STAN and Annual National Accounts databases, May 2003

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Table D.9.1. **Manufacturing trade[1] by industry, total OECD[2]**

		Share in total manufacturing[3]										Average annual growth			
	ISIC Rev.3	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	1992-1996	1996-2000	2000-2001	1992-2001
High-technology industries		19.7	20.6	20.9	21.2	21.6	22.7	23.9	25.1	26.9	26.1	9.8	10.6	-5.4	8.3
Aircraft and spacecraft	353	3.3	3.0	2.6	2.2	2.4	2.9	3.4	3.4	3.3	3.7	3.3	10.2	10.4	6.3
Pharmaceuticals	2423	2.1	2.2	2.2	2.3	2.4	2.5	2.7	2.9	2.8	3.5	10.2	12.5	20.3	11.2
Office, accounting and computing machinery	30	5.1	5.5	5.6	5.8	5.9	6.3	6.4	6.6	6.6	6.2	11.0	2.8	-9.6	7.2
Radio, TV and communciations equipment	32	5.6	6.3	6.9	7.3	7.3	7.5	7.7	8.5	10.2	8.7	12.7	7.0	-16.9	10.2
Medical, precision and optical instruments	33	3.6	3.6	3.6	3.5	3.6	3.7	3.7	3.8	4.0	4.1	7.0	5.9	-0.1	6.5
Medium-high-technology industries		38.9	38.4	38.9	39.1	39.4	39.2	39.2	39.2	38.1	38.3	6.7	2.6	-2.2	4.9
Electrical machinery and apparatus, n.e.c.	31	4.1	4.3	4.4	4.5	4.7	4.7	4.8	4.9	5.0	4.8	9.6	3.6	-5.9	6.9
Motor vehicles, trailers and semi-trailers	34	13.7	13.4	13.5	13.1	13.5	13.5	13.9	14.5	13.8	14.0	6.3	4.0	-1.3	5.3
Chemicals excluding pharmaceuticals	24 excl. 2423	9.2	9.1	9.3	9.7	9.4	9.3	8.9	8.8	8.6	8.8	6.8	1.9	-0.6	4.6
Railroad equipment and transport equipment, n.e.c.	352 + 359	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	4.5	5.0	-2.3	4.7
Machinery and equipment, n.e.c.	29	11.3	10.9	11.0	11.1	11.4	11.1	11.0	10.5	10.2	10.1	6.1	0.8	-2.8	3.7
Medium-low-technology industries		16.5	16.2	15.8	16.0	15.6	15.4	14.8	14.1	14.7	14.7	5.0	2.0	-2.6	3.7
Building and repairing of ships and boats	351	0.6	0.7	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.8	4.5	5.8	3.6
Rubber and plastics products	25	2.9	2.8	2.8	2.8	2.8	2.8	2.9	2.8	2.7	2.8	6.2	2.8	-0.1	4.7
Coke, refined petroleum products and nuclear fuel	23	2.6	2.6	2.2	1.9	2.2	2.2	1.6	1.8	2.5	2.6	3.0	8.2	0.5	5.3
Other non-metallic mineral products	26	1.8	1.7	1.7	1.7	1.6	1.6	1.6	1.5	1.4	1.4	4.4	0.7	-1.4	2.7
Basic metals	27	5.9	5.8	5.9	6.4	5.7	5.6	5.6	4.8	5.0	4.8	5.3	-1.0	-7.3	2.5
Fabricated metal products	28	2.8	2.6	2.6	2.7	2.7	2.7	2.7	2.7	2.5	2.6	5.4	2.2	-1.8	4.0
Low-technology industries		24.9	24.7	24.3	23.6	23.3	22.6	22.0	21.5	20.3	20.8	4.5	1.1	-0.2	3.0
Manufacturing, n.e.c.; Recycling	36-37	3.5	3.6	3.5	3.3	3.4	3.4	3.4	3.5	3.5	3.5	5.9	4.1	-1.6	5.1
Pulp, paper, paper products, printing and publishing	21-22	4.1	3.9	3.9	4.3	3.9	3.6	3.6	3.5	3.4	3.4	4.2	1.2	-4.6	2.9
Food products, beverages and tobacco	15-16	7.9	7.8	7.7	7.3	7.2	6.9	6.6	6.3	5.7	6.1	3.7	0.0	4.1	2.0
Textiles, textile products, leather and footwear	17-19	8.1	7.9	7.7	7.3	7.4	7.3	7.2	6.8	6.5	6.7	4.4	0.9	0.3	2.8
Wood and products of wood and cork	20	1.4	1.5	1.5	1.4	1.4	1.4	1.3	1.3	1.2	1.2	7.2	-1.1	-6.2	3.4
Total manufacturing	**15-37**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	6.5	3.2	-2.7	5.0

1. Average value of exports and imports.
2. Total OECD excludes Czech Republic, Korea, Luxembourg and Slovak Republic.
3. Total may not add to 100% because of residual category.

Source: OECD STAN database, May 2003.

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Table D.9.2. **Export shares**[1]

	Total manufacturing		High-technology industries												Medium-high-technology industries											
			Total		Aircraft and spacecraft		Pharmaceuticals		Office, accounting and computing machinery		Radio, television and communication equipment		Medical, precision and optical instruments		Total		Electrical machinery and apparatus, n.e.c.		Motor vehicles, trailers and semi-trailers		Chemicals excluding pharmaceuticals		Railroad equipment and transport equipment, n.e.c.		Machinery and equipment, n.e.c.	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Canada	100.0	100.0	11.3	14.3	3.1	5.4	0.4	0.7	2.8	2.2	3.9	4.3	1.1	1.6	43.0	43.5	1.8	2.4	29.5	27.9	6.3	6.2	0.5	0.4	4.9	6.6
Mexico	100.0	100.0	21.2	29.9	0.6	0.5	0.7	0.8	3.3	9.4	14.1	15.6	2.5	3.6	50.1	46.7	16.0	14.0	19.9	22.0	7.3	3.6	0.2	0.4	6.7	6.6
United States	100.0	100.0	32.4	37.9	11.4	8.7	1.7	2.7	7.3	7.5	6.7	12.3	5.4	6.8	39.1	37.1	4.3	5.0	11.1	10.0	10.6	9.7	0.4	0.4	12.8	12.1
Australia	100.0	100.0	9.9	13.5	2.0	1.4	1.6	3.6	2.9	2.7	1.5	2.3	1.9	3.5	15.2	19.8	1.7	2.1	3.9	7.3	4.5	4.8	0.1	0.2	4.9	5.2
Japan	100.0	100.0	30.1	30.8	0.2	0.7	0.6	1.0	9.2	7.4	15.3	15.6	4.8	6.2	51.9	52.2	5.5	6.5	23.8	21.5	6.8	8.4	1.6	1.7	14.2	14.1
Korea	..	100.0	..	32.4	..	0.4	..	0.4	..	9.0	..	21.2	..	1.3	..	29.4	..	2.6	..	10.4	..	8.9	..	0.2	..	7.3
New Zealand	100.0	100.0	2.1	3.0	0.2	0.2	0.6	0.7	0.1	0.3	0.5	0.9	0.7	0.9	8.8	13.0	1.2	2.1	0.5	0.8	3.7	6.3	0.0	0.0	3.3	3.9
Austria	100.0	100.0	9.8	15.6	0.2	1.6	2.2	3.1	1.6	1.8	3.3	6.6	2.4	2.5	41.2	40.5	7.0	6.0	11.5	14.2	5.7	5.2	0.9	1.2	16.1	13.8
Belgium	100.0	100.0	8.3	15.0	0.9	0.6	2.6	6.3	1.2	2.4	2.5	3.9	1.1	1.7	40.0	42.0	2.7	2.5	17.9	16.3	12.9	15.6	0.3	0.5	6.2	7.1
Czech Republic	..	100.0	..	12.1	..	0.5	..	0.9	..	3.2	..	6.0	..	1.5	..	45.0	..	9.4	..	17.1	..	5.3	..	1.0	..	12.2
Denmark	100.0	100.0	13.4	20.6	0.0	0.0	4.3	7.8	1.9	2.2	3.2	5.8	4.0	4.9	26.6	29.0	2.7	6.4	3.1	2.9	5.0	5.4	1.0	0.9	14.8	13.4
Finland	100.0	100.0	9.7	24.4	0.1	0.4	0.9	0.8	2.4	0.8	4.2	19.5	2.1	2.7	25.4	25.4	3.7	4.9	5.1	3.9	5.2	5.0	0.1	0.1	11.1	11.5
France	100.0	100.0	18.3	25.4	6.5	7.8	2.6	5.0	3.2	3.0	3.3	6.6	2.7	3.0	40.2	39.8	4.4	4.7	14.1	14.6	11.5	11.0	0.6	0.4	9.6	9.1
Germany	100.0	100.0	14.7	20.6	3.0	4.3	2.2	3.6	2.4	2.9	3.3	5.7	3.9	4.2	52.3	51.1	4.9	5.3	18.5	20.4	10.9	9.7	0.6	0.4	17.3	15.3
Greece	100.0	100.0	2.0	9.0	0.3	0.5	0.5	3.7	0.2	0.9	0.6	3.1	0.4	0.8	8.9	15.1	2.1	2.9	0.7	1.5	4.2	6.0	0.0	0.2	1.8	4.4
Hungary	100.0	100.0	8.1	28.3	0.7	0.0	2.9	1.8	0.3	8.7	2.9	16.0	1.3	1.7	28.6	40.5	6.0	9.7	6.3	19.0	8.9	4.5	0.2	0.5	7.1	6.7
Iceland	100.0	100.0	0.3	3.4	0.0	0.0	0.0	1.9	0.0	0.1	0.0	0.0	0.2	1.4	0.8	3.7	0.0	0.1	0.0	0.1	0.0	0.7	0.0	0.0	0.7	2.8
Ireland	100.0	100.0	32.7	58.2	0.7	0.6	8.0	11.3	16.6	28.4	3.2	13.1	4.2	4.9	21.7	23.9	2.6	2.8	0.7	0.8	13.8	17.9	0.0	0.1	4.6	2.3
Italy	100.0	100.0	10.6	11.8	2.1	1.5	1.7	3.4	2.4	1.3	2.3	3.3	2.1	2.4	37.4	38.8	3.5	3.6	7.6	8.0	5.3	5.8	0.9	1.0	20.1	20.6
Netherlands	100.0	100.0	16.6	29.8	2.3	0.8	1.8	3.6	6.4	15.8	3.2	4.8	2.9	4.8	30.1	29.0	2.8	2.9	4.3	5.5	14.7	14.0	0.4	0.5	7.9	6.1
Norway	100.0	100.0	8.6	12.0	1.1	2.1	2.1	2.3	1.7	1.5	1.9	3.4	1.8	2.6	24.5	25.8	2.2	2.9	2.3	2.6	12.6	12.3	0.2	0.1	7.2	7.8
Poland	100.0	100.0	3.7	6.8	0.5	0.7	1.4	0.6	0.2	0.3	0.7	4.5	0.9	0.6	27.0	33.3	4.7	6.2	4.8	13.7	8.8	5.5	0.7	0.8	8.1	7.0
Portugal	100.0	100.0	6.3	11.2	0.4	1.1	0.6	1.4	0.4	1.1	4.1	6.8	0.7	0.9	20.9	31.6	5.0	5.6	7.2	16.4	4.0	3.9	0.3	0.4	4.4	5.4
Slovak Republic	..	100.0	..	6.0	..	0.2	..	1.0	..	0.8	..	3.3	..	0.8	..	42.7	..	5.9	..	19.1	..	6.9	..	1.3	..	9.4
Spain	100.0	100.0	9.3	10.2	2.0	1.4	1.6	2.5	2.1	1.5	2.3	3.5	1.3	1.4	46.9	46.8	3.8	4.0	27.1	26.0	7.1	8.4	0.5	0.8	8.4	7.6
Sweden	100.0	100.0	17.6	23.5	1.5	1.9	4.2	6.0	2.4	1.2	5.7	10.7	3.7	3.6	36.1	36.3	3.5	4.4	13.5	12.9	4.7	5.1	0.3	0.4	14.0	13.5
Switzerland	100.0	100.0	28.3	37.1	0.9	0.9	10.4	18.5	1.1	1.5	1.5	2.0	14.3	14.3	42.7	38.0	5.2	5.3	1.4	1.3	14.4	12.7	0.3	0.3	21.5	18.4
Turkey	100.0	100.0	2.8	6.6	0.0	2.1	0.5	0.6	0.1	0.2	1.9	3.5	0.2	0.3	13.8	22.5	2.6	3.6	2.4	9.3	6.2	4.0	0.0	0.1	2.6	5.5
United Kingdom	100.0	100.0	25.7	40.3	7.0	11.2	3.5	5.5	6.4	7.7	4.5	11.5	4.2	4.5	38.4	33.3	3.8	4.1	10.3	9.0	12.0	10.3	0.2	0.2	12.1	9.7
European Union	100.0	100.0	15.5	23.5	3.3	4.0	2.5	4.5	3.4	4.9	3.3	6.6	3.0	3.4	41.1	40.2	4.0	4.3	13.3	13.6	10.1	10.0	0.5	0.5	13.2	11.8
Total OECD[2]	100.0	100.0	20.0	26.4	3.9	4.3	2.2	3.6	4.6	5.5	5.5	8.6	3.8	4.4	41.8	40.7	4.3	5.0	14.5	14.5	9.5	9.2	0.6	0.6	12.8	11.5

1. Share of industries in total manufacturing exports.
2. Total OECD excludes Korea, Luxembourg, Czech Republic and Slovak Republic.

Source: OECD, STAN database, May 2003.

Table D.9.2. **Export shares**[1] *(cont.)*

	Medium-low-technology industries												Low-technology industries											
	Total		Coke, refined petroleum products and nuclear fuel		Rubber and plastic products		Other non-metallic mineral products		Building and repairing of ships and boats		Basic metals and fabricated metal products		**Total**		Manufacturing, n.e.c. and recycling		Wood and products of wood and cork		Pulp, paper, paper products, printing and publishing		Food products, beverages and tobacco		Textiles, textile products, leather and footwear	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Canada	18.4	16.6	2.8	3.3	2.3	3.3	0.9	1.0	0.2	0.3	12.3	8.8	27.2	25.6	1.8	3.1	6.6	6.0	12.2	8.9	5.4	5.7	1.2	2.0
Mexico	13.4	8.1	1.7	0.1	2.5	1.9	2.2	1.5	0.0	0.0	7.0	4.7	15.4	15.3	3.2	3.5	0.9	0.3	1.9	1.0	3.6	3.0	5.8	7.6
United States	11.1	10.6	2.0	1.5	2.3	2.9	1.0	1.0	0.4	0.3	5.5	5.0	17.3	14.3	2.1	2.7	1.2	0.6	4.3	3.3	6.9	4.9	2.8	2.8
Australia	40.7	32.5	4.6	5.7	1.0	1.1	0.7	0.7	1.3	0.7	33.1	24.4	34.2	34.2	1.5	1.5	1.5	1.2	1.7	1.9	23.5	25.6	6.0	4.0
Japan	11.7	11.4	0.5	0.4	1.2	1.2	1.2	1.2	2.4	2.2	6.5	6.4	6.2	5.6	2.6	2.6	0.0	0.0	0.9	0.7	0.5	0.7	2.2	1.6
Korea	..	22.9	..	5.3	..	2.5	..	0.7	..	6.5	..	7.9	..	15.4	..	1.6	..	0.1	..	1.4	..	1.3	..	11.0
New Zealand	12.6	10.9	0.7	0.2	1.5	1.7	0.4	0.4	0.3	0.7	9.8	8.0	76.6	73.1	1.1	0.8	4.8	5.8	5.4	4.2	55.5	56.2	9.7	6.0
Austria	22.0	18.3	0.4	0.7	5.1	3.8	3.3	1.9	0.0	0.2	13.3	11.7	27.0	25.7	3.7	3.6	3.9	3.5	7.7	7.4	2.8	5.0	8.9	6.2
Belgium	22.3	18.3	4.1	4.4	3.7	3.3	2.6	1.8	0.1	0.0	11.8	8.7	29.3	24.8	5.5	5.2	1.0	1.0	3.2	2.9	11.0	8.5	8.5	7.2
Czech Republic	..	23.5	..	1.3	..	4.7	..	4.6	..	0.0	..	12.7	..	19.5	..	4.2	..	1.8	..	3.4	..	3.3	..	6.8
Denmark	15.7	12.9	1.8	1.8	3.6	3.5	1.9	1.5	2.5	0.8	5.9	5.4	44.3	37.4	5.8	4.9	1.7	1.4	3.0	2.5	27.3	22.0	6.6	6.7
Finland	21.1	18.9	3.2	3.1	2.1	1.8	1.3	1.2	2.3	3.7	12.2	9.0	43.9	31.4	1.3	0.9	6.8	5.1	30.9	21.9	2.2	1.8	2.7	1.6
France	17.0	14.7	2.1	2.0	3.3	3.0	2.1	1.7	0.7	0.9	8.9	7.1	24.4	19.7	2.2	2.0	0.6	0.6	3.3	2.9	11.8	8.9	6.5	5.3
Germany	15.9	14.6	1.1	1.3	3.5	3.4	1.7	1.4	0.6	0.6	9.0	7.9	17.0	13.7	2.3	1.9	0.5	0.6	3.4	3.1	5.0	4.2	5.9	3.8
Greece	26.6	34.8	6.0	12.5	1.8	3.3	5.4	3.8	0.5	0.6	12.9	14.6	62.5	41.1	0.8	1.2	0.6	0.4	1.1	1.8	24.0	16.6	35.9	21.2
Hungary	19.4	11.3	3.5	1.7	2.4	2.7	2.5	1.4	0.1	0.0	10.9	5.6	43.5	20.0	2.2	3.7	1.7	1.0	1.6	1.6	17.7	6.0	20.3	7.6
Iceland	14.0	27.0	0.1	0.2	0.2	0.4	0.1	0.1	0.7	1.8	13.0	24.5	84.9	66.0	0.0	0.1	0.0	0.0	0.1	0.3	82.8	64.4	1.9	1.2
Ireland	7.4	3.0	0.4	0.3	2.5	1.0	1.1	0.5	0.1	0.0	3.3	1.2	38.2	15.0	1.6	0.6	0.5	0.3	6.1	4.8	25.8	8.3	4.2	1.0
Italy	18.5	18.0	2.0	1.9	3.5	3.6	4.2	3.6	0.3	0.9	8.5	8.0	33.5	31.3	6.8	6.7	0.5	0.6	2.2	2.3	5.7	5.3	18.4	16.5
Netherlands	20.0	17.3	6.7	8.0	3.4	2.4	1.4	0.8	0.6	0.5	7.9	5.6	33.3	23.9	2.0	2.1	0.6	0.3	4.5	3.4	20.7	14.4	5.4	3.7
Norway	43.6	39.3	9.3	10.9	1.4	1.2	1.0	0.9	12.5	7.6	19.4	18.7	23.3	22.9	1.6	2.0	2.0	1.3	7.2	6.9	11.0	11.6	1.5	1.1
Poland	35.6	27.1	3.5	2.4	1.4	4.1	3.4	2.6	4.3	5.6	22.9	12.4	33.7	32.8	4.5	8.1	5.0	3.2	2.1	3.9	11.8	7.7	10.3	9.9
Portugal	13.2	13.3	2.9	1.6	1.4	2.7	4.6	3.6	0.9	0.2	3.4	5.1	59.6	43.8	2.1	2.4	5.4	4.6	5.3	5.0	6.9	6.2	40.0	25.8
Slovak Republic	..	29.3	..	6.2	..	3.9	..	3.1	..	0.4	..	15.8	..	22.1	..	3.2	..	2.0	..	5.4	..	3.0	..	8.4
Spain	21.9	19.2	3.1	2.9	3.2	3.8	3.7	3.7	1.9	0.7	9.9	8.0	22.0	23.8	2.3	2.6	0.8	0.8	3.2	3.4	8.5	9.6	7.1	7.4
Sweden	19.5	17.4	3.4	3.2	2.8	2.6	1.1	0.9	0.8	0.5	11.4	10.2	26.9	22.8	2.4	2.3	4.7	3.7	15.7	12.2	1.9	2.6	2.2	2.0
Switzerland	11.8	12.0	0.1	0.3	2.7	2.5	0.9	0.8	0.0	0.0	8.0	8.4	17.2	12.9	6.0	4.2	0.5	0.5	2.9	2.8	3.0	2.5	4.8	2.9
Turkey	24.1	23.1	1.9	1.4	2.1	3.2	4.4	4.6	1.1	1.1	14.6	12.7	59.3	47.8	0.6	2.5	0.3	0.4	0.7	1.0	10.7	6.9	47.1	37.1
United Kingdom	15.6	11.9	3.0	2.6	2.9	2.3	1.5	1.1	0.3	0.3	7.9	5.7	19.4	13.8	2.4	2.2	0.2	0.2	3.8	3.0	7.8	5.0	5.3	3.5
European Union	17.7	15.3	2.5	2.6	3.3	3.0	2.2	1.7	0.6	0.6	9.0	7.3	25.7	20.8	3.1	2.9	1.0	0.9	4.4	3.9	9.1	7.0	8.1	6.1
Total OECD[2]	16.2	14.2	2.1	2.1	2.8	2.7	1.8	1.5	0.9	0.8	8.6	7.1	22.0	18.6	2.9	2.9	1.2	1.0	4.1	3.6	7.6	6.0	6.3	5.1

1. Share of industries in total manufacturing exports.
2. Total OECD excludes Korea, Luxembourg, Czech Republic and Slovak Republic.

Source: OECD, STAN database, May 2003.

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Table D.9.3. **Contribution to the manufacturing trade balance**[1]

	Total manufacturing		High-technology industries												Medium-high-technology industries											
			Total		Aircraft and spacecraft		Pharmaceuticals		Office, accounting and computing machinery		Radio, television and communication equipment		Medical, precision and optical instruments		Total		Electrical machinery and apparatus, n.e.c.		Motor vehicles, trailers and semi-trailers		Chemicals excluding pharmaceuticals		Railroad equipment and transport equipment, n.e.c.		Machinery and equipment, n.e.c.	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Canada	0.0	0.0	-4.5	-3.9	0.1	0.9	-0.5	-0.8	-1.5	-1.6	-1.5	-1.3	-1.1	-1.2	-2.4	-1.8	-1.4	-1.3	2.7	3.1	-0.3	-0.8	0.0	-0.1	-3.4	-2.6
Mexico	0.0	0.0	1.0	2.0	-0.3	0.1	-0.2	-0.2	0.2	2.1	1.8	-0.3	-0.3	0.3	5.3	2.5	3.2	2.1	7.5	4.5	-0.8	-2.2	-0.1	0.1	-4.4	-2.1
United States	0.0	0.0	3.8	5.4	4.2	2.6	0.3	0.2	-0.3	-0.1	-1.4	1.1	1.0	1.5	1.9	0.6	0.0	0.1	-3.1	-3.2	2.6	1.7	-0.1	-0.1	2.4	2.1
Australia	0.0	0.0	-6.8	-6.6	-1.0	-0.7	-0.6	-0.6	-2.2	-2.2	-1.6	-2.5	-1.3	-0.6	-10.3	-8.6	-1.2	-1.0	-3.4	-2.9	-1.9	-1.3	-0.2	-0.2	-3.6	-3.2
Japan	0.0	0.0	5.3	0.2	-1.0	-0.4	-0.9	-0.7	2.3	-0.8	4.6	1.9	0.4	0.2	13.9	14.9	1.2	1.0	8.6	8.6	-0.3	0.6	0.6	0.6	3.9	4.1
Korea	..	0.0	..	-0.7	..	-0.2	..	-0.4	..	1.8	..	0.2	..	-2.1	..	-0.2	..	-1.3	..	4.0	..	-1.5	..	-0.1	..	-1.4
New Zealand	0.0	0.0	-10.5	-9.0	-3.0	-1.6	-1.4	-1.2	-2.6	-2.5	-2.2	-2.4	-1.3	-1.2	-13.9	-12.7	-1.1	-0.5	-4.8	-6.0	-3.6	-2.4	-0.2	-0.2	-4.2	-3.5
Austria	0.0	0.0	-2.4	-1.6	-0.3	-0.1	-0.2	-0.3	-1.1	-0.9	-0.5	0.1	-0.4	-0.4	-0.7	0.5	1.2	0.4	-1.7	-0.1	-1.3	-0.9	0.0	0.2	1.1	1.0
Belgium	0.0	0.0	-1.2	-1.6	0.0	0.0	0.1	-0.3	-0.7	-0.5	-0.1	-0.3	-0.6	-0.5	-1.1	0.1	-0.2	-0.3	1.5	0.3	-0.1	0.6	-0.1	-0.1	-2.2	-0.4
Czech Republic	..	0.0	..	-3.8	..	-0.1	..	-0.9	..	-1.0	..	-1.0	..	-0.7	..	2.2	..	0.6	..	3.6	..	-1.6	..	0.2	..	-0.6
Denmark	0.0	0.0	-0.7	0.8	0.0	0.0	1.0	2.4	-1.7	-1.6	-0.5	-1.0	0.6	0.9	-3.6	-2.1	-0.4	0.8	-1.9	-2.1	-2.7	-1.2	-0.4	-0.9	1.7	1.4
Finland	0.0	0.0	-4.2	-1.2	-0.4	-0.5	-1.0	-1.1	-1.3	-2.0	-0.8	2.6	-0.7	-0.3	-7.2	-5.9	-0.6	-0.9	-1.7	-2.4	-3.1	-2.3	-0.2	-0.2	-1.7	-0.2
France	0.0	0.0	0.1	0.8	1.4	1.8	0.3	0.4	-0.9	-1.2	-0.5	0.1	-0.3	-0.3	2.1	1.7	0.6	0.4	1.5	1.3	0.5	0.5	0.0	-0.1	-0.4	-0.5
Germany	0.0	0.0	-2.0	-2.7	-0.5	-0.2	0.3	0.4	-1.4	-1.9	-0.7	-1.2	0.4	0.3	9.0	7.1	0.6	0.0	3.2	4.1	1.2	0.0	0.0	-0.1	4.0	3.2
Greece	0.0	0.0	-3.5	-3.6	-0.4	-0.4	-0.8	-0.6	-0.6	-0.8	-0.8	-0.9	-0.9	-0.9	-11.3	-7.2	-0.1	0.1	-5.4	-2.8	-2.0	-1.4	-0.2	-1.0	-3.6	-2.0
Hungary	0.0	0.0	-4.5	-0.4	-0.1	0.0	-0.2	-0.2	-2.0	1.1	-1.1	-1.0	-1.2	-0.3	-4.7	0.5	0.8	1.1	-0.6	3.3	-1.9	-1.5	-0.1	0.1	-2.9	-2.4
Iceland	0.0	0.0	-5.6	-6.8	-0.4	-1.8	-1.1	-0.6	-1.3	-1.8	-1.6	-1.8	-1.2	-0.8	-13.4	-12.1	-2.8	-3.1	-3.6	-3.0	-2.9	-3.0	-0.1	-0.1	-4.0	-2.9
Ireland	0.0	0.0	3.7	4.6	-0.6	-1.0	2.2	3.1	2.8	3.9	-1.3	-1.9	0.7	0.4	-4.5	-0.2	-1.1	-0.6	-2.3	-2.6	1.5	4.8	-0.1	-0.1	-2.6	-1.8
Italy	0.0	0.0	-3.5	-3.7	0.0	-0.3	-0.5	-0.3	-0.8	-1.3	-1.3	-1.2	-0.8	-0.6	-0.5	-0.1	0.2	0.0	-3.3	-2.9	-3.3	-2.8	0.1	0.1	5.7	5.5
Netherlands	0.0	0.0	-1.3	-2.5	0.0	-0.2	-0.1	-0.2	-0.5	-0.1	-0.5	-2.1	-0.2	0.0	-1.9	-0.4	-0.4	-0.4	-2.1	-1.6	1.8	2.1	-0.3	-0.1	-0.9	-0.3
Norway	0.0	0.0	-3.7	-4.3	-0.7	-1.1	0.0	-0.2	-1.4	-2.0	-0.8	-0.8	-0.7	-0.2	-4.1	-3.4	-1.2	-0.7	-2.1	-3.2	2.6	2.6	-0.2	-0.3	-3.3	-1.9
Poland	0.0	0.0	-7.1	-5.5	0.1	0.1	-1.4	-1.9	-1.9	-1.7	-2.4	-1.2	-1.4	-0.8	-7.1	-3.3	0.6	0.8	-0.8	1.4	-2.0	-2.7	0.1	0.2	-5.1	-3.0
Portugal	0.0	0.0	-3.2	-3.1	-0.1	-0.3	-0.6	-0.9	-1.3	-1.1	-0.4	0.0	-0.9	-0.8	-11.1	-3.3	0.5	0.8	-5.0	0.2	-2.5	-2.1	-0.3	-0.1	-3.8	-2.1
Slovak Republic	..	0.0	..	-4.3	..	0.0	..	-1.2	..	-1.1	..	-1.0	..	-1.0	..	-0.9	..	-0.3	..	2.3	..	-0.7	..	0.2	..	-2.3
Spain	0.0	0.0	-3.7	-3.7	0.0	-0.1	-0.3	-0.6	-1.1	-1.0	-1.1	-1.1	-1.2	-0.8	1.6	1.1	-0.1	0.0	5.4	3.0	-1.6	-0.6	-0.3	0.1	-1.8	-1.5
Sweden	0.0	0.0	-0.9	-0.2	-0.3	-0.2	1.0	1.6	-1.7	-2.0	0.4	0.8	-0.2	-0.3	0.3	-1.1	-0.8	-0.6	2.2	0.6	-2.0	-1.9	-0.1	-0.1	1.0	0.9
Switzerland	0.0	0.0	5.4	5.3	-0.4	-0.4	3.5	3.8	-1.8	-1.9	-0.8	-1.0	4.9	4.8	3.9	3.3	0.6	0.7	-3.9	-3.6	1.9	1.7	-0.3	-0.1	5.6	4.6
Turkey	0.0	0.0	-6.8	-5.1	-1.9	0.3	-0.8	-1.9	-1.3	-1.0	-1.2	-1.2	-1.5	-1.3	-17.4	-8.7	-1.0	0.0	-2.7	1.4	-5.5	-5.5	-0.2	-0.1	-8.1	-4.5
United Kingdom	0.0	0.0	2.0	3.6	1.6	1.1	0.8	0.9	-0.5	0.0	-0.3	1.4	0.4	0.3	2.1	0.4	0.1	0.3	-0.5	-2.0	1.5	1.4	-0.1	-0.1	1.2	0.9
European Union	0.0	0.0	-1.2	-1.0	0.2	0.1	0.2	0.3	-0.9	-0.9	-0.6	-0.4	-0.1	-0.1	2.2	1.9	0.2	0.1	0.6	0.4	0.0	0.1	-0.1	-0.1	1.5	1.4
Total OECD[2]	0.0	0.0	0.3	0.3	0.6	0.5	0.1	0.2	-0.5	-0.7	-0.1	0.0	0.2	0.3	2.9	2.3	0.2	0.1	0.9	0.5	0.4	0.4	0.0	0.0	1.5	1.3

1. Observed trade balance of industry minus theoretical trade balance, expressed in hundreds of manufacturing trade (see box in text).
2. Total OECD excludes Korea, Luxembourg, Czech Republic and Slovak Republic.

Source: OECD, STAN database, May 2003.

Table D.9.3. **Contribution to the manufacturing trade balance[1]** *(cont.)*

	Medium-low-technology industries														Low-technology industries											
	Total		Coke, refined petroleum products and nuclear fuel		Rubber and plastic products		Other non-metallic mineral products		Building and repairing of ships and boats		Basic metals		Fabricated metal products, except machinery and equipment		**Total**		Manufacturing, n.e.c. and recycling		Wood and products of wood and cork		Pulp, paper, paper products, printing and publishing		Food products, beverages and tobacco		Textiles, textile products, leather and footwear	
	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001	1992	2001
Canada	2.4	1.3	0.8	1.1	-0.5	-0.1	-0.4	-0.2	0.0	0.0	3.2	1.1	-0.7	-0.4	4.5	4.4	-0.7	-0.1	2.9	2.6	4.0	2.5	0.3	0.6	-2.1	-1.2
Mexico	-3.9	-4.4	-0.6	-0.4	-1.7	-2.0	0.4	0.2	0.0	0.0	-0.7	-1.2	-1.3	-0.9	-2.5	-0.2	0.4	0.8	-0.1	-0.1	-1.2	-1.1	-1.6	-0.5	0.0	0.7
United States	-1.2	-1.5	-0.6	-1.4	0.0	0.4	-0.2	-0.1	0.2	0.1	-0.6	-0.4	-0.1	0.0	-4.5	-4.4	-1.9	-1.7	-0.2	-0.4	0.8	0.5	1.1	0.7	-4.3	-3.4
Australia	11.7	8.5	0.9	1.8	-1.3	-1.2	-0.5	-0.3	0.6	0.1	12.4	8.8	-0.4	-0.6	5.4	6.6	-0.9	-1.0	0.0	0.1	-1.8	-0.9	8.9	9.7	-0.8	-1.2
Japan	-3.1	-0.8	-2.9	-2.2	0.3	0.4	0.0	0.0	1.0	1.0	-1.6	0.1	0.2	0.0	-16.1	-14.4	-1.5	-1.4	-1.8	-1.5	-0.7	-0.6	-7.7	-5.9	-4.5	-4.9
Korea	..	1.1	..	-0.3	..	0.5	..	-0.4	..	3.0	..	-1.9	..	0.3	..	-0.2	..	0.2	..	-0.4	..	-0.5	..	-2.2	..	2.7
New Zealand	-2.1	-2.9	-0.6	-1.9	-1.2	-1.0	-0.6	-0.6	-0.5	0.1	1.4	1.0	-0.7	-0.4	26.5	24.6	-0.8	-1.0	2.2	2.6	-0.6	-0.6	24.7	24.2	0.9	-0.6
Austria	2.0	-0.3	-0.5	-0.9	0.6	-0.1	0.5	0.0	0.0	0.0	0.9	0.8	0.5	-0.1	1.0	1.3	-0.2	-0.2	1.1	1.0	1.5	1.5	-0.5	0.0	-0.9	-1.0
Belgium	1.8	1.1	0.5	0.3	0.0	0.0	0.3	0.2	0.0	0.0	1.2	0.8	-0.2	-0.2	0.5	0.4	0.0	-0.2	-0.1	0.0	-0.6	-0.3	1.1	0.6	0.1	0.4
Czech Republic	..	0.2	..	-0.9	..	-0.5	..	1.3	..	0.0	..	-0.9	..	1.3	..	1.3	..	1.1	..	0.5	..	-0.3	..	-0.3	..	0.3
Denmark	-1.6	-2.5	-0.4	-0.5	-0.1	-0.1	0.1	-0.2	0.8	-0.1	-2.3	-1.4	0.1	-0.2	5.9	3.9	1.6	0.9	-0.5	-0.5	-1.5	-1.1	7.7	5.9	-1.4	-1.3
Finland	0.0	0.6	-0.7	-0.2	-0.7	-0.6	-0.3	-0.1	0.5	1.4	1.6	0.3	-0.4	-0.3	11.4	6.6	-0.6	-0.7	2.9	2.0	13.2	8.9	-1.3	-1.6	-2.8	-2.0
France	-0.5	-0.7	-0.7	-0.3	0.0	-0.1	0.0	-0.1	0.2	0.2	0.0	-0.4	0.0	-0.1	-1.6	-2.0	-0.7	-0.6	-0.1	-0.2	-0.7	-0.5	1.4	0.8	-1.5	-1.5
Germany	-1.0	-0.6	-0.8	-0.6	0.1	0.2	-0.2	-0.1	0.2	0.1	-0.6	-0.5	0.2	0.2	-6.0	-3.9	-0.6	-0.5	-0.5	-0.2	-0.3	-0.2	-1.4	-0.9	-3.2	-2.2
Greece	3.1	5.8	1.4	3.9	-0.3	0.3	1.3	0.8	-1.3	-1.7	2.5	2.6	-0.4	-0.1	11.7	5.0	-0.6	-0.5	-0.3	-0.3	-0.9	-0.9	4.0	2.2	9.5	4.6
Hungary	1.2	-2.2	0.5	0.2	-0.3	-0.9	0.3	-0.2	0.0	0.0	0.6	-0.8	0.1	-0.6	7.9	2.1	-0.4	1.0	0.2	0.1	-1.7	-0.8	6.3	1.6	3.4	0.3
Iceland	-8.5	-1.3	-4.1	-4.2	-1.9	-1.6	-0.9	-0.9	-3.3	-0.7	3.6	8.5	-1.9	-2.4	27.4	20.1	-2.0	-1.9	-1.4	-1.0	-2.7	-1.7	36.9	27.3	-3.5	-2.6
Ireland	-4.0	-3.4	-1.3	-1.0	-0.8	-0.7	-0.4	-0.3	0.0	0.0	-0.9	-0.7	-0.6	-0.6	4.8	-1.0	-0.3	-0.5	-0.3	-0.3	0.1	0.8	7.6	0.8	-2.3	-1.7
Italy	0.0	0.4	-0.5	-0.1	0.6	0.6	1.2	1.1	0.0	0.2	-2.5	-2.5	1.2	1.0	4.0	3.5	2.5	2.3	-0.6	-0.5	-0.5	-0.6	-2.6	-1.5	5.2	3.6
Netherlands	1.3	1.6	2.4	2.4	-0.4	-0.3	-0.3	-0.2	0.2	0.2	-0.2	-0.3	-0.2	-0.2	1.8	1.3	-0.7	-0.5	-0.6	-0.4	-0.3	-0.1	5.3	3.3	-1.9	-1.1
Norway	8.4	7.3	3.5	4.0	-1.1	-0.9	-0.3	-0.4	3.5	1.4	3.4	4.0	-0.7	-0.8	-0.6	0.3	-1.0	-0.9	0.2	-0.4	0.9	1.3	3.0	3.1	-3.8	-2.7
Poland	8.9	3.1	-0.5	0.2	-1.4	-0.4	0.6	0.1	2.1	1.9	7.1	0.5	0.9	0.8	5.3	5.7	1.0	2.9	2.3	1.1	-1.5	-0.2	0.8	1.3	2.7	0.6
Portugal	-1.0	-1.9	0.1	-0.6	-0.8	-0.4	1.5	0.9	0.3	0.1	-2.1	-1.9	0.0	0.1	15.3	8.2	-0.2	0.0	2.3	1.7	1.0	0.7	-1.1	-1.7	13.3	7.6
Slovak Republic	..	4.6	..	2.1	..	-0.6	..	0.5	..	0.1	..	2.9	..	-0.3	..	0.5	..	0.4	..	0.5	..	0.8	..	-1.2	..	0.1
Spain	3.5	1.5	0.5	0.0	0.2	0.3	1.0	1.1	0.8	0.1	0.9	-0.3	0.1	0.2	-1.4	1.1	-0.3	0.1	-0.2	-0.2	-0.3	0.2	-0.3	0.7	-0.3	0.3
Sweden	-0.7	-0.2	-0.4	0.1	-0.6	-0.5	-0.5	-0.3	0.0	0.2	0.9	0.3	0.0	0.0	1.3	1.5	-0.6	-0.3	1.8	1.2	5.9	4.5	-2.1	-1.8	-3.8	-2.0
Switzerland	-2.8	-3.5	-1.6	-1.4	-0.4	-0.2	-0.6	-0.4	-0.1	0.0	-0.6	-1.8	0.3	0.3	-6.5	-5.1	-1.1	-0.9	-0.4	-0.3	-1.2	-1.0	-1.0	-0.8	-3.0	-2.1
Turkey	2.3	-3.0	-0.6	-1.8	0.0	-2.7	1.4	1.8	0.0	-0.3	1.6	-0.1	-0.2	0.0	21.9	16.8	-0.2	0.7	0.0	0.0	-0.8	-0.9	2.2	1.9	20.7	15.2
United Kingdom	-0.1	0.3	0.6	0.4	0.0	-0.1	0.1	0.0	0.0	0.1	-0.7	-0.1	0.0	0.0	-4.5	-4.6	-0.5	-0.7	-0.8	-0.5	-0.8	-0.5	-0.8	-0.8	-1.6	-2.1
European Union	0.0	0.0	-0.1	0.0	0.0	0.0	0.2	0.2	0.1	0.1	-0.4	-0.4	0.2	0.1	-1.1	-1.0	-0.1	-0.1	-0.2	-0.1	0.0	0.1	0.1	0.0	-0.8	-0.8
Total OECD[2]	-0.3	-0.4	-0.4	-0.5	-0.1	0.0	0.0	0.1	0.3	0.2	-0.2	-0.2	0.0	0.0	-2.9	-2.2	-0.6	-0.6	-0.2	-0.1	0.1	0.2	-0.3	0.0	-1.8	-1.6

1. Observed trade balance of industry minus theoretical trade balance, expressed in hundreds of manufacturing trade (see box in text).
2. Total OECD excludes Korea, Luxembourg, Czech Republic and Slovak Republic.

Source: OECD, STAN database, May 2003.

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OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16
PRINTED IN FRANCE
(92 2003 04 1 P) ISBN 92-64-10364-3 – No. 53187 2003