OECD Science, Technology and Industry Scoreboard

TOWARDS A KNOWLEDGE-BASED ECONOMY

SCIENCE AND INNOVATION

OECD

2001

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy.
- 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.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), Korea (12th December 1996) and the Slovak Republic (14th December 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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TABLEAU DE BORD DE L'OCDE DE LA SCIENCE, DE LA TECHNOLOGIE ET DE L'INDUSTRIE
Vers une économie fondée sur le savoir

FOREWORD

The *Science, Technology and Industry Scoreboard* 2001 brings together the latest internationally comparable data in order to analyse trends in the knowledge-based economy. It draws mainly on OECD databases and indicators 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 in traditional as well as emerging areas such as biotechnology, information technologies, environment and health.
- The rising importance of the *information economy*: resources and infrastructure for the information economy, the diffusion of Internet technologies and electronic commerce, the contribution of information and communication technologies, including software, to economic performance.
- The increasing *international integration of economic activity*: emerging channels of economic integration and technology diffusion, such as direct and portfolio investment, international strategic alliances, mergers and acquisitions, 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.
- *Economic growth and performance*: comparison of OECD economies in terms of income, productivity and industrial performance and the growing importance of technology and knowledge-intensive industries.

Indicators that capture the changing relationship between science, innovation and economic performance are crucial so that policy makers may make informed decisions, set priorities and address the challenges of the knowledge-based economy. This publication develops indicators for measuring the knowledge-based economy in four interconnected areas:

- **The creation and diffusion of knowledge.** These indicators build on the work of the OECD National Experts on S&T Indicators (NESTI). Research and development (R&D) data, based on the methodological guidelines set in the OECD *Frascati Manual*, offer a unique view of the size of inventive efforts funded and carried out by government, private non-profit institutions, universities and the business sector. Human resources in science and technology are covered by a new set of indicators that build on methodological work by the OECD and Eurostat (the "Canberra Manual", 1995). They seek to address important policy issues, such as the mobility of science and technology resources across industries and borders. Patent indicators provide a measure of "output" of inventive activity that complements "input" measures such as R&D. For the first time, patent families have been used to improve the comparability of patent-based indicators across countries.
- **The information economy.** In order to measure countries' readiness for the new information technologies and their diffusion and impact, a set of indicators builds on the work of the OECD Working Party on Telecommunication and Information Services Policies (TISP) and the Working Party on Indicators for the Information Society (WPIIS). The infrastructure indicators, complemented by the Internet access price database, provide timely comparisons of countries' readiness and the barriers to the uptake of new technologies and thus a key set of policy-relevant indicators. The ICT supply database uses the OECD definition of the information and communication technology sector and provides international comparisons for a key growth sector in OECD economies. Over a very short time span, national statistical offices have made great strides towards providing high-quality, timely ICT usage statistics. For the first time, this publication relies on these official sources to look at the diffusion of the Internet among the population and businesses.

- **The global integration of economic activity.** To measure the extent of the international integration of commodity, capital markets and production activities, a set of indicators builds on the work of the OECD Statistical Working Party of the Committee on Industry and Business Environment (SWIC) and its forthcoming *Manual on Economic Globalisation Indicators*. The Activities of Foreign Affiliates (AFA) database provides detailed information on firms' adoption of global strategies. Data on the activity of foreign affiliates in the services sector are used for the first time.
- **Economic structure and productivity.** To measure economic performance from a structural perspective and account for differences across industries, the indicators build on the work of the OECD Statistical Working Party of the Committee on Industry and Business Environment (SWIC). The STAN (Structural Analysis) database, based on ISIC Rev. 3 and extended to include services activities, is used to compare countries' industrial structure and productivity growth. An improved classification of technology and knowledge-intensive industries has been developed and is used for the first time here.

The STI *Scoreboard* 2001 is the fourth in a biennial series. Particular attention was given to offering new or improved measures for international comparisons in emerging areas of policy interest. Owing to the novelty of some of the databases and indicators, country comparisons should be interpreted with caution when absolute differences are small. The STI *Scoreboard* 2001 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). The four themes were developed by Alessandra Colecchia (information economy), Günseli Baygan (global integration of economic activity), Mosahid Khan (creation and diffusion of knowledge) and Colin Webb (economic structure and productivity). Alessandra Colecchia served as general editor of the publication, Brigitte van Beuzekom provided statistical co-ordination and Beatrice Jeffries secretarial support. Elena Anton-Zabalza, Elena Bernaldo, Hélenè Dernis, Isabelle Desnoyers-James, Karine Lepron, Pierre Montagnier, Laurent Moussiegt, Chai So and Sharon Standish provided statistical support. Thomas Andersson, Dominique Guellec, Michael Freudenberg, Thomas Hatzichronoglou, Dirk Pilat and Andrew Wyckoff offered guidance and commented on the draft.

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HIGHLIGHTS

There is a clear trend in the OECD area towards a knowledge-based economy…

The ability to create, distribute and exploit knowledge is increasingly central to competitive advantage, wealth creation and better standards of living. The STI S*coreboard* 2001 presents the latest OECD indicators on the knowledge-based economy. Many are new, and they are brought together for the first time in one publication. As a range of new indicators show, the knowledge-intensity of OECD economies is increasing. Investment in knowledge, particularly in R&D and software, is rising, as is investment in ICT. Moreover, the composition of investment is changing, particularly in R&D where a growing proportion is funded by business. Knowledge flows within and across OECD economies are increasing as well, as shown by growing co-operation in science and innovation, greater international mobility of high-skilled workers and continued globalisation of trade and investment. Information and communications technologies are also spreading quickly and support more rapid knowledge creation and diffusion.

… which is reflected in the economic and innovative performance of certain OECD countries.

The knowledge-based economy is also reflected in the economic performance of several OECD countries. High-technology sectors contribute to more rapid growth in some, and the share of these sectors – both in manufacturing and services – continues to grow. Moreover, the overall efficiency of capital and labour has increased in some OECD countries in the 1990s, partly owing to more rapid technological progress. Indicators of patenting confirm the swift pace of innovation.

Nevertheless, large differences continue to mark the move towards a knowledge-based economy.

While the overall trends are clear, large differences remain within the OECD area. The Nordic countries, notably Finland and Sweden, and the United States appear to be in the lead in the transition to a knowledge-based economy, as high investment in knowledge, rapid innovation and the pace of diffusion of ICT indicate. Countries such as Japan and several large European countries appear to lag in important areas, including investment in knowledge, innovation and growth of a high-skilled workforce. For certain OECD countries, openness to international knowledge flows also seems to lag. This suggests scope for further progress. However, the transition to a knowledge-based economy requires progress in many areas, and even countries that are ahead in many of them lag in others.

New indicators show that the knowledge-intensity of OECD economies is increasing

Investment in knowledge is growing more rapidly than investment in fixed capital…

Investment in knowledge, defined as public and private spending on higher education, expenditure on research and development (R&D) and investment in software, accounts for about 4.7% of OECD-wide GDP. It would exceed 10% of GDP if education expenditure for all levels was included. By this measure, Sweden, the United States, Korea and Finland are the four most knowledge-based economies. During the 1990s, investment in knowledge increased by 3.4% annually in the OECD area, while investment in fixed capital increased by 2.2%.

… and ICT has been the most dynamic element.

ICT hardware and software have been the most dynamic area for investment. The available data show that it rose from less than 15% of total non-residential investment in the business sector in the early 1980s to between 15% and 35% in 1999. Investment in software accounted for 25-40% of the contribution of ICT to overall investment growth.

Investment in education and skills underpins the growth of a skilled workforce.

Education and skills, which underpin the growth of a skilled workforce, account for the bulk of investment in knowledge. In 1999, 65% of the population aged 25-64 in the OECD area had completed upper secondary schooling. The share is more than 20 percentage points higher in the United States and Japan than in the European Union. In 1999, 14% of the OECD-area population aged 25-64 had university-level education.

Human resources in science and technology are expanding…

In 1999, there were about 38 million workers (about 25% of the labour force) in highly skilled S&T-related occupations in the European Union. The share was highest – about one-third – in the Nordic countries (Sweden, Denmark, Finland) and in the Netherlands, Germany and Belgium. Human resources in science and technology (HRST) grew significantly between 1995 and 1999 in southern Europe, Ireland and Finland. The growth rate of HRST was similar in European Union countries and the United States (about 3% annually).

… as is expenditure for R&D.

OECD-area expenditure on R&D has increased considerably over the past two decades. It has grown by almost 4% a year and has accelerated since the mid-1990s. Most of the increase between 1994 and 1999 was due to the United States. During the 1990s, R&D expenditure grew by more than 13% annually in Ireland, Mexico and Iceland. In 1999, OECD countries allocated about USD 553 billion to R&D, or approximately 2.2% of overall GDP. Since the mid-1990s, R&D intensity has increased continuously in Japan and the United States and has remained more or less stable in the European Union.

Innovation relies also on venture capital.

Despite a recent slowdown, venture capital remains a major source of funding for new technology-based firms. Between 1995 and 1999, it amounted to 0.21% of GDP in the United States and 0.16% of GDP in Canada and the Netherlands for early and expansion stages. Almost half of venture capital investment in the OECD area is for ICT, representing more than 67% in the United States and over 53% in Ireland and Norway. Biotechnology is also of growing importance, accounting for the bulk of venture capital investments in Hungary, and about 15% in the United States.

The role of business in R&D is increasing

Business is the main source of increased spending on R&D.

The business sector is the major source of R&D financing. In 1999, it provided more than 60% of domestic R&D funding in OECD countries, a slight increase from 1990. Over the decade, the business sector's share increased from 57% to 67% of total R&D funding in the United States; it remained stable in Japan at around 72% and increased from 52% to 55% in the European Union. In most countries, government's role in funding R&D declined over the 1990s.

More R&D spending is directed towards basic research…

Most countries spent a higher share of GDP on basic research in 1998-99 than in the early 1980s. Since 1995, the ratio of expenditure on basic research to GDP has been flat in the United States, but it has grown in Japan, France and Italy. Relative to GDP, Switzerland allocates close to 0.8% of GDP to basic research, almost twice as much as the United States or Japan. In Korea, Japan and Ireland, around one-third of basic research is performed by the business sector.

… with less going to defence…

During the 1990s, the share of defence R&D budgets relative to GDP dropped in most countries, largely owing to the overall reduction in military spending. France, the United States and Sweden experienced the strongest decline. Nonetheless, more than half of the US government R&D budget is

allocated to defence, as is around a third of the total R&D budget in the United Kingdom and around a quarter in France and Spain.

… and more to health…

During the 1990s, government support for health-related R&D rose quickly in Japan (10%) and the United States (8%), with growth rates about double that in the European Union (5%). Compared to the European Union and Japan, government support for health R&D is high in the United States. In 2000, it represented about 0.2% of GDP, far above the figures for the European Union (0.05% in 1998) and Japan (0.03%). This difference is partly due to institutional differences. When appropriate adjustments are made, however, Finland, Austria and the Netherlands have health R&D budgets relative to GDP similar to that of the United States. The difference in government support for health R&D between the United States and the European Union also narrows sharply.

… with a growing share for biotechnology.

A significant and increasing part of health R&D concerns biotechnology. Data for biotechnology R&D are currently only available for 20 OECD countries and do not include the United States and Japan. They show that, in 1997, public funding of biotechnology R&D amounted to approximately USD 3.4 billion. Germany (USD 1.0 billion), the United Kingdom (USD 0.7 billion) and France (USD 0.6 billion) account for the bulk of it. Belgium and Canada have the highest ratio of biotechnology R&D to total government budget appropriations for R&D (14% and 10%, respectively).

R&D in the ICT sector also contributes significantly to overall R&D.

ICT also accounts for a growing share of overall R&D. Data for 19 OECD countries indicate that, in 1998, R&D expenditure for ICT manufacturing was approximately USD 96 billion; for the ICT services industries, data for 11 OECD countries show expenditure of USD 18 billion. In 1998, Finland was the only country to allocate more than 1% of GDP to ICT-related manufacturing R&D. ICT-related R&D intensities of the large European economies are well below those of the United States and Japan. In the 1990s, the United Kingdom is the only large European country where ICT-related R&D increased slightly in manufacturing and services industries (by 1% and 3% a year, respectively). In manufacturing, ICT-related R&D decreased in Germany, France and Italy by 1%, 2% and 0.5%, respectively.

Knowledge flows within and across economies take on greater importance

Innovation increasingly relies on co-operation between firms and universities.

The use and generation of knowledge depend not only on the creation of knowledge but also on flows of knowledge within and among economies. Collaboration between business and non-business entities is rising, and the share of R&D performed by the higher education and government sectors and funded by the business sector is increasing. It represented 6.1% and 4.1% of higher education and government research, respectively, in 1998. Data from innovation surveys show that firms with co-operation arrangements with higher education or government institutes account for around 10% of total employment.

International co-operation in science and innovation is growing rapidly…

Production of scientific research and technological know-how also increasingly depends on research conducted in other countries. In the mid-1990s, 27% of scientific publications in the OECD area were the work of multinational teams and 7% of patents were the result of international co-operative research. In smaller European countries, such as Belgium, Denmark and Austria, over 40% of scientific publications have a foreign co-author. When intra-EU co-operation is factored out, researchers in the United States and the European Union have a similar propensity to co-operate with foreign researchers; in Japan, instead, international co-operation in science and technology is quite limited.

… as is cross-border ownership of inventions.

More and more technology is owned by firms from a country other than the inventor's country of residence. 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 15% of inventions made abroad. Foreign ownership of domestic inventions is high in several small OECD countries, but also in Canada and the United Kingdom, where US companies own a large share of inventions. Domestic ownership of foreign inventions is also high in small countries; 39% of all inventions owned by Swiss residents were invented abroad. In the United States, the share of foreign inventions in the patent portfolio is only 13%. Japan and Korea are the least internationalised in this respect.

Worker mobility supports the flow of knowledge across borders…

Knowledge flows also result from migration. In the United States, for instance, the largest number of scientists and engineers (S&Es) with S&E doctorates who were born elsewhere in the OECD area are from the United Kingdom and Canada; relatively few are from Germany or Japan. However, three times as many foreign-born scientists are from China and twice as many from India as from the United Kingdom. In 1998, for the 14 European countries as a whole, non-national HRST amounted to only 3%. However, European countries differ widely; Luxembourg employs by far the largest share of non-nationals (33%), followed by Austria, Belgium and the United Kingdom.

… as does student mobility.

International mobility of students also represents a potential flow of qualified workers. Five countries are host to more than 70% of all foreign students in OECD countries. The United States attracts 29% of foreign students, followed by the United Kingdom (14%) and Germany (12%). English-speaking countries account for over 50% of the OECD total. In Switzerland, Australia, Austria, Belgium and the United Kingdom, foreign students represent more than 10% of total enrolments. In Korea, Mexico and Poland, they account for less than 1%.

The globalisation of the knowledge economy is apparent in the rapid growth of international transactions.

National economies also integrate in other ways. Financial transactions (*e.g.* direct investment and portfolio investment) constitute the fastest-growing segment of international transactions. The upsurge in direct investment and portfolio investment was especially rapid in the second half of the 1990s. However, such investment flows have proven highly volatile. The lowering of trade and non-trade tariff barriers has also contributed to a steady rise in international trade.

Trade is growing rapidly, particularly in services…

The share of trade in international transactions has remained persistently high, averaging 15% of OECD GDP in the 1990s. That of trade in goods is four times that of trade in services, despite the acceleration of the latter. In the second half of the 1990s, international trade in services as a share of GDP picked up slightly, partly as the result of the growing tradability of certain services, *e.g.* software, financial services and accounting. The trade-to-GDP ratio is only around 10% for the United States, Japan and the European Union when intra-EU trade flows are excluded. During the 1990s, the international trade-to-GDP ratio grew on average about 2% in the European Union and the United States but declined slightly in Japan.

… and foreign direct investment has picked up in recent years...

Flows of foreign direct investment (FDI) have surged in recent years, owing to renewed dynamism in the world economy and a favourable international investment environment. FDI flows as a percentage of GDP are high for Belgium-Luxembourg, New Zealand, Sweden, the Netherlands, Switzerland and the United Kingdom. They remain small in Turkey, Korea, Japan and Italy. In Germany, Japan and the United Kingdom, outward investment greatly exceeds inward investment, while Australia, Hungary, Poland and Spain receive more foreign capital than they invest abroad.

… partly owing to increases in mergers and acquisitions.

Mergers and acquisitions are the most common form of FDI. During the 1990s, cross-border mergers and acquisitions increased more than five-fold worldwide on a value basis. The United States was the main target during the 1995-99 period, attracting on average four times as many deals in terms of number than the United Kingdom, the second target country. Germany and France took third and fourth place. During the 1990s, the most active sectors at global level were oil, automotive equipment, banking, finance and telecommunications.

Multinational firms also account for a growing share of activity in many countries…

The share of turnover under foreign control in the manufacturing sector ranges from about 70% in Hungary and Ireland to under 2% in Japan. In the period 1995-98, the shares of foreign affiliates in manufacturing turnover rose almost everywhere. In terms of manufacturing employment, their shares range from around 50% in Ireland, Luxembourg, and Hungary to 1% in Japan. In the second half of the 1990s, when manufacturing employment typically declined in national firms, it rose in foreign affiliates in all countries except Germany and Netherlands. In most cases, this reflected changes of ownership owing to buy-outs and acquisitions.

… and increasingly in the services sector as well.

The share of turnover under foreign control in the services sector is over 20% for Hungary, Belgium, Ireland and Italy. In terms of employment, the share of foreign affiliates ranges from 19% in Belgium and around 14% in Hungary and Ireland to less than 1% in Japan. In all countries except Norway and Finland, the share of turnover of foreign affiliates was greater for manufacturing than for services.

Information and communications technologies are diffusing rapidly

The knowledge-based economy is accompanied by the rapid diffusion of ICT, especially the Internet.

The diffusion of information and communications technology is a key enabler of the knowledge-based economy. Access to ICT has grown rapidly over the past years. At the end of 1999, OECD countries had more than one network access channel for every two inhabitants and several countries had more than one access channel per inhabitant. The Nordic countries maintain a clear lead over the rest of the OECD area when connectivity provided by wireless networks is taken into account. Internet technologies are diffusing very rapidly. At the end of 1999, there were nearly 50 million Internet subscribers in the United States, close to 11 million in Japan and in Korea, 9 million in Germany, 7.4 million in the United Kingdom and 6.2 million in Canada. A ranking of countries in terms of Internet subscribers per 100 population shows high levels of take-up in Korea, Sweden, Denmark, Canada, the United States, Netherlands, Iceland and Norway.

Access to the Internet is soaring in most countries…

Personal computers are still the main device used by households to access the Internet. In most countries for which data are available, more than half of all households now have computers. In 2000, there was a noticeable gap between northern European countries such as the Netherlands (69%), Denmark (65%) and Sweden (60%) and southern European countries such as Italy (28%), France (27%) and Turkey (12%). Internet access in households is soaring everywhere, especially in Italy where the access rate grew by 144% between 1999 and 2000, as well as in the United Kingdom (75%), Japan (74%) and France (73%).

… as is its use, but Internet transactions remain limited.

The share of adults using the Internet from any location is also increasing rapidly. More than half of the adult population now uses the Internet in Sweden (68%), Denmark (62%), Finland (54%) and Canada (53%). The Internet is still mostly used to search for information, and the propensity to carry out transactions over the Internet varies widely. In Sweden, 43% of Internet users purchase over the Internet, followed by the United Kingdom (33%), the

United States (30%) and Denmark (29%). Business use of the Internet is increasing very rapidly. Internet penetration in businesses with ten or more employees has reached 80-90% in the Nordic countries, Australia, Canada, the Netherlands and the United Kingdom. In the Nordic countries, over 40% of employees use the Internet in their daily work. The use of the Internet to conduct transactions, although rising fast, is limited. The value of Internet sales in 2000 ranged between 0.4% and 2% of total sales, while electronic sales (including those over all computer-mediated networks) reached almost 6% in the United Kingdom.

The rate of diffusion differs between users and across countries…

Internet penetration in households is strongly affected by household income. The difference between Internet access in households belonging to the lowest and highest income quartiles is highest in the United States and lowest in Denmark. Internet usage rates are much higher in large than in small enterprises and vary in different economic sectors. The most intensive business users are generally firms in finance and insurance, business services and wholesale trade.

… partly owing to differences in access costs.

A key determinant of cross-country differences in the diffusion of the Internet and electronic commerce is access cost. There are large differences in prices of leased lines, which provide the infrastructure for business-to-business electronic commerce. The Nordic countries have the lowest charges, at about one-fifth the OECD average. Differences in Internet access cost for consumers are even more marked. At peak times, countries which traditionally have had unmetered local calls – Australia, Canada, Mexico, New Zealand, the United States – are among the least expensive.

The structure of OECD economies and of trade reflects the increasing role of knowledge

As knowledge has grown in importance, so has the share of knowledge-intensive industries…

By the end of the 1990s, high- and medium-high technology manufacturing accounted for about 9% of total OECD value added. The share of high- and medium-high technology industries was largest in Ireland, where they accounted for over 16% of value added, and in Korea (12.6%). Among the G7 countries, Germany and Japan had the largest shares of such industries, at 11.7% and 10.7% of total value added, respectively. In many OECD countries, including the United States, this sector has grown rapidly over the 1990s.

… and knowledge-intensive services.

Knowledge-based "market" services accounted for 18% of total value added in the OECD area. Post and telecommunications, finance and insurance and business services are typically the most intensive technology users among market services. These sectors accounted for almost 25% of total value added in Switzerland. Among the G7 countries, the United States and the United Kingdom had the largest knowledge-intensive services sector. In Mexico and Greece, this sector accounted only for about 10% of value added. If knowledge-intensive "non-market" services (education and health) are included, knowledge-intensive services account for about 29% of total value added in the OECD area.

The changing structure of OECD economies is also reflected in business R&D.

Services have a much smaller share in R&D than in GDP. In 1998, they accounted for about 17% of total business sector R&D in the OECD area, an increase of 2% from 1992. Countries differ widely, however. In Norway, 48% of total business R&D is carried out in the services sector, 37% in Denmark and 31% in the United States. Although the share of services R&D increased over the 1990s in Germany, France and Japan, these countries still have the lowest share of services R&D (less than 10%).

The ICT sector has grown very rapidly in several OECD countries.

The ICT sector makes a substantial contribution to the economy. In 1999, ICT value added represented between 5% and 14% of business sector value added in OECD countries. The importance of ICT supply has been increasing, not only in countries like Hungary, the Czech Republic and Mexico, which are catching up in terms of infrastructure, but also in Finland, Sweden, Norway, the Netherlands and the United Kingdom. In Finland, the ICT sector's share of value added increased by 4.7 percentage points over the 1995-99 period. It now represents over 13% of total business sector value added. The ICT sector is a major source of employment growth. OECD employment in the sector grew by over 12% in the 1995-99 period, *i.e.* an average annual rate of over 3% a year, double that of overall business sector employment. ICT services are driving this growth.

International trade in high-technology goods is also rising rapidly…

The growing importance of knowledge-intensive industries is also visible in the structure of OECD manufacturing trade. The share of high-technology industries in total OECD trade increased from 18% in 1990 to one-quarter in 1999. The highest growth rates in OECD manufacturing trade in the 1990s were in high-technology industries: pharmaceuticals, radio, television and communication equipment and computers. The shares of medium-low- and low-technology industries have gradually declined.

… although only a few OECD countries have a strong comparative advantage in high-technology industries.

In spite of the growing importance of high-technology industries in overall trade, few OECD countries specialise in high- and medium-high-technology industries. In 1999, the structural surplus in these industries represented more than 15% of total manufacturing trade for Japan, about 7.5% for Switzerland and around 5% for Germany, Mexico and 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 of Turkey, New Zealand and Iceland in these industries accounted for more than 20% of total manufacturing trade. For most OECD countries, these specialisation patterns have changed little over the past decade.

Knowledge and innovation increasingly underpin economic performance

Innovation is a key driver of economic growth…

Recent patterns show that knowledge and innovation make a large contribution to growth. A high share of investment in fixed capital goes for ICT. Moreover, the overall efficiency of the use of capital and labour in the production process, or multi-factor productivity (MFP), increased rapidly in Ireland, Finland, Australia, Canada and the United States in the second half of the 1990s. More rapid MFP growth points to faster technological progress. Furthermore, rapid productivity growth in high-technology sectors such as ICT has contributed strongly to growth in several countries.

… and patenting is accelerating, although differences among OECD countries are large.

Indicators of patenting confirm the brisk pace of technological progress. Over the 1990-97 period, patent applications at the European Patent Office increased annually by 5.7% for the European Union, 4.8% for the United States and 1.1% for Japan. During the 1990s, growth rates for patents in ICT (8%) and biotechnology (10%) for the OECD area were almost twice that of total patent applications (5%). Indicators of patent families – patents taken at the European Patent Office, the US Patent and Trademark Office and the Japanese Patent Office to protect a single invention – show that there were about 32 000 patent families in the OECD area in 1995. The United States accounted for about 35%, followed by the European Union (32%) and Japan (27%). When population size is taken into account, Switzerland patents the most by far in the OECD area. In 1995, there were close to 100 patent families per million population in Switzerland, far above Sweden (74) and Japan (69).

A.1. Towards a knowledge-based economy

- Gross fixed capital formation covers investment in structures and machinery and equipment. It is a channel for the diffusion of new technology, especially to manufacturing industries. It represents around 21.0% of OECD-wide GDP, ranging from 29.8% (Korea) to 16.0% (Sweden). For most countries, this ratio decreased during the 1990s.
- Investment in knowledge is by nature much more difficult to measure. A rough indication can be gained by including public and private spending on higher education, expenditure on R&D and investment in software. Investment in knowledge accounts for about 4.7% of OECD-wide GDP and would exceed 10% if education expenditure for all levels was included in the definition of investment in knowledge.
- Sweden, the United States, Korea and Finland are the four most knowledge-based economies, as their investment in knowledge amounts to 5.2-6.5% of GDP. The ratio of investment in knowledge to GDP in Sweden, Finland and the United States is more than two-thirds of the ratio of investment in machinery and equipment to GDP. Among countries for which data are available, investment in knowledge is lowest in Mexico, Greece and Portugal, at less than 2% of GDP.
- By this measure, most OECD countries are moving towards a knowledge-based economy, especially the Nordic countries, Ireland and Austria, which are allocating more and more resources to production of knowledge. During the 1990s, investment in knowledge increased by 3.4% annually in the OECD area, while gross fixed capital formation increased by 2.2% annually. In the United States and Australia and in contrast to most OECD countries, gross fixed capital formation grew more than investment in knowledge; this could be due to the inclusion of some component of investment in knowledge (such as software expenditure) in gross fixed capital formation.

Measuring investment in knowledge

Total 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 between the three components (R&D and software, R&D and education, software and education). Therefore, before calculating the total investment in knowledge, the data required various transformations in order 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 higher education expenditure (both public and private sources).
- All expenditure on software cannot be considered investment. Some is considered as consumption. Purchase of packaged software by households and operational services in firms was estimated using data from private sources and excluded.
- 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 education and software expenditure; however, the available information indicates that the overlap is quite small.

A more complete picture of investment in knowledge would also include other components. Owing to the lack of data availability, it was not possible to include them:

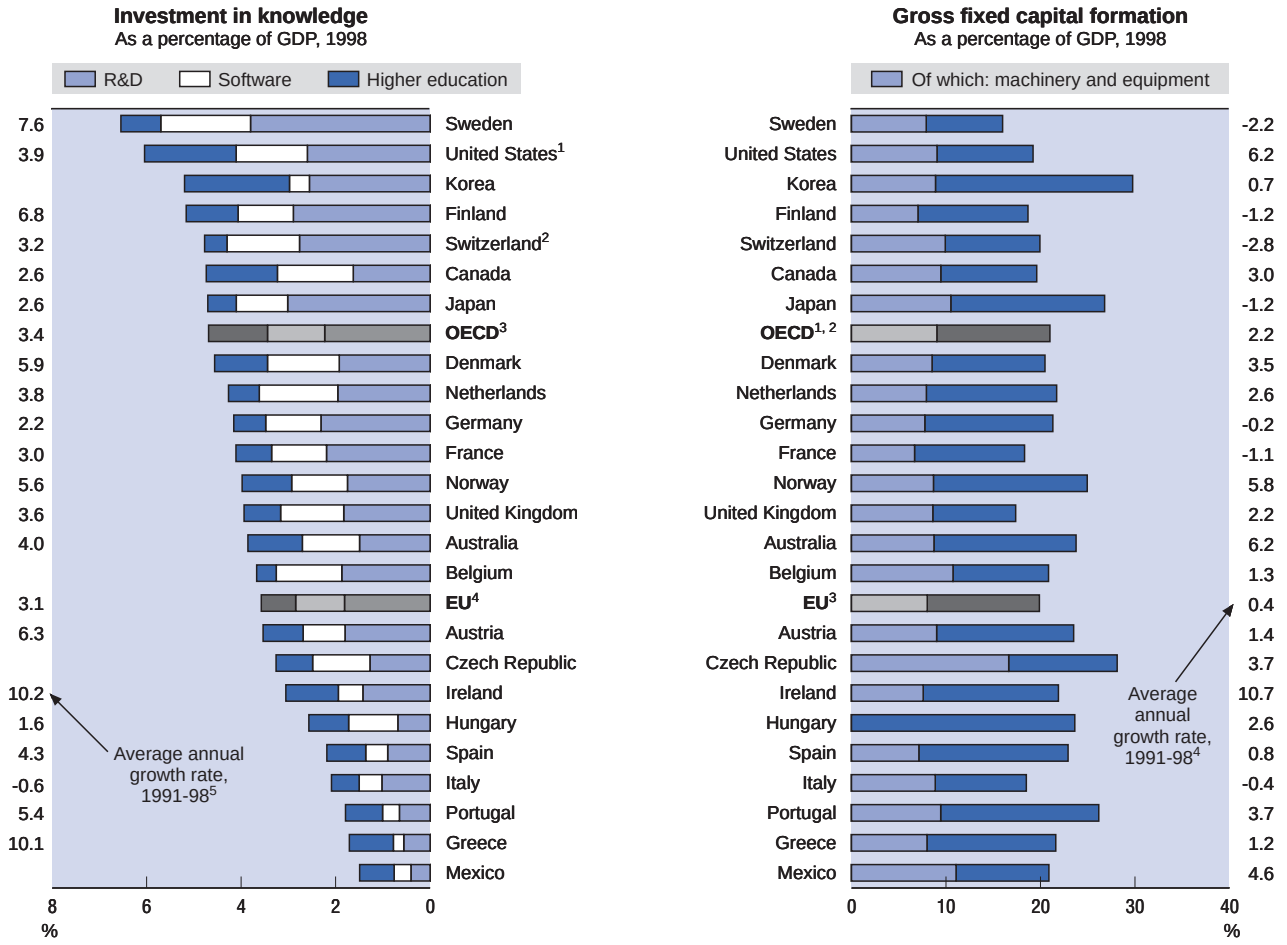
- Data relating to expenditure on the design of new goods are collected from innovation surveys but are only available for a few countries. The data for European countries are available for the reference year 1996 only.
- Data on spending by enterprises on job-related training programmes are scarce.
- Other components, such as spending on organisational change, are even more difficult to estimate at this stage.

Data relating to investment in knowledge were also reported in the 1999 *Science, Technology and Industry Scoreboard*. However, as a result of changes in methodology and availability of additional data, figures on investment in knowledge reported here should not be compared with those in the 1999 edition.

For further information, see OECD, "Investment in Knowledge", forthcoming in STI *Review* (No. 27, 2001).

For more details, see Annex, Table A.1.1.

A.1. Towards a knowledge-based economy



1. Education data also includes post-secondary non-tertiary education (ISCED 4).
2. Average annual growth rate refers to 1992-98.
3. OECD total refers to the available countries, and the average annual growth rate excludes Belgium, Czech Republic, Korea, Mexico and Switzerland.
4. Average annual growth rate excludes Belgium.
5. 1995 US dollars using purchasing power parities.

1. OECD total excludes Hungary.
2. Average annual growth rate excludes Belgium, Czech Republic, Korea, Mexico and Switzerland.
3. Average annual growth rate excludes Belgium.
4. 1995 US dollars using purchasing power parities.

Source: OECD, National Accounts database, MSTI database, Education database and International Data Corporation, March 2001.

A.2. Trends in domestic R&D expenditure

- OECD countries allocated about USD 553 billion (current USD PPP) to R&D in 1999, or approximately 2.2% of overall GDP.
- OECD-area R&D expenditure in constant USD PPP has increased continuously over the past two decades (except during 1991-94), accelerating since the mid-1990s. Between 1981 and 1999, it grew by 4% annually. Most of the increase between 1994 and 1999 is due to the United States. As a result, the gap in the volume of spending between the United States on the one hand and the European Union and Japan on the other has widened. In 1999, 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 economies. Compared to OECD average growth (2.8%) over the 1991-99 period, R&D expenditure grew by half or less in Germany (1.4%) and the United Kingdom (1.2%). Among OECD countries, R&D expenditure declined only in the Slovak Republic, Hungary and Italy.
- In the major OECD regions, R&D expenditure relative to GDP trended downward in the early 1990s. Since the mid-1990s, R&D intensity has increased continuously in Japan and the United States. In Japan, it was mainly due to the stagnation of GDP growth after 1997, rather than to a significant increase in R&D expenditure. In the United States, it was mainly due to significant increases in R&D expenditure, as GDP also grew rapidly. In the European Union, R&D intensity remained more or less stable.
- Sweden, Finland and Japan are the only three OECD countries that allocate more than 3% of their GDP to R&D, well above the OECD average of 2.2%. The fastest growth in R&D expenditure during the 1990s occurred in Ireland, Mexico and Iceland, which had average annual growth rates of more than 13%.

Resources allocated to gross domestic expenditure on R&D – GERD

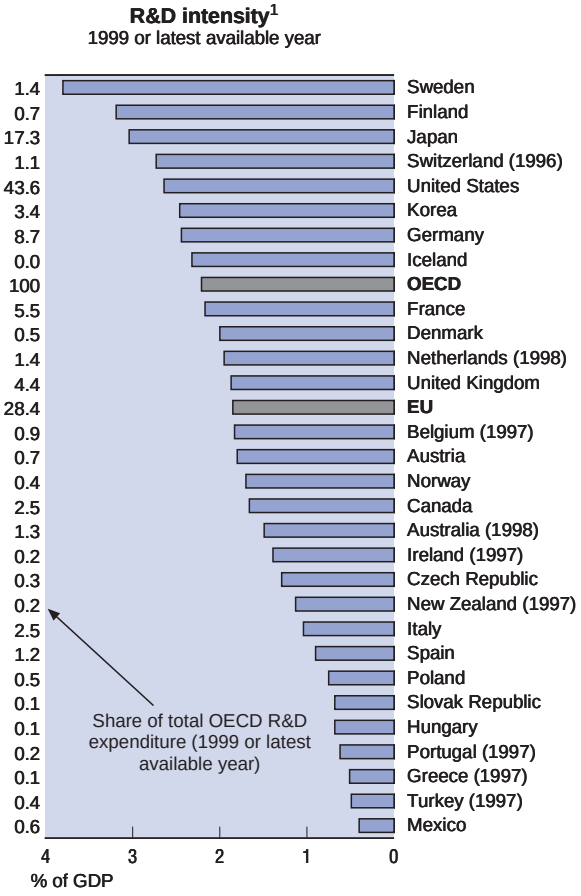
Resources allocated to a country's R&D efforts are measured using two indicators, R&D expenditure and personnel. For R&D expenditure, the main aggregate used for international comparisons is gross domestic expenditure on R&D (GERD), the domestic R&D-related expenditure of a country for a given year. R&D data were compiled on the basis of the methodology of the *Frascati Manual* 1993 (OECD, Paris, 1994).

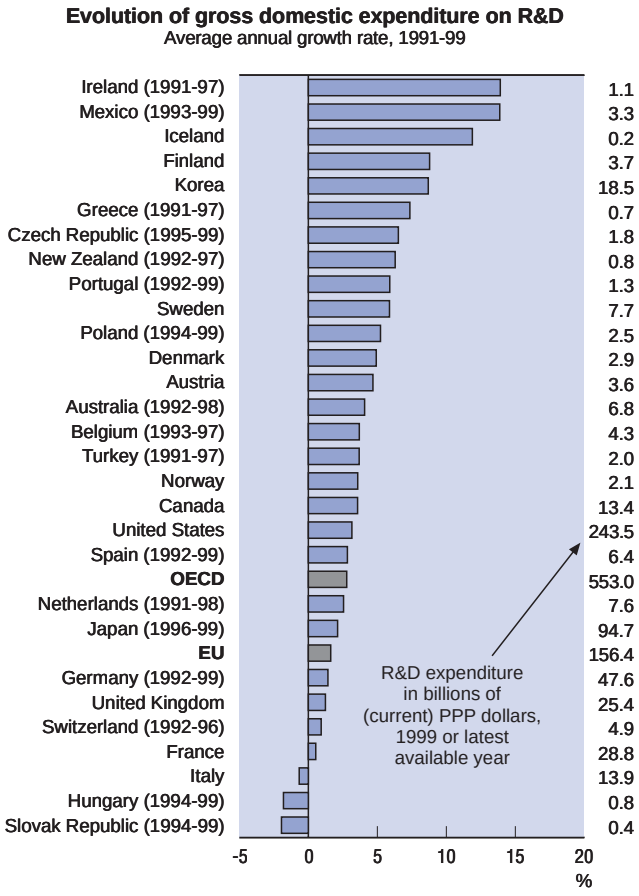
The magnitude of estimated resources allocated to R&D is affected by several national characteristics, principally:

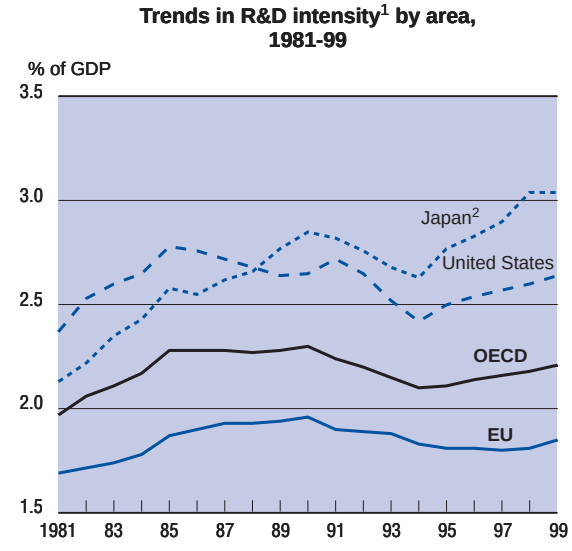
- Improvements in national surveys on R&D: this includes wider coverage of firms, particularly in the services sector (United States, 1992; Norway, 1987 and 1995; the Netherlands, 1994; Japan, 1995); and improved estimates of resources allocated to R&D by the higher education sector (Finland, 1991; Germany, 1987; Greece, 1989; Japan, 1996; the Netherlands, 1990; Spain, 1992).
- Improved international comparability: in Japan, R&D personnel data are expressed in full-time equivalents 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 by the higher education sector is not covered as of 1990 (this amounts to about 11% of that sector's expenditure in 1989); a similar change occurred in Sweden in 1995.
- Probable underestimation of R&D data for Korea (SSH excluded), the United States and Sweden (see Box A.5).

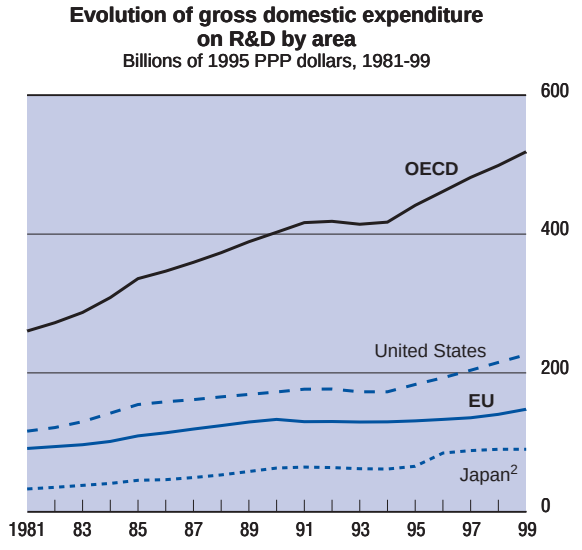
For more details, see Annex, Tables A.2.1.1. *and* A.2.1.2.

A.2. Trends in domestic R&D expenditure









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

Source: OECD, MSTI database, May 2001.

A.3. R&D financing and performance

- The business sector is the major source of financing of total domestic R&D (GERD). In 1999, it provided more than 60% of funding for domestic R&D carried out in OECD countries, a slight increase from 1990.
- The role of the business sector in funding R&D differs sharply across the three main regions. About 72% of R&D in Japan and 67% of R&D in the United States is funded by the business sector, compared with 55% in the European Union. During the 1990s, the share of business funding of R&D increased significantly in the United States; it remained stable in Japan and increased slightly in the European Union.
- At country level, the business sector's share of the funding of R&D declined significantly in Hungary and Austria. In Iceland, Ireland and Turkey, its share increased over the 1990s.
- During the 1990s, the increase in the share of business sector funding of R&D relative to GDP in the United States and the European Union was similar in size to the decrease in that of the government sector. This is partly due, particularly for the United States, to a decrease in defence R&D (see A.6.5.).
- In most countries, the role of government in funding R&D declined over the 1990s, Hungary and the Czech Republic being the main exceptions. However, government is still the major source of R&D funding in a third of all OECD countries.
- The business sector not only plays a major role in financing R&D, it also performs most R&D. The contribution of the business sector to the total R&D effort has increased since the mid-1990s and represents, according to the latest available data, about 70% of total R&D expenditure.
- Overall trends hide differences. In the United States, the share of R&D performed by the business sector increased 3 percentage points between 1991 and 1999. In the European Union and Japan, the business sector's contribution remained stable. The business sector's share also increased in Canada, Finland, Iceland, Ireland and Turkey.
- The higher education and government sectors account for around 28% of total R&D expenditure in the OECD area. Their combined share is double the OECD average in smaller countries, such as Greece, New Zealand and Portugal.

Sectors of R&D performance and funding

The R&D effort (expenditure and personnel) is usually broken down among four sectors of performance: business enterprises, higher education, government and private non-profit institutions serving households (PNP). This breakdown is based to a large extent 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.

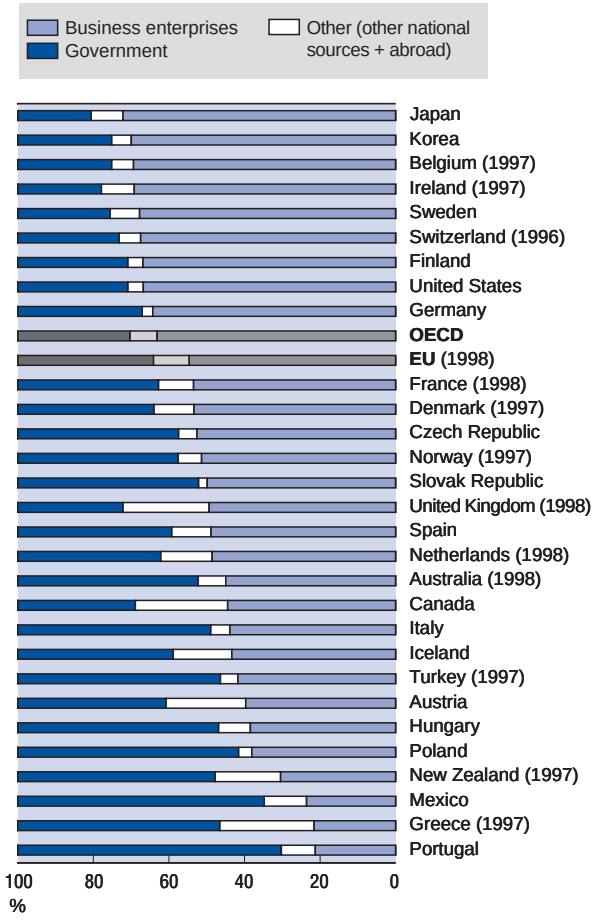
R&D has various sources of financing. Five sources are generally considered: the four R&D-performing sectors previously mentioned and funds from "abroad". Flows of funds are measured using performance-based reporting of the funds received by one unit, organisation or sector from another unit, organisation 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 the purposes of international comparisons, public general university funds (GUF) are included in the sub-total for government funds. These are the funds which higher education establishments allocate to R&D from the general grant they receive from the Ministry of Education or the corresponding provincial or local authorities in support of their overall research and teaching activities.

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). In addition, the role of the government and higher education sectors in Sweden and the United States is underestimated (in the United States, changes in methods reduced the government sector's contribution to higher education R&D by roughly 20% to 25% from 1990-91). 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.

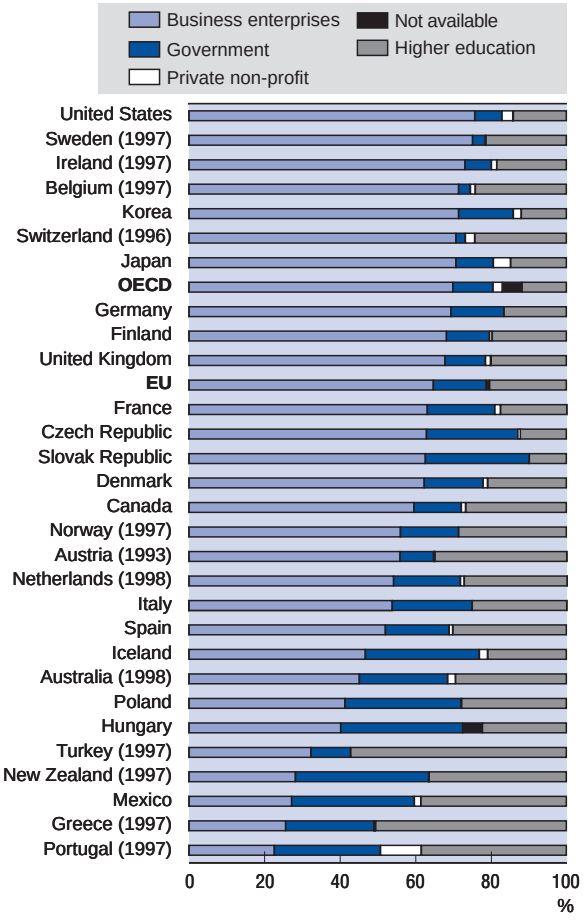
For more details, see Annex, Tables A.3.1, A.3.2, *and* A.3.3.

A.3. R&D financing and performance

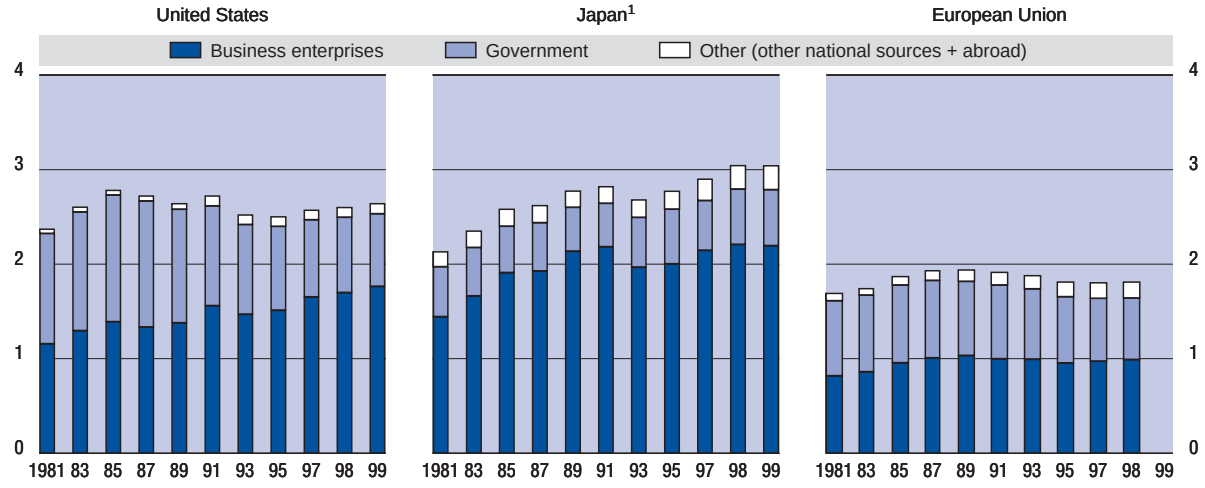
R&D expenditures by source of financing
Percentage share in national total, 1999



R&D expenditures by performing sector
Percentage share in national total, 1999



R&D expenditures as a percentage of GDP by source of financing, 1981-99



1. Data is adjusted up to 1995.
Source: OECD, MSTI database, May 2001.

A.4.1. Business R&D

- Business enterprise R&D accounts for the bulk of R&D activity within OECD countries, in terms of both performance and funding (see A.3). In 1999, R&D performed by the business sector in OECD countries amounted to about USD 387 billion (current USD PPP), or close to 70% of total R&D.
- In the OECD area, R&D performed by the business sector (in 1995 USD PPP) increased steadily over the past two decades. However, the pace of growth has picked up since the mid-1990s, mostly due to business R&D in the United States that increased by 3.7% annually between 1991 and 1999, compared with 2.2% in the European Union.
- In the three principal regions of the OECD, business R&D intensity (expenditure relative to domestic product of industry) increased steadily in the early 1980s and then declined in the early 1990s. It has been increasing again since the mid-1990s. The fluctuations are mostly due to divergences in the pace of growth of R&D expenditure and GDP.
- For Japan and the United States, business R&D intensity (about 2.4% each) is well above the OECD average (1.9%), whereas it is well below for the European Union (1.6%). For Finland and Sweden, however, business R&D intensity is significantly above the OECD average.
- Business enterprise R&D intensity increased continuously over the 1990s in the Nordic countries and Ireland but declined in the United Kingdom. In Germany and Italy, it declined in the early 1990s, but has been increasing since 1996-97.
- In the OECD area, annual average growth rates of business enterprise R&D over the 1991-99 period are highest for Mexico, smaller European countries and New Zealand. They are among the lowest for large European countries such as Germany, Italy and the United Kingdom.

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 the 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:

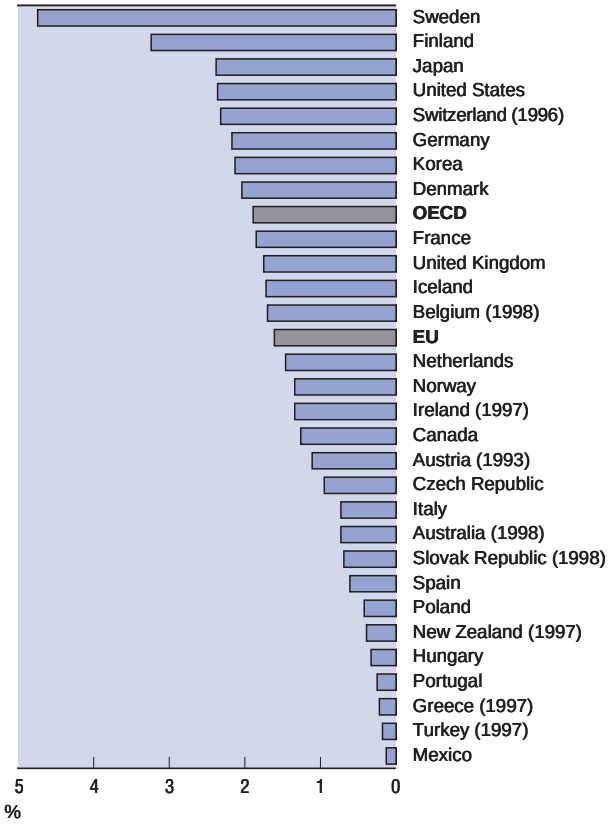
- All firms, organisations and institutions whose primary activity is the market production of goods and services for sale to the general public at an economically significant price.
- The private and non-profit institutes mainly serving them.

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.).

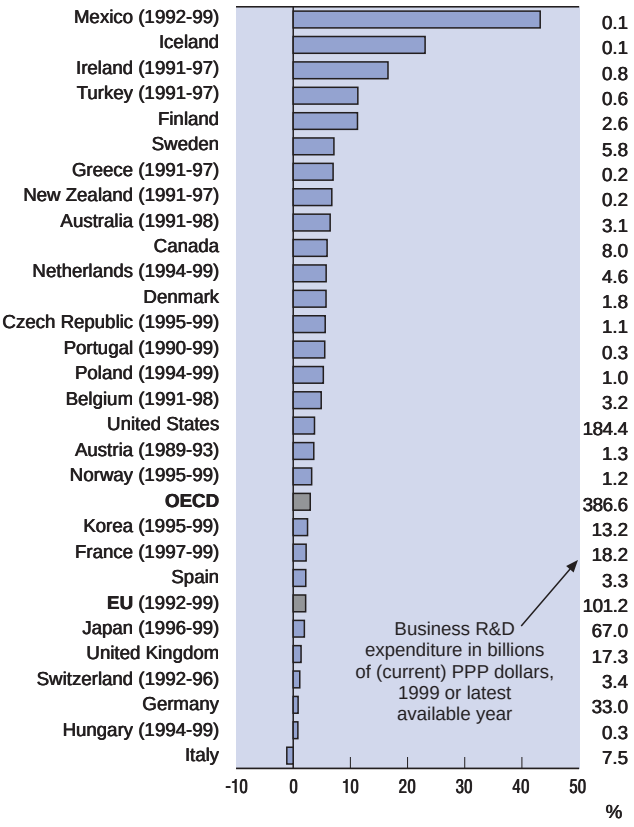
For more details, see Annex, Tables A.4.1.1. *and* A.4.1.2.

A.4.1. Business R&D

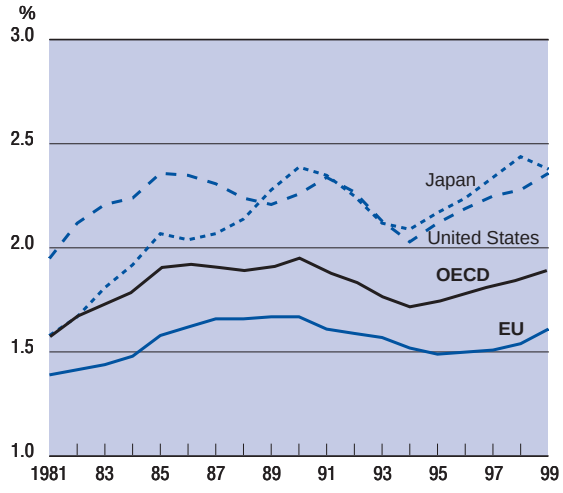
Business R&D intensity[1]
1999 or latest available year



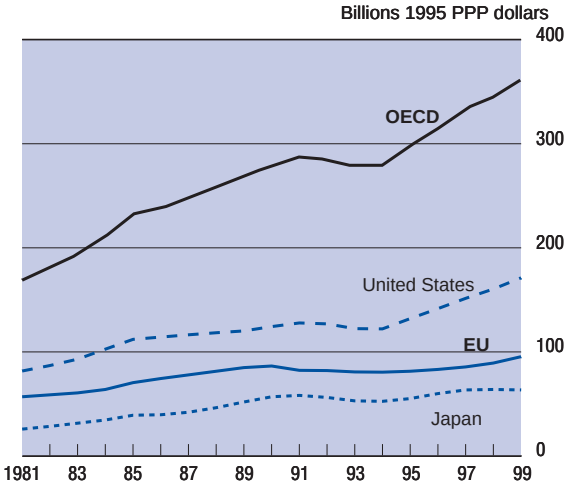
Business R&D, 1995 PPP[2] dollars
Average annual growth rate, 1991-99



Evolution of business R&D intensity,[1] 1981-99



Evolution of business R&D, 1981-99
Billions 1995 PPP[2] dollars



1. Business enterprise sector R&D expenditure as a percentage of domestic product of industry.
2. 1995 US dollars using purchasing power parities.

Source: OECD, MSTI database, May 2001.

A.4.2. Business R&D by industry

- The economic structure of OECD countries has moved towards services, which now accounts for the largest share of GDP in all countries, a share which continues to grow.
- Services have a much smaller share in R&D than in GDP. In 1998, they accounted for about 17% of total business sector R&D in the OECD area, an increase of 2 percentage points from 1992. Given the measurement difficulties associated with services, this share is a lower bound and is in fact much higher (double) in some countries that have undertaken special measurement efforts in this area.
- Almost half (48%) of total business R&D in Norway is carried out in the services sector. Denmark (37%) and the United States (31%) are the only two other countries where services sector R&D represents more than 30% of total business R&D. 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, France and Japan, these countries still have the lowest share of services R&D (less than 10%). This may partly be due to limited coverage of the services industries in their R&D surveys.
- For all countries except the Czech Republic, the average annual growth rates for R&D were higher in services than in manufacturing over the 1990s. The most notable difference in R&D growth rates for the two sectors was in the Netherlands. Between 1991 and 1998, Dutch R&D in services increased by about 18.5% a year, but in manufacturing it increased only by 1.2%.
- Manufacturing industries are grouped according to their R&D intensity in four categories: high, medium-high, medium-low and low technology (see D.5).
- Within the OECD area, high-technology industries account for more than 50% 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 hand. In 1999, high-technology industries accounted for 60% of total manufacturing R&D in the United States, compared to 46% and 43% in the European Union and Japan, respectively.
- Manufacturing R&D expenditure in Canada, Ireland, Finland is skewed towards high-technology industries, while in the Czech Republic, Poland and Germany, medium-high-technology industries account for 60% or more.

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 this sector. In the process, however, certain methodological issues have emerged which still 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 which overcomes problems of international comparability and the temporal discontinuities associated with the official BERD data provided to the OECD by its Member countries.

For the definition of industries, see D.5 and Annex 1.

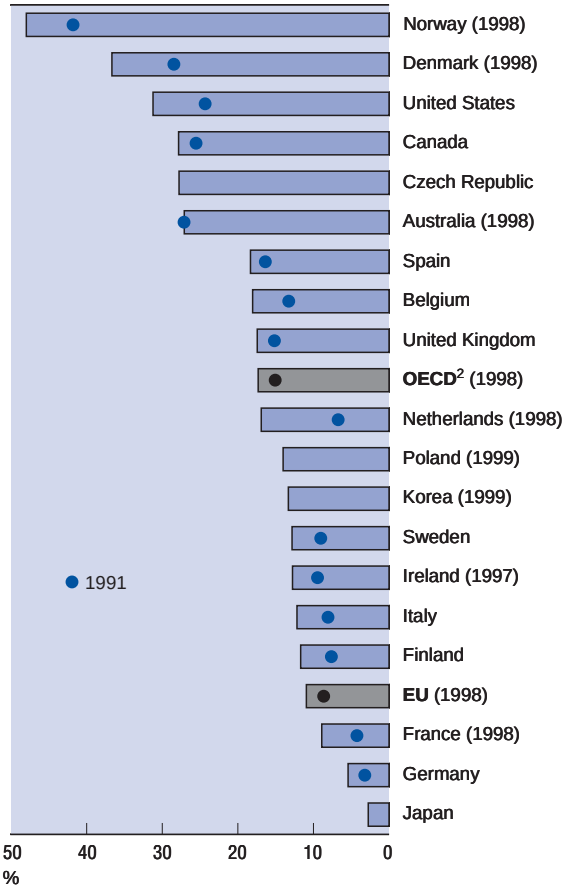
The current ANBERD database covers 19 OECD Member countries and 58 sectors and has greater coverage of services. The data are based on ISIC, Rev. 3 as from 1987. The ANBERD data are estimated by the OECD based on official data supplied by national statistical authorities. Although the OECD has attempted 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*, Paris, 2001 (forthcoming).

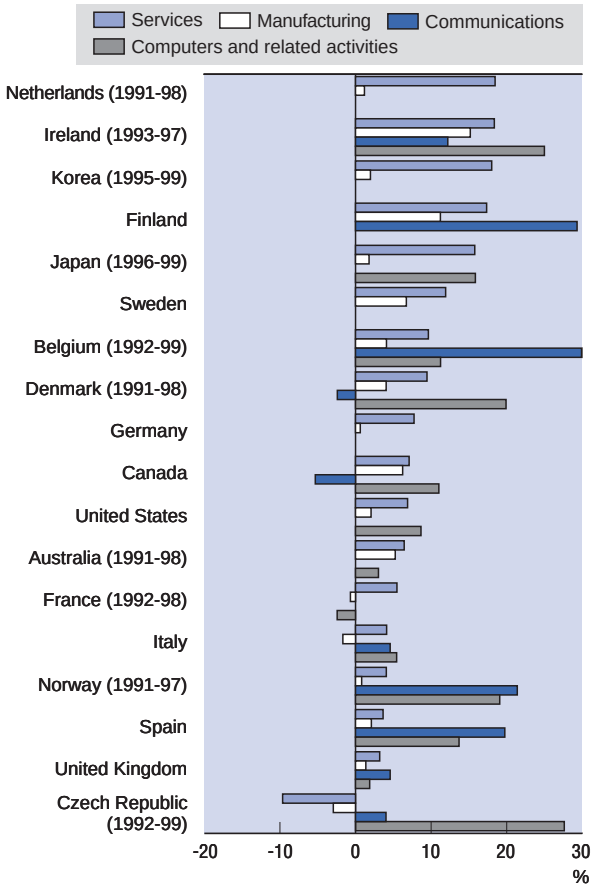
For more details, see Annex, Tables A.4.2.1 *and* A.4.2.2.

A.4.2. Business R&D by industry

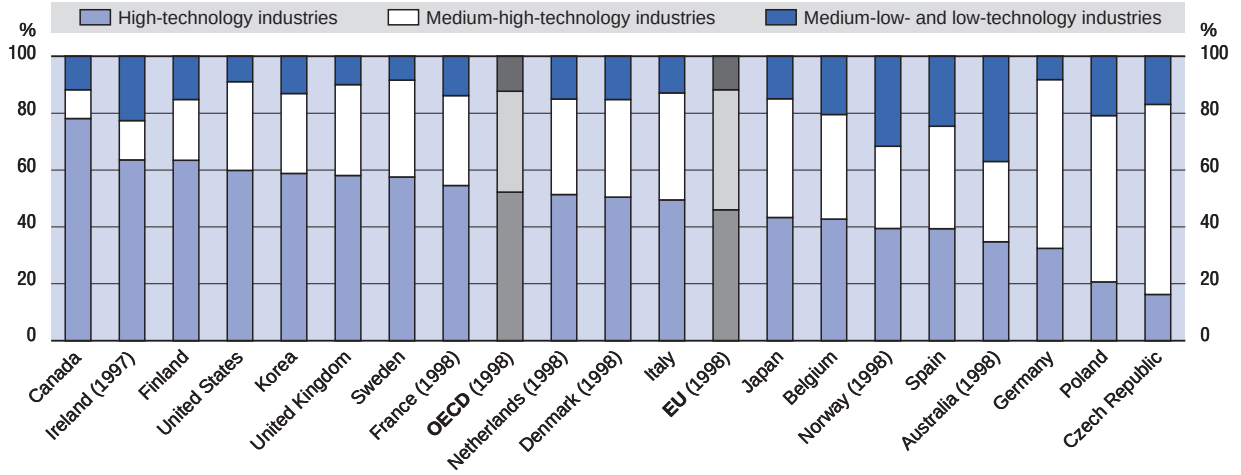
Share of services in business R&D,[1] 1999



R&D growth in selected services industries and manufacturing sector
Average annual growth rate 1991-99



Share of business R&D in manufacturing sector by technology intensity, 1999



1. Share of services in total services and manufacturing industries.
2. Excluding Ireland, Korea and Poland.

Source: OECD, ANBERD database, May 2001.

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

- Data for 19 OECD countries show that, in 1998, business R&D expenditure for information and communication technology (ICT) manufacturing was approximately USD 96 billion (current PPP dollars), while for the ICT services industries, data for 14 OECD countries show expenditure of USD 21 billion.
- In countries with data for both manufacturing and services industries, ICT-related R&D expenditure generally expanded much more rapidly in the services industries during the 1990s.
- The ratio of R&D expenditure by ICT industries to GDP or to the total business enterprise R&D can indicate the R&D specialisation of ICT industries. Small OECD countries such as Finland, Korea and Sweden are relatively more specialised than the large ones in both ICT manufacturing and services. Finland was the only country to allocate more than 1% of GDP to ICT-related manufacturing R&D expenditure in 1998.
- ICT-related R&D intensities of the large European economies are well below those of the United States and Japan. Over the 1990s, the United Kingdom is the only large European country where ICT-related R&D increased slightly in manufacturing and services industries (by 1% and 3% a year, respectively). In manufacturing, ICT-related R&D decreased in Germany, France and Italy by 1%, 2% and 0.5%, respectively.
- The trend of the output indicator (patents) of ICT-related industries is similar to that of the input indicator (R&D expenditure). During the 1990s, ICT patents grew at 8% in the OECD area, 3 percentage points above total patent applications (5%). In 1997, ICT patents represented about 13% of total OECD patent applications.
- ICT patents increased much more rapidly in the European Union and the United States than in Japan over the 1990s, at 13%, 8% and 1%, respectively. Shares of ICT patents are higher in Japan and the United States than in the European Union; in 1997, about one in five Japanese patent applications were for ICT, compared to about one in ten for the European Union.
- Shares of ICT patents are high in smaller OECD countries, such as Finland and Korea (which also have high ICT R&D expenditure). ICT patents have also increased much more rapidly in Norway, Sweden and Finland than in larger countries.

Measuring R&D expenditure in selected ICT industries

Data for the selected ICT industries reported here are different from those reported in other OECD publications (such as *Measuring the* ICT *Sector*, OECD, 2000), because of differences in industry coverage. Hence, R&D figures for ICT industries should not be compared to those for ICT sector R&D. For the definition of the ICT sector, see Box B.7.1.

The definition of the ICT sector is largely based at the 4-digit level; however, data on R&D expenditure at the 4-digit level are scarce. Therefore, the ICT R&D indicators reported here are calculated at the 2-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).

Patent counts are one measure of innovative output (for more information, see Boxes A.12.1 and A.12.2). ICT patents include patents from any of the following classes of the International Patent Classification (IPC): computing, calculating and counting (G06); information storage (G11); and electric communication technique (H04). Patent data reported here are based on patent applications filed at the European Patent Office (EPO).

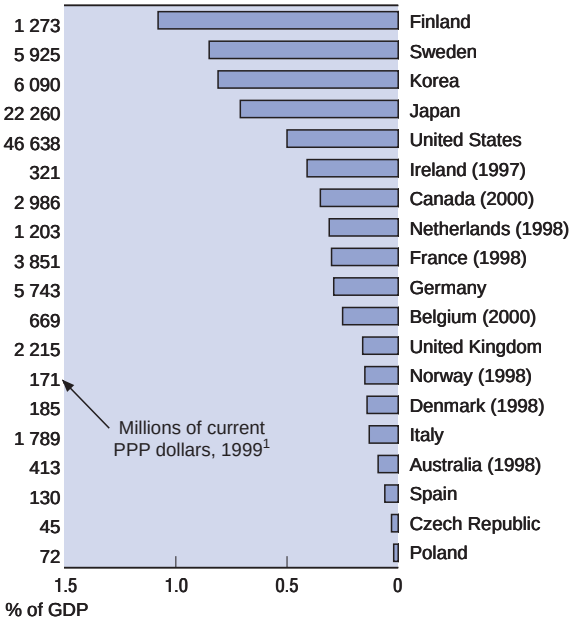
Data for R&D expenditure by the selected ICT industries are from OECD's ANBERD database, which is closer to product field than to enterprise level. ANBERD data are estimated by the OECD on the basis of official business enterprise R&D data (OFFBERD), and the ANBERD data may differ significantly from the official data.

For further information see *Research and Development Expenditure in Industry*, OECD, Paris, 2001.

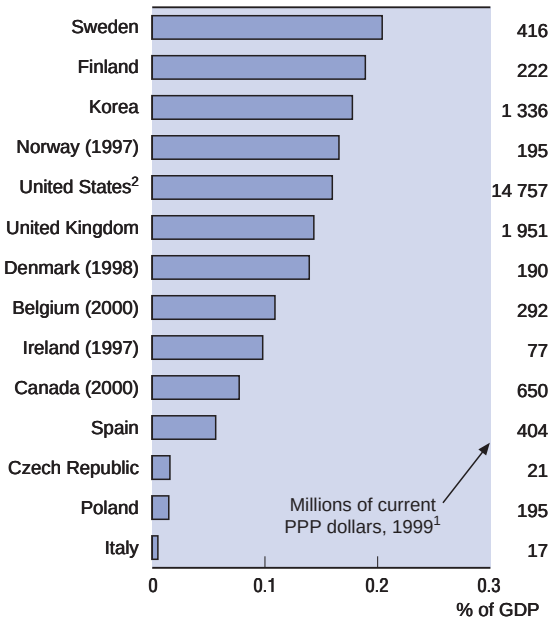
For more details, see Annex, *Tables* A.4.3.1 *and* A.4.3.2.

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

Business R&D expenditure by selected ICT manufacturing industries, 1999[1]
Percentage of GDP



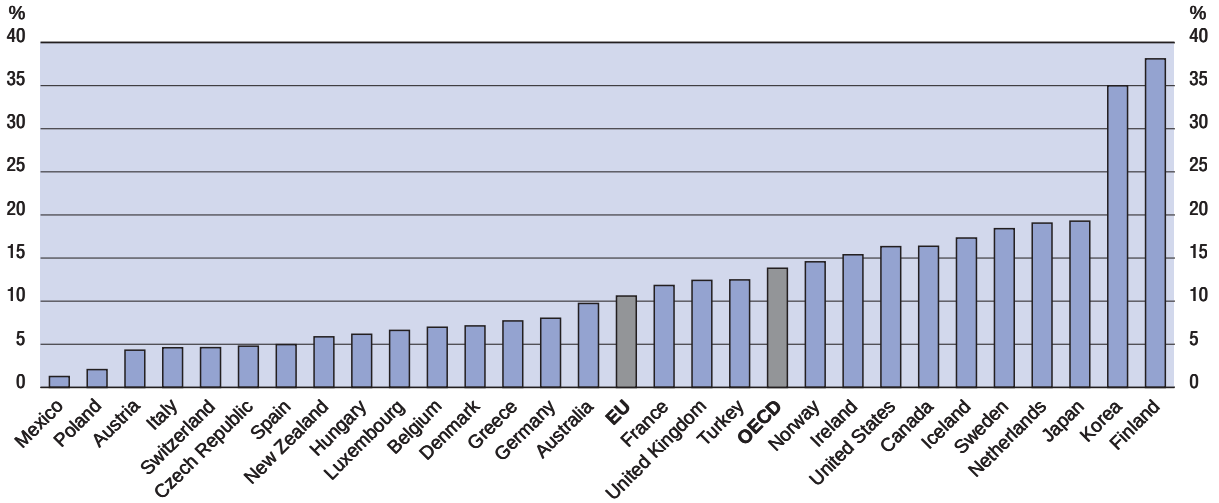
Business R&D expenditure by selected ICT services industries, 1991[1]
Percentage of GDP



1. 1999 or latest available year.
2. Due to unavailability of R&D data for division 64, class 642 (Telecommunication) is included as a proxy. Available information shows that in the United States class 642 accounts for about 97-98% of division 64 total.

Source: OECD, ANBERD database, May 2001.

ICT[1] patents as a percentage of total national patents filed at the EPO,[2] for priority year 1997



1. Classes of International Patent Classification: G06, G11 and H04.
2. European Patent Office.

Source: OECD, Patent database, May 2001.

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 in business R&D varies across OECD countries. The share of R&D performed by small and medium-sized enterprises (SMEs) (defined here as firms with fewer than 500 employees) is generally higher in smaller economies than in larger ones (with the exception of Korea and Sweden).
- Firms with fewer than 500 employees account for the bulk of business R&D in Norway (55%), Poland (62%), Portugal (67%) and Iceland (95%). In the United States and the European Union the share is about 20%. The OECD area average is 18%. In Japan, SMEs account for only 7% of business R&D.
- The smallest category of firms, with fewer than 100 employees, also accounts for a significant share of business R&D. They account for more than a quarter in Iceland, Australia, Norway and Portugal.
- Government-financed business R&D in OECD countries such as Australia, Switzerland and Poland is mainly targeted to firms with fewer than 500 employees. In large countries, such as the United States, France, Germany and the United Kingdom, government-financed business R&D is mainly aimed at firms with over 500 employees. The strong focus on large firms is mainly seen in countries with high defence spending.

R&D data by size class of firms

The importance of small firms in innovation is increasingly recognised. They are a source of constant renewal of technology, of technological breakthroughs and of competitive pressures for large incumbents, 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. At the same time, SMEs face specific problems for innovating and for adopting new technologies (access to funds, to markets, to skilled labour). Moreover, it is often argued that public policies are biased against SMEs and that this justifies "counter-measures" in their favour. This is of particular concern to policy makers.

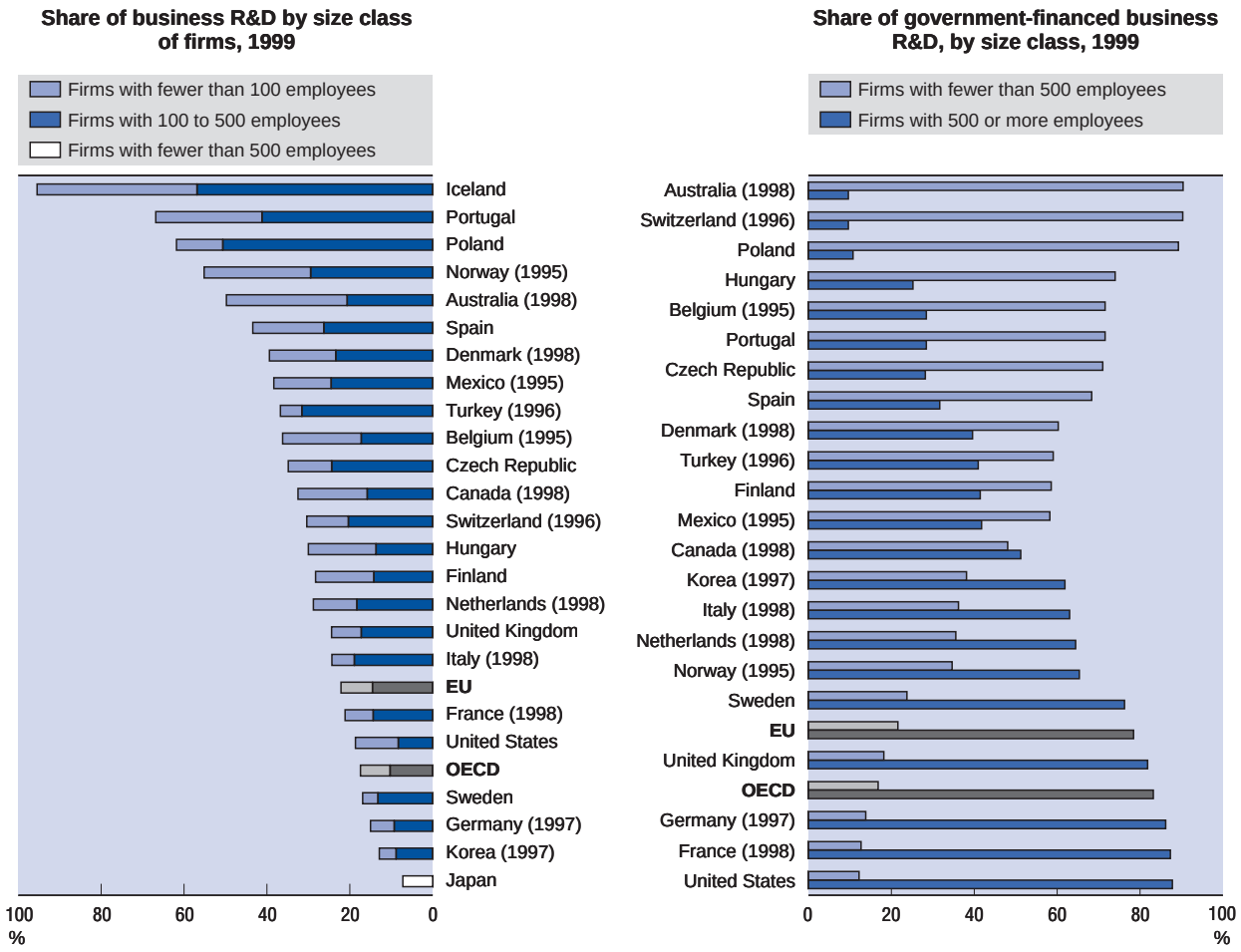
On the other hand, the role of large firms must not be ignored: they play a leading role in structuring markets, carrying out large-scale innovations, and even in co-ordinating smaller firms. The respective and complementary roles of small and large firms may vary across industries and across countries. 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 for the Meeting of the Committee for Scientific and Technological Policy (CSTP) at Ministerial level held in June 1999 and again in May 2001 for this publication. To compare the countries by size class, the data had to be aggregated according to two categories: fewer than 500 and 500 or more employees, as countries had not broken the data into identical size classes. Unfortunately, it was not possible to use all the data made available by Member countries.

These data make it possible to discern whether government support is biased towards larger firms. It appears that this is the case particularly in countries with large defence budgets. More detailed information by firm size would make possible a better representation of the situation in OECD Member countries.

For more details, see Annex, Tables A.4.4.1 *and* A.4.4.2.

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



Source: OECD, STI/EAS Division, May 2001.

A.4.5. Collaborative efforts between business and the public sector

- Collaboration between business and non-business entities is becoming more common. Businesses are eager to exploit research undertaken by the higher education and government sectors, the higher education sector is interested in obtaining funding for current and future research activities by commercialising its research efforts and governments look to alliances that ensure that the economy benefits from public research.
- The share of R&D performed by the higher education and government sectors and funded by the business sector is increasing but is still small. Within the OECD area, the business sector funded 6.1% and 4.1% of higher education and government research, respectively, in 1998.
- Business funding of higher education research in the United States and the European Union is close to the OECD average. For Japan, the share is less than half of the OECD average.
- For most OECD countries, business funds more government research than higher education research. However, in the United States, there is no business funding of government research. In the European Union, the shares of business funding for the higher education (49%) and government (51%) sectors are similar. In Turkey, Germany, Canada and Greece, the higher education sector performs more than three-quarters of the research funded by business in the higher education and government sectors.
- For some countries, innovation surveys include a question on firms with co-operation arrangements (of any type) for innovation with higher education or government institutes. Firms with such arrangements account for around 10% of total employees, except in the Nordic countries where the share is significantly higher. Moreover, such arrangements are more common for large firms than for smaller ones.

Collaborative efforts between business and the public sector

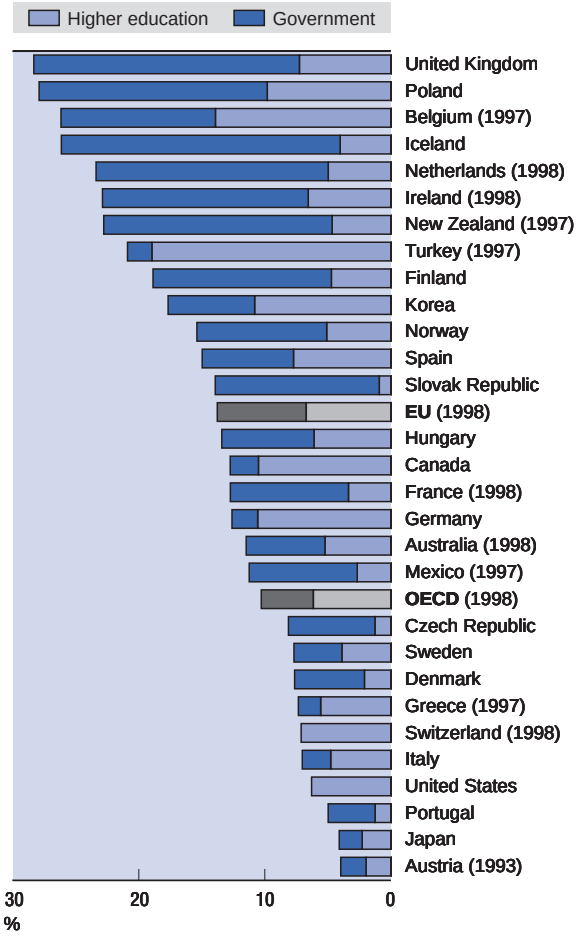
One way of measuring private and public sector co-operation on R&D is to show business funding of R&D performed in the higher education and government sectors. Certain kinds of business funding, such as charge-free provision of machinery or use of experimental facilities, are not taken into consideration here; the figures relating to co-operation between business and higher education are therefore underestimated.

Innovation surveys also provide an indication of R&D collaborative efforts (see Box A.11). In the context of innovation surveys, co-operation is interpreted more restrictively: it means active participation in joint R&D and other innovation projects with other organisations. It does not necessarily imply that both partners derive immediate commercial benefit from the venture. Pure outsourcing, where there is no active participation, is not regarded as co-operation. In the survey question on co-operation agreements, respondents are asked to break down these agreements by type of partner organisation (universities and other higher education establishments, public institutions, private non-profit institutions, etc.) and by country of residence of the partner.

For more details, see Annex, Table A.4.5.

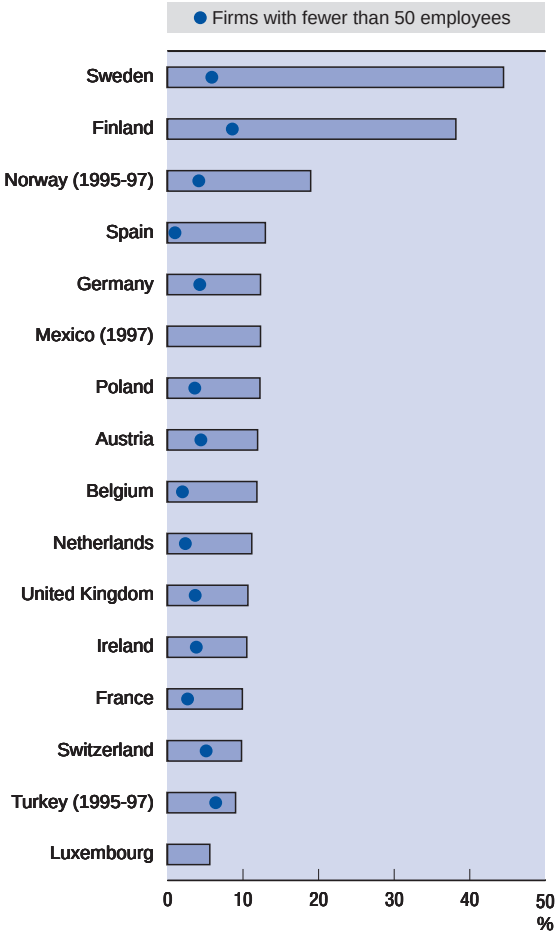
A.4.5. Collaborative efforts between business and the public sector

Share of business in the funding of research performed by government and higher education
1999



Source: OECD, R&D database, May 2001.

Share of firms with co-operation arrangements with government or higher education institute[1]
1994-96



1. Weighted by the number of employees.

Source: Eurostat, May 1999 and OECD, STI/EAS Division, May 2001.

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

- In the OECD area, R&D performed by the higher education sector represents about 0.4% of GDP; northern European countries and Switzerland exceed the average. The higher education sector performs about 17% of total domestic R&D in the OECD area (see A.3).
- The higher education sector has slightly over 15 researchers per 10 000 labour force, but employs more than 25% of the research workforce. These shares are influenced by underestimates for the United States (see box); they are much larger in more than half of the OECD countries, notably those with low industrial research intensity.
- In Mexico, Greece, Turkey and Portugal, R&D performed by the higher education sector (relative to GDP) is below the OECD average. Nonetheless, this sector performs a significant proportion of their total R&D (see A.3).
- In the main OECD regions, R&D performed by the higher education sector increased modestly over the 1990s (in constant prices), although it levelled off at the end of the period. Since the mid-1990s, however, it has been stable relative to GDP in the European Union, decreased slightly in the United States (where GDP has increased more rapidly) and increased significantly in Japan (where GDP has stagnated since 1997).
- Government performance of R&D has declined over the last decade. It accounted for 0.28% of GDP in 1991 and only 0.23% in 1999. This pattern is observed for France, Italy, the United Kingdom and the United States, where it is due to a decrease in defence spending (see Box A.6.5) and transfers of public agencies to the private sector (see box below). Japan is the only large OECD country where R&D performed by the government sector increased, from 0.23% to 0.30% of GDP between 1991 and 1999.
- The government sector accounts for one-tenth of total R&D performed in the OECD area. However, it tends to conduct around three times that in New Zealand, Mexico, Hungary, Poland and Iceland. In the Slovak Republic, the Czech Republic, Hungary, and Iceland, the government sector performs more R&D (relative to GDP) than the higher education sector.

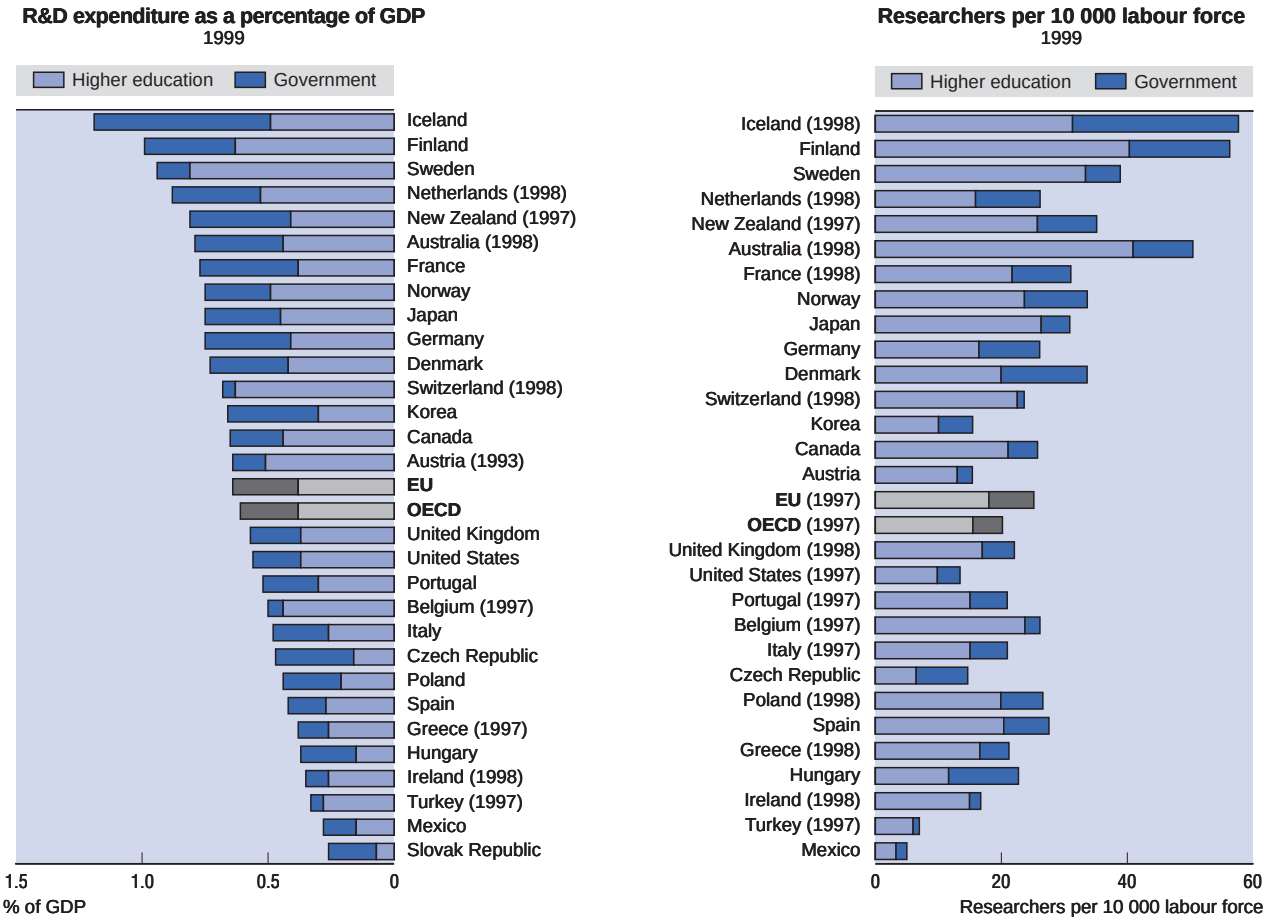
Measuring R&D performance in the government and higher education sectors

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

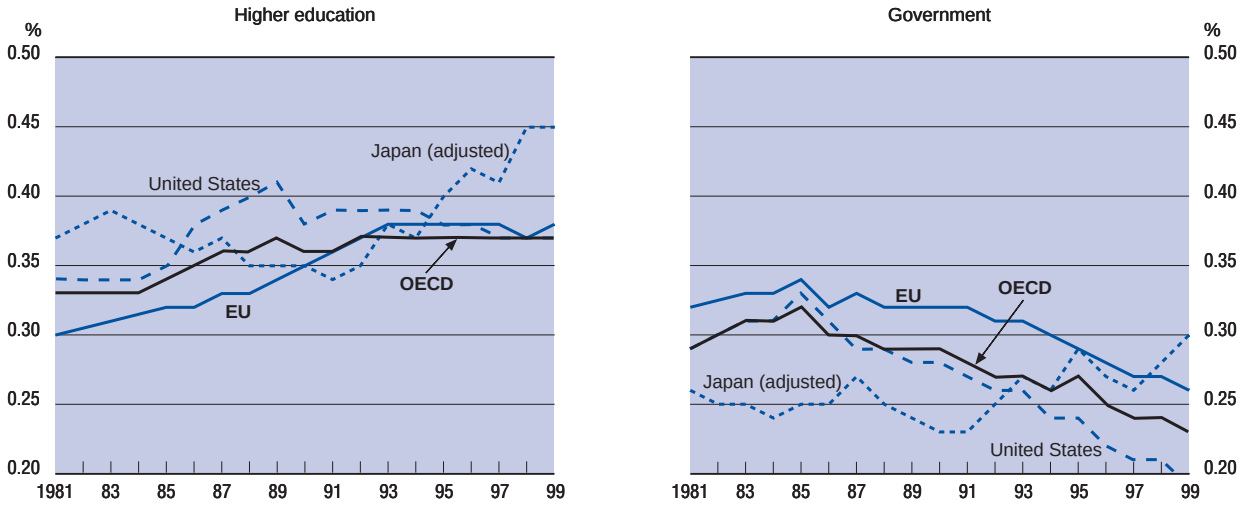
- Figures for the government and higher education sectors in the United States are probably underestimated, as public sector R&D only covers federal government activities, not those of individual states and local government, and researchers exclude military personnel in the government sector since 1985. 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 in terms of 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 of the overestimation of the number of researchers, the figures for R&D personnel costs are also overestimated before 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.5.1.2.

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



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



Source: OECD, R&D and MSTI databases, May 2001.

A.6.1. Public funding of biotechnology R&D and biotechnology patents

- Owing to scientific advances in areas such as genomics and genetic engineering, research in biotechnology is receiving considerable attention in OECD countries. Internationally comparable data on biotechnology R&D are extremely limited, so that it is difficult to measure its extent (see box). The data presented here give only a partial picture for the OECD area, as it is not yet possible to include the United States and Japan, countries that invest quite heavily in biotechnology R&D.
- Data on government budget appropriations or outlays on R&D (GBAORD) indicate the relative importance of biotechnology funding in individual OECD Member countries. In 1997, public funding of biotechnology R&D amounted to approximately USD 3.4 billion (PPP dollars). Germany, the United Kingdom and France accounted for two-thirds of this.
- Biotechnology R&D relative to GBAORD varies widely across countries. Belgium has the highest ratio of biotechnology R&D to GBAORD (14%). In terms of absolute numbers, public funding for biotechnology is highest in Germany, however, as a ratio of GBAORD, its biotechnology R&D is only half that of Belgium.
- Growth in biotechnology patents in the OECD area has been much more rapid than growth in overall patent applications. During the 1990s, the growth rate of biotechnology patents (10%) was double that of total patent applications (5%).
- Most biotechnology patents originate from the United States rather than from the European Union or Japan. In 1997, biotechnology patents accounted for about 6% of all US patents, compared to about 3% and 2% for the European Union and Japan respectively. The United States ranks fourth in the OECD area for the share of biotechnology patents relative to total patents, although it accounts for 50% of all OECD-area biotechnology patents.
- Shares of biotechnology-related patents are high in Denmark and Canada, where close to one in ten patents is biotechnology-related. Shares of biotechnology patents are also relatively high in Portugal and Slovak Republic, but it should be noted that their overall number of patents is small relative to that of other countries.

Measuring biotechnology R&D and patents

Because of limited internationally comparable data on biotechnology R&D in OECD countries, the OECD is undertaking to develop a statistical definition of the biotechnology sector with a view to collecting internationally comparable data on this area. In the second *ad hoc* meeting on biotechnology statistics held in Paris in 2001, a "provisional" single definition and a list-based definition of biotechnology were adopted.

The "provisional" definition of biotechnology is as follows: "The application of science and technology (S&T) to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services."

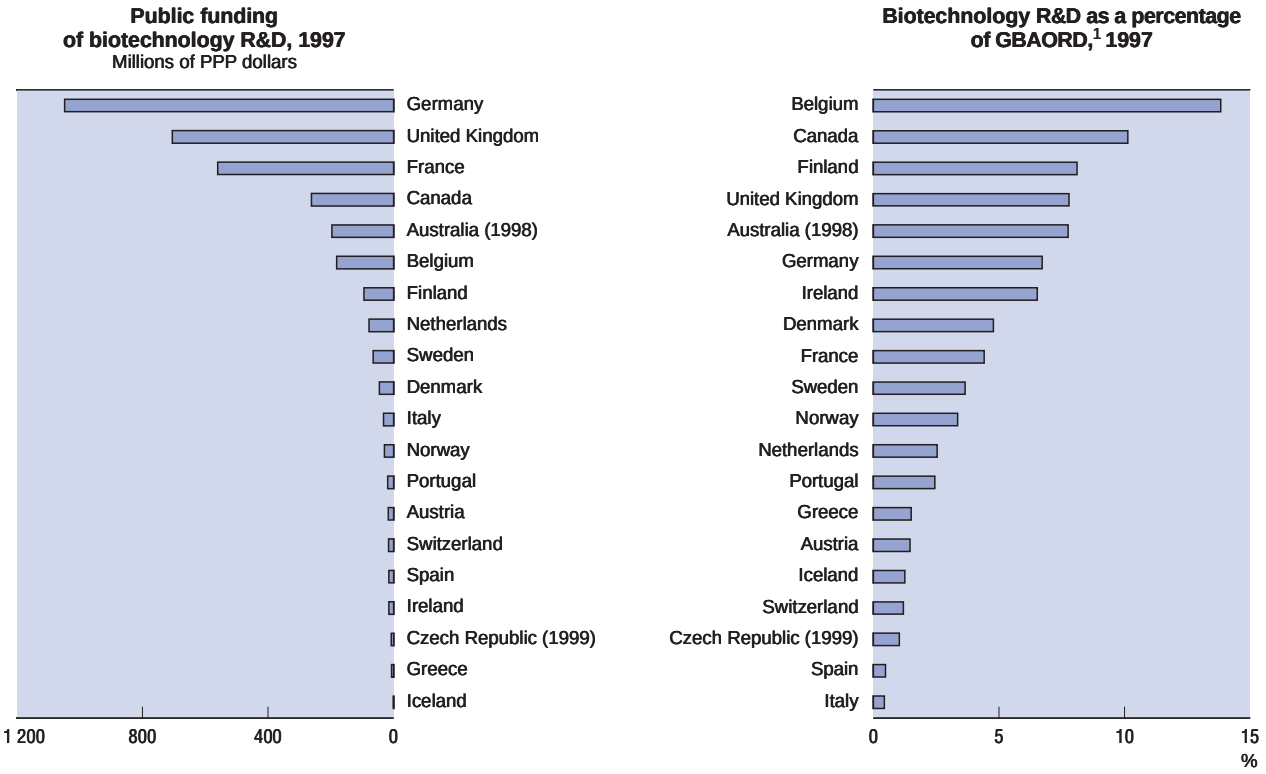
The list-based definition includes the following five categories: *a*) DNA (the coding): genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering; *b*) Proteins and molecules (the functional blocks): protein/peptide sequencing/synthesis, lipid/protein engineering, proteomics, hormones and growth factors, cell receptors/signalling/pheromones; *c*) Cell and tissue culture and engineering: cell/tissue culture, tissue engineering, hybridisation, cellular fusion, vaccine/immune stimulants, embryo manipulation; *d*) Process biotechnology: bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurisation, bioremediation and biofiltration; *e*) Sub-cellular organisms: gene therapy, viral vectors.

Biotechnology patents include patents from the following International Patent Classification technology classes: C12M (Apparatus for enzymology or microbiology); C12N (Micro-organisms or enzymes; propagating, preserving, or maintaining micro-organisms; mutation or genetic engineering; culture media); C12P (Fermentation or enzyme-using processes to synthesise a desired chemical compound or composition or to separate optical isomers from a racemic mixture); C12Q (Measuring or testing processes involving enzymes or micro-organisms; compositions or test papers therefor; processes of preparing such compositions; condition-responsive control in microbiological or enzymological processes); C12S (Processes using enzymes or micro-organisms to liberate, separate or purify a pre-existing compound or composition; processes using enzymes or micro-organisms to treat textiles or to clean solid surfaces of materials).

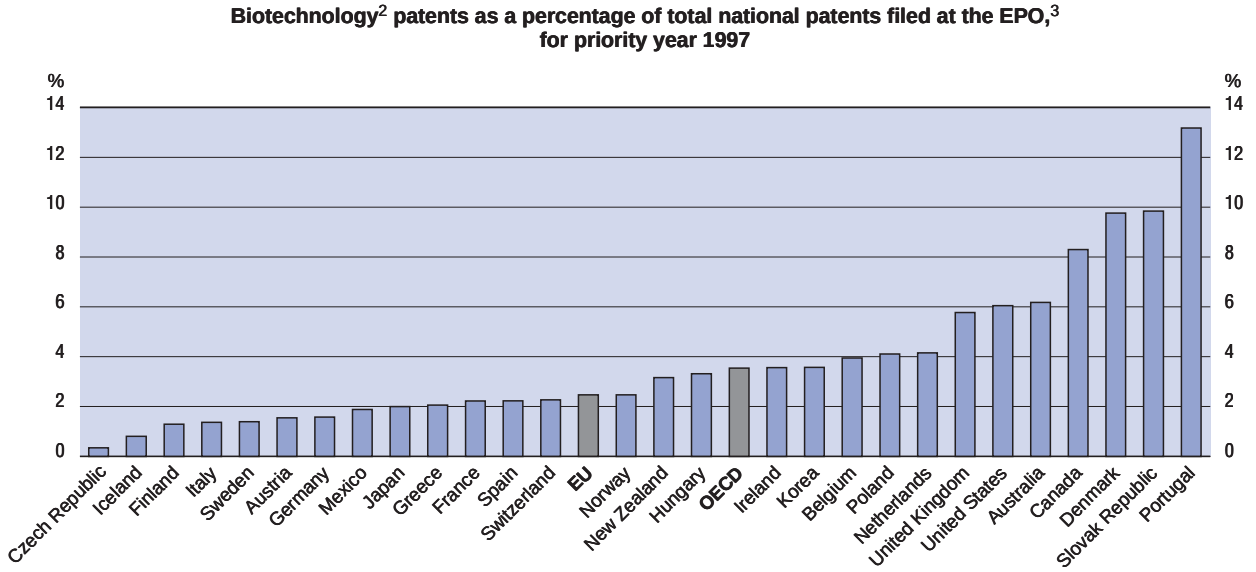
For further information on the availability of biotechnology statistics, see OECD, "Biotechnology Statistics in the OECD Member Countries: Compendium of Existing National Statistics", STI Working Paper, forthcoming, 2001.

For more details, see Annex, Tables A.6.1.1 *and* A.6.1.2.

A.6.1. Public funding of biotechnology R&D and biotechnology patents



Source: OECD, based on data from the European Commission *(Inventory of Public Biotechnology R&D Programmes in Europe, 2000)*, Eurostat, Statistics Canada, and national sources, May 2001.



1. Government budget appropriations or outlays for R&D.
2. Classes of International Patent Classification: C12M, C12N, C12P, C12Q and C12S.
3. European Patent Office.

Source: OECD, Patent database, May 2001

A.6.2. Environmental R&D in the government budget

- During the 1990s, the protection of the environment has risen considerably on the political agenda of most OECD governments. One way to measure the extent to which countries allocate resources to environmental protection is to look at government support for environmental R&D programmes (see box).
- In 1998, USD 2.9 billion (in current PPP dollars) were allocated to environment programmes in the OECD area. This amounted to 2.5% of civil government budget appropriations or outlays for R&D (GBAORD). European Union countries represented about two-thirds of the OECD total, a share that has remained stable over the past decade. Of the three major economic zones, Japan had the largest increase in its environmental R&D budget, at 10% a year over the period 1991-99, whereas the increase was a little over 2% in Europe and less than 1% in the United States.
- While the share of government support for environmental R&D relative to civil GBAORD increased in Japan during the 1990s, it still only allocated 0.75% of its R&D budget for the environment in 1999. In the European Union, support for environmental R&D in the government budgets of the United Kingdom, Germany and Italy was over 3% of the civil budget in 1998/99.
- Portugal, Canada and the Netherlands are the only three countries that allocate more than 4% of civil GBAORD to environmental R&D. During the 1990s, the environmental R&D budget in Iceland, Portugal, Greece, Ireland and Canada increased by more than 10% annually.

Measuring government support for environmental R&D

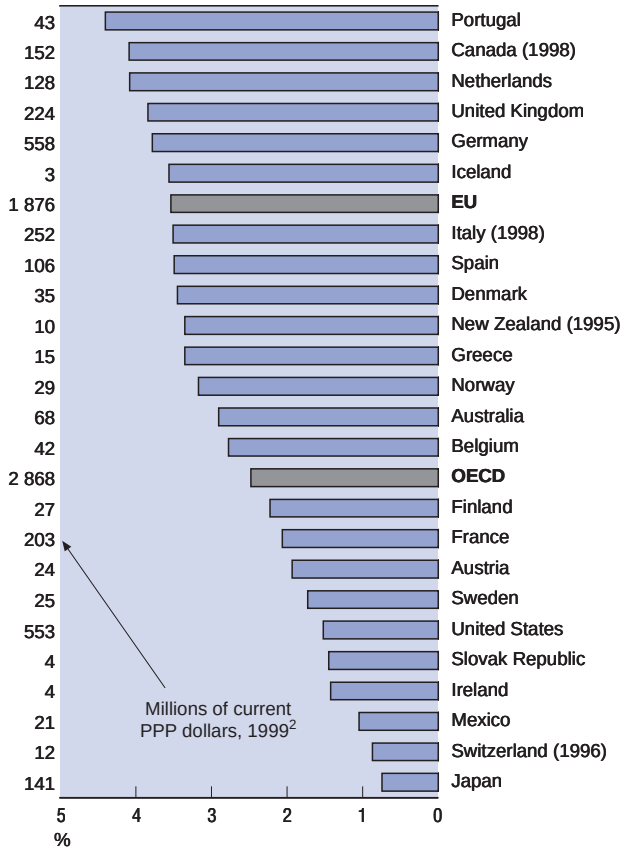
The vast majority of OECD countries report Government Budget Appropriations or Outlays for R&D (GBAORD) broken down by main socio-economic objectives. The environmental R&D budget falls under Chapter 5 (Control and Care of the Environment) of the socio-economic objectives, which covers R&D budgets directed towards an "undestroyed" physical environment. It includes pollution in or due to air, water, soil and substrata, noise, solid waste disposal, and radiation (see OECD, *Frascati Manual*, 1994).

Environmental R&D data based on GBAORD only provide a partial picture. They include budget allocations to programmes where environmental R&D is the prime purpose but not those for which environmental programmes are a secondary purpose. Hence, data based on GBAORD Chapter 5 may underestimate the overall government effort in environmental R&D. For general information about GBAORD budget data, see boxes A.6.3 and A.6.5.

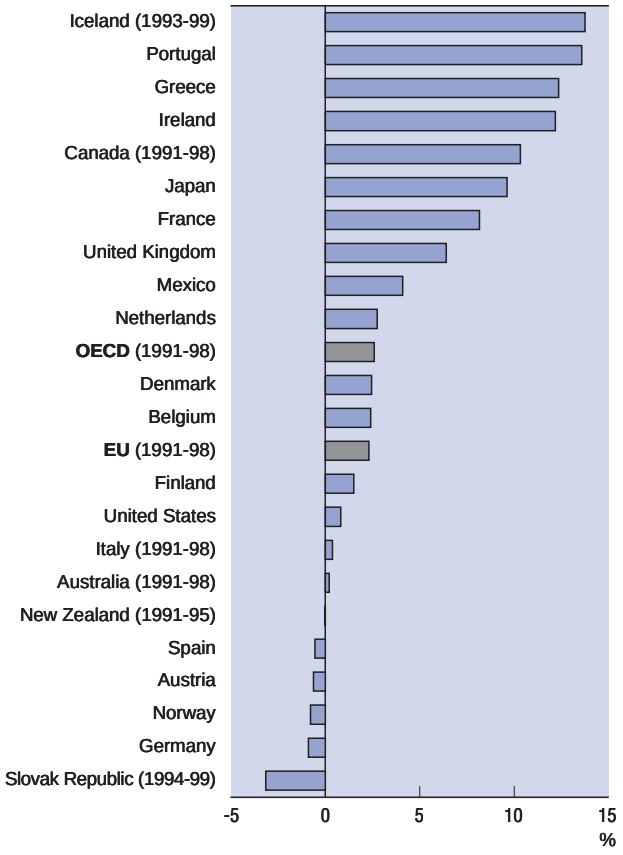
For more details, see Annex, Table A.6.2.

A.6.2. Environmental R&D in the government budget

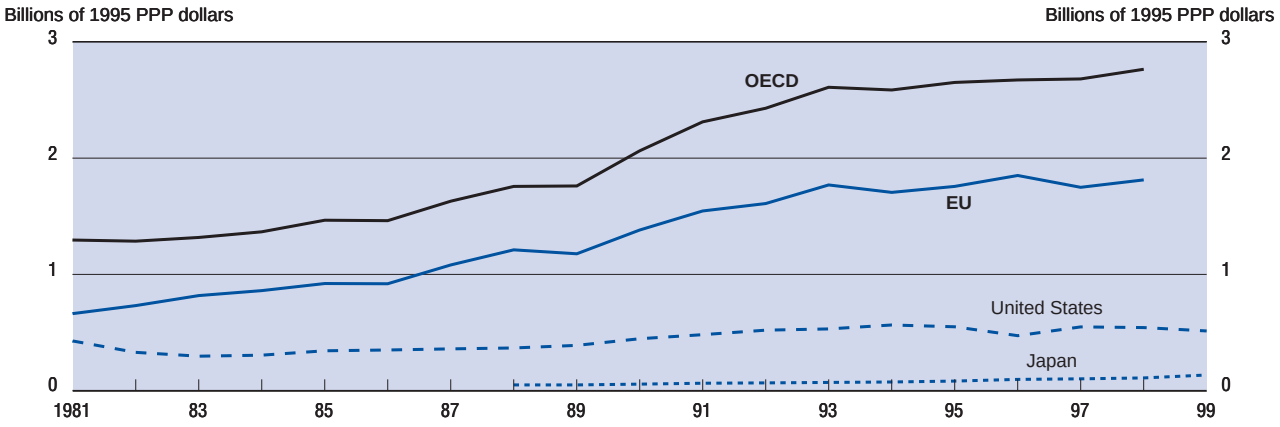
Environmental R&D in the government budget as a percentage of civil GBAORD[1]
1999



Change in environmental R&D in the government budget (GBAORD)[1]
Annual average growth 1991-99[3]



Environmental R&D in the government budget by area
1981-99, in constant prices



1. Government budget appropriations or outlays for R&D.
2. 1999 or latest available year.
3. 1991-99 or closest available years.

Source: OECD, R&D database, May 2001.

A.6.3. 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 1998, government support for health-related R&D (based on government budget appropriations for R&D-GBAORD) in OECD countries was about USD 19 billion (in current PPP US dollars), or approximately 0.1% of their combined GDP.
- Compared to the European Union and Japan, government support for health R&D is high in the United States. In 2000, it represented about 0.2% of GDP, far above the levels for the European Union (0.05% in 1998) and Japan (0.03%). During the 1990s, the growth rate of government support for health-related R&D in Japan (10%) was about double that in the United States (5.5%) and the European Union (5%).
- When data from additional GBAORD categories are used to adjust for some of the institutional differences as regards 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 Finland, Austria and the Netherlands. The difference in government support for health R&D between the United States and the European Union also narrows sharply.
- Another indicator often used as a proxy to measure health-related R&D is R&D expenditure by the pharmaceutical industry. In 1999, it represented close to 0.47% of GDP in Sweden, a significant increase from 1991 (0.25%). It was also high in the United Kingdom (0.29%), Belgium (0.25%) and Denmark (0.24).
- The share of pharmaceutical R&D in business sector R&D is high in the United Kingdom and Denmark. Pharmaceuticals account for approximately 20% of total business R&D expenditure. While the ratio of pharmaceutical R&D to GDP is low in Italy and Spain, this sector accounts for a significant share of total business R&D in both countries.

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 objective (SEO) such as health (excluding pollution), where it is defined as:

- "This category covers R&D programmes directed towards the protection and improvement of human health. It includes R&D on food hygiene and nutrition; radiation used for medical purposes, biochemical engineering; medical information; rationalisation of treatment and pharmacology (including the testing of medicines and the breeding of laboratory animals for scientific purposes), as well as research relating to epidemiology, prevention of industrial diseases and drug addiction." (Frascati Manual, OECD, 1994.)

The health category in GBAORD is used here as a proxy for total central government funding of health R&D. However, it should be borne in mind that the health category of GBAORD only covers programmes for which health is the primary objective. Furthermore, classification of funding of programmes and institutions 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).

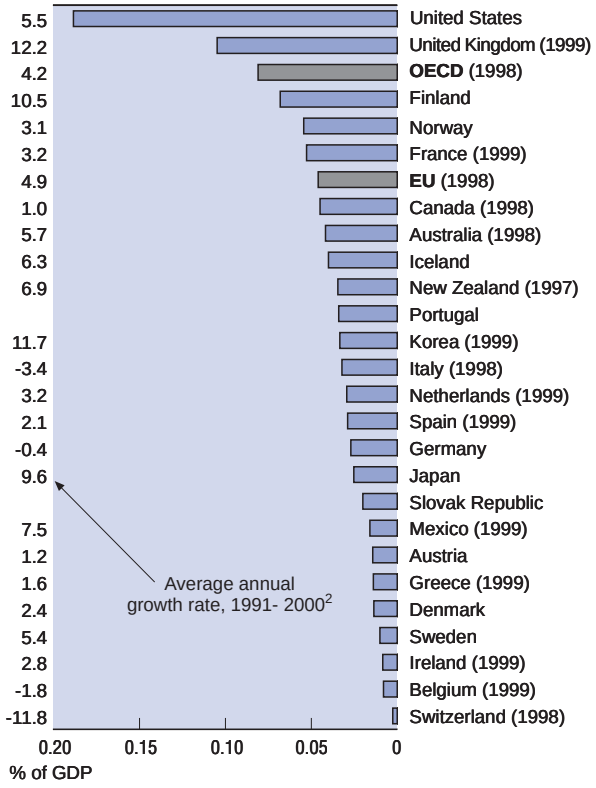
To address some of the limitations mentioned above and to provide a more complete picture of health-related R&D, funding of medical sciences via advancement of research and general university funds (GUF) are included when available.

For further information, see OECD, *Measuring Expenditure on Health-related* R&D, OECD, Paris, 2001.

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

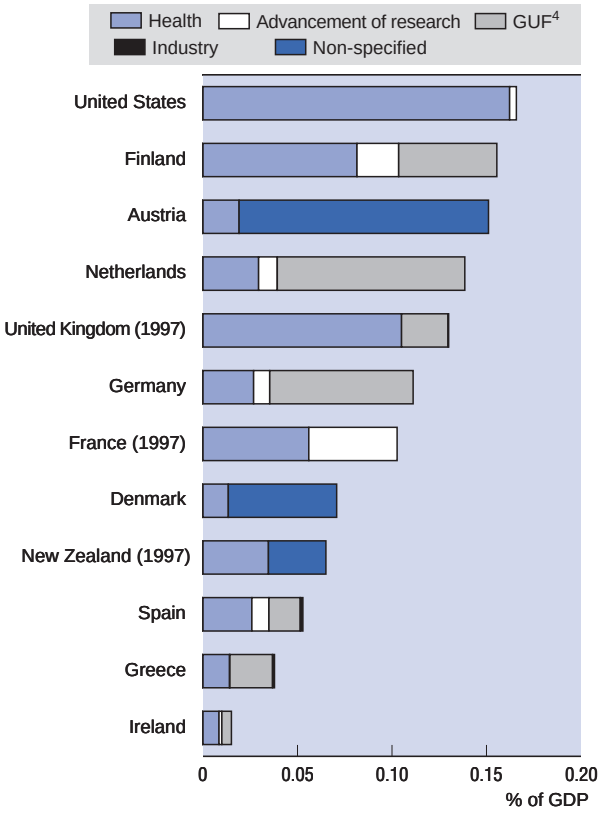
A.6.3. Health-related R&D

Health R&D in government budgets (GBAORD)[1] as a percentage of GDP, 2000



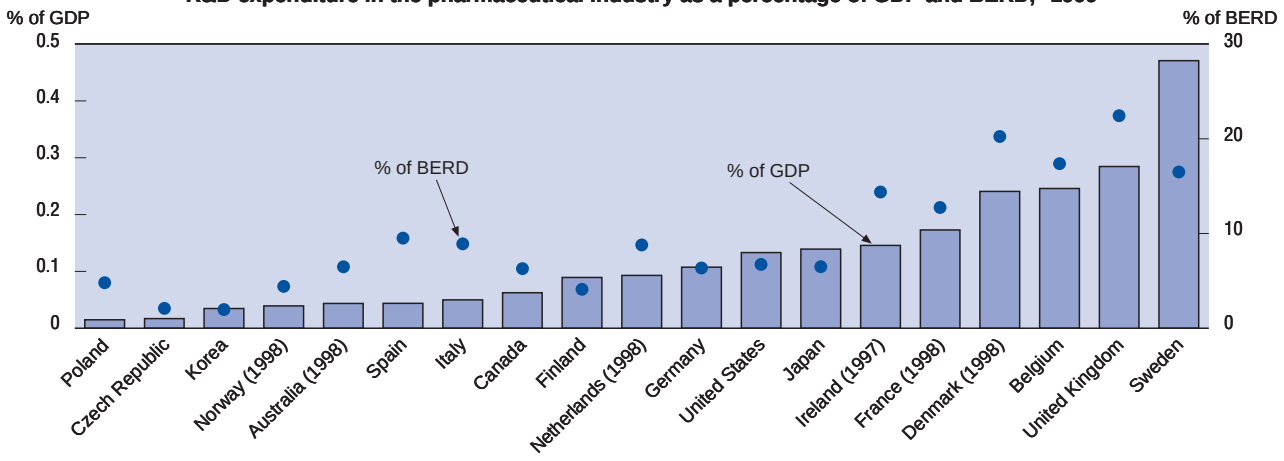
Source: OECD, R&D database, May 2001.

Effect of including other health-related NABS[3] categories in health GBAORD, 1998



Source: OECD, Eurostat and national publications, May 2001.

R&D expenditure in the pharmaceutical industry as a percentage of GDP and BERD,[5] 1999



1. Government budget appropriations or outlays for R&D.
2. Growth rate: Belgium, France, Greece, Ireland, Mexico, Netherlands, Spain and United Kingdom (1991-99); Australia, Canada, European Union, Italy and OECD (1991-98); New Zealand (1991-97); Switzerland (1992-98).
3. Nomenclature for the analysis of science budgets.
4. General University Funds.
5. Business enterprise expenditure on R&D.

Source: OECD, ANBERD database, May 2001.

A.6.4. Basic research

- There is evidence that innovation efforts draw increasingly on basic research, owing to greater possibilities of commercialisation of its results. For example, basic research in biotechnology is leading to direct applications.
- Relative to GDP, Switzerland allocates close to 0.8% of GDP to basic research, which is almost twice as much as the respective figures for the United States and Japan. In Switzerland, approximately 75% of basic research is performed by the higher education sector, while the other quarter is performed by the business sector.
- Although the proportion of GDP allocated to basic research in Hungary, Mexico, Poland and Portugal is low compared with other OECD countries, their basic research expenditure relative to total R&D expenditure is among the highest of all OECD countries. This is due to the relatively low share of the business sector in total GERD and the high share of the government and higher education sectors in total GERD (see A.3), where the bulk of basic research is performed.
- Industrial basic research is relatively more developed in Korea, Japan and Ireland where around one-third of basic research is performed by the business enterprise sector. This could mainly be due to the large share of R&D performed by the business sector, approximately 70% of overall R&D. This contrasts with Central and Eastern European countries where more than half of total basic research is carried out by the government sector.
- Most countries spent a higher share of GDP on basic research in 1998-99 than in the early 1980s. However, in the early 1990s, expenditure on basic R&D decreased in the United States, both relative to the GDP and in constant prices. Since 1995, the US ratio of expenditure on basic research to GDP has stabilised; this indicates a strong increase in expenditure on basic R&D, as GDP has grown rapidly since 1995.

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 an over-simplified model of the workings of the scientific and technological system and also involves an important element of subjective assessment.

Data on basic research are often estimated in large part by the national authorities, notably for the higher education sector, which is the main performer of basic research in most countries.

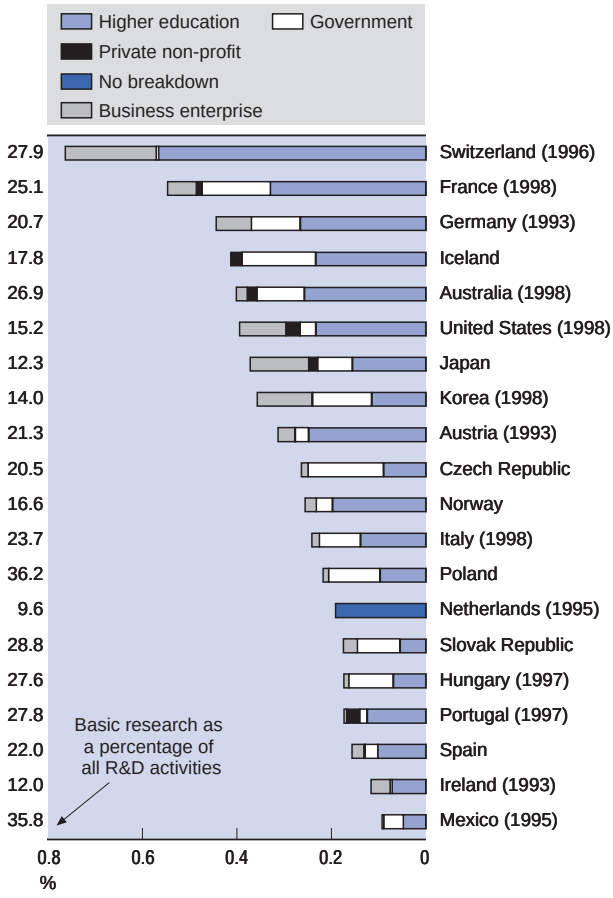
The breakdown may be applied at the project level or, if necessary, at a more detailed level, and, for the purposes of international comparison, should be based on current expenditures only.

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, Austria, the Czech Republic, France, Iceland, Italy, Japan, Korea, the Netherlands, Portugal, Switzerland and Turkey). In the case of the United States, capital write-downs are included instead of capital expenditure in the business enterprise sector.

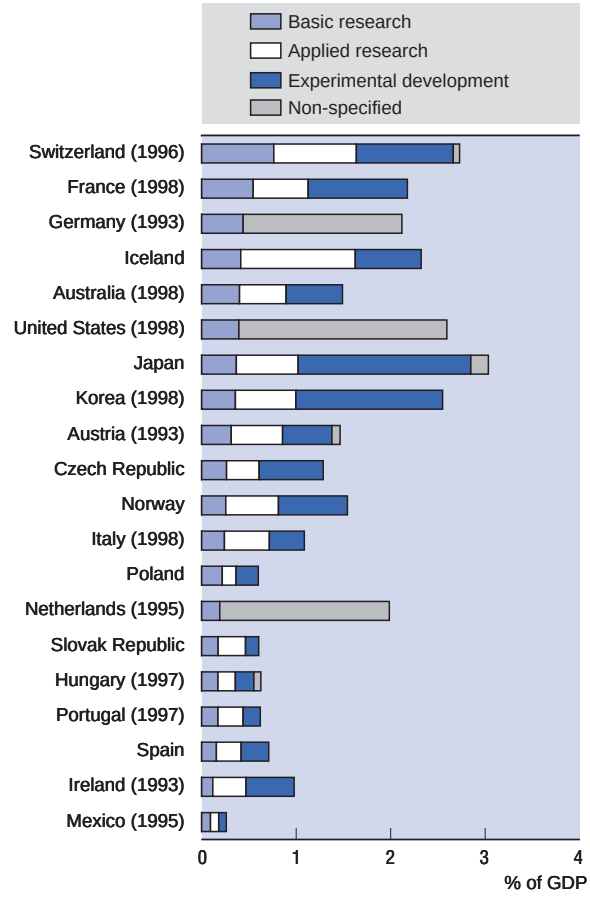
For more details, see Annex, Tables A.6.4.1 *and* A.6.4.2.

A.6.4. Basic research

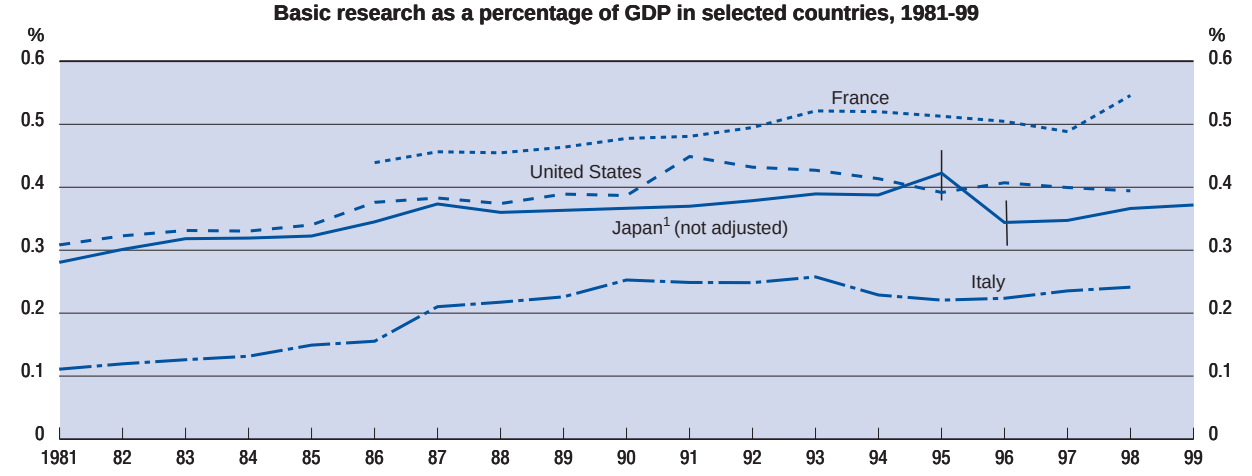
Basic research as a percentage of GDP by sector of performance
1999



Breakdown of R&D expenditure by type of research as a percentage of GDP
1999



Basic research as a percentage of GDP in selected countries, 1981-99



1. Break in series between 1995 and 1996.
Source: OECD, R&D database, May 2001.

A.6.5. Defence R&D in government budgets

- Data on government budget appropriations or outlays for R&D provide an indication of the relative importance of various socio-economic objectives, such as defence, health and the environment.
- Three countries accounted for approximately 90% of total OECD-area defence R&D budgets in 1998. The defence R&D budget of the United States amounted to almost 80%, and France and the United Kingdom accounted for 6% each.
- More than half of the US government R&D budget is allocated to defence. The UK defence R&D budget is more than a third of the total government R&D budget. In France and Spain, it is around a quarter of the total.
- In 1999, the US defence R&D budget amounted to 0.45% of GDP, far above that of the United Kingdom and France (0.26% and 0.22%, respectively). During the 1990s, the share of defence R&D budgets relative to GDP has declined in most countries, largely owing to the overall decline in military expenditure. Sweden, the United States and France have seen the largest decrease in the share of the defence R&D budget in GDP. In contrast to the general trend, the share of defence research relative to GDP increased in Portugal and Spain.

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.

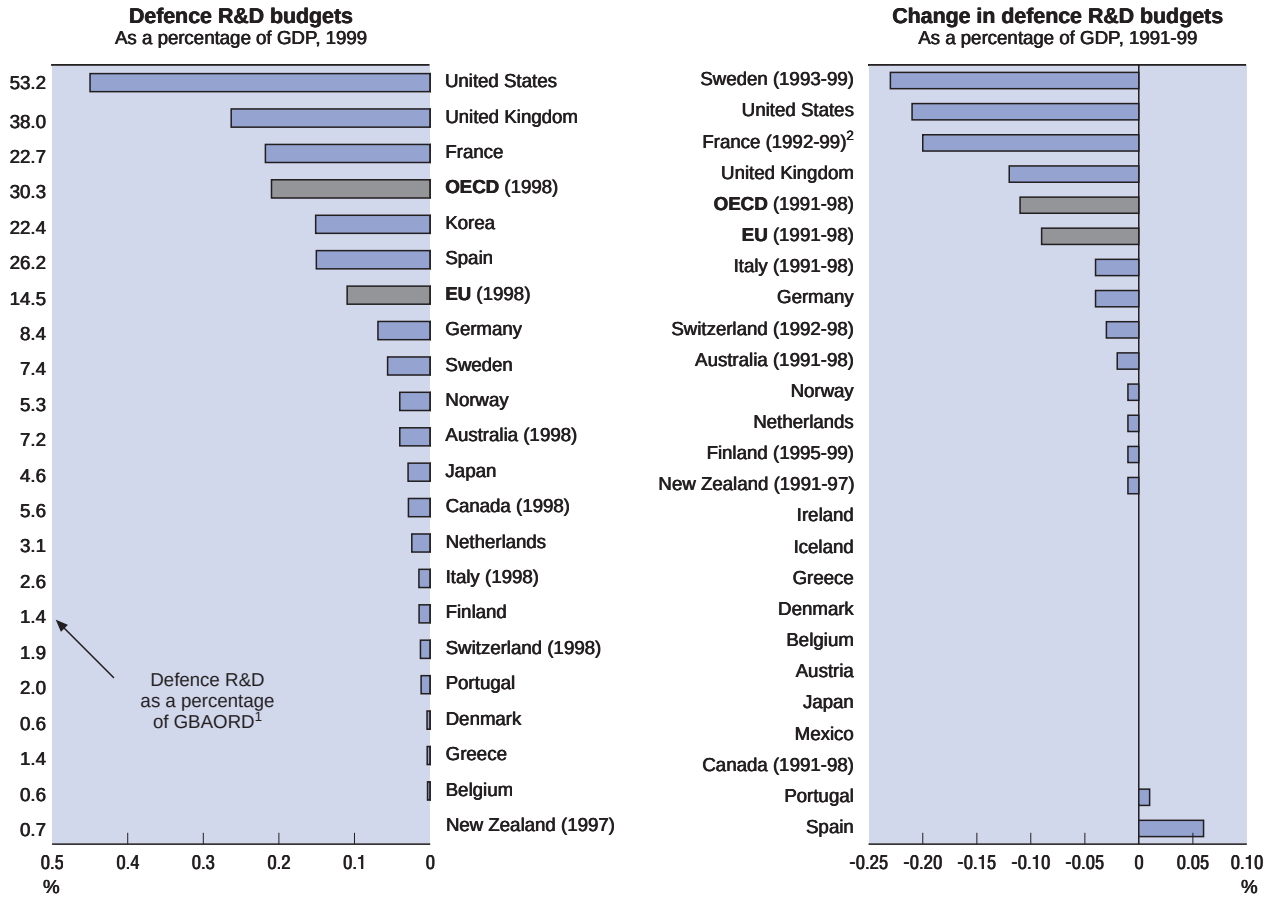
A first distinction can be made between defence programmes, which are concentrated in a small number of countries, and civil programmes, which can be broken down as follows:

- Economic development: promotion of agriculture, fisheries and forestry; promotion of industry; infrastructure; energy.
- Health and environment: human health, social development, protection of the environment, exploration and exploitation of the Earth and the atmosphere.
- Civil space.
- Advancement of research that includes non-oriented programmes.
- 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.

For more details, see Annex, Table A.6.5.

A.6.5. Defence R&D in government budgets



1. Government budget appropriations or outlays for R&D.
2. OECD estimate.

Source: OECD, MSTI database, May 2001.

A.6.6. Tax treatment of R&D

- Most OECD countries have special tax schemes for R&D expenditures, such as immediate write-off of current R&D expenditures (all except New Zealand) and various types of R&D tax credits.
- As a policy instrument, tax credits are on the rise in OECD countries. The most significant moves towards a favourable R&D tax regime occurred in Portugal, the Netherlands and Austria in the 1990-99 period.
- Depending on the country, R&D tax credits can be "flat rate" (*e.g.* on the amount of R&D, as in Canada) or "incremental" (*e.g.* taking account of the difference between current R&D and a past reference point as in the United States). Tax relief may apply equally to all firms performing R&D or give special treatment to small firms or to collaborative R&D.
- These schemes resulted in tax subsidies for R&D in 12 OECD countries in 1999. The largest subsidies are observed for Spain, Canada and Portugal (large firms).
- There are no R&D subsidies for large firms in Italy and the United Kingdom, but both countries have a favourable tax credit system for small and medium-sized firms. In most countries, tax incentives are geared more towards SMEs than towards large firms.
- R&D subsidies in Australia decreased significantly over the 1990-99 period, due to a reduction of the depreciation allowances from 150% to 125%.

The B-index

The amount of tax subsidies 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.

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

where A = the net present discounted value of depreciation allowances, tax credits and special allowances on R&D assets; 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 and 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 where 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.

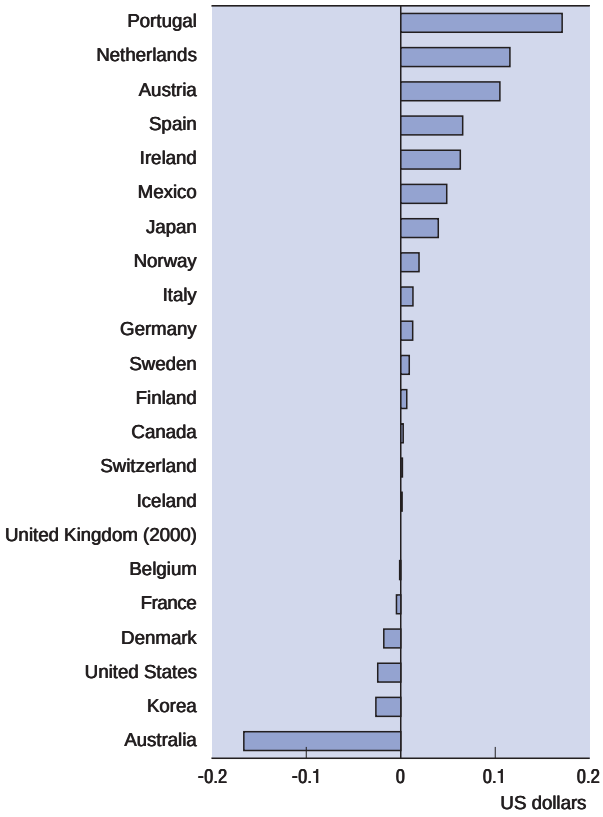
The effective impact of the R&D tax allowance or credit on the after-tax cost of R&D is influenced by the level of the CITR. An increase in the CITR reduces the B-index only in those countries with the most generous R&D tax treatment. If tax credits are taxable (as in Canada and the United States), the 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 Warda, J., "Measuring the Value of R&D Tax treatment in OECD Countries", forthcoming in STI *Review* No. 27, 2001.

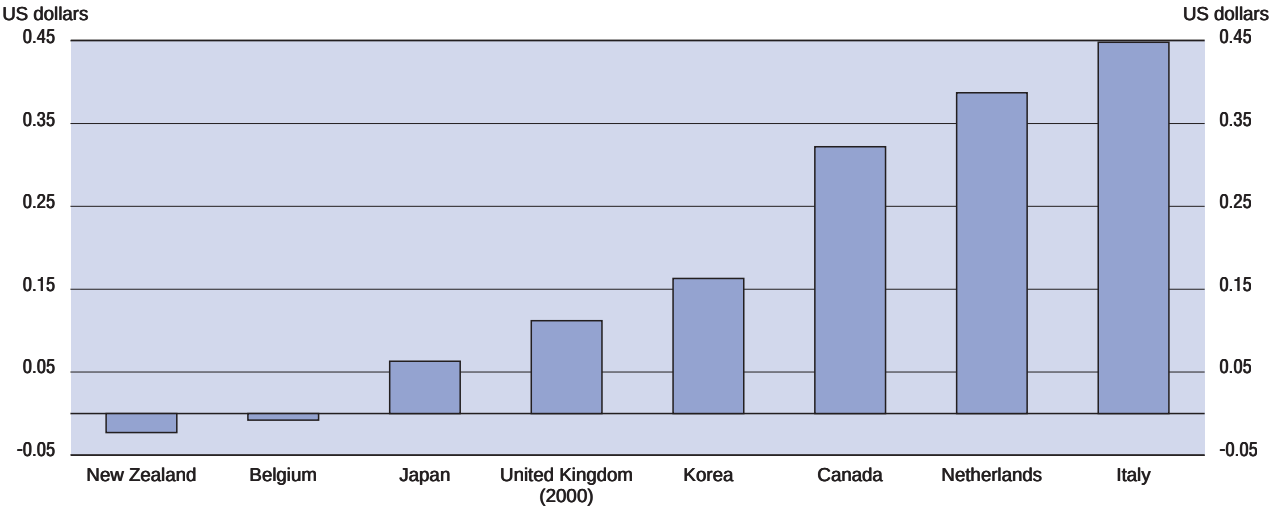
A.6.6. Tax treatment of R&D

Rate of tax subsidies for 1 US dollars of R&D,[1] large firms, 1999

Change in the rate of tax subsidies for 1 US dollars of R&D, large firms, between 1990 and 1999



Rate of tax subsidies for 1 US dollar of R&D,[1] SMEs, 1999



1. Tax subsidies are calculated as 1 minus the B index. For example, in Spain, 1 dollar of R&D expenditure by large firms results in 30 cents of tax relief.
Source: OECD, STI/EAS Division, May 2001.

A.7. Venture capital

- Although venture capital investment is quite small relative to GDP, it is a major source of funding for new technology-based firms and plays a crucial role in promoting the radical innovations often carried out by these firms.
- The venture capital data presented here were compiled during the second half of 2000. As the venture capital market is extremely dynamic over short time periods, the country profiles reflect the situation at that time. Since the second quarter of 2000, venture capital investment has declined sharply.
- Countries such as the United States, Canada, the Netherlands and Iceland have significant venture capital investment relative to GDP and tend to direct finance towards firms in their early stages. In contrast, countries such as Portugal and Spain have low venture capital investment relative to GDP and tend to finance the expansion of firms already present. Between 1995 and 1999, venture capital investment for early and expansion stages amounted to 0.21% of GDP in the United States and 0.16% of GDP in Canada and the Netherlands.
- High-technology sectors (communications, information technology and health and biotechnology) accounted for more than 80% of total venture capital investment in the United States and around 67% in Canada. This is far above the figures for Japan and the European Union.
- For most OECD countries, information technology accounts for the bulk of venture capital investment. It accounts for more than a third of total venture capital in the United States (45%), Ireland (38%) and Canada (37%).
- A significant proportion of the venture capital of Scandinavian countries, Switzerland, Canada and Greece is directed towards financing firms in the health and biotechnology sectors; the share of Japanese venture capital invested in this sector is almost negligible.
- International flows of venture capital are increasing. Firms from the United States increasingly invest in Europe and Asia, and there is also significant cross-border investment within Europe and Asia. International flows of venture capital to Denmark and Ireland (country of destination), are more than four times the investments managed by their domestic venture capital firms (country of management).

Venture capital

Venture capital is provided both by specialised financial firms acting as intermediaries between primary sources of finance (such as pension funds or banks) and firms (formal venture capital) and by so-called "business angels" (usually wealthy individuals experienced in both business and finance who invest directly in firms).

Data on venture capital are collected among their members by national or regional venture capital associations. Only formal venture capital (provided by specialised intermediaries) is captured by statistics. According to estimates, business angels in the United States invested almost twice as much annually in new firms as venture capital funds. This figure is probably much lower in most other OECD Member countries.

Three financing stages can be identified in relation to the development of a venture-backed company:

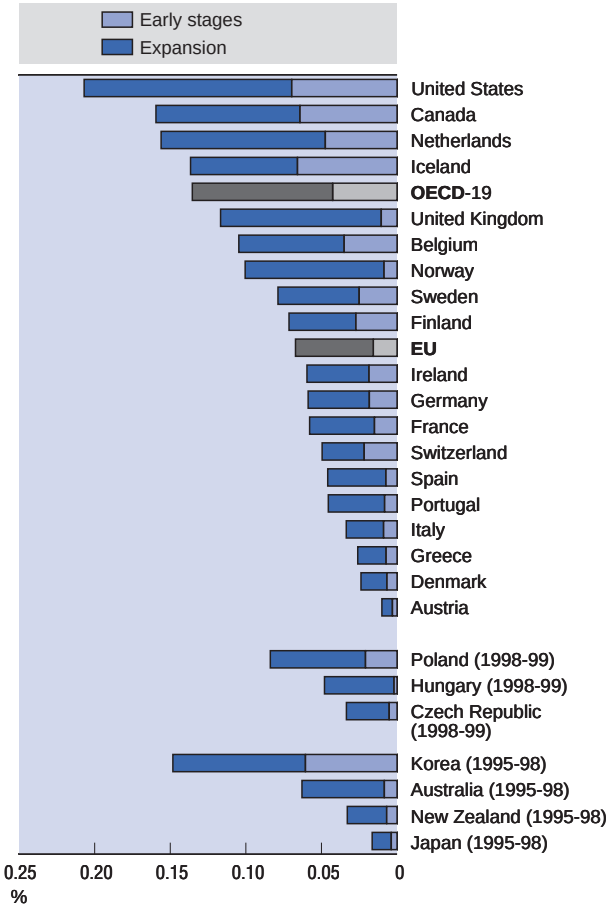
- Seed capital is provided to research, assess and develop an initial concept.
- Start-up is financing provided to companies for product development and initial marketing. Companies may be being set up or may have been in business for a short time, but have not yet sold their product commercially.
-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

Not all funds managed by a venture capital firm that operates in a given country are from investors from that country. In fact, there are substantial and increasingly important cross-border flows of funds raised, 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 approach 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.

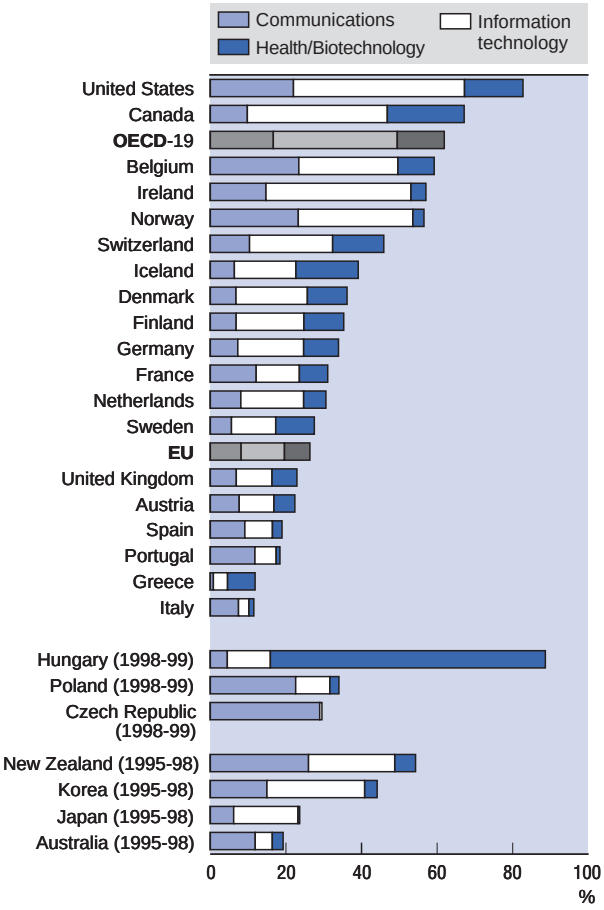
For further information, see Baygan, G. and M. Freudenberg, "The Internationalisation of Venture Capital Activity in OECD Countries: Implications for Measurement and Policy", STI Working Paper 2000/7, OECD, Paris.

A.7. Venture capital

Investment in venture capital as a percentage of GDP, 1995-99

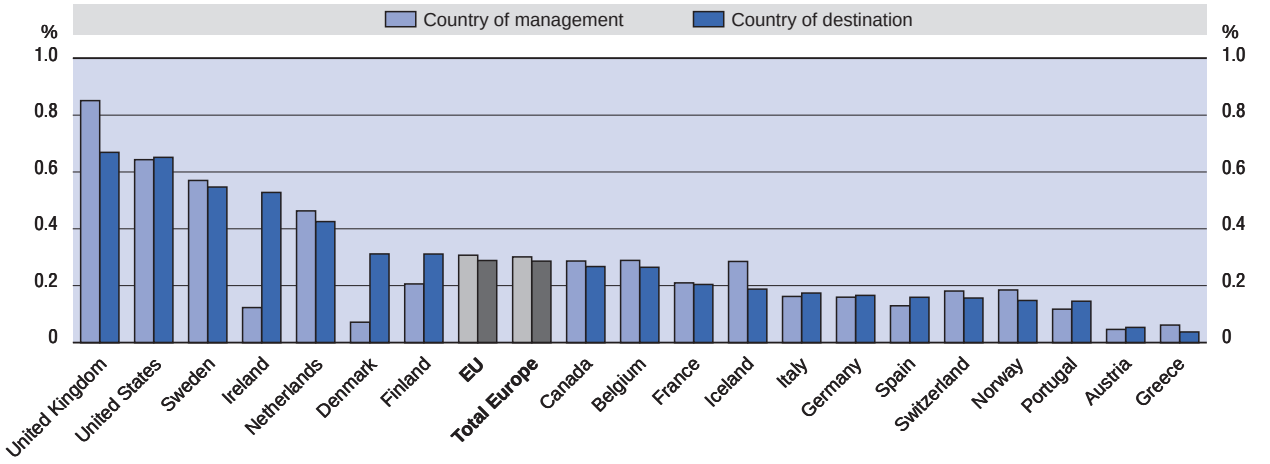


Share of high-technology sectors in total venture capital, 1995-99



Venture capital investment by country of management and destination, 1999

As a percentage of GDP



Source: OECD, based on data from EVCA (Europe); NVCA (United States); CVCA (Canada); Asian Venture Capital Journal (*The 2000 Guide to Venture Capital in Asia*). Data compiled in the second half of 2000.

A.8. Human resources

- Measures of educational attainment are the most commonly used proxies for human capital, despite their imperfections; for example, they do not cover quality of schooling and formal or on-the-job training.
- In the OECD area, 65% of the population aged 25-64 has completed upper secondary schooling. The share in the United States and Japan is more than 20 percentage points higher than in the European Union. It exceeds 80% for the United States, the Czech Republic, Norway, the United Kingdom, Switzerland, Germany and Japan. In contrast, it is below 50% for southern European countries: Portugal (21%), Turkey (22%), Spain (35%) and Italy (44%).
- In the OECD area, 14% of the population aged 25-64 have university-level education. The share is highest in the United States, Norway and the Netherlands (above 20%); in Austria, Denmark and Portugal, it is half the OECD average.
- Approximately 1% of a typical age cohort in OECD countries obtains an advanced research degree such as a Ph.D. This ratio is more than double the OECD average in Switzerland (2.6%) and Sweden (2.4%). In contrast in Turkey, Italy and Spain, the ratio is less than half the OECD average.
- Expenditure per student for tertiary level education (ISCED 5A, 5B and 6) varies by a factor of 8 between Turkey and the United States. Expenditure per student is highest in the United States (USD 18 493) and Switzerland (USD 17 310), roughly double the OECD average (USD 9 255). Expenditure per student in southern European countries 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, including:

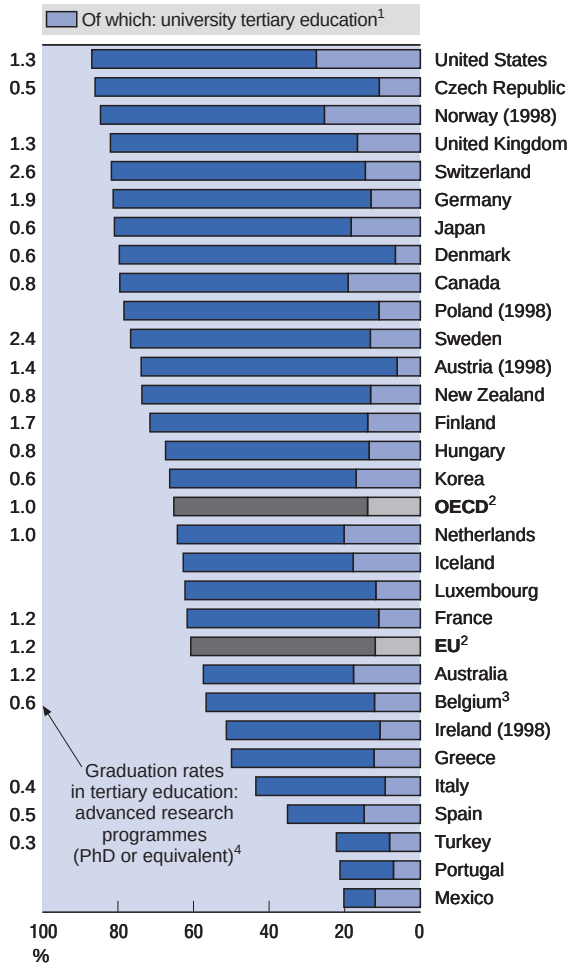
- The highest level of education completed by each adult (educational attainment) reflects his/her skill level. ISCED (International Standard Classification of Education) classifies educational attainment in six categories of educational programmes, two of which (categories 5A and 6) are for university 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 than ISCED 5A. ISCED 6 programmes are those that lead to an advanced research qualification and are devoted to advanced study and original research.
- Educational attainment is related to the stock of knowledge and skills in the population. The tertiary graduation rate reflects the rate of production of higher-level knowledge by the education system. A country with a high proportion of graduates is more likely to be developing and maintaining a highly skilled labour force. The tertiary level graduation rate measure used here reflects ISCED 6 figures.
- 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 tertiary level education 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. The national currency data is converted into equivalent USD PPP.

For further information, see OECD, *Education at a Glance*, OECD *Indicators*, Paris, 2001; OECD and Eurostat (1995), "Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual", Paris; OECD, *Human Capital Investment*, Paris, 1998.

For more details, see Annex, Table A.8.1.

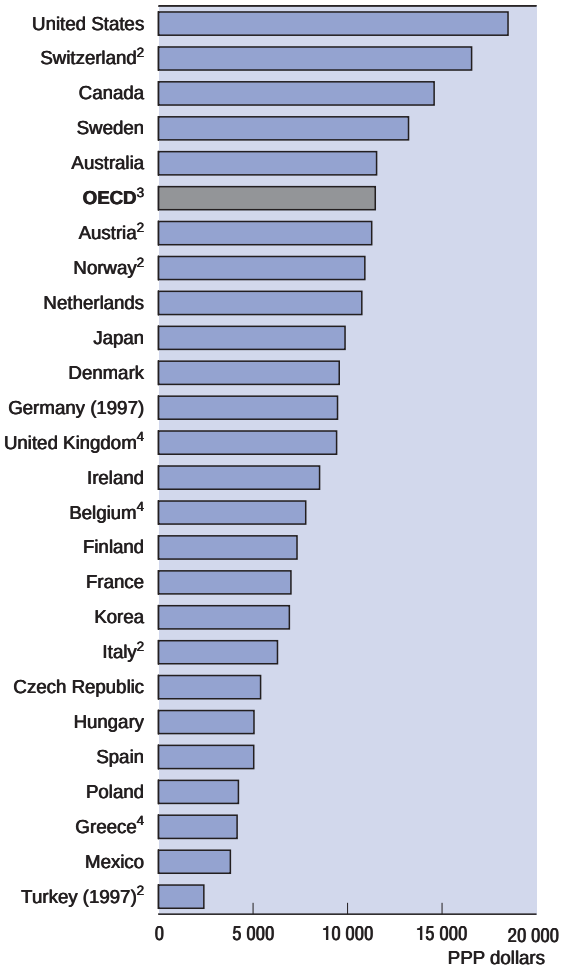
A.8. Human resources

Share of the population aged 25-64 with at least an upper secondary education level
1999



1. Tertiary type A and advanced research programmes (ISCED 5A and 6).
2. Average of the available countries.
3. Graduation rate refers to the Flemish Community only.
4. Graduation rates refer to the net graduation rate, however for a few countries the gross graduation rate is used if the net figure is unavailable, see Annex Table A.8.1 for details.

Expenditure per student for tertiary level education[1]
1998, PPP dollars



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

Source: OECD, Education database, May 2001.

A.9.1. Human resources in science and technology

- As measured here, human resources in science and technology (HRST) encompass workers in highly skilled S&T-related occupations (see box). The definition goes beyond R&D by including workers actively involved in technological innovation and diffusion. However, comparable data are available only for European countries and, in part, for the United States.
- In 1999, there were about 38 million HRST in the European Union, or about 25% of the labour force. The share was highest – about one-third – in the Nordic countries (Sweden, Denmark, Finland) and in the Netherlands, Germany and Belgium. In southern European countries (Portugal, Greece, Spain) and Ireland, the share was less than one-fifth.
- The number of HRST grew significantly between 1995 and 1999 in countries where shares were lowest (southern Europe and Ireland) and in Finland. Growth was slower in Austria, France, Germany and Sweden (countries where growth of total employment was also low). The growth rate of HRST was similar in European Union countries and the United States (about 3% annually).
- In 1999, the European Union had about 8 million workers classified as scientists and engineers (defined more narrowly than HRST, as associate professionals are excluded, see box); in 1997, the United States had 10.6 million (with a definition somewhat broader than that for the European Union, see box). The share of scientists and engineers in the total labour force is highest in the United States (7.7%). Except in the United Kingdom, the share of scientists and engineers in the total labour force in the large European countries is about half that in the United States.

Measuring human resources in science and technology (HRST)

Human resources in science and technology (HRST) are defined according to the Canberra Manual (OECD and Eurostat, 1995) as a person 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).

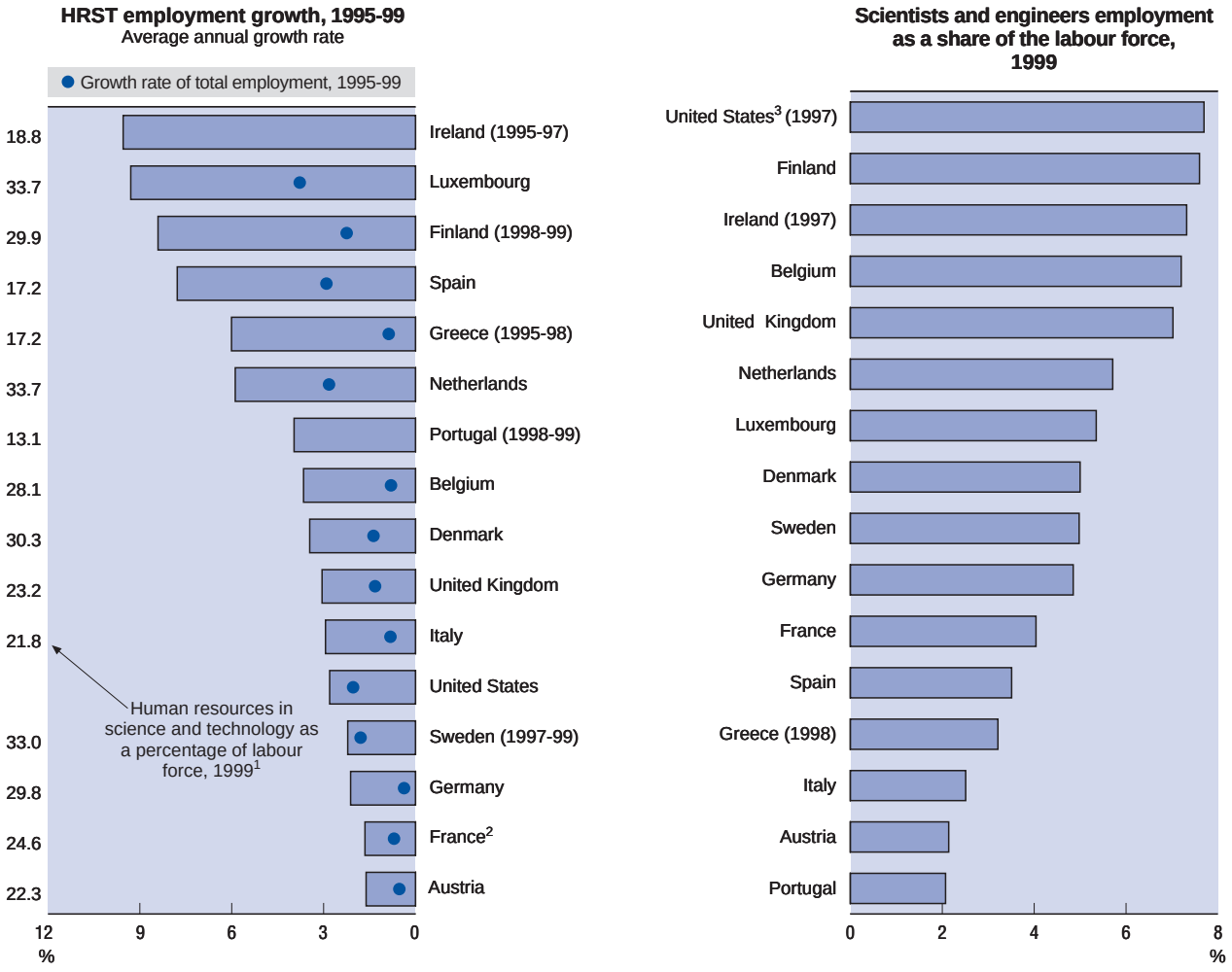
Data relating to HRST reported here include the following categories:

For European countries:

- HRST includes all persons employed in occupations which are classified in ISCO-88 major groups 2 or 3, those considered to be employed in an S&T occupation, as well as certain managers, ISCO 121, 122, 131 (if they have completed tertiary-level education).
- Scientists and engineers are defined as persons in one of the following two categories: physical, mathematical and engineering science professionals (ISCO-21); life science and health professionals (ISCO-22).
- For the United States:
- HRST includes the following US Bureau of Labor Statistics occupational categories: engineering, architects and surveyors (43-63); natural scientists (69-83); health diagnosing occupations (84-89); health assessment and diagnosing occupations (95-106); technicians and related support occupations (203-235, excluding 213, 229 and 233); social scientists and urban planners (166-173); lawyers and judges (178-179); teachers post-secondary (113-154); mathematical and computer specialists (64-68); computer technicians (213, 229, 233); computer equipment operators (308-309).
- The term "scientists and engineers" includes all persons who have received a bachelor's degree or higher in a science or engineering (S&E) field, plus persons holding a non-S&E bachelor's or higher degree who were employed in an S&E occupation during the 1993, 1995 or 1997 United States SESTAT (US Scientists and Engineers Statistical Data System) surveys.

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

A.9.1. Human resources in science and technology



1. 1999 or latest available year.
2. Growth rate of total employment refers to 1995-98.
3. The definition of scientists and engineers is somewhat broader than that of other countries.

Source: OECD, based on data from the Eurostat Labour Force Survey, the US Current Population Survey and STAN database, May 2001.

A.9.2. Trends in researchers

- In 1998, approximately 3.2 million researchers were engaged in R&D in the OECD area. This corresponds to about 61 researchers per 10 000 labour force, a significant increase from the 1991 level (54 researchers per 10 000 labour force).
- In the major OECD regions, Japan has the highest number of researchers relative to the labour force, followed by the United States and the European Union. However, around 37% of total OECD area researchers reside in the United States, 28% in the European Union and 21% in Japan.
- Five large OECD countries (the United States, Japan, Germany, France and the United Kingdom) account for about 75% of all OECD researchers.
- In Japan and the European Union, the share of researchers in the OECD total is similar to their share in R&D expenditure. The United States' share of researchers is some 7 percentage points below its share of R&D expenditure (see A.2). This difference is partly due to the exclusion of military personnel (government sector) from the calculation of US researchers (see box).
- Finland, Japan, Iceland, Sweden and the United States have an R&D intensity, in terms of researchers and R&D expenditure, substantially above the OECD average. In Norway and Australia, R&D intensity is above the OECD average in terms of researchers, but below it in terms of R&D expenditure.
- The bulk of R&D is funded and carried out by the business enterprise sector (see A.3), which is the core of the national innovation system. In 1998, approximately 2 million researchers (about 63% 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. In both the European Union and Japan, the business sector's share of researchers in the national total is lower than its share in R&D expenditure; the opposite holds for the United States.
- The United States, Japan and Sweden are the only countries where business researchers exceed 50 per 10 000 of the economy-wide labour force; in the large European economies, there are only about 30 researchers per 10 000 labour force.
- Mexico, Turkey, Portugal and Greece have an extremely low intensity of business researchers (fewer than five per 10 000 of the economy-wide labour force). However, this is mainly due to national characteristics: in these countries, the business sector plays a significantly 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 20-30% of total R&D expenditure.
- Growth in the number of business researchers is most dynamic in smaller OECD economies such as Iceland, Turkey, Ireland and Portugal, where the number of business researchers increased by more than 10% annually over the last decade.

Human resources allocated to R&D

The indicator of R&D personnel is limited to researchers, who are viewed as the central element of the R&D system. Researchers 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 are used as a proxy. The number of researchers is expressed in full-time equivalent (FTE) and includes staff engaged in R&D during the course of one year. The data have been compiled on the basis of the methodology of the *Frascati Manual* 1993 (OECD, Paris, 1994).

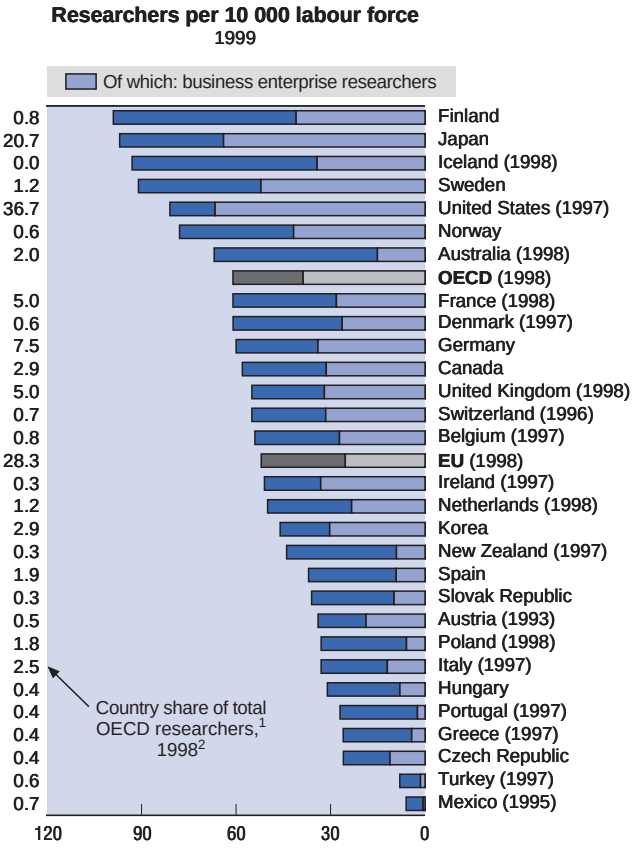
The magnitude of estimated resources allocated to R&D is affected by national characteristics (see Box A.2).

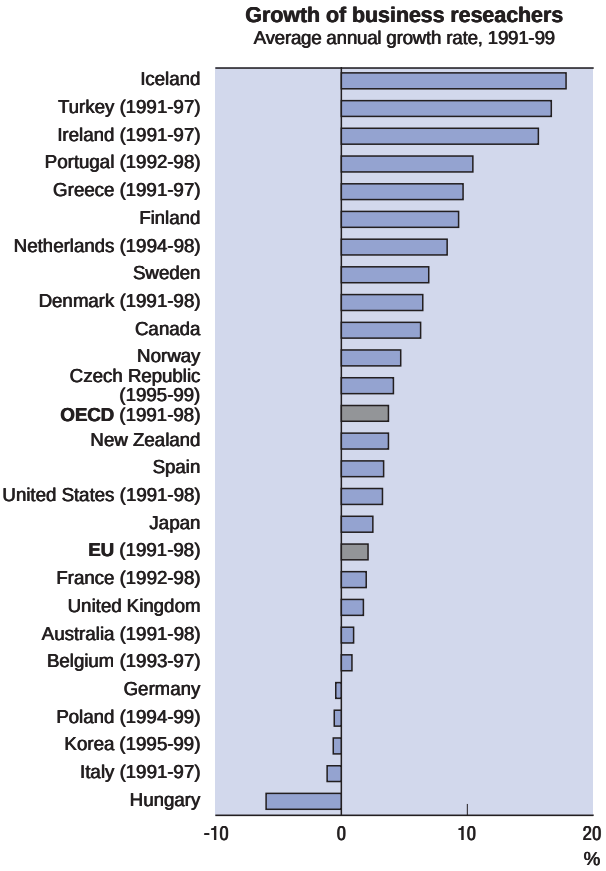
Underestimation of researchers in the United States is due to the exclusion of military personnel in the government sector (see Box A.5).

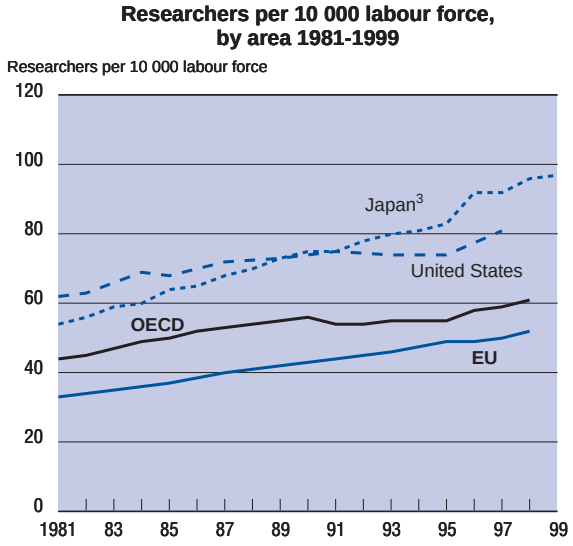
The business enterprise sector covers scientists and engineers carrying out R&D in firms and business enterprise sector institutes. While the government and the higher education sectors also carry out R&D, industrial R&D is more closely linked to the creation of new products and production techniques,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

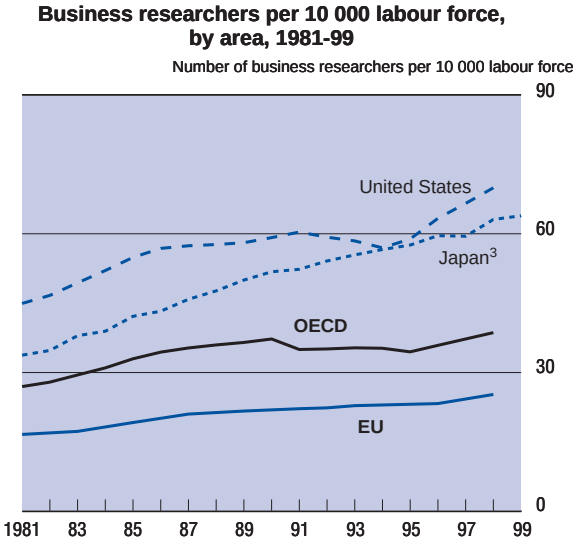
For more details, see Annex, Tables A.9.2.1, A.9.2.2 *and* A.5.1.2.

A.9.2. Trends in researchers









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 1997 as a percentage of total OECD researchers in 1997.
2. 1998 or latest available year.
3. Adjusted up to 1995.

Source: OECD, MSTI database, May 2001.

A.10.1. International mobility of human capital

- In recent years, the international mobility of high-skilled workers (often known as "brain drain") has received increasing attention from policy makers and the media. However, internationally comparable data that track the international flow of scientists and researchers are extremely limited. For example, data on foreign-born scientists and engineers, which only show inflows to the United States, provide only a partial picture of international mobility (see box).
- In the United States, the largest number of scientists and engineers (S&Es) with S&E doctorates born in the OECD area are 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 in the United States from China and twice as many from India as from the United Kingdom.
- In 1998, the relative share of non-national human resources in science and technology (HRST) as defined by occupational groups ISCO 2 and 3 (see box), for the 14 European countries was 3%. However, European countries differ widely in this respect. As a percentage of national HRST, Luxembourg employs by far the largest share of non-nationals (33%). This is partly due to a sizeable banking sector, a small labour market and the presence of various EU institutions. Belgium also employs a relatively high share of non-nationals: 7% for all occupational groups and 5% for HRST. Again, this is partly due to the presence of various European institutions and the European headquarters of many multinationals. Austria and the United Kingdom also attract relatively high proportions of non-national HRST. In the United Kingdom, the relative share of non-national HRST is higher than that of non-nationals for all occupation groups.

International mobility of human capital

The extent of international mobility of HRST is difficult to measure owing to a lack of internationally comparable data. Two indicators are used here to gauge the extent of international mobility in the OECD area. The first relates to scientists and engineers (S&E) in the United States with a doctorate qualification who are not US citizens. Data relating to foreign S&Es in the United States are based on a sample survey. They include all non-US citizens with science or engineering doctorates from a US university. They also include S&E doctorate holders with degrees from non-US universities if they were in the country in 1990, the date of the US Census which provided the framework for NSF surveys throughout the 1990s. Thus, 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 rate 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.

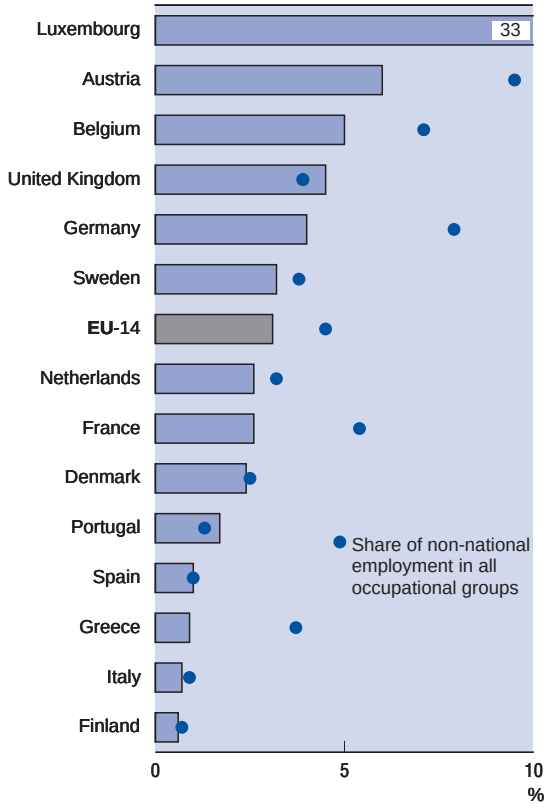
The second indicator relates to human resources in science and technology (HRST), defined here according to occupational groups (see Box A.9.1 for a definition of HRST). The HRST indicator reported here includes all persons in International Standard Classification of Occupations (ISCO-88) major groups 2 (Professionals) and 3 (Technicians and associate professionals). These groups cover activities such as science and engineering, computing, architecture, health, education, business, legal activities, etc. Data for the European countries reported here are from the Eurostat Labour Force Survey. The advantage of using this type of survey rather than ones based on population census is that it allows cross country comparisons. However, there are some 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.

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, March 2001.

Relative share of non-national HRST[1] employment in the Europan Union
1998



1. Human resources in science and technology (HRST) defined on the basis of occupational groups. HRST includes only ISCO-88 major groups 2 and 3 (professionals and technicians and associate professionals).

Source: OECD, based on data from the Eurostat Labour Force Survey, March 2001.

A.10.2. International mobility of students

- International mobility of students represents a potential flow of qualified workers. Foreign students who become part of the domestic labour force, either during or after completing their studies, can be considered as HRST migration. Migration of foreign students may also provide an indication of the future international mobility of qualified workers.
- The share of foreign students in total enrolments (domestic plus foreign) is high in Switzerland, Australia, Austria, Belgium and the United Kingdom, where they represent more than 10% of total student enrolments. The share is lowest in Korea, Mexico and Poland, where they account for less than 1%.
- A breakdown by discipline makes it possible to measure the internationalisation of various disciplines. Compared to the social sciences and the humanities, the number of foreign students in science and engineering is relatively low. In most countries, the social sciences receive the largest number of foreign students. The share of foreign students in science and engineering varies from about 7% in Iceland to 36% in Canada. Their share is relatively high in Canada, Finland, Germany and Switzerland, where more than one in three is enrolled in science and engineering, and it is relatively low in Denmark, Hungary, Luxembourg and Iceland, where foreign students are fewer than one in five.
- Five countries account for more than 70% of all foreign students in OECD countries. The United States attracts 29% of foreign students, followed by the United Kingdom (14%) and Germany (12%). English-speaking countries account for over 50% of the OECD total.

International mobility of students

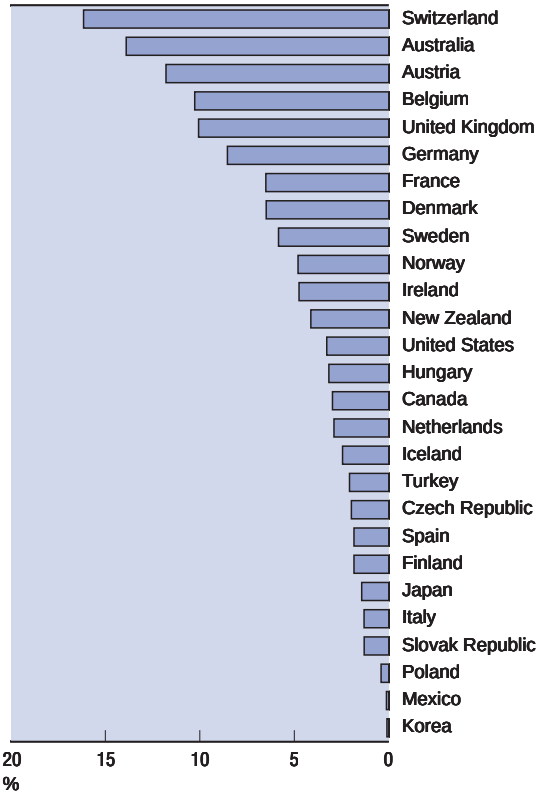
The data used here are from the Indicators for Education Systems (INES) project conducted jointly by the OECD, UNESCO and Eurostat. The number of students from each country enrolled abroad is measured from data available in OECD Member countries. Thus, foreign students in countries that do not provide 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 their 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 reports by the countries of destination.

The education levels of students used here are based on the classification developed by UNESCO, International Classification of Education (ISCED-97). The ISCED 5 level corresponds to the first stages of tertiary education and ISCED 6 corresponds to programmes that lead to an advanced or research qualification.

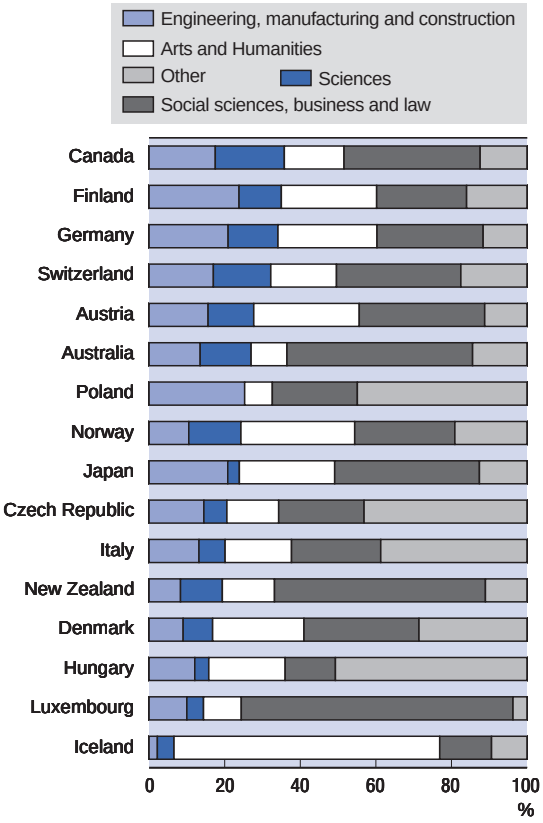
For further information, see OECD, *Education at a Glance*, OECD *Indicators*, Paris 2001; OECD, "Student mobility between and towards OECD countries: a comparative analysis", forthcoming in the proceedings of the OECD conference on International Mobility, OECD, June, 2001.

A.10.2. International mobility of students

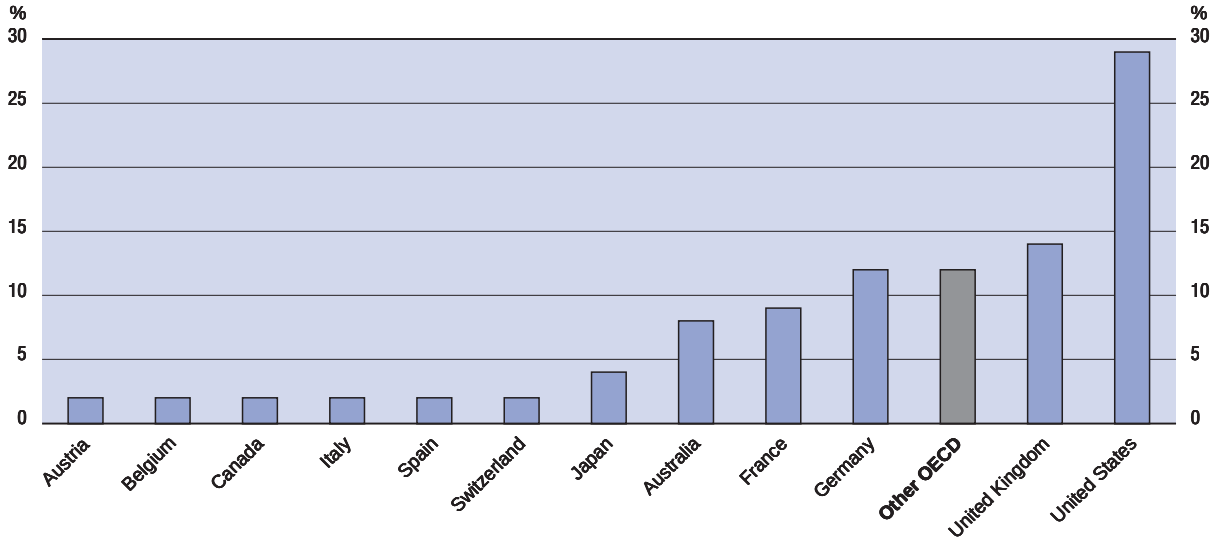
Foreign students[1] in university level education as a percentage of total enrolment
1999



Distribution of university level foreign students by field of study
1998



Distribution of foreign students in the OECD countries by host country , 1999



1. Includes foreign students in university education from both OECD and non-OECD countries.
Source: OECD, Education database, May 2001.

A.11. Innovation expenditure and output

- Data from innovation surveys are available for a limited number of countries. Such surveys are relatively new and data may not be comparable across countries. In particular, the coverage of services is partial in some countries.
- In manufacturing industries, average expenditure on R&D represents about half the expenditure on innovation, and the non-R&D share of technological innovation can be up to twice that of R&D.
- In most countries, expenditure on innovation (relative to sales) is higher for manufacturing than for services. Innovation expenditure as a share of sales is three times higher in manufacturing than in services in Switzerland, France and Poland. In the United Kingdom, Iceland and Norway, the share is higher for the services sector.
- In manufacturing, expenditure on innovation is highest in Sweden and Switzerland (more than 6% of total sales) and lowest in Portugal, Mexico, Spain and Australia (less than 2%).
- Services industries also spend heavily on innovation, although most is not formal R&D. In services, expenditure on innovation is highest in Iceland, Denmark and the United Kingdom (4% or more of total sales).
- The share of firms having introduced at least one new or improved product or process on the market over a given period of time is an indicator of the output of innovative activities. It is weighted here by number of employees. In most countries, innovative firms (weighted by size) represent between 25% and 80% of all firms.
- For most countries, and notably Norway and Sweden, the share of innovative firms is higher in manufacturing than in services. The exceptions are Portugal and Belgium, and to a lesser extent Germany and Ireland, where a higher proportion of innovative firms are in services.
- In general, there are more innovators in manufacturing in large firms than in small ones, notably in Luxembourg, Poland and Finland. However, in Italy, Portugal, and Belgium, small manufacturing firms are almost as innovative as large ones. In the services sector, small firms seem almost as innovative as large ones in the United Kingdom, Switzerland and Portugal.

Measuring innovation expenditure and output

Innovation surveys, based on the *Oslo Manual* methodology, attempt to collect firm-level data on input to and output from innovation. The most well-known is the Community Innovation Survey (CIS), managed by Eurostat, which co-ordinates national innovation surveys in all countries of the European Union plus Norway. These surveys cover manufacturing firms and a selection of services. Most refer to 1996, but the data are for 1995 for Switzerland, 1997 for Australia, Mexico, Norway and Portugal, 1998 for Iceland and manufacturing in Poland and 1999 for services in Poland.

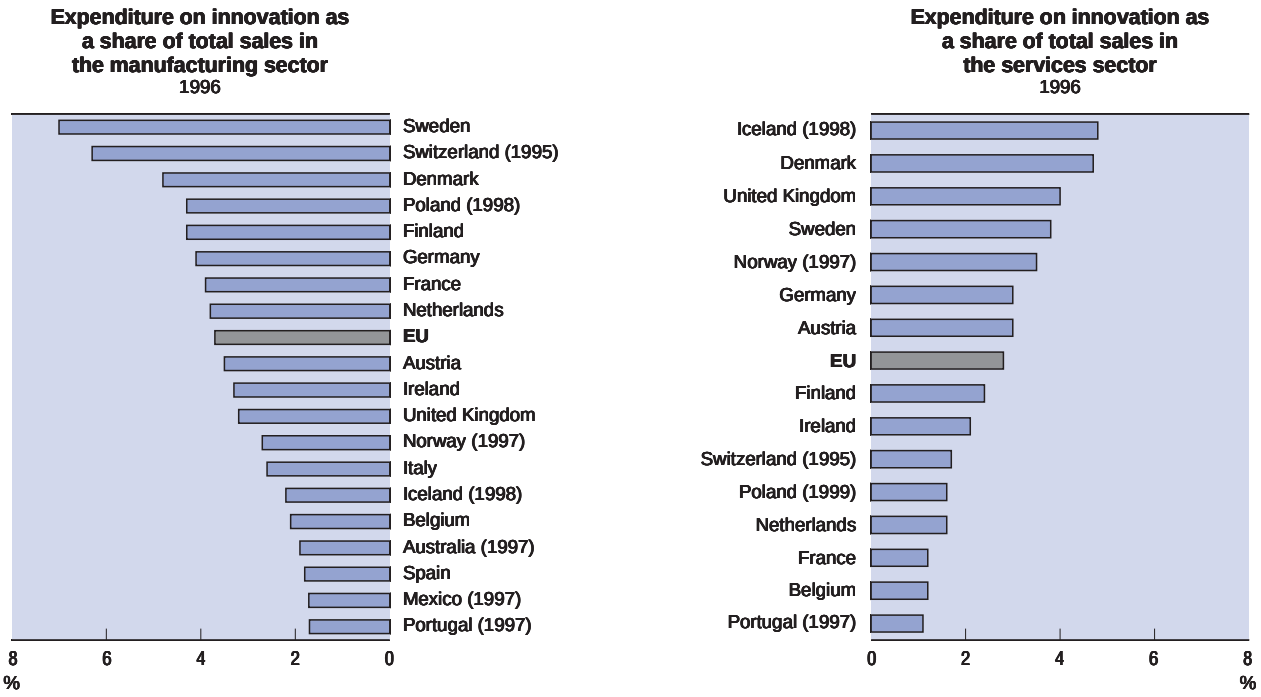
Expenditure on innovation includes all expenditure related to the scientific, technological, commercial, financial and organisational steps that are meant to lead to the implementation of technologically new or improved products and processes. The information requested concerns expenditure in a given year for innovation activities performed by enterprises having introduced a technologically new or improved product (or service) or process over a period of three years ending in the year of expenditure.

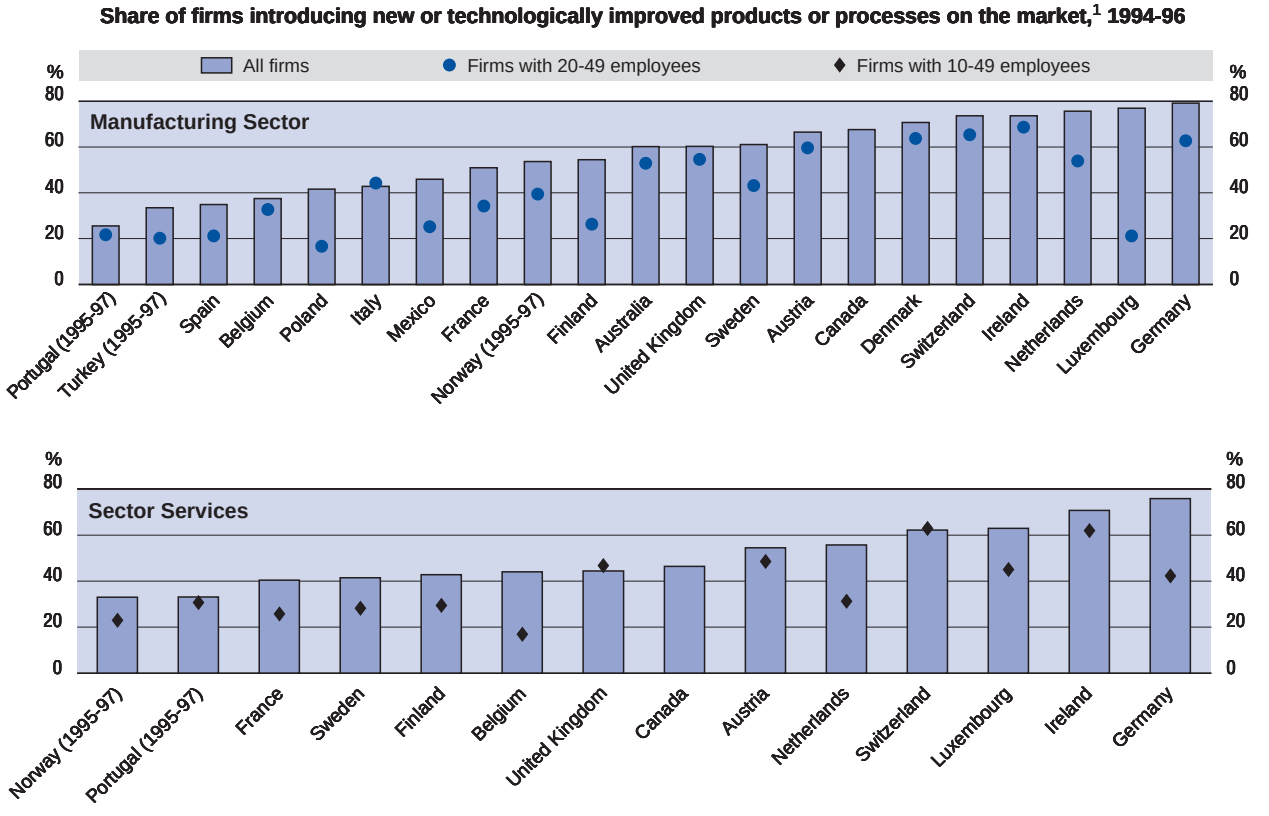
Few enterprises keep separate records of innovation expenditure other than R&D, and many firms have difficulty reporting innovation expenditure. Experience has shown, however, that they are able to give acceptable estimates for the non-R&D portion. Another difficulty is the issue of extramural expenditure for innovation activities, which is not available separately for most enterprises. Therefore, special care has to be taken to avoid double-counting when aggregating individual firm numbers to industry or national figures.

The number of firms having introduced at least one technologically new or improved product or process has been weighted by the number of employees, so as not to underestimate the weight of large firms. Unweighted results would give an unduly large weight to the mass of small firms, and the results would be heavily skewed towards the responses of such firms.

For more details, see Annex, Table A.11.1.

A.11. Innovation expenditure and output





1. Weighted by number of employees.
Source: Eurostat; OECD, STI/EAS Division, May 2001.

A.12.1. Patent applications to the European Patent Office (EPO)

- Patent-based statistics are widely used indicators of the output of inventive activity. There were 82 846 patent applications filed by OECD countries at the European Patent Office (EPO) in 1997 (priority year), a 37% increase from 1990. Almost half of the total patent applications filed at the EPO are from European Union countries, far above the shares of the United States (29%) and Japan (17%). However, the European Union's share most likely overestimates its actual share in world inventions owing to the "home advantage" factor, as patents taken at the EPO primarily reflect the domestic market of the European countries.
- Germany leads the large European countries, accounting for 20% of the total EPO patent applications, about three times France's share.
- The number of patent applications from Korea, the Slovak Republic, New Zealand and Turkey increased by more than 20% annually, far above the OECD average of 5%. This indicates that the "home advantage" bias is not significant as far as growth rates are concerned.
- To reduce the effect of country size, patent applications are related to size of population. Viewed in this way, differences in the propensity to patent of the three major OECD regions are smaller than differences in absolute numbers. Patent applications relative to population are highest in Switzerland (295), Sweden (227) and Germany (210).
- Patent intensity (patent applications as a share of business R&D expenditure) is far higher for the European Union (0.3) than for the United States (0.1) and Japan (0.2). This is partly due to the "home advantage" factor, because once patent intensity is calculated using data from "triadic" patent families, the ratio of patents to business R&D expenditure is lower for the European Union than for Japan (see A.12.2). Since the mid-1990s, this ratio has increased more rapidly in the European Union than in the United States and Japan.

Patents as indicators of technological performance

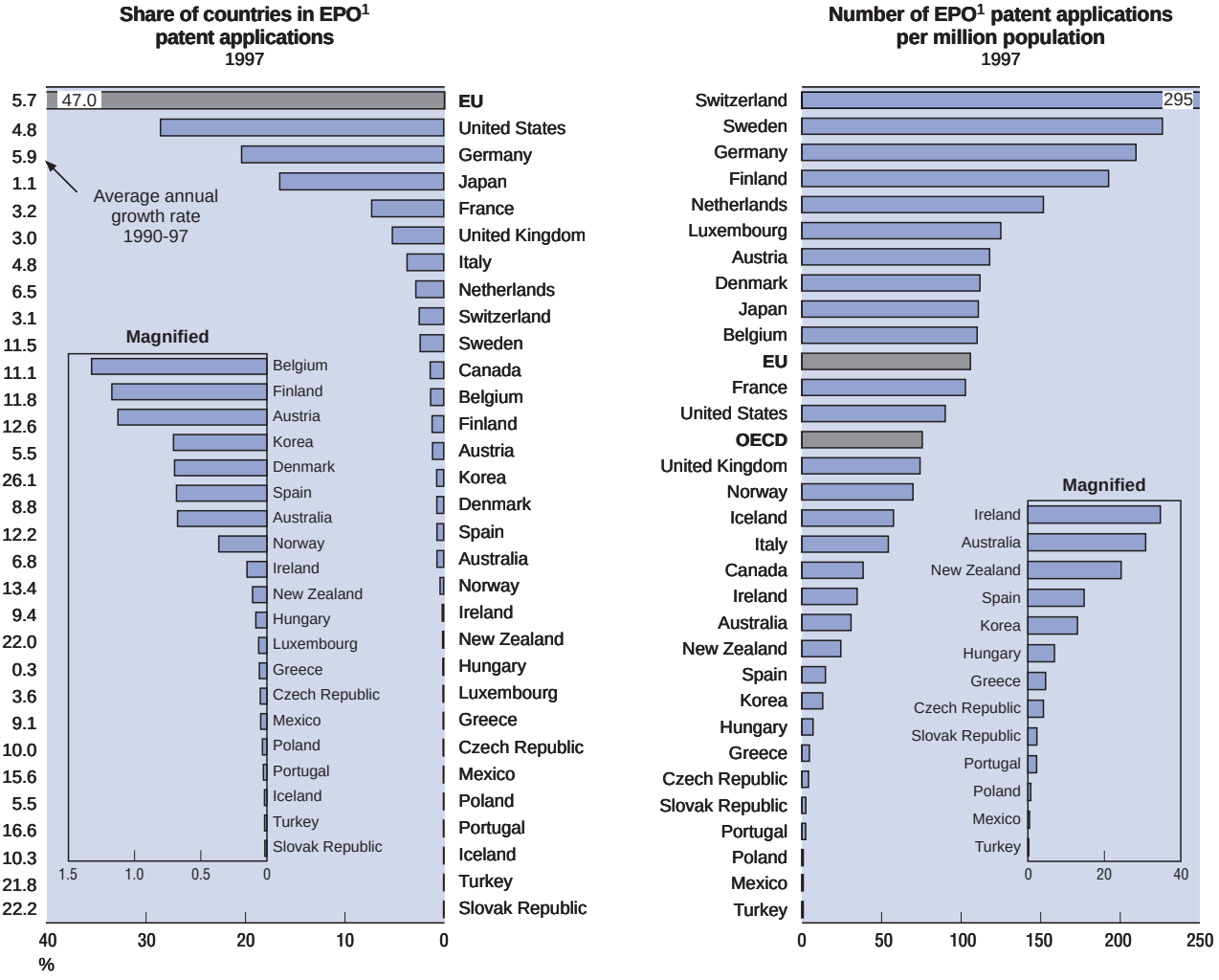
Patent data are readily available from patent agencies, and they contain much information (applicant, inventor, technology, claims, etc.). Patent indicators have some weaknesses, however. For instance, many inventions are not patented, and the propensity to patent differs across countries and industries. 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.

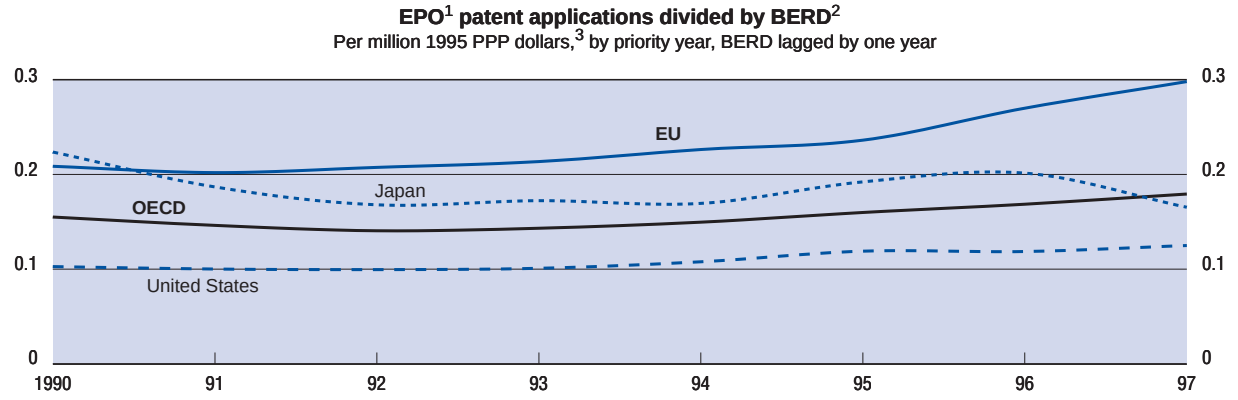
- *Geographical distribution of patents.* Three main criteria can be used: *i*) counts by priority office (country where the first application is filed, before protection is extended to other countries); *ii*) counts by the inventor's country of residence, which indicates the inventiveness of the local 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 counting patents 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 also 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.
- *The 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. Some 40% of options are not exercised and thus never become applications. When counting, it is inappropriate to mix PCT applications with other types. 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 OECD, "Using Patent Data as Science and Technology Indicators – Patent Manual", Paris, 1994.

For more details, see Annex, Table A.12.1.

A.12.1. Patent applications to the European Patent Office (EPO)





1. The patent data presented here refer to patent applications to the European Patent Office (EPO) by inventor's country of residence and priority date, using a fractional counting procedure.
2. Business enterprise expenditure on R&D.
3. 1995 dollars using purchasing power parities.

Source: OECD, Patent database, May 2001.

A.12.2. Patent families

- Patent indicators are generally based on patent applications and/or patents granted by the national patent offices and/or regional patent offices (such as the European Patent Office – EPO). A major weakness of existing patent indicators is a bias due to the "home advantage" factor. To overcome this problem, the OECD has developed indicators based on "patent families".
- In 1995, there were about 32 000 patent families in the OECD area. The United States accounted for about 35%, followed by the European Union (32%) and Japan (27%). The shares of patent families contrast sharply to those obtained from EPO data (A.12.1).
- When the "home advantage" is eliminated, the gap between the shares of major regions in patent applications is reduced. For example, using EPO data (A.12.1), the share of the European Union in 1995 is about 14 percentage points above the United States (reference year 1995). In the patent families data, the European Union's share is about 3 percentage points below that of the United States.
- When population size is taken into account, Switzerland is the country that patents the most by far in the OECD area. In 1995, there were close to 100 patent families per million population in Switzerland, far above Sweden (74) and Japan (69). High ratios of patent families to population are also observed in the northern European countries and the United States (42). In contrast, Turkey, Poland, Mexico and Greece have a low patent-to-population ratio.
- Japan has a high patent intensity (patent applications as a share of business R&D expenditure) compared with the European Union and the United States. The ratio of patents to business R&D expenditure of the European Union and the United States is similar. This is a different picture from that obtained with EPO data (see A.12.1).

Patent families

Patent-based indicators provide a measure of the output of a country's R&D: its inventions. However, the methodologies 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 high heterogeneity of patent values within a single office. The aim of building patent families is to suppress 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 (when a first application in a country – the priority – is then extended to other offices). The patent family indicators compiled by the OECD relate to patents applied for at the European Patent Office (EPO), the US Patent & Trademark Office (USPTO) and the Japanese Patent Office (JPO).

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 thus only concern patents taken in the same set of countries. The geographical influence on patenting disappears as the measures are not longer influenced by the region in which the patents are taken; in general, patent indicators suffer from a "home advantage" bias as a country will take more patents in its domestic market than in another region.

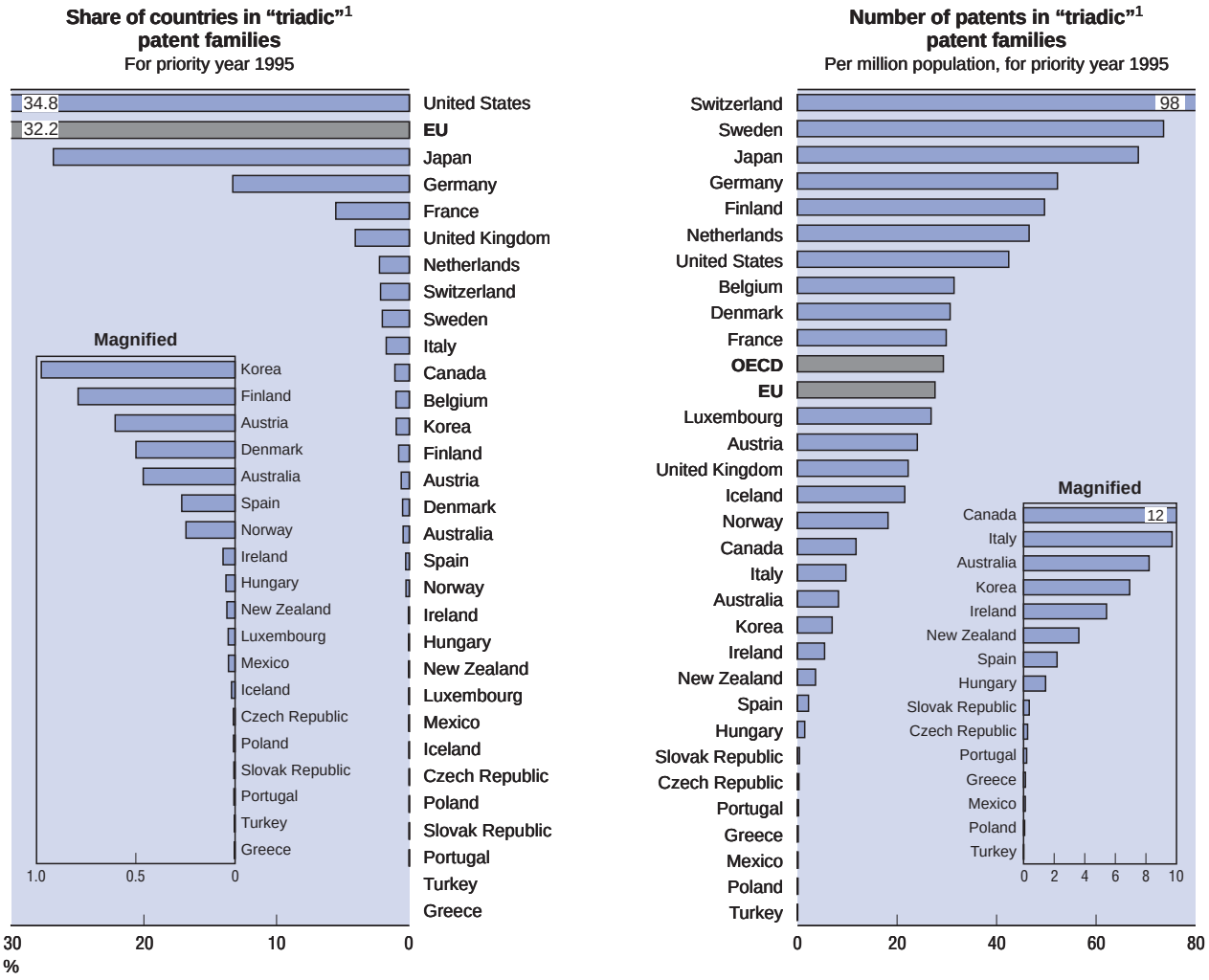
To create a family, a patent must be filed in several countries. The patentee takes on the additional costs to extend protection to other countries only if it seems worthwhile to do so. Thus, patents that are members of families will generally be of higher value than those filed only in a single country.

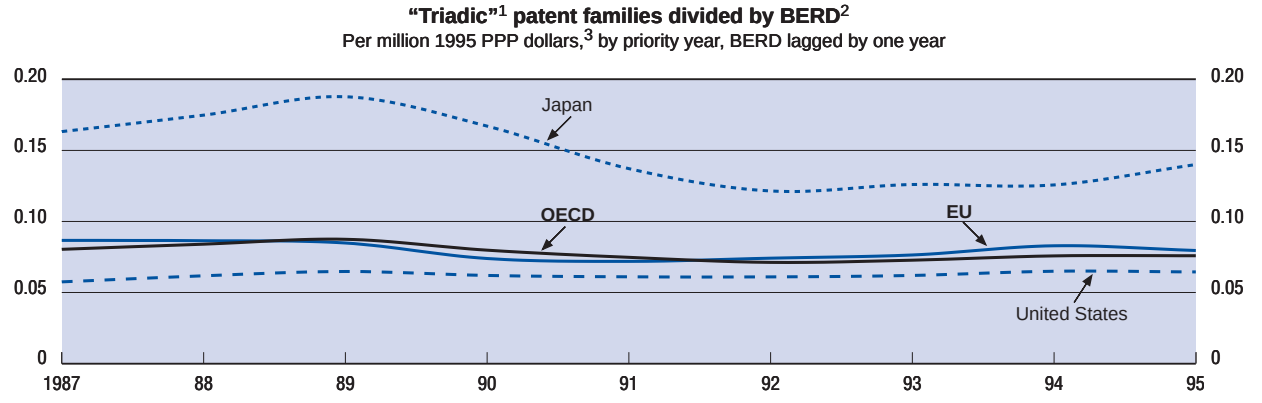
As for traditional patent counts, it is important to rely on a method for counting patent families:

- *Geographical distribution*: patent families are based on a fractional count by country of residence of the inventors (see A.12.1).
- *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 to an element 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 A.12.1).

For more details, see Annex, Table A.12.2.

A.12.2. Patent families





1. European Patent Office (EPO), US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO).
2. Business enterprise expenditure on R&D.
3. 1995 dollars using purchasing power parities.

Source: OECD, Patent database, May 2001.

A.13. Scientific publications

- Publications are the major output of scientific research. With the increase in scientific activity and the strong incentive for researchers to publish (publications are used to evaluate researchers in many countries), the number of journals and articles has long been growing steadily. By 1997, the scientific output of the OECD area amounted to around half a million articles annually.
- The number of scientific publications relative to the population is high in Switzerland and in the Nordic and English-speaking countries. In Switzerland, scientific publications per capita are over three times the OECD average.
- In terms of absolute numbers, five countries produced more than two-thirds of the OECD total in 1997: the United States (35%), Japan (10%), the United Kingdom (9%), Germany (9%) and France (7%). The combined share of these five countries in scientific publication is similar to their combined R&D expenditure, which was about 80% of the OECD total in 1997.
- The scientific output of OECD countries varies considerably. In the Nordic countries, most of the articles are in the life sciences, while in Central and Eastern European countries, the physical sciences account for the largest share.
- In the fields of physics, chemistry and social and behavioural sciences, the scientific output of the United States and Japan differs significantly. In physics and chemistry, Japan's share of articles in physics and chemistry is about double that of the United State. In contrast, the social and behavioural sciences account for some 13% of all scientific publications in the United States but only around 1% in Japan.

Scientific publications

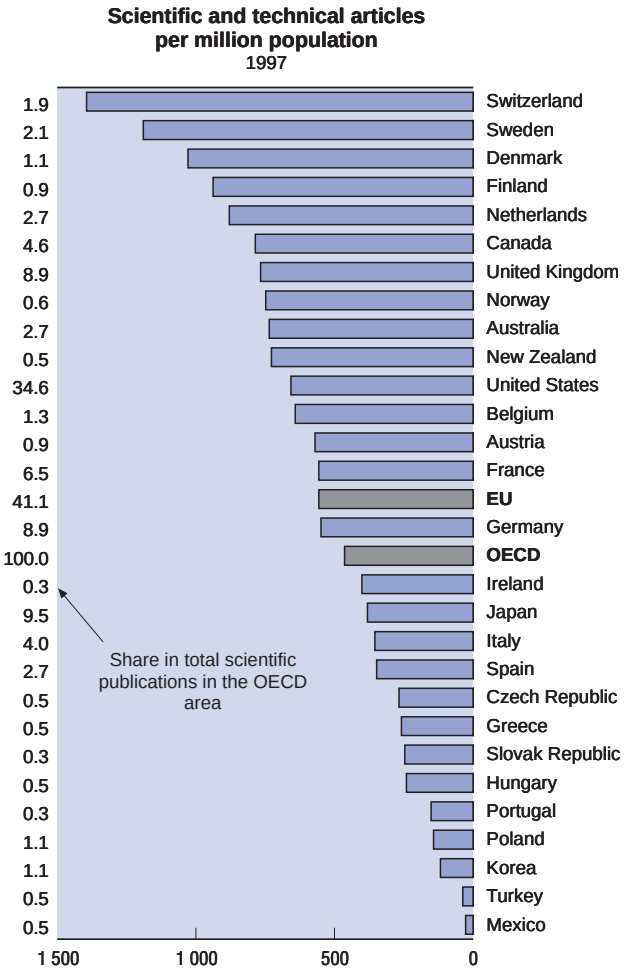
The output of scientific research is varied: it includes improvement of skills (especially for doctorates and post-doctorates), new scientific instruments and intermediate products, new methods, prototypes and publications. The last of these is the major output in that it partly captures the others.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

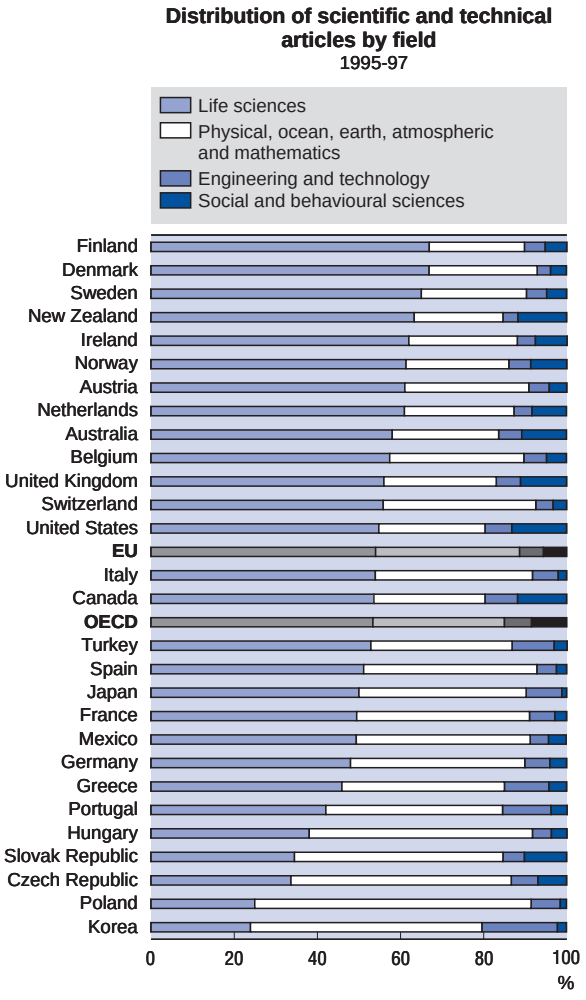
Scientometrics, the domain of science which is concerned with measuring scientific output, addresses various types of counts of scientific publications. Publication counts are affected by certain statistical difficulties:

- The propensity to publish differs across countries and across scientific fields, biasing the relationship between actual output and publication-based indicators.
- Most journals are published in English. This tends to favour researchers from English-speaking countries (although this bias seems to be decreasing as researchers in most countries are becoming more able to communicate in English).
- As publishing is increasingly used as an instrument for evaluating researchers in university and government laboratories, 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 (*e.g.* country level), citation-weighted counts do not give a very different result from simple counts.

Articles 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.

A.13. Scientific publications





Note: 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.

Source: *National Science Foundation, Science and Engineering Indicators 2000.*

Note: Articles are assigned to fields based on journal field classifications developed by CHI Research, Inc. based on a classification of journals covered by the Institute for Scientific Information's Science and Social Science Citation Indexes (SCI, SSCI).

B.1. Investment in information and communication technologies (ICTs)

- Investment in physical capital plays an important role in growth, by expanding and renewing the capital stock and enabling new technologies to enter the production process. Investment in information and communication technologies (ICTs) has been the most dynamic component of such investment in recent years.
- The available data for a number of OECD countries show that ICT investment rose from less than 15% of total non-residential investment in the business sector in the early 1980s to between 15% and 35% in 1999.
- The growth rate of real ICT investment accelerated in the second part of the 1990s. Investment in software led, accounting for 25-40% of the contribution of ICTs to overall investment growth.
- Real growth in ICT investment has been fuelled by a steady decline in the relative prices of computer components. On the basis of harmonised price indexes, constructed using the US as a benchmark, the rate of decline in the prices of computers and office equipment has increased from the 1980s to the 1990s, even doubling in some cases.

Measuring investment in ICT equipment and software

A correct measurement of ICT investment series 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 across OECD countries based on national accounts (SNA93) vary considerably, especially as regards the measurement of investment in software, the deflators applied, the breakdown by institutional sector and the time coverage. Several measurement issues should be considered when analysing ICT investment series across countries.

Estimates of current prices for ICT *investment, especially for software*. 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 that 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, treating expenditure on software as capital expenditure in the national accounts is very recent and the methodologies used 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.

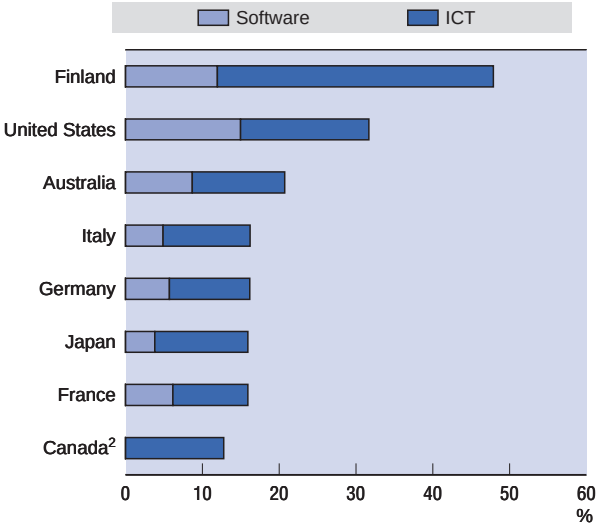
Choice of index number formula: fixed-weight versus chain aggregation. Some countries value real GDP components, such as investment, in terms of a fixed set of prices (*e.g.* real investment in 1999 evaluated at 1995 prices is interpreted as the value of 1999 investment had all prices remained constant at the 1995 base year). One drawback of this "fixed-weight" methodology is the so-called "substitution bias" problem. Quantities of assets with declining relative prices, such as computers, tend to grow faster; the further back the base year, the larger the weight of the faster growing categories. As a result, the growth rate of a real variable changes with the choice of the base year.

Real investment: deflation methods and adjustment for quality. The measurement of investment in real terms requires price indexes that take changes in the quality of products into account. This is particularly important for products subject to rapid technological change such as computers or ICT products more generally. Computer quality has changed significantly; in constant quality terms (*i.e.* taking improved performance into account), computer prices have fallen very rapidly, while computer quantities (quality-adjusted) have risen very rapidly. Some statistical agencies apply so-called "hedonic" techniques to capture price changes in ICT goods. In the case of computers, the method consists in relating changes in computer prices to product characteristics such as memory, MIPS (million instructions per second) and processor speed. In the United States, hedonic deflation methods are used for most components of ICT investment. Other countries (*e.g.* Canada, Japan, France) are starting to introduce hedonic adjustment to measure real computer investment and sometimes base their deflators on the US ones. The measure of real investment shown here is based on "harmonised" price indexes for ICT products. The "harmonised" series assumes that price ratios between ICT and non-ICT products have the same time patterns across countries, with the United States as the benchmark.

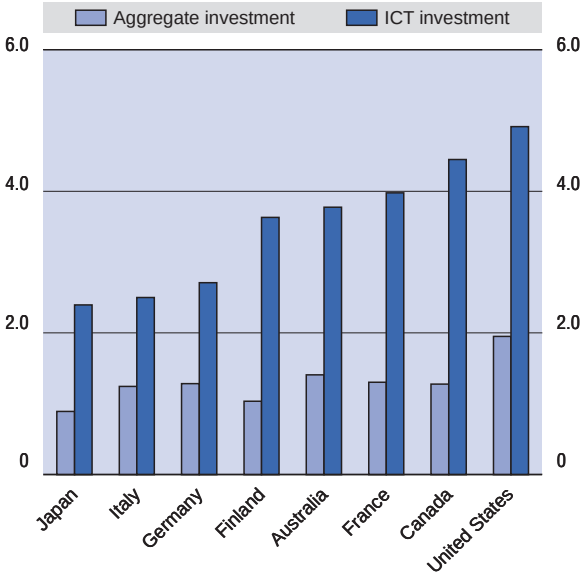
For further information see Colecchia, A., "The Contribution of ICT to Output Growth", STI Working Paper 2001, OECD, forthcoming; and Schreyer, P., "Computer Price Indices and International Growth and Productivity Comparisons", STD/DOC(2001)1, OECD.

B.1. Investment in information and communication technologies (ICTs)

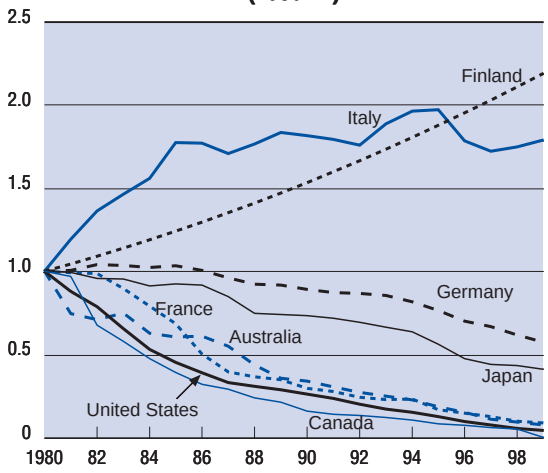
ICT investment[1] in selected OECD countries, 1999
Percentage of non-residential gross fixed capital formation, business sector



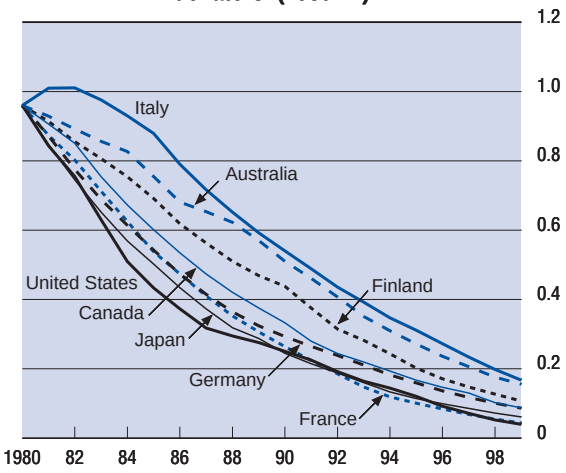
Growth in ICT investment at constant prices in selected OECD countries, 1999 index (1990 = 1)
Based on harmonised deflators for ICT products[3]



Price indexes for ICT products national deflators[4] (1980 =1)



Price indexes for ICT products, harmonised deflators[3] (1980 =1)



1. ICT equipment is defined here as computer and office equipment and communications equipment; software includes both purchased and own account software.
2. Investment in software not available.
3. Estimates of "harmonised" price indexes assume that price ratios between ICT and non-ICT products have the same time patterns across countries, with the United States as the benchmark.
4. Australia, France, Japan, United States: national accounts deflators for computers and peripheral equipment. Canada, Germany, Italy: national accounts deflators for computer and office equipment. Finland: smoothed office, accounting and computing machinery production price from OECD/STAN database.

Source: OECD, STI/EAS estimates based on National Accounts (SNA93), March 2001.

B.2. Information and communication technology (ICT) expenditures

- Participation in the information economy is partly reflected in the financial resources countries devote to it. In 1999, OECD countries spent over 7% of GDP on ICT goods and services, up from almost 6% in 1992.
- The ICT intensity (ICT expenditures as a percentage of GDP) of Japan has been rising rapidly since 1995 and, in spite of a decline in 1998-99, it is now level with the United States (8%). The European Union lags the other major regions by about 2 percentage points. This masks a wide gap between northern European countries with an intensity well above the OECD average – Sweden (9.2%); the Netherlands (8.0%); the United Kingdom (7.8%); Denmark (7.4%) – and southern European countries with an intensity at the bottom end of the scale, in the range of 4.5%. New Zealand ranks first for ICT intensity (10.6%), followed by Sweden (9.2%), Switzerland (8.7%) and Australia (8.7%).
- Telecommunication accounts for the largest share of ICT expenditures in all countries and this reflects the link between basic infrastructure and economic development. When telecommunication spending is excluded from ITC data, the ranking of countries by ICT intensity shows the resources dedicated to the diffusion of the other ICT components for a given telecommunication infrastructure. The figures point to a considerable gap between Sweden, Switzerland, Canada, the United States, the Netherlands and the United Kingdom, with an expenditure for hardware, software and other IT services of over 5% of GDP, on the one hand, compared to 1-1.5% in Greece, Turkey and Mexico on the other hand.
- For all ICT good and services, the increase in ICT intensity over the 1992-99 period is mostly driven by investment in telecommunications infrastructure, particularly in countries such as southern and central European countries that are catching up in terms of infrastructure. For the other countries, software has been the most dynamic component of ICT expenditure.

Measuring expenditures in ICT goods and services

Official international data on expenditures for ICT goods and services could be derived from data gathered to measure purchasing power parity (PPP) price baskets, input-output tables or national accounts. However, in the first two cases, data collection is carried out only at particular points in time. For example, the latest available year in the OECD PPP database is 1996, and input-output tables are also not uniformly available across countries. Internationally comparable national accounts statistics lack the level of detail that allows for identifying investment in and consumption of ICT goods and services.

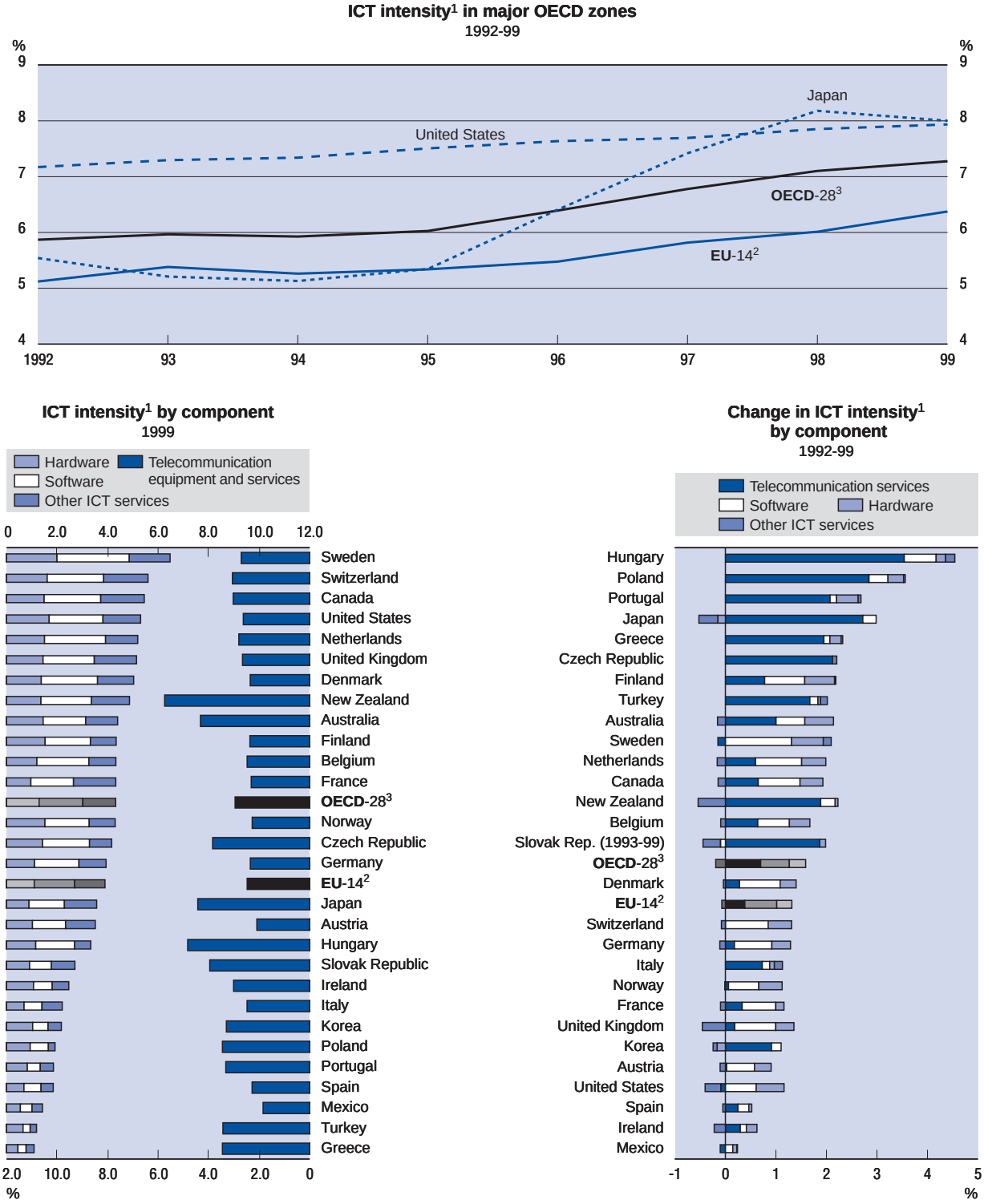
The main international source for expenditure on ICT goods and services currently remains International Data Corporation (IDC), that collects data on both internal and external spending in three main categories of products and services: *i*) Information technology (IT) hardware; *ii*) IT services and software; and *iii*) telecommunications equipment and services.

The IDC data refer to purchases by corporations, households, schools or government agencies. It therefore includes both investment and consumption and refers to the whole economy; however, small businesses are not included in the survey. Hence, calculations based on IDC figures are not comparable to those used in B.1, which are based on investment data from national accounts.

For IT hardware and telecommunications services, the data used are those published in WITSA/IDC.* For software, IDC data were used to obtain estimates of software investment, rather than expenditure, including both purchased and own account software. Other ICT services refers to IT services and IT internal spending (spending that cannot be directly tied to a vendor), excluding the software services component used to estimate software investment.

* World Information Technology and Services Alliance (WITSA) *Digital Planet – The Global Information Economy,* 2000.

B.2. Information and communication technology (ICT) expenditures



1. ICT expenditures as a percentage of GDP.
2. Excludes Luxembourg.
3. Excludes Luxembourg and Iceland.

Source: OECD, based on World Information Technology and Services Alliance (WITSA)/International Data Corporation (IDC), 2000.

B.3. Occupations and skills in the information economy

- Indicators of skills required for the information economy are of increasing importance to policy makers, especially because of growing ICT skills shortages.
- Generally, when new technologies are introduced into the production process, demand drops for low-skilled workers and rises for high-skilled workers. However, not all ICT-related occupations are high-skill. Also, adoption of ICT at firm level does not necessarily translate into an increase in the economy-wide demand for higher skills. For example, new technologies may replace middle-level managers, who are typically considered high-skilled workers.
- The figures reported here are based on a comparison of data on occupations from the US Current Population Survey (CPS) with ISCO-88 occupation data from the Eurostat Labour Force Survey. While the data are not strictly comparable in terms of levels, the distribution of high- and low-skill ICT-related occupations in the United States and the European Union shows an interesting pattern. Although the share of ICT workers is growing everywhere, in 1999 the US ICT workforce appeared to be relatively more high-skilled (77%) than that of the European Union (56%). However, the European average hides wide disparities.
- High-skill ICT workers are the most rapidly growing component of high-skilled workers; over the 1997-99 period, Finland had an annual growth rate of about 49%. Only in Portugal, which has a very low share of high-skilled ICT workers, is the share declining. In 1999, high-skilled ICT workers represented between 0.6% and over 3% of total employment in EU member states. The EU average was 1.6% (about 2.4% in the United States). The shares were highest in the Netherlands (3.2%) and Sweden (2.8%) and lowest in Greece (0.6%) and Portugal (0.9%).
- Computer workers represent the largest component of high-skilled ICT workers. Over the 1995-99 period, the gap in computer workers between northern and southern European countries appeared to be increasing.

Measuring ICT-related skills

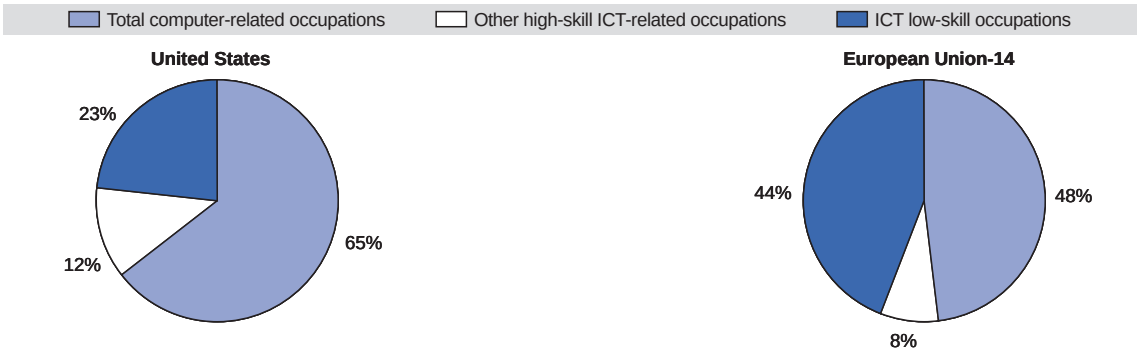
Skills are difficult to measure, and proxies are often used to capture observable characteristics such as educational attainment, on the supply side, and occupations, on the demand side. While an international classification of occupations exists (ISCO-88, International Standard Classification of Occupations, 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 selected. In order 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 self-declared occupations.

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 here defined as the sum of ISCO-88 213 and 312.

For the United States, data from the Current Population Survey (CPS), 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).

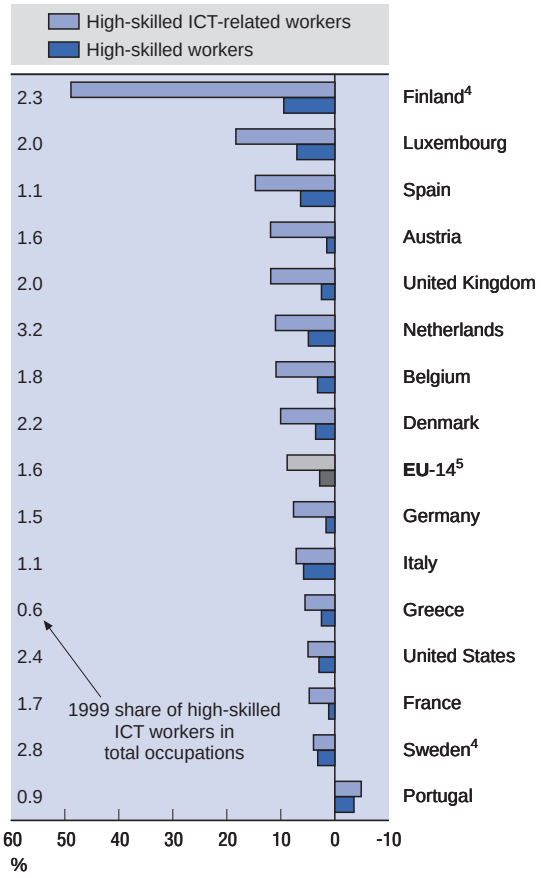
B.3. Occupations and skills in the information economy

Share of high and low skills within the ICT-related occupations in the European Union[1] and the United States, 1999



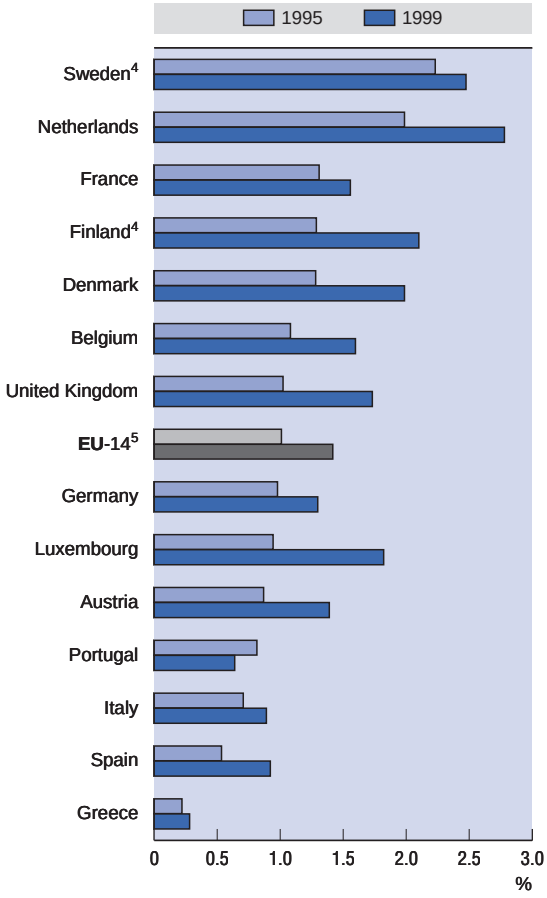
High-skilled ICT workers[2] and high-skilled workers[3] in the European Union and the United States

Average annual employment growth (1995-99)



Computer workers[2] in the European Union

Share in total occupations, 1995 and 1999



1. Excludes Ireland.
2. High-skill ICT-related occupations are defined here as ISCO-88 classes 213, 312 and 313, while computer workers refer only to the sum of the first two classes, see box.
3. High-skill occupations refer to ISCO-88 classes 1, 2 and 3.
4. 1997 instead of 1995.
5. 1995 estimated.

Source: OECD, based on the Eurostat Labour Force Survey and the US Current Population Survey, May 2001.

B.4.1. Infrastructure for the information economy

- The extremely dynamic pace of network expansion makes some traditional indicators of ICT network size less useful for policy analysis. For example, penetration rates of standard access lines measure single connections whereas some technologies now provide multiple communication channels.
- Telecommunication networks continue to expand rapidly. At the end of 1999, OECD countries had more than one network access channel for every two inhabitants, and several had more than one access channel per inhabitant. In terms of standard access lines, Sweden has long enjoyed the highest penetration rate in the OECD area, and it remains the OECD country with the highest PSTN (public switched telephone network) in terms of fixed network penetration. However, other networks, such as wireless and high speed networks, also need to be taken into consideration in terms of access to communication.
- The Nordic countries maintain a clear lead over the rest of the OECD area when the connectivity provided by wireless networks is taken into account. The leading countries are Norway, Sweden, Iceland and Finland. All had more than 120 telecommunication access paths per 100 inhabitants by the end of 1999.
- Differences in the development of individual access paths in OECD countries will depend on the development of the network, the relative pricing structure and the level of competition for a particular access technology. Countries with low penetration rates for standard access lines (Czech Republic, Hungary, Poland, Mexico, Turkey and to a lesser extent Ireland) have continued to expand their network in the 1990s. In countries with unmetered telecommunications pricing (*e.g.* Australia, Canada, the United States), a second residential line is generally used to keep a line free for telephony.
- In countries with metered telecommunication charges, it is sometimes as economical to install an ISDN connection as to have two standard access lines. Access to mobile communications, typically higher in the Nordic countries, has spread rapidly to other countries, especially to those ones where operators have actively-marketed prepaid cards.
- With increased demand for higher speed Internet access, new access channels are emerging and ISDN lines are likely to be rapidly overtaken by digital subscriber lines (DSL) or cable modems. By the end of 2000, there were 22 countries with commercial high-speed digital subscriber line services – up from just seven in 1999. High-speed Internet access *via* cable modems was available in 21 OECD countries. This is beginning to change the access landscape. For example, although Korea has had a low penetration rate for some Internet access indicators, its broadband penetration rate increased from 0.6 per 100 inhabitants at the end of 1999 to 10.3 at the end of February 2001. Only two other countries – Canada (4.54) and the United States (2.25) – had exceeded two broadband subscribers per 100 inhabitants by the end of 2000. The trend towards greater infrastructure competition in local markets will encourage the shift towards higher speed access technologies.

Measuring the telecommunication network

In the past, the penetration rate for standard access lines provided a reasonable indication of the extent to which basic connection is available to users. In the new environment, use of standard access lines would present a distorted view of network development. Indeed, in more than half of OECD countries, the number of standard access lines has begun to decrease in recent years as the take-up of ISDN (Integrated services digital network) has increased.

A different methodology than the one traditionally used for the penetration rate of standard access lines is used to measure 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.

For a true appreciation of the 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 line (DSL).

For further information, see OECD, *Communications Outlook* 2001, Paris, 2001.

For more details, see Annex, *Tables* B.4.1 *and* B.4.2.

B.4.1. Infrastructure for the information economy

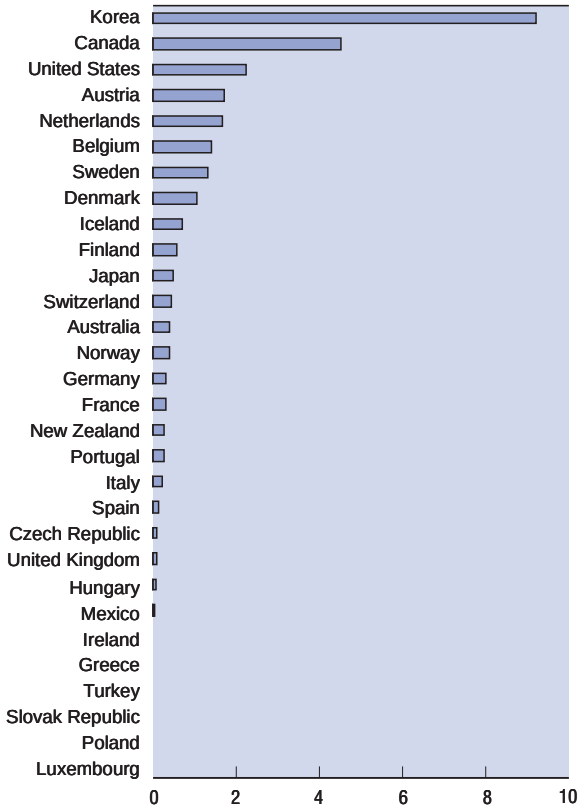
Access paths[1] per 100 inhabitants, 1999

1. Telecommunication access paths include the total of fixed access channels (standard telecommunication lines and ISDN connections) and cellular mobile subscribers.

Source: OECD, *Communications Outlook 2001*, May 2001.

Broadband penetration rates in OECD countries

Number of DSL[1] and cable modem lines per 100 inhabitants, January 1st 2001



1. Digital Subscriber Lines.

Source: OECD, Telecommunications database, June 2001.

B.4.2. Internet infrastructure

- The Internet continues to grow at an extremely fast pace. By October 2000, the number of Internet hosts in the OECD area reached 90 million, up from 54 million in July 1999.
- The number of hosts per 1 000 population gives an indication of the relative development of Internet infrastructure in various countries. In October 2000, the OECD average was 81.5 hosts per 1 000 inhabitants; the EU average was 37.4 hosts per 1 000 inhabitants. The United States is far ahead of the other OECD countries, with more than 234 hosts per 1 000 inhabitants in October 2000. Other countries with over 100 hosts per 1 000 inhabitants are Finland (159), Sweden (106), Canada (127), Iceland (131) and Norway (116). By way of contrast, Mexico and Turkey had 3.8 and 3.3 hosts per 1 000 inhabitants, respectively.
- While the Nordic countries have among the highest penetration rates, only Sweden matched the growth rate achieved in the United States and Canada between July 1999 and July 2000. Accordingly, even among the leading countries, recent growth rates have been uneven. Thus, large gaps between countries remain.
- While the number of Internet hosts gives an indication of the size of the Internet, the number of active Web sites provides information on countries' relative development of Internet content. The United States leads Web site hosting, with 12.6 million Web sites in July 2000. Germany ranks second, hosting 1.8 million Web sites in July 2000. The United Kingdom (1.4 million) was the only other country with more than 1 million Web sites.
- In terms of number of Web sites per capita, there were 17.5 Web sites per 1 000 inhabitants across the OECD region and 12.7 per 1 000 across the European Union in July 2000. The United States had the highest penetration of Web sites in July 2000, with 46.5 per 1 000 inhabitants. Norway (30.4), Canada (24.7), the United Kingdom (24.2), Germany (22) and Denmark (21) were the other countries with more than 20 Web sites per 1 000 inhabitants.

Measuring the size and growth of the Internet

The number of Internet hosts is one of the most commonly used indicators of Internet growth. It includes any computer system connected to the Internet (via full-time or part-time, direct or dial-up connections), although some systems may not be accessible owing to technologies such as firewalls. Hosts can thus be thought of as an indicator of the minimum size of the public Internet.

Surveys of Internet hosts are undertaken by several entities. Every six months, Network Wizards, on behalf of the Internet Software Consortium (ISC), carries out the longest running host survey. RIPE conducts monthly surveys of Internet hosts for countries in their region. A third source of statistics is Netsizer's Internet Sizer from Telcordia Technologies which provides daily updates of the number of Internet hosts based on a random sample of IP addresses throughout the day. Telcordia provides hosts by country as well as by top-level and second-level domains. Hosts by country are computed by redistributing the hosts with three-letter domains (*e.g.* .com, .net, etc.) to individual countries and then adding them to the hosts by two-letter country domains.

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.

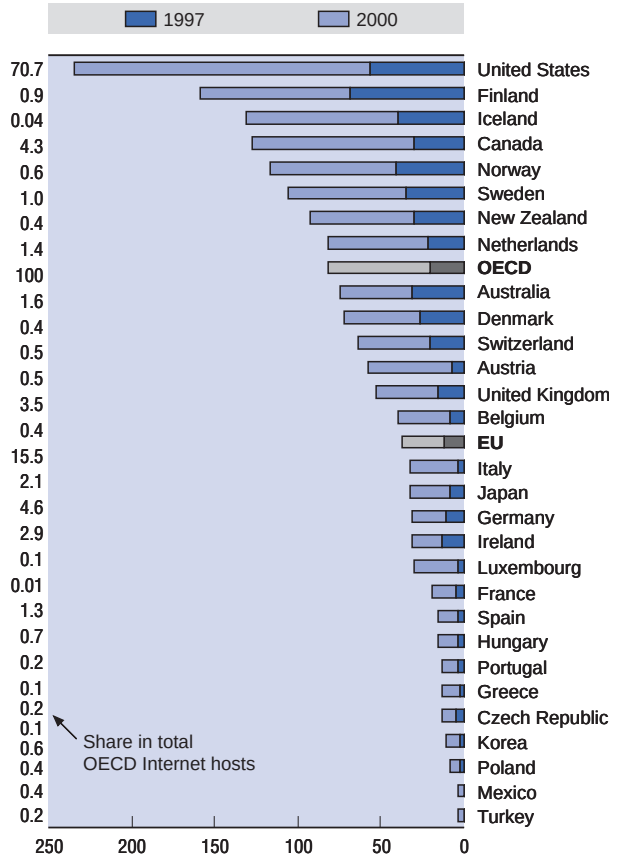
- A host is a domain name that has an IP (Internet Protocol) address "record" associated with it.
- Internet Protocol (IP) addresses are the numbers used to identify computers, or other devices, on a TCP/IP network.
- Servers are computers that host World Wide Web content.
- A top-level domain name (TLD)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

For more information, see OECD, *Communications Outlook* 2001.

For more details, see Annex, Table B.4.3.

B.4.2. Internet infrastructure

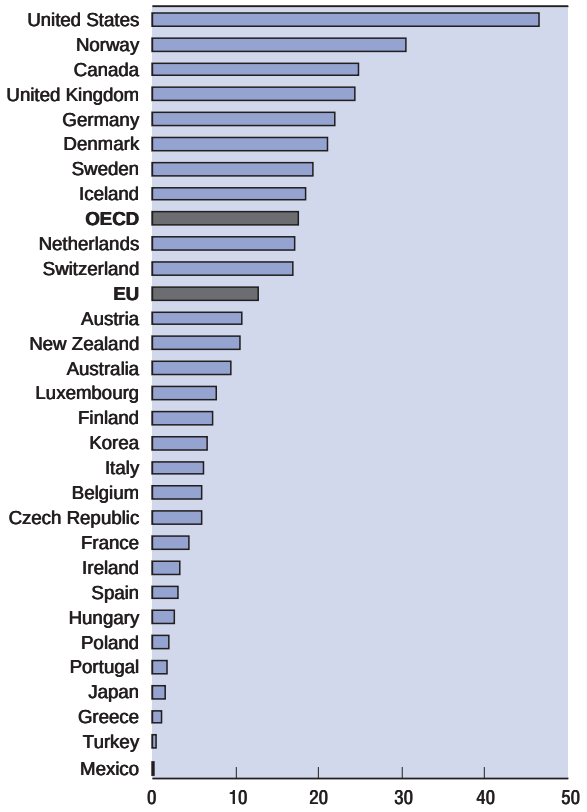
Number of Internet hosts per 1 000 inhabitants, gTLDs adjusted,[1]
July 1997-October 2000



1. Global top-level domains (gTLDs) are distributed to country of location.

Source: OECD, *Communications Outlook 2001*; OECD calculations based on Netsizer (*www.netsizer.com*), May 2001.

Web sites per 1 000 inhabitants
July 2000



Source: OECD, *Communications Outlook 2001*; OECD calculations based on Netcraft (*www.netcraft.com*), May 2001.

B.5.1. Internet use and hours spent on line

- For technologies based on networks, such as the Internet, the more people connected, the greater the potential benefits of the network. Among policy makers, there is tremendous interest in the diffusion and use of the Internet, but as yet there are few internationally harmonised measures.
- At the end of 1999, there were at least 49.7 million Internet subscribers in the United States, close to 11 million in Japan and in Korea, 9 million in Germany, more than 7.4 million in the United Kingdom and 6.2 million in Canada. Between 1998 and 2000, subscriber numbers grew rapidly, fuelled by "subscription free" Internet service providers (ISPs). Consequently, the data shown simply represent a snapshot. Nevertheless, they give a picture of relative Internet take-up at the end of 1999. A ranking of countries in terms of Internet subscribers per 100 population shows high levels of take-up in Korea, Sweden, Denmark and Canada.
- In itself, the number of subscribers does not indicate the extent to which the Internet is actually accessed and used. As an indicator, average online time per subscriber deserves far more attention in international comparisons. It is particularly important when considering the growth of electronic commerce in different countries.
- An increasing number of ISPs report the amount of on-line time per subscriber on a monthly or quarterly basis. Broadly speaking, in countries where metered telecommunication charges apply, usage generally falls within a band of 5 to 9 hours a month. In 1999, this was the case for the Czech Republic, France, Germany, Portugal, Switzerland, and the United Kingdom. Some exceptions were Sweden and Norway, where average use was up to 12 hours a month. By way of contrast, average use is much higher in countries, such as New Zealand and the United States, with unmetered Internet access.

Measuring Internet access using information on subscribers

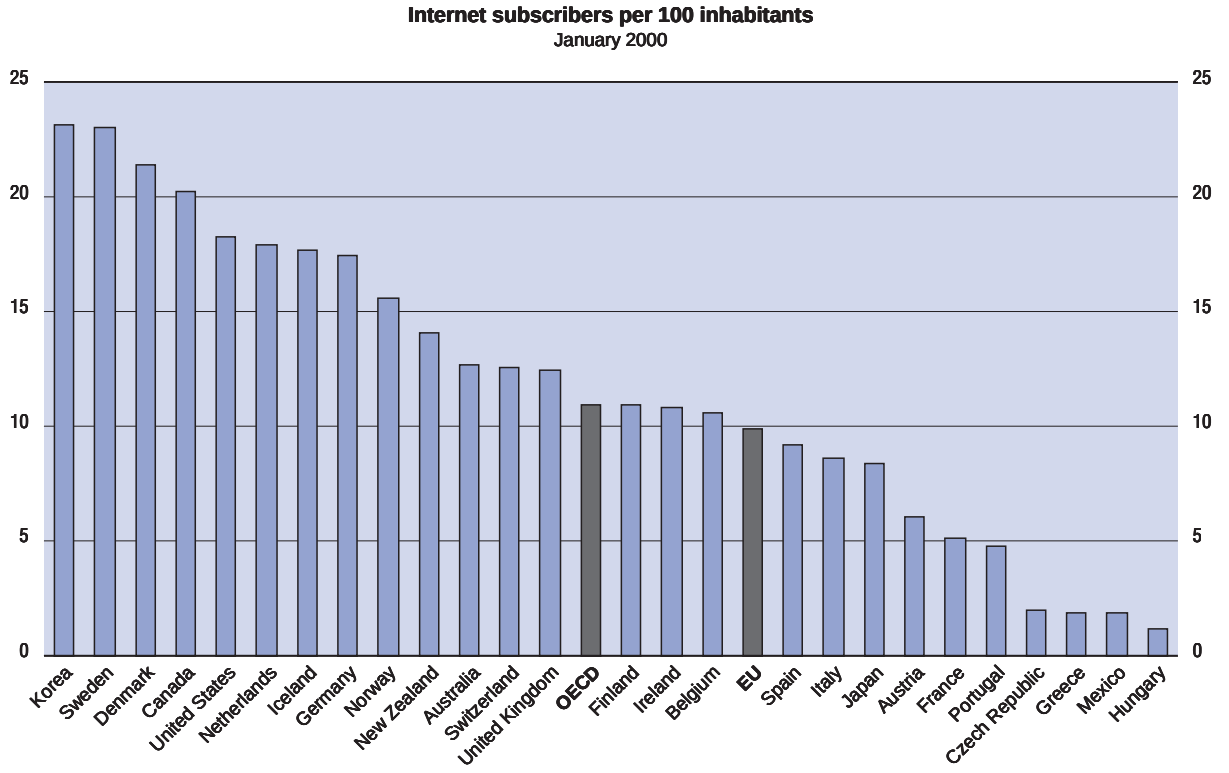
Many public-sector and private-sector organisations report on the number of "users", "people" or "households" on line. National statistical agencies typically measure Internet access on the basis of surveys of businesses, households or individuals (see box in B.5.2). Statistical offices also collect information on Internet users by surveying 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 the length of connection and volume of data downloaded. One problem relating to such surveys is the dynamism of the ISP industry, which is reflected in high numbers of entries, exits and mergers.

An alternative approach is to compile information on Internet subscribers by country. This information can be obtained from reports of the largest telecommunication carriers 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 the best placed to know subscriber numbers on an industry-wide basis and market share. Moreover, "subscribers" has a more specific meaning than, for example, "users". For most carriers, "subscribers" means registered Internet accounts that have been used during the previous three months.

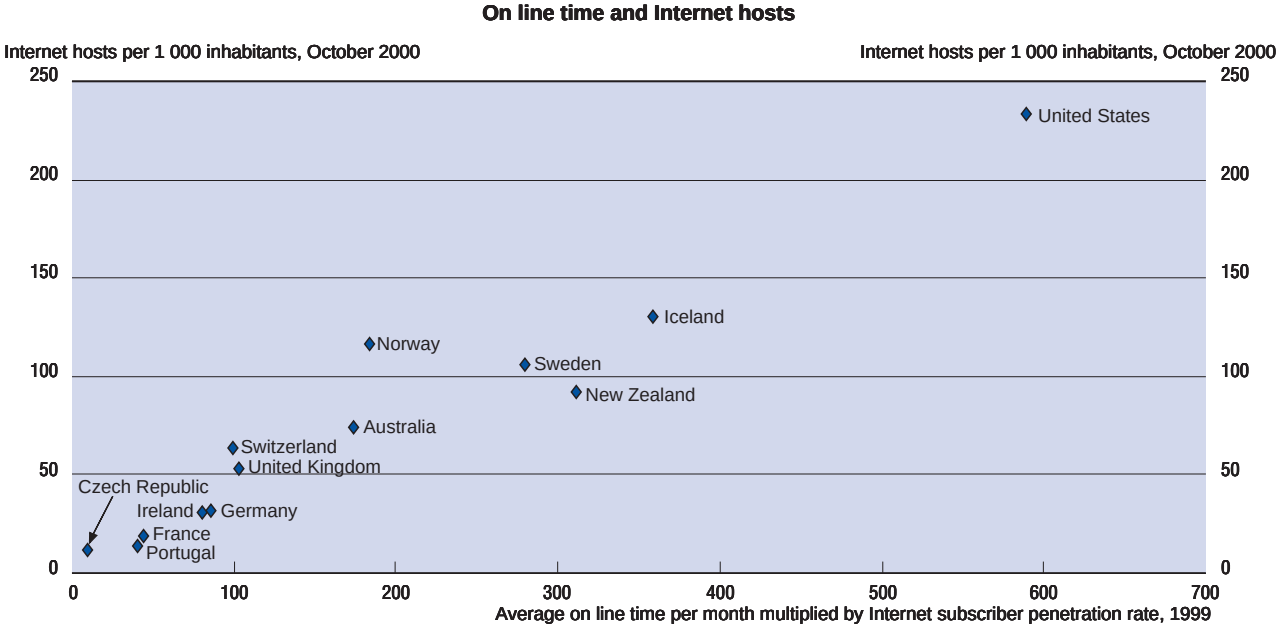
For further information, see OECD, *Communications Outlook* 2001.

For more details, see Annex, Table B.5.1.

B.5.1. Internet use and hours spent on line



Source: OECD, Telecommunications database, June 2001.



Source: OECD; Netsizer (*www.netsizer.com*), April 2001.

B.5.2. Access to and use of the Internet by households and individuals

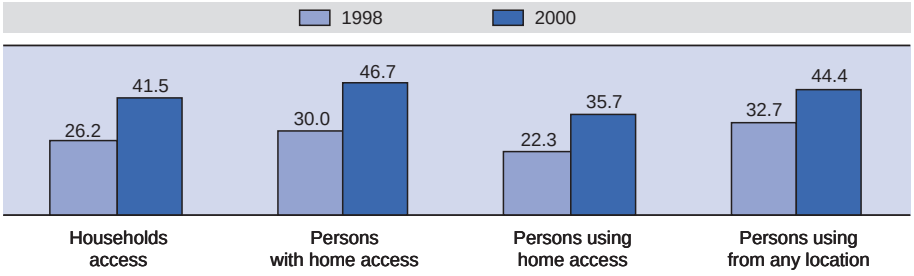
- The growing interest of policy makers in issues such as universal access, the digital divide, consumer trust and privacy protection in the on-line environment has raised demand for indicators on access to and use of ICT, especially the Internet, by households and individuals.
- Personal computers are still the main device used by households to access the Internet. In most countries for which data are available, more than half of all households now have computers. While keeping in mind differences in survey methodologies and household structure, there was a noticeable gap in 2000 between the Netherlands (69%), Denmark (65%) and Sweden (60%) on the one hand, and Italy (28%), France (27%) and Turkey (12%) on the other hand. For Turkey, the figures refer only to households in urban areas; the average penetration rate of computers would be even lower if households in rural areas were surveyed.
- Internet access in households is soaring everywhere, especially in Italy where the access rate grew by 144% between 1999 and 2000, as well as in the United Kingdom (75%), Japan (74%) and France (73%). The propensity of households to access the Internet once they have a home computer differs across countries. It is highest in Sweden, the United States and the United Kingdom and lowest in Germany, where only 34% of households with a computer have Internet access.
- Internet penetration in households is strongly affected by household income. The difference between Internet access in households belonging to the lowest and highest income quartiles is highest in the United States and lowest in Denmark.
- The share of adults using the Internet from any location is also increasing rapidly, and more than half of the adult population now use the Internet in Sweden (68%), Denmark (62%), Finland (54%) and Canada (53%). Apart from Denmark, the share of Internet users is highest in those countries with a relatively lower average Internet price basket over the 1995-2000 period (see B.6).

Measuring Internet access and use with household- and person-based indicators

Over a very short period of time, national statistical offices (NSOs) have made great progress in providing high-quality, timely indicators of ICT use. From an international perspective, the major drawback of official ICT use statistics is that they are based on different standards and definitions 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.

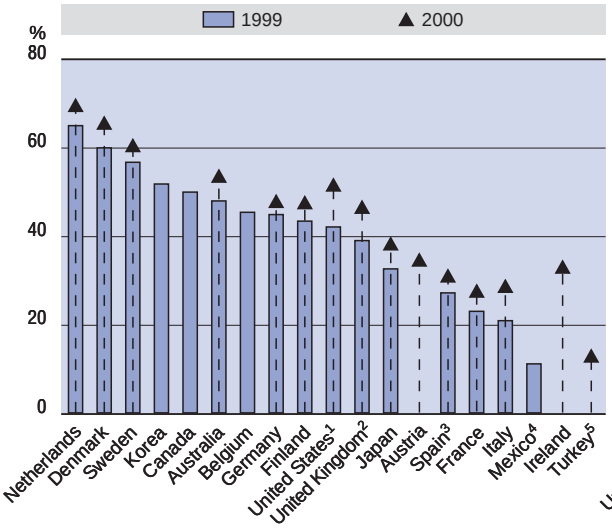
Another important issue for international comparability is the choice between households or individuals as the survey unit. Household surveys generally provide information on both the household and the individuals in that household. Person-based data typically provide information on the number of individuals with access to a technology, those using the technology, the location from 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 ICT use statistics in business). 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 both 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). This complicates international comparisons and makes benchmarking exercises based on a single indicator of Internet access or use quite misleading, since the ranking of countries changes according to the indicator used.

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

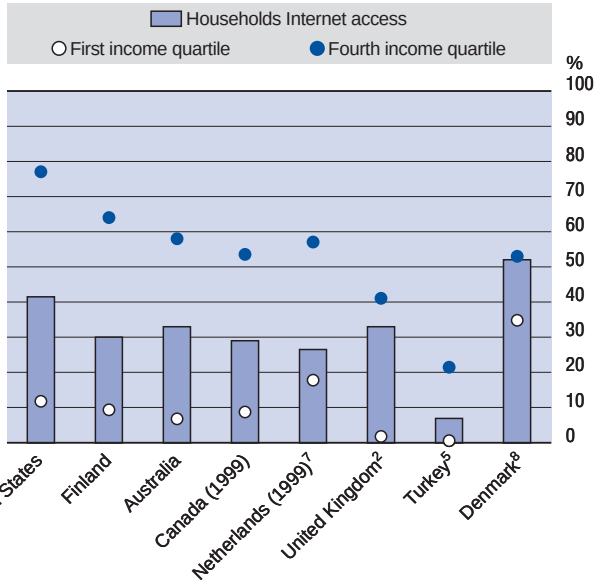


B.5.2. Access to and use of the Internet by households and individuals

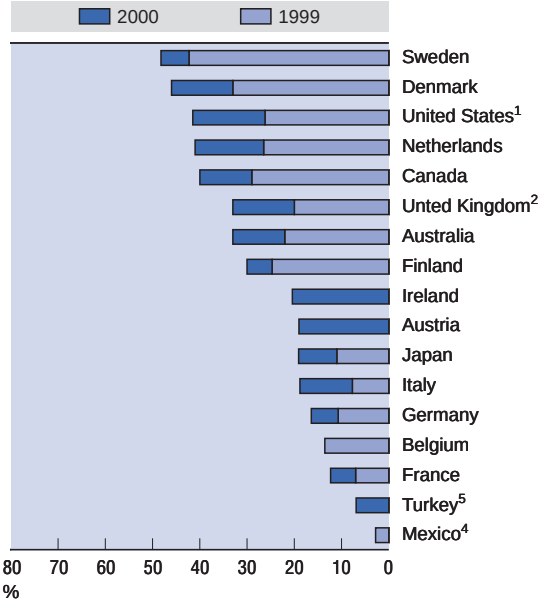
Households with access to a home computer, 1999 and 2000
Percentages



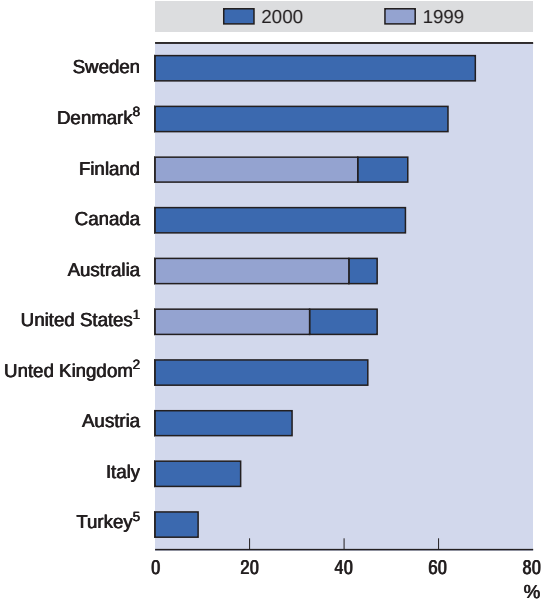
Households with access to Internet by income level,[6] 2000
Percentages



Households with access to Internet,[6] 1999 and 2000
Percentages



Individuals using the Internet from any location,[9] 1999 and 2000
Percentages



1. 1998 instead of 1999.
2. Last quarter 2000.
3. Provisional data
4. Households in urban areas with more than 15 000 inhabitants only.
5. Households in urban areas only.
6. For Denmark, Ireland, the Netherlands and the United Kingdom, access to the Internet via a home computer; for the other countries access to the Internet through any device (*e.g.* computer, phone, TV, etc.).
7. For the Netherlands, first and last deciles instead of quartiles.
8. First quarter 2001.
9. Age cut-off: 16 years and older except for Canada and Finland (15+), Italy (11+) and Australia and Turkey (18+).

Source: OECD, ICT database, July 2001.

B.5.3. Internet access by enterprise size and industry

- International comparisons of ICT access and use suggest interesting patterns but should be interpreted with caution (see box).
- Some 80-90% of all businesses with ten or more employees had access to the Internet in 2000. The share of those businesses that also have a Web home page is increasing extremely rapidly and is highest in Sweden and the United Kingdom.
- In general, Internet access is highest in larger enterprises. While country rankings may change according to the class size, Finland generally has the highest penetration rates. Differences in Internet access in the nine countries for which data are available are greater for smaller enterprises.
- Internet penetration also varies across sectors. The most intensive business users are generally firms in finance and insurance, business services and wholesale trade. Retail trade has the lowest Internet access rates. These patterns are consistent across the seven countries examined. Canada is an exception, as Internet access is higher in manufacturing than in market services.

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

Technology diffusion varies across 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. The "number of businesses" is extremely sensitive to the sample used in a survey. In countries surveying all businesses (no cut-off), like Australia, the smallest firms' results dominate. Using cut-offs, *e.g.* of five or more employees (Denmark, Finland) or of ten or more employees (Sweden, the United Kingdom), shifts the weight to different size groups. One possibility is to compare overall "numbers" weighted by firm size with the weights expressed in terms of turnover or employment. The figures below use Danish data to show the sensitivity of indicators of "proportion of businesses using the Internet" and of "percentage of employment in businesses using the Internet" to different cut-offs and size groups.

Indicators of Internet access weighted by the "number of enterprises" and by "employment in enterprises"
Sensitivity to survey cut-off and enterprise size groups, an example with Danish data

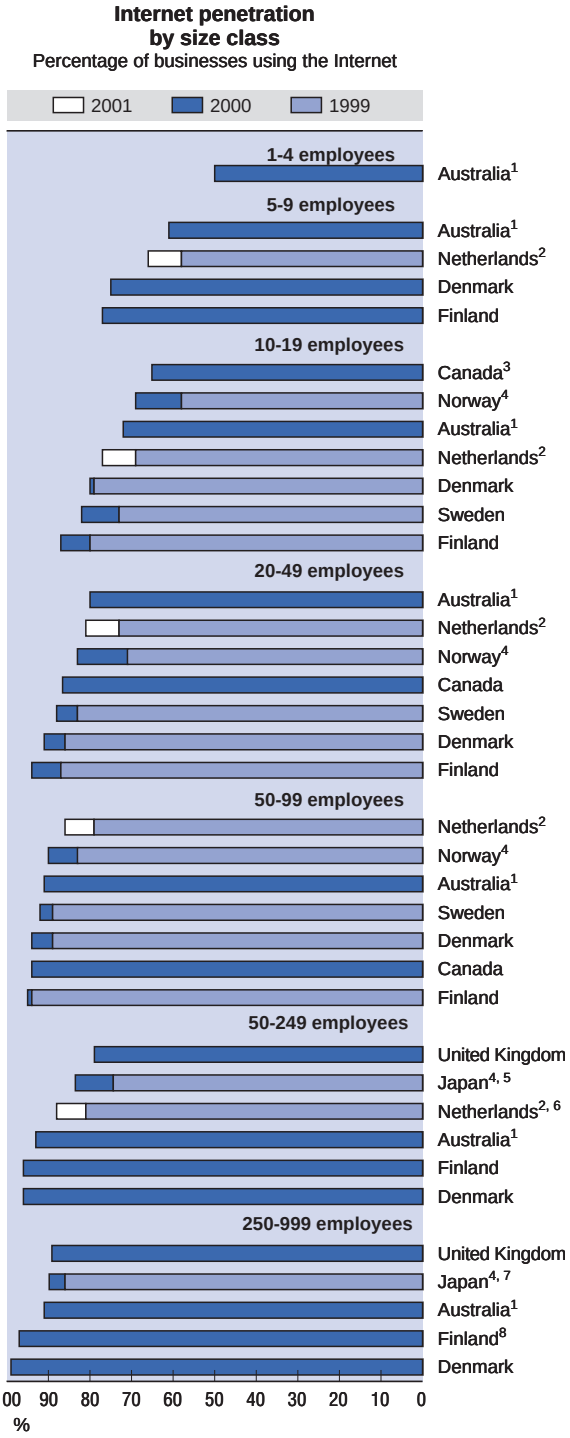
Source: Statistics Denmark, calculations based on *Use of ICT in Danish Enterprises 2000*.

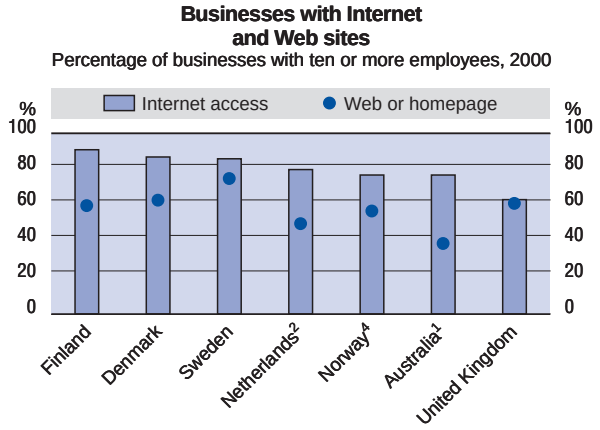
Internet access weighted by employment should not be interpreted as the share of employees with access to the Internet, since this would assume that in each enterprise all workers, or the same proportion of workers, have access to the Internet. For example, in Canada 63.4% of private sector businesses (weighted by revenue) had access to the Internet in 2000, but only 39% of employees had access to the Internet. In Denmark and Finland, while the share of businesses with five or more employees with access to the Internet in 2000 was 80% and 84% respectively, the share of employees who used personal computers and had access to the Internet, was 40% and 44%, respectively.

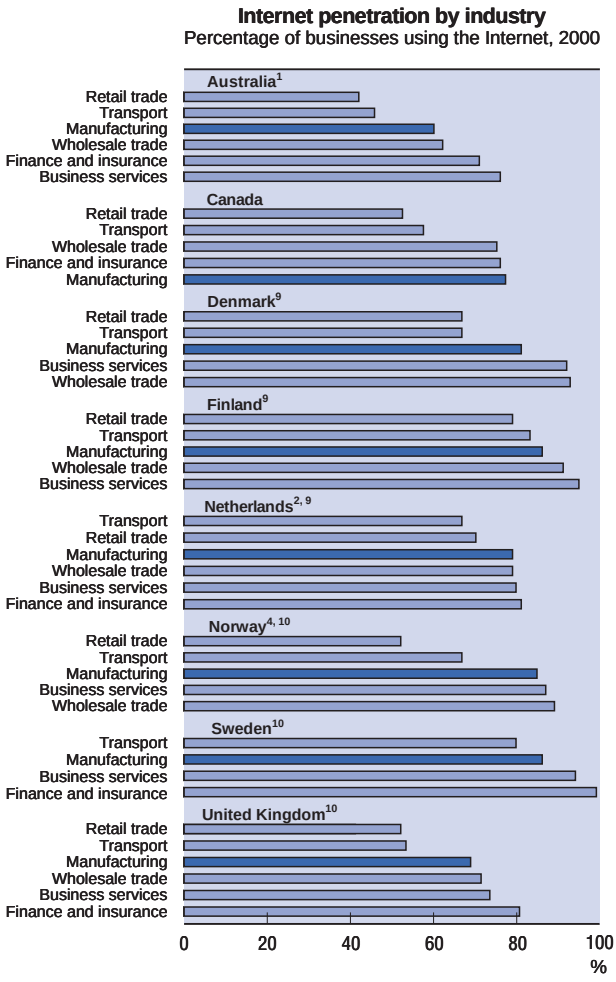
It should also be borne in mind that international comparisons of ICT usage indicators are affected by differences in the sectoral coverage of surveys. While figures for Canada and Australia cover the whole private sector, Danish and Finnish surveys cover selected sectors; for example they exclude finance and insurance.

International comparisons are made more difficult by the lack of harmonisation in the definitions of the indicators. The OECD has worked with the Voorburg Group and Eurostat to develop a model survey of the use of ICT in the business enterprise sector. The draft survey, approved by the OECD in April 2001, is currently being finalised. It 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.

B.5.3. Internet access by enterprise size and industry







1. 1999-2000.
2. The figure refers to the Internet and other computer mediated networks. 1st quarter 2001.
3. 1-19 employees.
4. Expectations for 2000.
5. 100-299 employees.
6. 50-199 employees.
7. 300-499 employees.
8. 250 and more employees.
9. All businesses with 5 or more employees.
10. All businesses with 10 or more employees.

Source: OECD, ICT database, July 2001

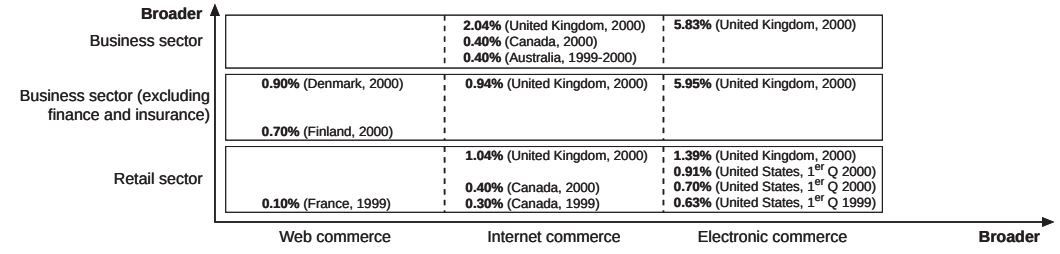
B.5.4. Internet and electronic commerce transactions

- The number of secure servers provides a picture of a country's infrastructure for Internet commerce. This indicator, based on Netcraft's Secure Socket Layer (SSL) surveys, measures the number of servers with a secure software commonly used for purchasing goods and services or transmitting privileged information over the Internet.
- Over the period 1998-2000, there was an increase of 470% in the number of secure servers in OECD countries. The United States accounted for more than 70% of the OECD total of secure servers in July 2000; the United Kingdom was second with 4.8%. At the same point in time, Iceland and the United States recorded the most intensive use, with 241 secure servers per million inhabitants. Other countries above the OECD average of 83 per million inhabitants were Australia (149), Canada (128), New Zealand (127), Switzerland (120), Luxembourg (103) and Sweden (92).
- National statistical surveys of business and individuals provide information on the extent to which the Internet is used to carry out transactions. Although rising fast, this is still limited, as only 20-30% of larger businesses that use the Internet do so to sell goods and services, while 30% to more than 70% use it to purchase. Hence, except in Australia, two to three times as many businesses use Internet commerce for purchases than for sales. Smaller businesses that use the Internet appear to have roughly the same propensity to sell over the Internet as larger ones in Australia, Denmark, Finland and the Netherlands.
- Few countries currently measure the value of Internet or electronic sales (see box). Total Internet sales in 2000 ranged between 0.4% and 2% of total sales, while electronic sales (including those over all computer-mediated networks) reached almost 6% in the United Kingdom.
- Less than one-fifth of Internet sales were business-to-consumer transactions in Canada and the United Kingdom. In general, the proportion of Internet users buying over the Internet is still quite low and varies widely across countries. It is highest in Sweden, where 43% of individuals using the Internet ordered products in 2000, followed by the United Kingdom (33%) and the United States (30%).

Measuring electronic commerce: OECD definitions of Internet and electronic transactions

Despite very recent improvements, internationally comparable statistics that measure the level, growth and composition of electronic commerce are still lacking. Comparisons of electronic commerce transactions are hampered by the use of different definitions across countries as well as by differences in survey coverage. Below are some examples of official estimates of electronic commerce transactions using narrower to broader definitions. The United States does not produce economy-wide estimates and uses a broad definition that includes sales over "Internet, extranet, EDI or other online systems". France currently only publishes estimates of Web retail sales. Figures for the Nordic countries refer to sales via a Web page and do not cover the financial sector. Australia and Canada have very similar definitions and coverage of Internet transactions.

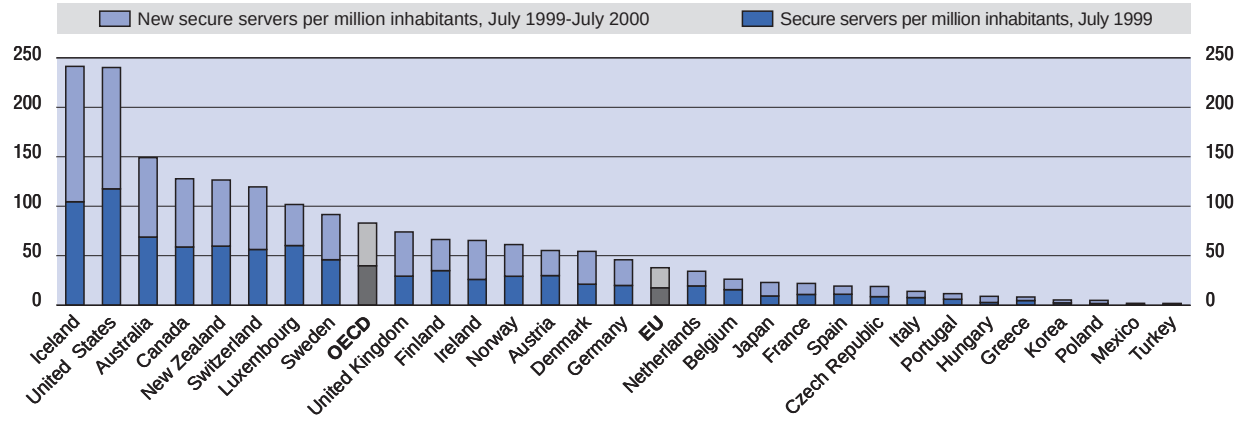
Official estimates of Web, Internet and electronic commerce transactions. Percentage of total sales or revenues



In order to improve the comparability of estimates of electronic commerce transactions, OECD Member countries endorsed, in April 2000, two definitions of electronic transactions (electronic orders) based on a narrower and broader definition of the communications infrastructure. According to the OECD definitions, it is the method by which the order is placed or received, not the payment or the channel of delivery, which 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 the interpretation of the electronic commerce definitions, and encouraged Member countries to take such guidelines into account when developing their questionnaires.

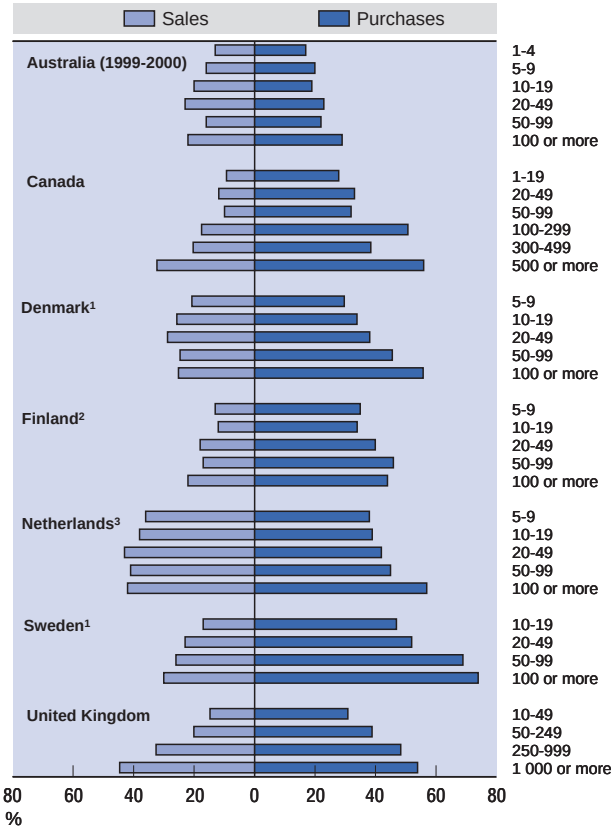
B.5.4. Internet and electronic commerce transactions

Internet commerce developments measured by the number of secure Web servers



Source: OECD, *Communications Outlook 2001;* Netcraft (*www.netcraft.com*), May 2001.

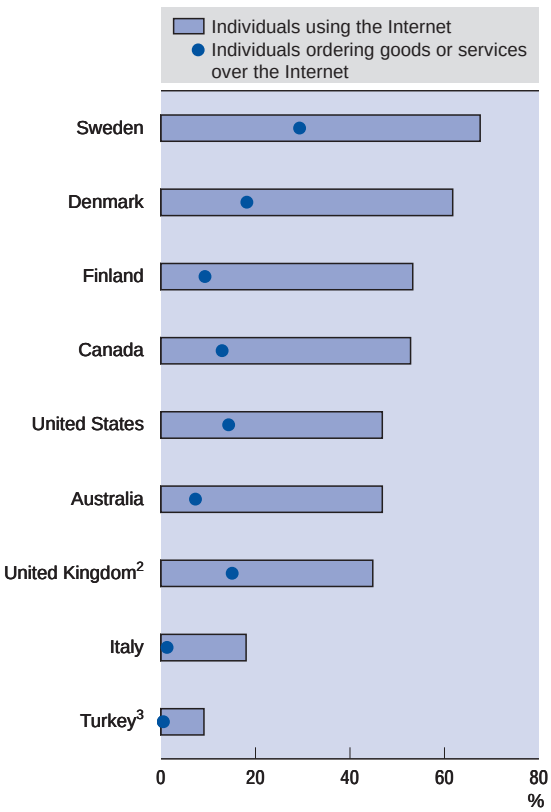
Internet/Web purchases and sales by country and enterprise size class, 2000



1. Orders received or made via a Web home-page.
2. Percentage of businesses able to receive or send orders via a Web home-page.
3. Orders received or made over the Internet and other computer mediated networks. 1st quarter 2001.

Source: OECD, ICT database, July 2001.

Percentage of individuals using and ordering goods and services over the Internet, 2000[1]



1. Age cut-off: 16 years and older except for Canada and Finland (15+), Italy (11+) and Australia and Turkey (18+).
2. Last quarter 2000.
3. Individuals belonging to households in urban areas.

B.6. The price of Internet access and use

- The investment and diffusion of ICT depends not only on the cost of investment goods themselves (see B.1), but also on the costs of communication and use once the hardware is linked to the network.
- Increased competition in the telecommunications industry has been driving down these costs. For example, prices of leased lines, which provide the infrastructure for business-to-business electronic commerce, have fallen significantly in recent years, particularly since 1998, following widespread liberalisation in the communication sector in Europe. However, large price differences remain. The Nordic countries have the lowest charges, at about one-fifth of the OECD average. Elsewhere, the least expensive countries are Switzerland, Ireland, the United Kingdom, the United States and France. At the other end of the spectrum, the Czech Republic and Hungary have charges of about 2.5 times the OECD average.
- Another barrier to ICT diffusion is the cost of Internet access for consumers. Prices continue to differ widely and the differences are among the largest for any communication service. Price differences for consumer access reflect the fixed and variable telephone charges set by telecommunications firms, but also the fees charged by the leading Internet service providers (ISPs).
- For 40 hours of Internet access, at peak and off-peak times, differences in Internet access cost for consumers are even more noticeable. At peak times, countries which traditionally have had unmetered local calls – Australia, Canada, Mexico, New Zealand, the United States – are among the least expensive. Turkey, where a call allowance is included in the line rental, is also inexpensive.
- Price differences seem to affect Internet take-up. Countries with lower average access prices over the period 1995-2000, such as Canada, Finland and the United States, typically have more Internet hosts (see B.4.2) than those with high average costs. Other factors also matter. Korea now has low average prices for consumer access but has traditionally had expensive leased line connection for business. This appears to be reflected in a high subscriber penetration but a low host penetration.

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 transport high volumes of traffic lower prices than the public switched telephone network (PSTN) and control over their telecommunication 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.

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

The comparisons use the prices in place as of 15 September 2000 for the largest telecommunication carrier in each country. Changes that had been announced but were not yet available are not included.

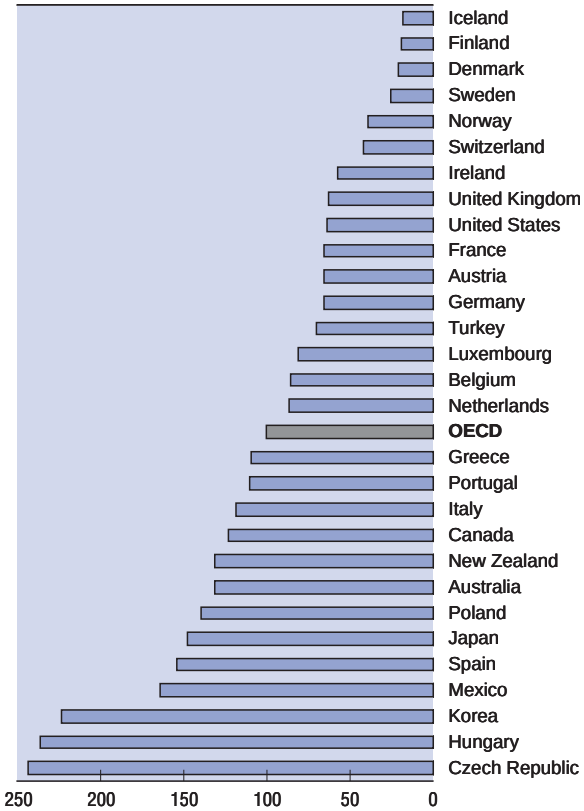
- Fixed charge: the monthly line rental for residential users.
- Usage charge: the price of local telephone calls (or special rates for Internet access) to an ISP for residential users.
- ISP charge: the price of Internet access from the largest telecommunication operator.
- Peak and off-peak times: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

For further information, see OECD, *Communications Outlook* 2001, Paris, 2001 and *www.oecd.org/dsti/sti/it/cm*

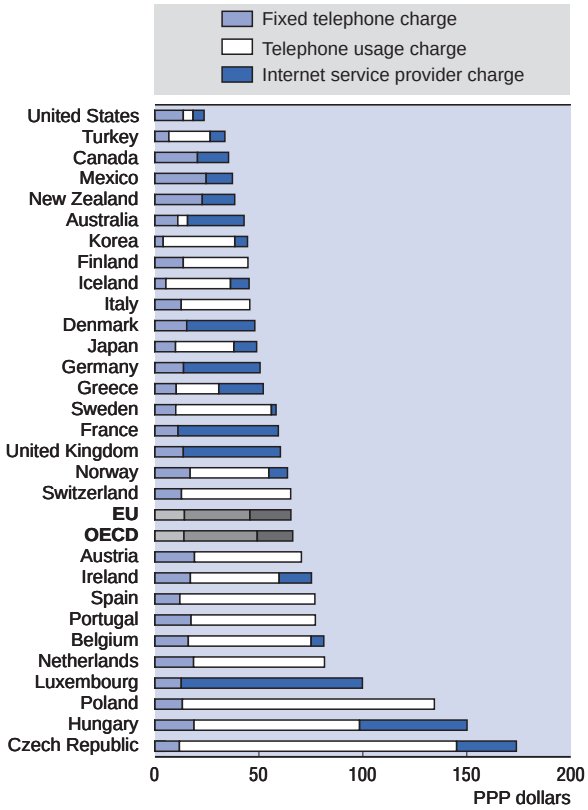
For more details, see Annex, Tables B.6.1. *and* B.6.2.

B.6. The price of Internet access and use

Price of leased lines in the OECD area, August 2000
Charges for basket of national leased lines of 2 megabits per second, OECD average = 100

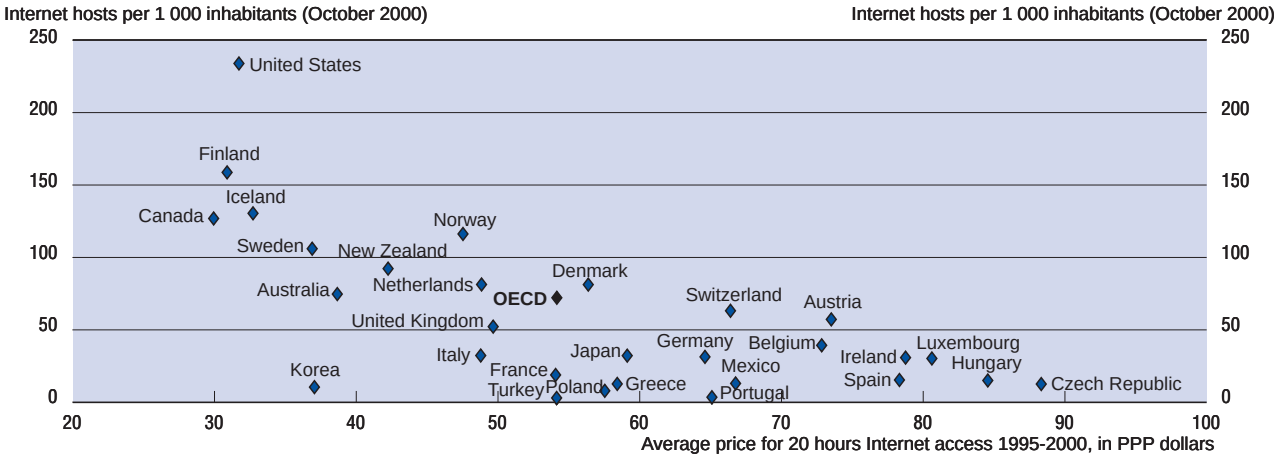


Price for 40 hours of Internet use at peak times, September 2000, in PPP dollars
OECD Internet access basket for 40 hours at peak times using discounted PSTN rates, September 2000[1]



1. In some countries, ISP and PSTN usage charges are bundled and included under the ISP charge.
Source: OECD, *Communications Outlook 2001*, May 2001.

Internet acces prices and Internet hosts[2]



2. Internet access costs include VAT and cover both peak and off-peak.
Source: OECD, *www.oecd.org/dsti/sti/it/cm*; Telcordia Technologies: *www.netsizer.com*, May 2001.

B.7.1. Size and growth of the ICT sector

- In 1998, OECD Member countries agreed on a definition of the ICT sector as a combination of manufacturing and services industries that capture, transmit and display data and information electronically (see box).
- The ICT sector makes a substantial contribution to economic activity in several OECD countries. In 1999, ICT value added represented between 5% and 14% of total business sector value added. The importance of ICT supply has been growing. Rapid growth is apparent not only in countries like Hungary, the Czech Republic and Mexico, which are catching up in terms of infrastructure, but especially in northern European countries, such as Finland, Sweden, Norway, the Netherlands and the United Kingdom. In Finland, the ICT sector's share of value added increased by 4.7 percentage points over the 1995-99 period and now represents over 13% of total business value added.
- In most cases, ICT services, such as telecommunication and computer services, constitute between 70% and 90% of total ICT sector value added. However, countries like Ireland, Finland, Korea, Japan and Mexico are specialised in the manufacture of ICT goods. In Finland, for example, the share of ICT in total manufacturing accounts for almost 20% of total manufacturing value added. Except for Ireland, where computing and office equipment account for almost 10% of manufacturing value added, the largest contribution to economic activity typically comes from the manufacture of telecommunication equipment.
- Most OECD countries already have a well developed telecommunication service sector which is reflected in the size of the ICT sector. 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 Sweden (5.8% in 1999), Ireland (5.4% in 1998), and the United Kingdom (4.1% in 1999).

OECD definition of the ICT sector

In 1998, OECD countries reached a consensus on an industry-based definition of the ICT sector based on 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:

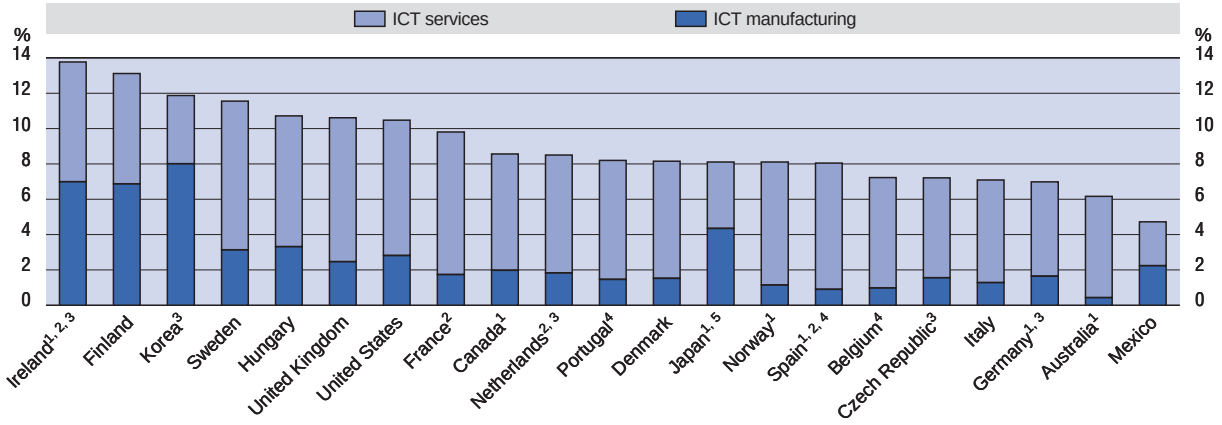
Manufacturing: 3000 – Office, accounting and computing machinery; 3130 – Insulated wire and cable; 3210 – Electronic valves and tubes and other electronic components; 3220 – Television and radio transmitters and apparatus for line telephony and line telegraphy; 3230 – Television and radio receivers, 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.

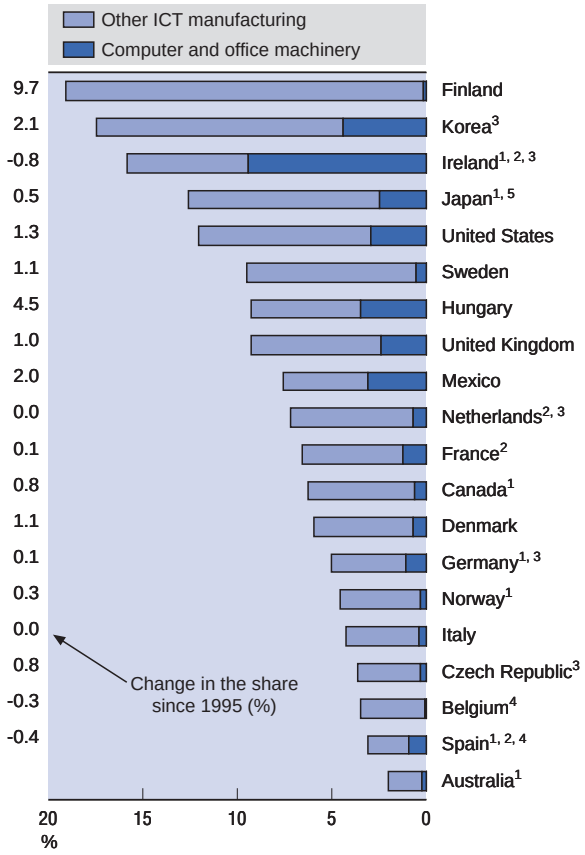
The existence of a widely accepted definition of the ICT sector is the first step towards comparisons across time and countries. However, the definition is not yet consistently applied and data provided by Member countries have been combined with different data sources to estimate ICT aggregates compatible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

B.7.1. Size and growth of the ICT sector

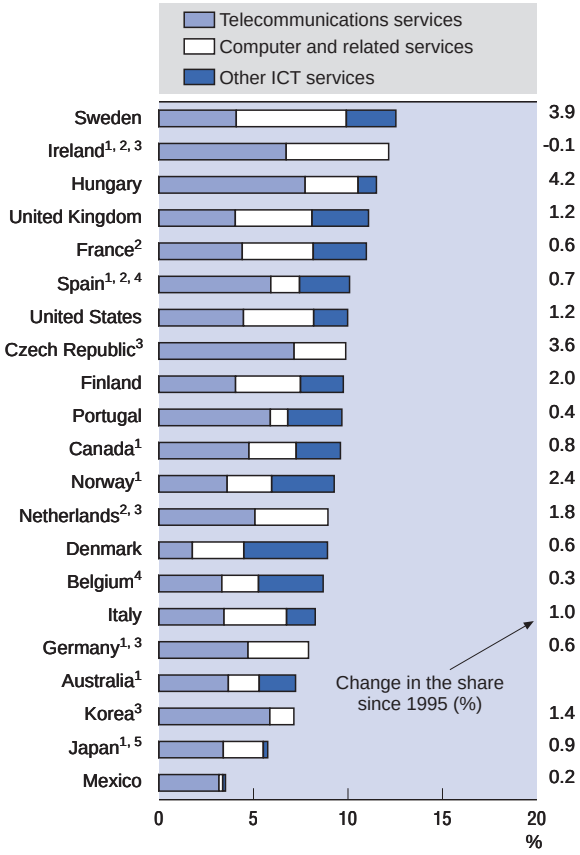
Share of ICT value added in business sector value added, 1999



Share of ICT manufacturing in total manufacturing value added,1999



Share of ICT services in total business services value added, 1999[6]



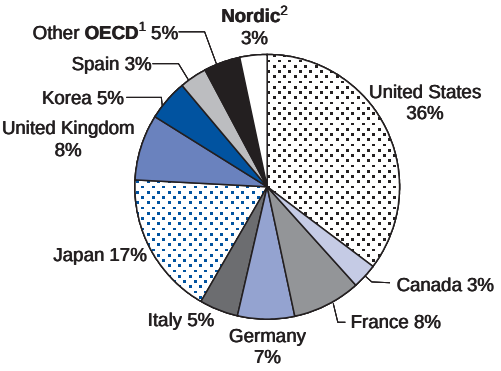
1. 1998.
2. Postal services included with telecommunications services.
3. ICT wholesale (5150) and rental of ICT goods (7123) are not available.
4. ICT wholesale (5150) is not available.
5. Includes only part of computer related activities (72).
6. "Other ICT services" is the sum of 5150 and 7123.

Source: OECD estimates, based on national sources; STAN and National Accounts databases, June 2001.

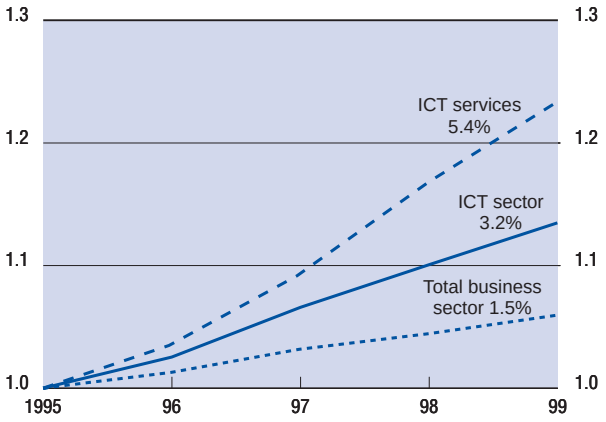
B.7.2. The contribution of the ICT sector to employment growth

- In 1999, the 17 OECD countries for which estimates are available employed over 14 million persons in the ICT sector, about 6% of total business employment. The United States represented about 35%, the EU (excluding Austria, Greece, Ireland and Luxembourg) 38% and Japan 17%.
- The ICT sector is a major source of employment growth. OECD employment in the sector grew by over 12% in the 1995-99 period, *i.e.* an average annual rate of over 3% a year, double that of overall business sector employment. ICT services are driving this growth; employment in the ICT manufacturing sector generally follows the declining trend of overall manufacturing employment, albeit to a lesser extent. Exceptions are Finland, where ICT manufacturing employment grew by over 9% per year, and Canada, the Czech Republic and Portugal, where it grew between 3% and 5%.
- ICT services employment is growing everywhere except in Japan and the Czech Republic. The Netherlands (11.7%), the United States (9.5%) and Finland (7.5%) registered annual growth rates above the OECD average (5.4%). Employment in computer-related services, mainly software services, is the most dynamic component, growing by an average of 6% a year in the OECD area and by over 22% in the Netherlands and Portugal.
- The share of ICT employment in total business sector employment in 1999 was higher than the OECD average in Finland (9.4%), Sweden (8.6%), the United Kingdom (7.7%), Denmark and Japan (about 7%), Belgium and Austria (about 6.5%). It was also high in France and the Netherlands, although these figures also include employment in postal services.
- The contribution of ICT manufacturing to total manufacturing employment has been stable over the 1995-99 period in most OECD countries. It continues to vary widely across the OECD area, ranging from 14.4% in Ireland to 2.2% in Australia. The average share of ICT services employment in market services, instead, has grown over time to reach about 5.5% in the OECD-17 area in 1999.

Employment in the ICT sector, selected OECD countries
Percentage share, 1999



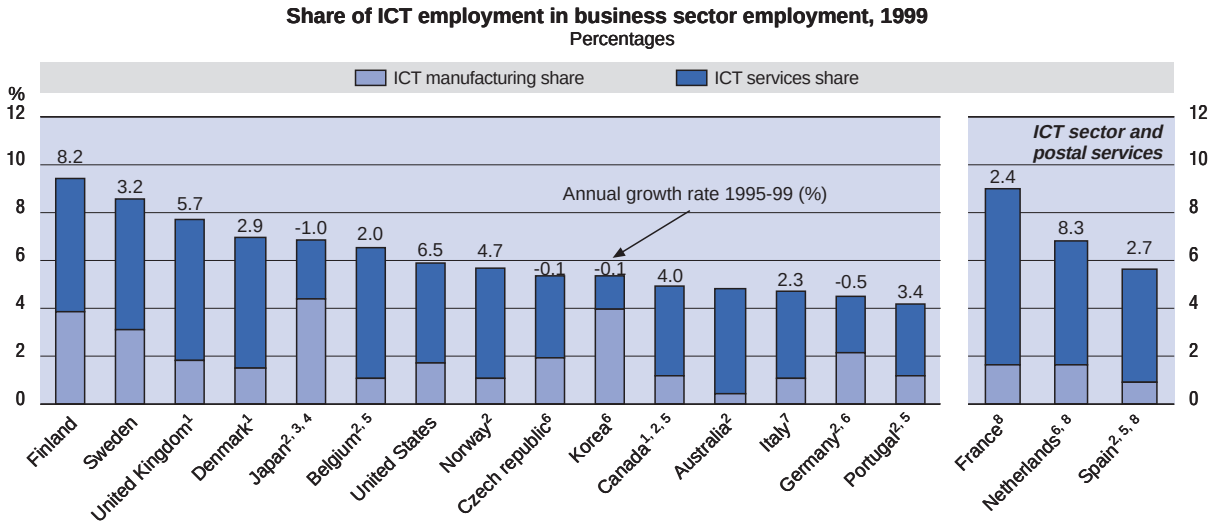
The contribution of ICT services to business sector employment growth, selected OECD countries
Average annual growth rate1995-99, index 1995 = 100

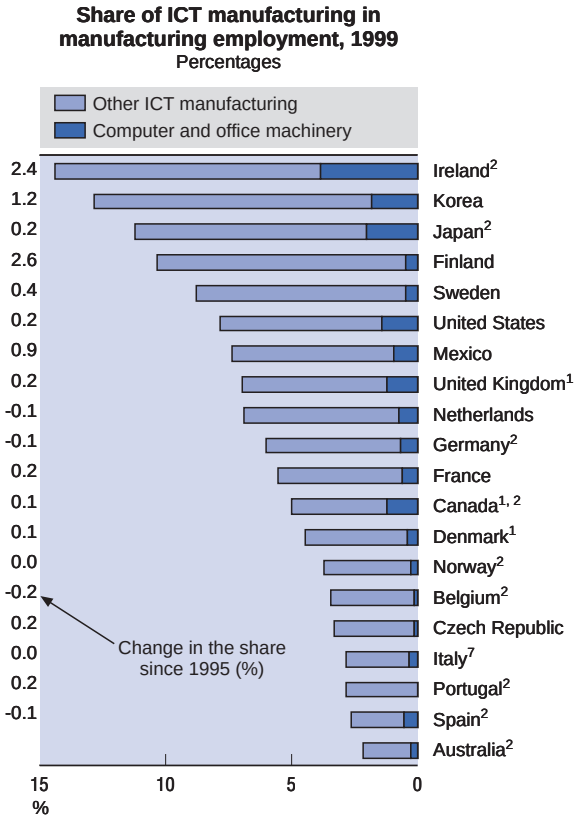


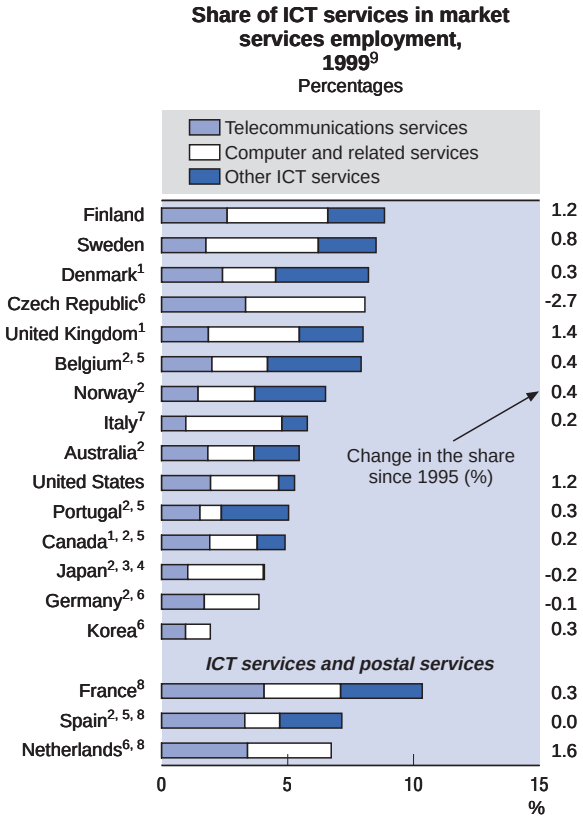
1. "Other OECD": Belgium, Czech Republic, the Netherlands and Portugal.
2. Denmark, Finland, Norway and Sweden.

Source: OECD, ICT database, June 2001.

B.7.2. The contribution of the ICT sector to employment growth







1. Based on employees figures only.
2. 1998 instead of 1999.
3. ICT wholesale (5150) is not available.
4. ICT services include market research and public opinion polling.
5. Rental of ICT goods (7123) is not available.
6. "Other ICT services" are not available.
7. Based on full-time equivalent employment figures.
8. ICT services include postal services.
9. "Other ICT services" is the sum of ICT wholesale (5150) and rental of ICT products (7123).

Source: OECD estimates, based on national sources; STAN and National Accounts databases, June 2001.

B.8. The contribution of the ICT sector to international trade

- The composition of OECD international trade in manufactured goods is increasingly shifting towards ICT. Calculations for ICT products show that the total value of OECD ICT exports in 1999 was highest for computers (USD 193 billion or 4.7% of total OECD exports); electronic components (USD 187 billion or 4.6% of total exports); and telecommunications equipment (USD 126 billion or 3.7% of total exports); while consumer electronics (USD 63 billion) accounted for 1.5% of total exports.
- Data on ICT trade in services are limited to telecommunications services (for 11 countries) and to computer-related services (for 24 countries). They generally only cover the 1996-99 period. Moreover, the data are not comparable to those for trade in goods (see box). In 1999, these ICT services accounted for little over 3% of the total services balance of payments.
- Converting trade in ICT products into trade by ICT activities (see box), shows the growing importance of the ICT sector in total manufacturing trade (average of manufacturing imports and exports). In 1990 it accounted for over 12% of OECD-wide trade in goods; by 1999, the share had reached 17.5%. ICT imports and exports contribute to total imports and exports by roughly the same amount (18% of imports and 17% of exports).
- ICT sector trade plays a particularly important role in Ireland (35% of manufacturing trade), Korea (31%) and the Netherlands, Japan, Hungary and Mexico, where it represented one quarter of total manufacturing trade in 1999.
- Looking at the overall trade balance gives a picture of countries' relative comparative advantage in ICT manufacturing. Only seven countries showed a positive ICT trade balance in 1999. The ICT trade surplus represented almost 10% of GDP in Ireland, 5% in Korea and 3% in Finland. The main source of comparative advantage in Finland and Sweden is telecommunications equipment; in Ireland and Mexico, it is computers.

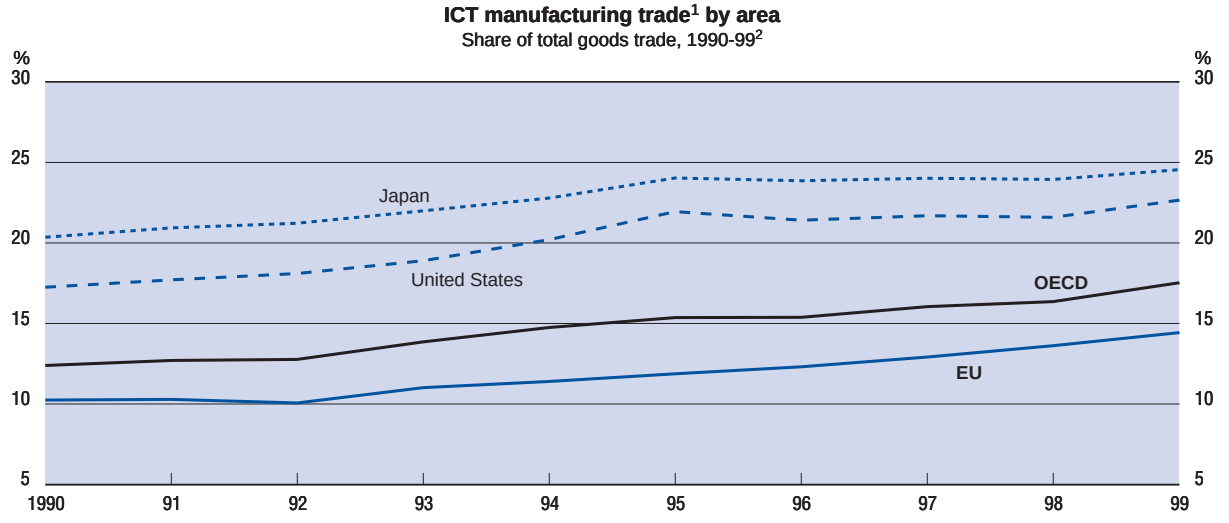
Measuring ICT sector trade

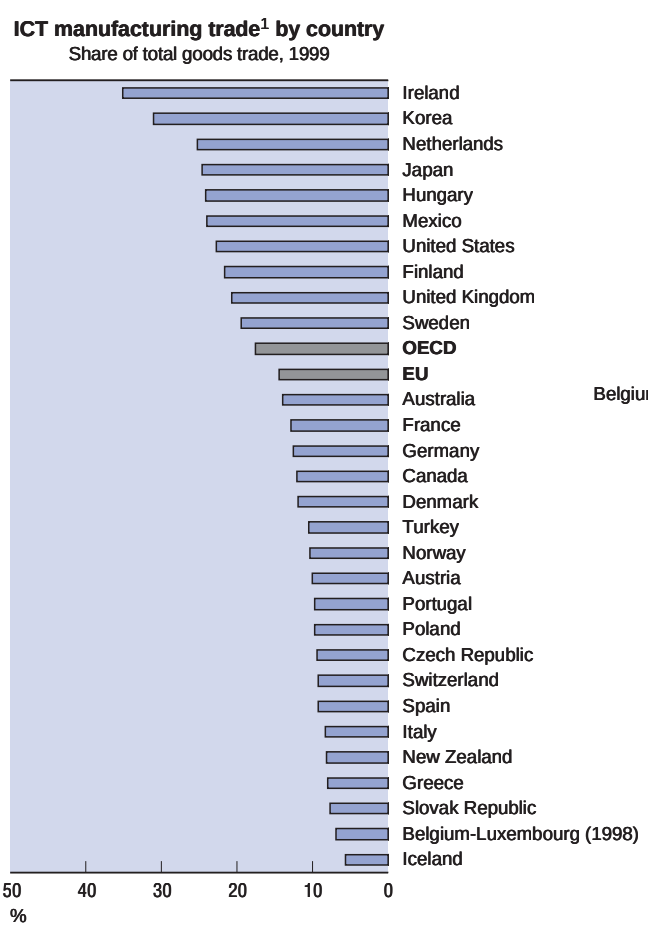
In the absence of tables of international trade in goods and services by detailed industrial activity that are compatible with the National Accounts, exports and imports of the ICT sector at current prices have been estimated using the OECD's International Trade in Commodity Statistics (ITCS) database. The product classification used in this database, which is based on the Harmonised System Rev. 1 (HS1), has been converted in the ISIC Rev. 3 activities belonging to the ICT manufacturing sector as defined by the OECD (see Box B.7.1). This means that the trade indicators constructed here reflect trade in goods for which the ICT manufacturing sector can be considered to be 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 reports.

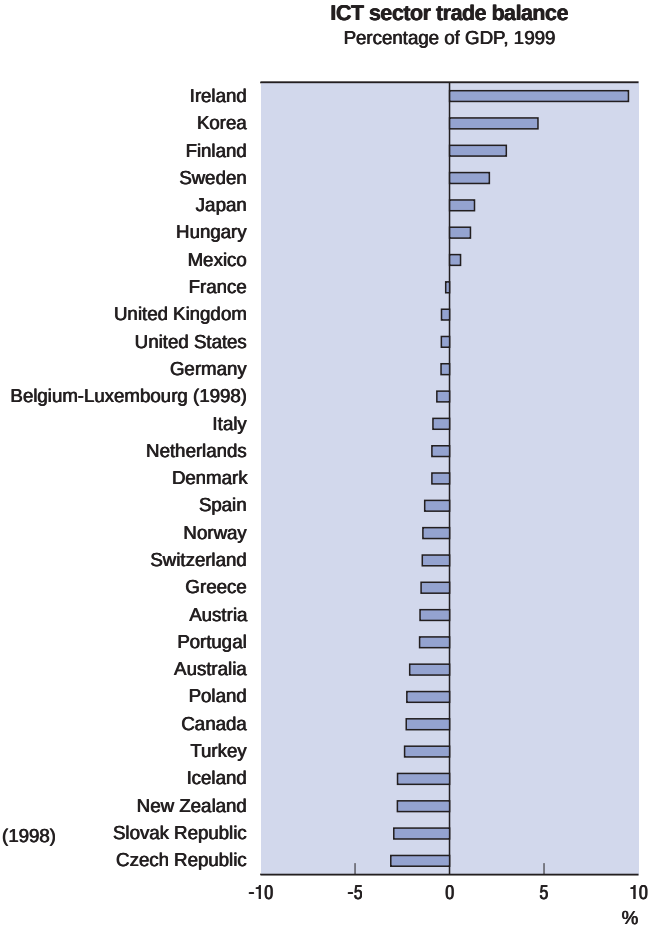
Data on selected ICT services (telecommunications and computer and related services) are instead collected from balance of payments data, and, as a general rule, cannot be compared to trade in ICT goods data based on custom surveys. Indicators of overall trade in ICT goods and services could therefore not be calculated.

Finally, data for both imports and exports of individual countries include imported goods that are subsequently re-exported. Imports and subsequent re-exports might be in the same, or in different, reference periods. In the latter case, this could influence not only indicators of countries' relative trade performance but also indicators of individual countries' trade balances.

B.8. The contribution of the ICT sector to international trade







1. Average of imports and exports.
2. Australia (1995-99), Belgium-Luxembourg (1990-98), Czech Republic (1993-99), Hungary (1992-99), Korea (1994-99), Poland (1992-99), Slovak Republic (1997-99).

Source: OECD, ITCS database, June 2001.

B.9. Cross-border mergers, acquisitions and alliances in the ICT sector

- Because of the rapid diffusion of ICT and technological convergence, the boundaries between the telecommunication and information technology sectors are blurring. The question therefore arises of the degree to which this leads to the creation of strategic alliances and mergers and acquisitions (M&As), both domestically and internationally.
- Cross-border M&As account for a significant share of cross-border capital flows. However, in 1999, only between 1% and 18% in OECD countries involved ICT firms, except in the Netherlands where the share reached almost 40%.
- An indicator constructed using acquirer and target countries reveals that ICT sector M&As are mainly domestic. In 2000, 83-86% were between firms in the same region (United States, Japan, European Union). Very few US (0.7%) or European (0.3%) M&As involved Japanese firms and about 50% of US cross-border M&As with European firms are with UK firms. The four largest EU countries (Germany, United Kingdom, France and Italy) are the target of about 66% of cross-border M&As among European firms.
- The ICT sector accounts for more than half of all strategic alliances in Luxembourg (69%), the United States (57%), Finland (54%), New Zealand (53%) and Korea (51%).
- In the Czech Republic, Denmark, Luxembourg and Turkey, almost all ICT strategic alliances are cross-border. In 1999, the ICT sector accounted for 50% of cross-border strategic alliances in Luxembourg, 36% in the United States and 35% in Canada. The ICT sector's propensity to form cross-border strategic alliances – measured as the ratio of cross-border ICT strategic alliances to total ICT strategic alliances divided by the same ratio for the whole economy – varies across countries. It is highest in Sweden (1.5 times the economy average), and lowest in Mexico (0.8%).

Measuring the degree of international activity in the ICT sector

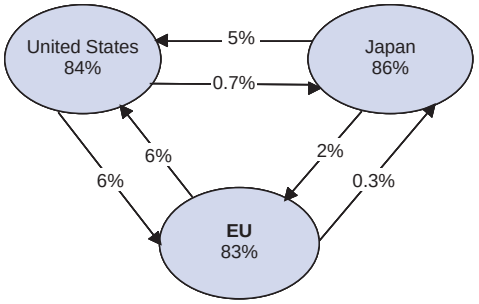
The indicators used here were constructed using the Thomson Financial database which contains more than 60 000 cross-border M&A transactions and almost 70 000 cross-border alliances, including joint ventures, research and development (R&D) agreements, sales and marketing agreements, etc., from 1988 to the present. Data sources include over 200 English and foreign language newspapers, SEC and international filings, trade publications, news wires and quarterly surveys of investment banks and advisers. However, like most other existing data banks on strategic alliances and M&As, the Thomson Financial database is based on public announcements. Thus, it does not include information on undisclosed alliances or M&As. In addition, the database is biased towards English language sources.

The indicators were constructed on the basis of the following criteria:

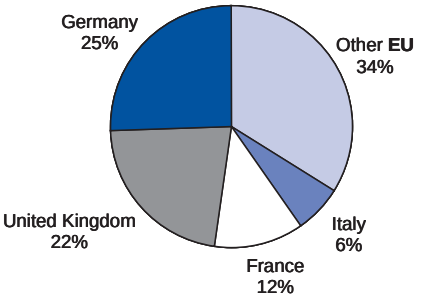
- Definition: the Thomson Financial database classifies firms according to US SIC codes. These were mapped into the ISIC industries included in the OECD definition of the ICT sector (see B.7.1). An ICT M&A was defined as one for which the target or acquirer primary industry code is included in that definition. An ICT cross-border alliance is one for which the primary industry code of the alliance is included in that definition.
- Even though the Thomson Financial database generally records each M&A or alliance transaction on the basis of both announcement and completion, it may be difficult to update completed transactions, particularly for strategic alliances. For strategic alliances, therefore, data on announced alliances were used. For the analysis of cross-border M&As, however, data on completed M&A transactions are used, since some announced M&As may fail to be completed for many reasons, including regulatory constraints.
- Cross-border strategic alliances are co-operative arrangements between independent firms based on contracts designed to enhance their competitive strategies. Strategic alliances can involve a minority equity purchase or transfers, including minority cross-shareholding. Because cross-border strategic alliances involve more than one country, they are double-counted, with the result that EU or OECD aggregates cannot be constructed.

B.9. Cross-border mergers, acquisitions and alliances in the ICT sector

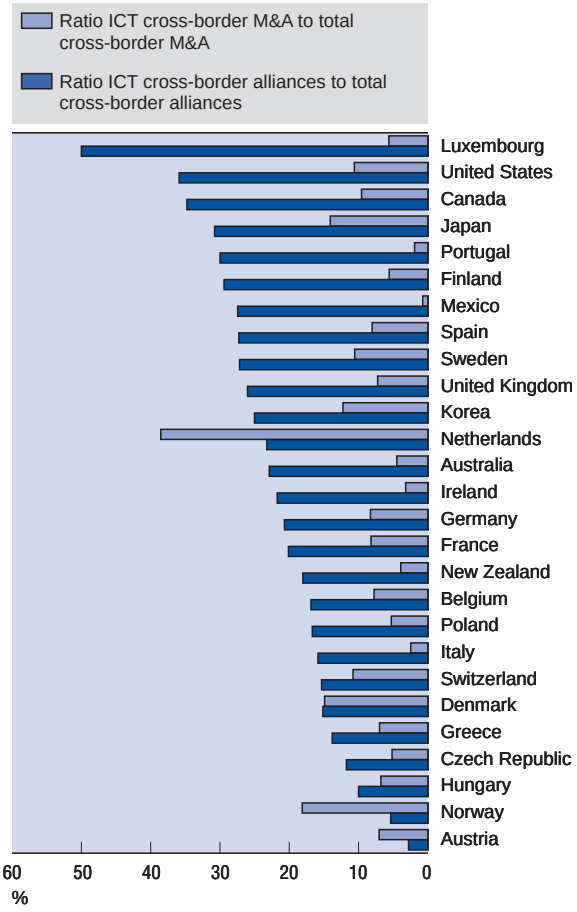
ICT M&As by acquirer and target area, 2000
Percentage of M&As taking place within and across regions[1]



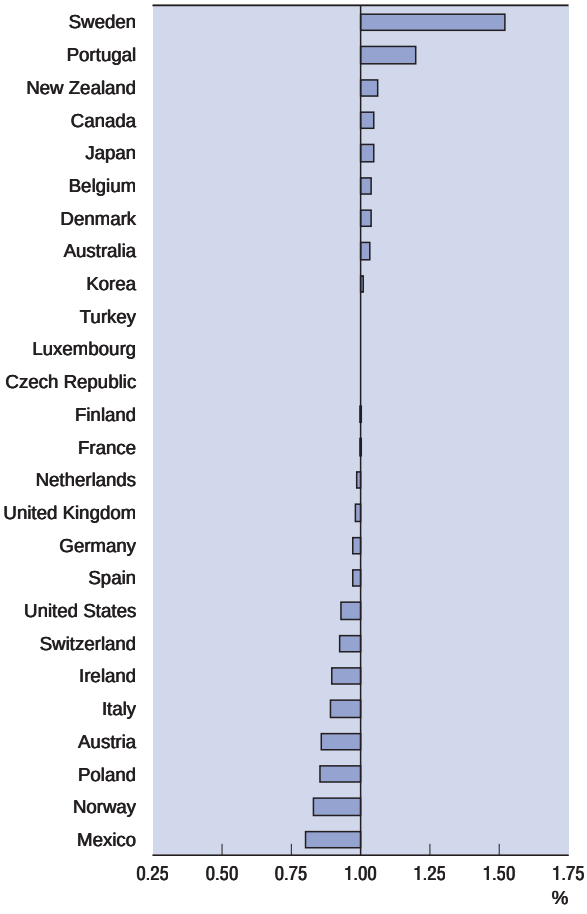
ICT M&As within the EU area, 2000
Percentage of cross-border M&As in which EU firms acquire an EU target



ICT cross-border M&As and alliances in OECD-27 countries, 1999



Relative propensity of ICT alliances to be cross-border[2] in OECD-27 countries, 2000



1. Percentages in the circle refer to M&As occurring between acquirer and target of the same nationality. For example, among the ICT M&As with a US acquirer, 84% had as a target a US firm, 6% a EU firm and 0.7% a Japanese firm. The rest of US M&As were targeted to firms outside the three regions.
2. Ratio of cross-border ICT strategic alliances to all ICT strategic alliances divided by the same ratio for the economy.

Source: Thomson Financial, November 2000.

C.1. Global integration of economic activity

- Globalisation is a dynamic, multidimensional process. National economies can integrate their activities and internationalise through different channels, *e.g.* trade in goods and services, capital and labour flows, transfer of production facilities and/or technology (see C.2-C.5).
- 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 liberalisation of trade and financial flows, advanced information and communication technology, lower transport costs, firms' strategies regarding location and the need to exploit worldwide technological and organisational advantages etc.
- As a result, the structure of international transactions has been gradually shifting over the past decade. Financial transactions (direct investment, portfolio investment, other 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 and tripled between 1995-99.
- 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, despite the acceleration of the latter in the 1990s.

Main components of international transactions

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 investment is defined as being "direct" if the foreign investor holds at least 10% of the ordinary shares or voting rights in the firm in which the investment is made. This 10% limit means that the direct investor is able to influence and participate in the management of a firm but does not necessarily require complete control (see C.3.1).

Portfolio investments. In cases where the foreign investor holds less than 10% of the capital (ordinary shares or voting rights) of a firm, the investment is considered to be a "portfolio investment". This type of investment usually corresponds to "short-term" investment transactions in which the investor has no intention of influencing the management of a firm. However, in cases where the shares in a firm are divided among a large number of shareholders, it would be feasible for a shareholder with a shareholding of less than 10% to be able to influence the management of that firm.

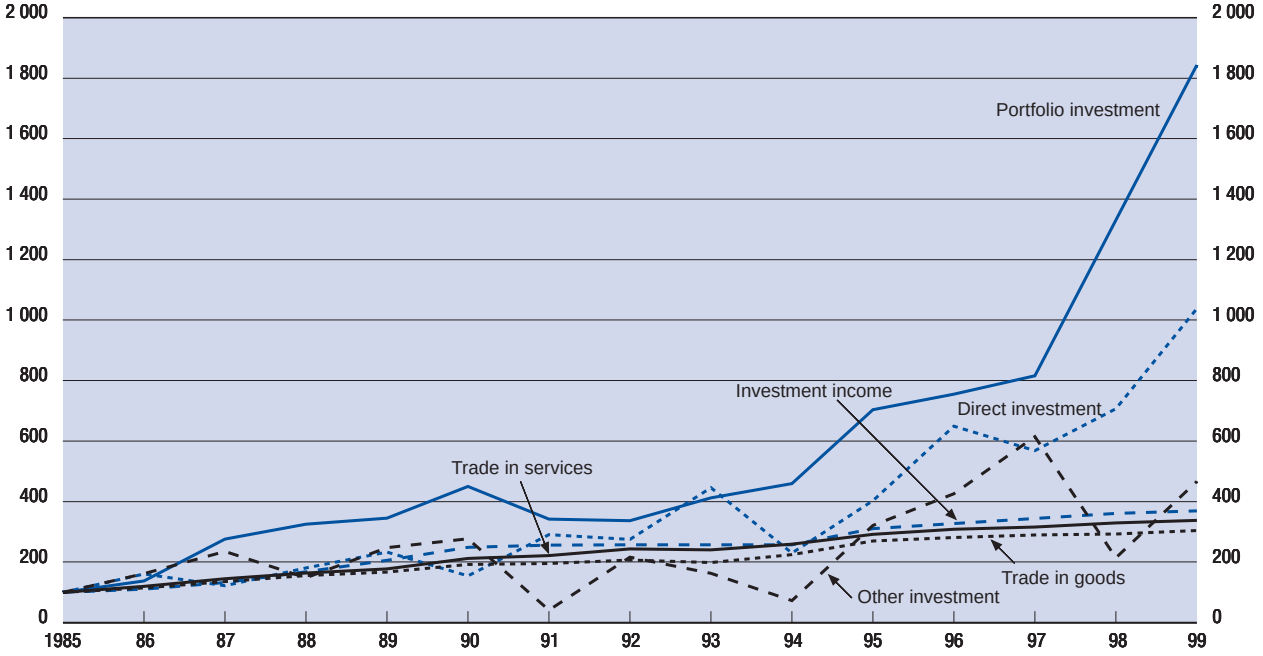
Other investment. This is a residual category that includes all financial transactions not covered in direct investment, portfolio investment or reserve assets. This type of investment comprises trade credits, loans, currency and deposits and other assets and liabilities.

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.

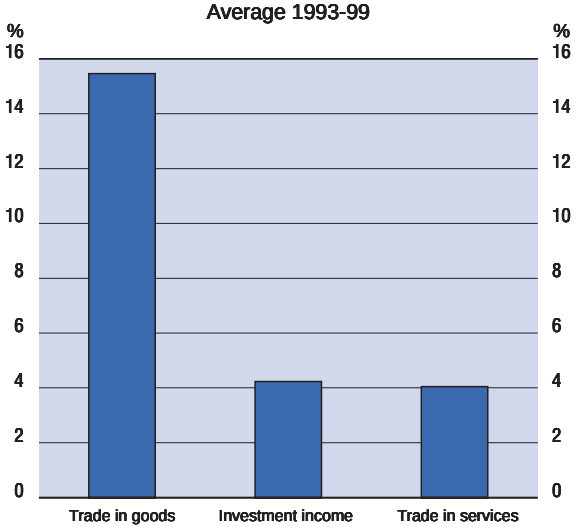
For more details, see Annex, Tables C.1.1 *to* C.1.3.

C.1. Global integration of economic activity

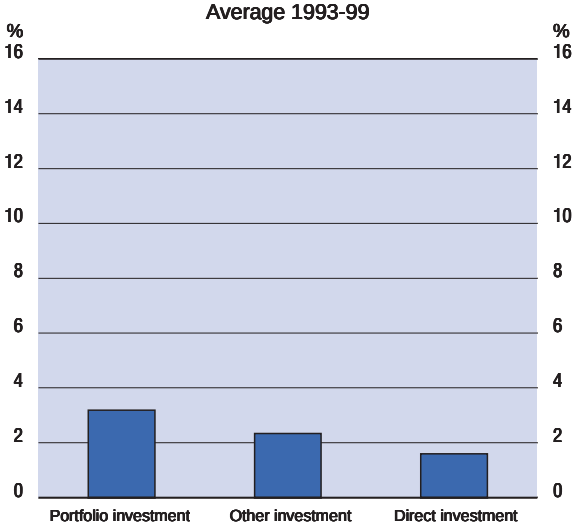
Trends in international transactions[1] by component
OECD,[2] 1985 = 100



Main components of the current account as a percentage of GDP,[3] OECD[4]
Average 1993-99



Main components of the financial account as a percentage of GDP,[5] OECD[4]
Average 1993-99



3. Average imports plus exports or average assets plus liabilities.
4. OECD excludes Luxembourg; Czech Republic, Hungary, Poland and Slovak Republic for 1985-92; Greece for 1998-99.
5. Imports + exports divided by 2 and by GDP.
6. OECD excludes Greece 1993-99, Poland 1993-94, Norway and New Zealand 1999.
7. Assets + liabilities (in absolute terms) divided by 2 and by GDP.

Source: IMF, Balance of Payments Statistics; OECD, ADB database, May 2001.

C.2.1. International trade

- Traditionally, the principal channel of economic integration has been international trade in goods. Other forms of exchange, however, have become prevalent in the 1990s as firms increasingly implement global strategies (see C.3-C.5).
- International trade in goods constituted on average about 15% of OECD GDP in the 1990s. The share of international trade in services was substantially lower, accounting for around 4% of GDP. In the second half of the 1990s, 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, 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 for certain countries that have recently implemented trade liberalisation policies, *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, Japan and the European Union when intra-EU trade flows are excluded. During the 1990s, the international trade-to-GDP ratio grew on average about 2% in the European Union and the United States, while it declined slightly in Japan.
- As a share of GDP, trade in services rose faster than trade in goods in most OECD countries in the 1990s. Average annual growth in the trade-to-GDP ratio in services was over 6% for the Czech Republic, Ireland, Luxembourg, Turkey and Greece. It was negative for the Slovak Republic, Mexico, Japan and Norway.

The trade-to-GDP ratio

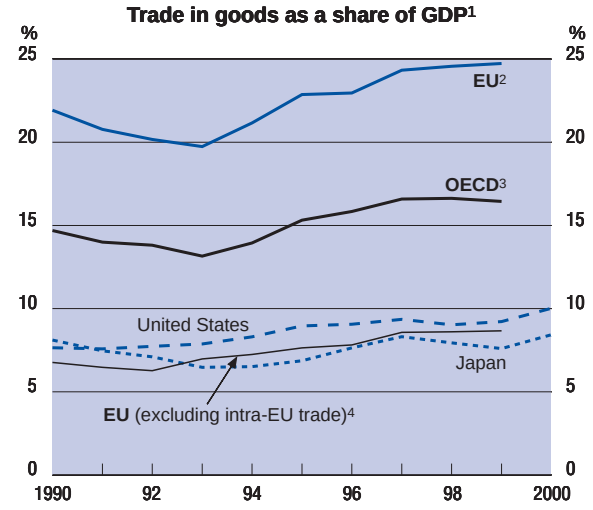
The most frequently used indicator of the importance of international transactions relative to domestic transactions is the trade-to-GDP ratio, which is the average share of exports and imports of goods and services in GDP.

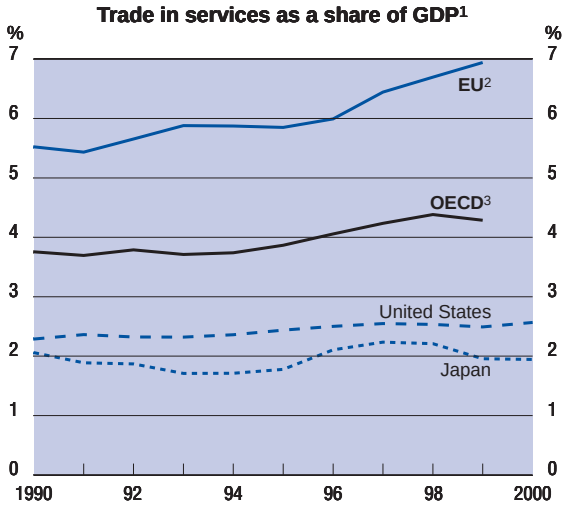
International trade tends to be more important for countries that are small (in terms of size or population) and surrounded by neighbouring countries with open trade regimes than for large, relatively self-sufficient countries or those that are geographically isolated and thus penalised by high transport 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).

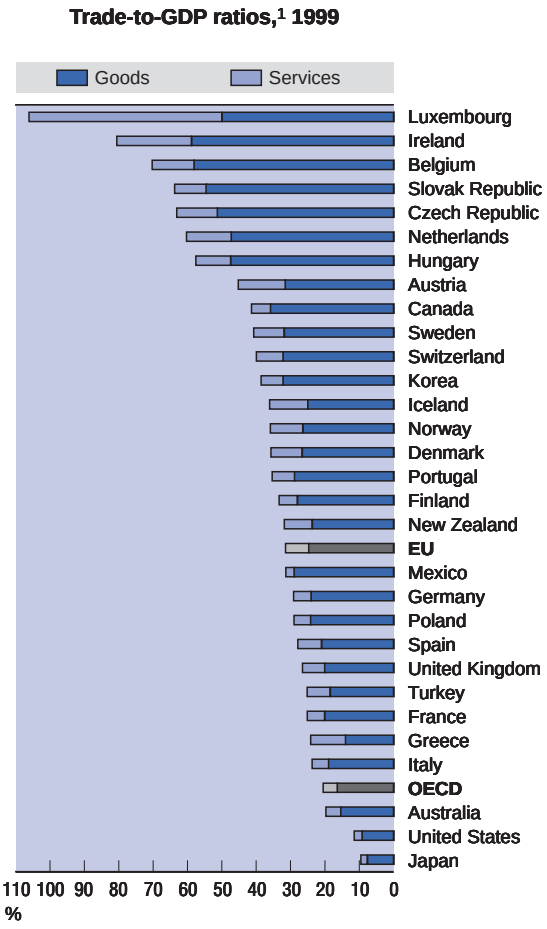
The trade-to-GDP ratio is often called the trade openness ratio. However, the term "openness" to international competition may be somewhat misleading. In fact, a low ratio for a country does not necessarily imply high (tariff or non-tariff) obstacles to foreign trade, but may be due to the factors mentioned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

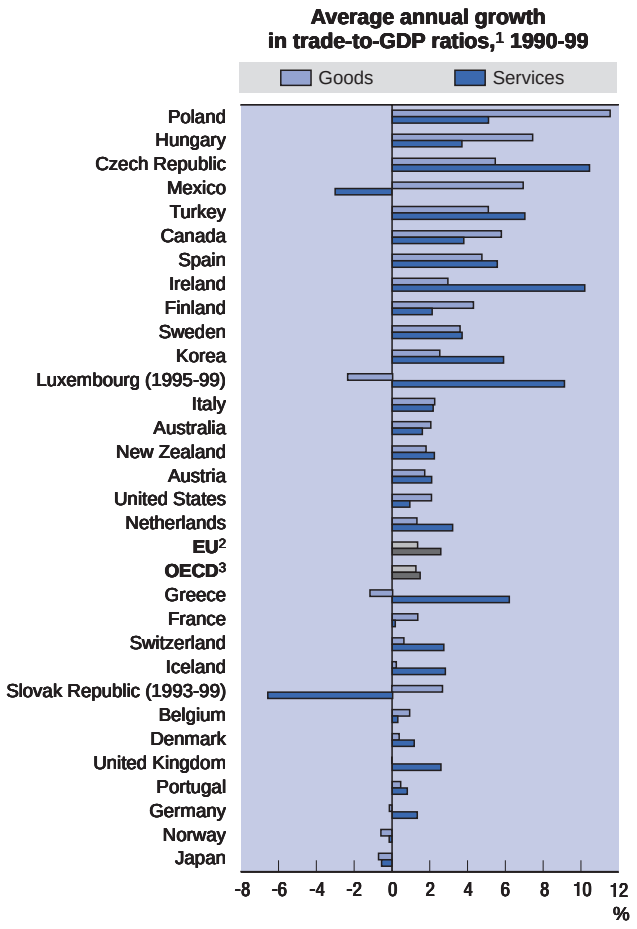
For more details, see Annex, Table C.2.1.

C.2.1. International trade









1. Average of imports and exports as a share of nominal GDP.
2. Includes intra-EU trade. Excludes Luxembourg from 1990 to 1994.
3. Excludes Slovak Republic 1990 to 1992 and Luxembourg from 1990 to 1994.
4. Excludes intra-EU trade (calculation based on ITCS database).

Source: OECD, ADB database, May 2001.

C.2.2. Exposure to international trade competition by industry

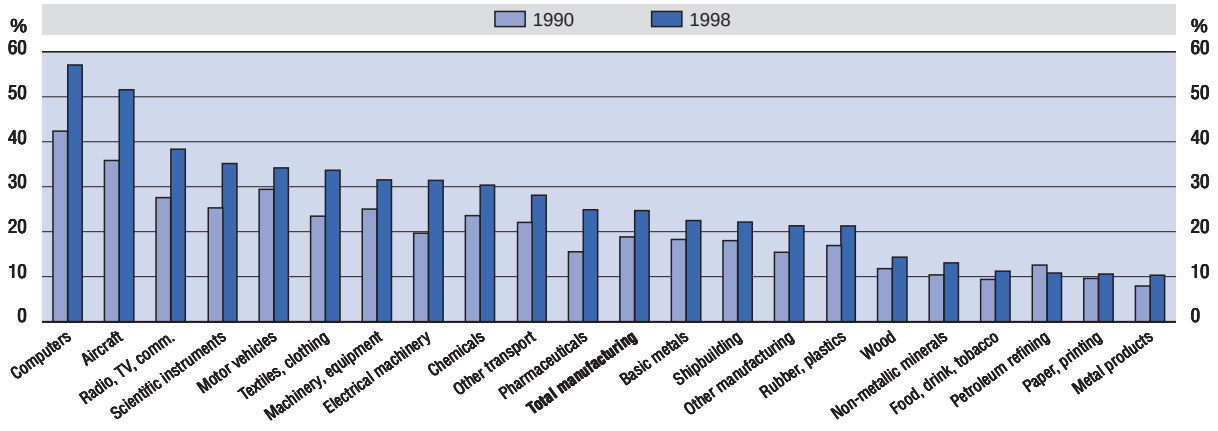
- The exposure of manufacturing industries to international trade has increased in OECD countries in the past decade. Between 1990 and 1998, the average export ratio and import penetration rate rose for virtually all manufacturing industries.
- The export ratios and import penetration rates for the United States, Japan and the European Union (excluding intra-EU trade) show similar patterns of internationalisation across manufacturing industries. The exposure of computers, aircraft and radio and television communication equipment to international trade competition is high, whereas that of paper, printing, metal products, and food, drink, tobacco is limited.
- 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, of textiles and motor vehicles in the United States; aircraft, wood, food, drink and tobacco in Japan; and computers in the European Union.
- 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 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 is the case 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, 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

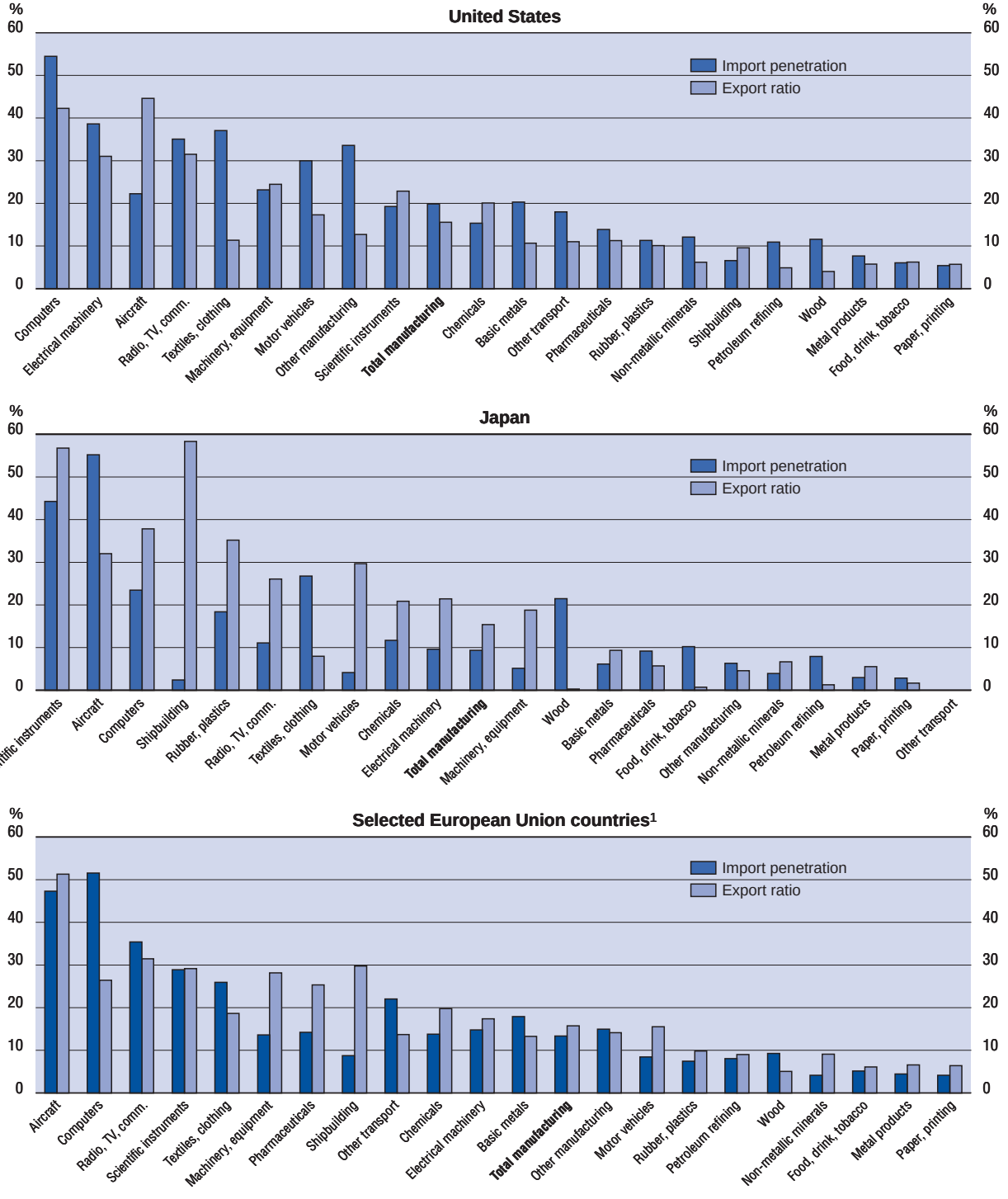


1. OECD includes Canada, Denmark, Finland, France, Germany, Italy, Japan, Spain, Sweden, United Kingdom and United States.
Source: OECD, STAN database, May 2001.

For more details, see Annex, Table C.2.2.1

C.2.2. Exposure to international trade competition by industry

Exposure of manufacturing industries, 1998



1. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom. Intra-EU trade is excluded.
Source: OECD, STAN database, May 2001.

C.3.1. Foreign direct investment flows

- Foreign direct investment (FDI) has played a fundamental role in furthering international economic integration and has been a driving force behind worldwide economic restructuring over the past 15 years. After a steady increase, FDI flows peaked as a percentage of GDP in 1989 and declined sharply for the following few years. With the renewed dynamism of the world economy in recent years and a favourable international investment environment, however, direct investment flows picked up again and continued to surge in the second half of the 1990s.
- The greater part of direct investment during the past 15 years corresponds to the acquisition or capacity enlargement of existing firms, *i.e.* change of ownership rather than creation of a new enterprise (see C.3.2). Thus, it is quite difficult to estimate the net contribution of FDI to recipient countries' output and productivity.
- The magnitude of FDI flows varies among countries and regions and over time. Several factors could have an effect on the direction and magnitude of such flows: infrastructure quality, level of taxation, technology, labour skills and the macroeconomic stability of the recipient country.
- FDI as a percentage of GDP is high for Belgium-Luxembourg, New Zealand, Sweden, the Netherlands, Switzerland and the United Kingdom. It is still small in Turkey, Korea, Japan, and Italy.
- In some countries, outward investment greatly exceeds inward investment. The main net outward investors include Germany, Japan and the United Kingdom. The Netherlands, Switzerland and Sweden also rank high as net outward investors. These countries differ from the others in that they are home to several multinational corporations that invest extensively abroad.
- Conversely, other countries receive more foreign capital than they invest abroad. These include central European economies like Hungary and Poland, as well as Australia and Spain.

Foreign direct investment flows

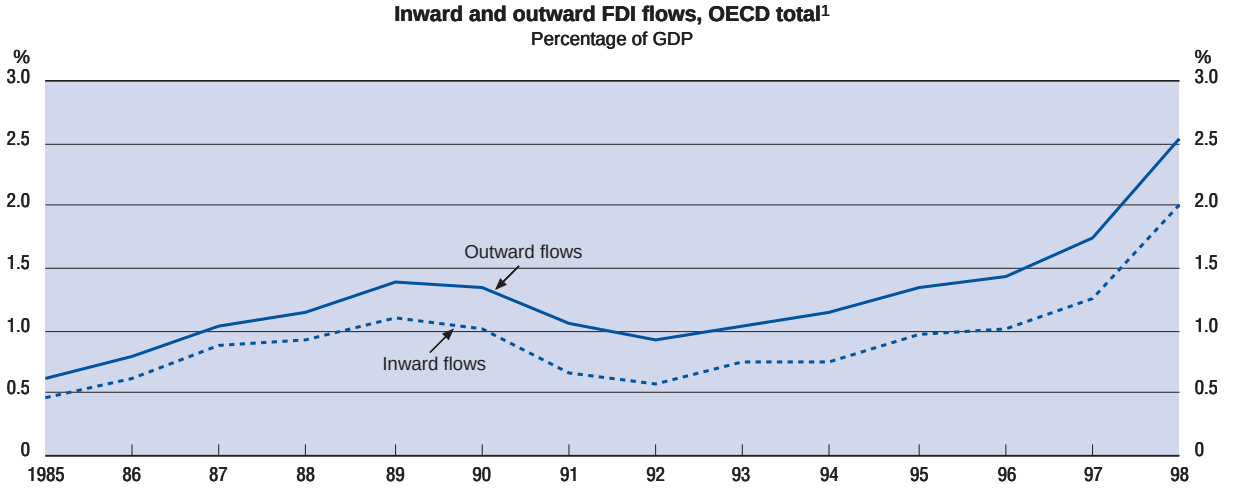
Foreign investment takes the form of direct investment, portfolio investment, reserve assets or other investments (see Box C.1). A foreign investment is classified as a direct investment if the foreign investor holds at least 10% of the ordinary shares or voting rights in an enterprise and exerts some influence over its management. Any investment amounting to less than 10% of ordinary shares is classified as portfolio investment.

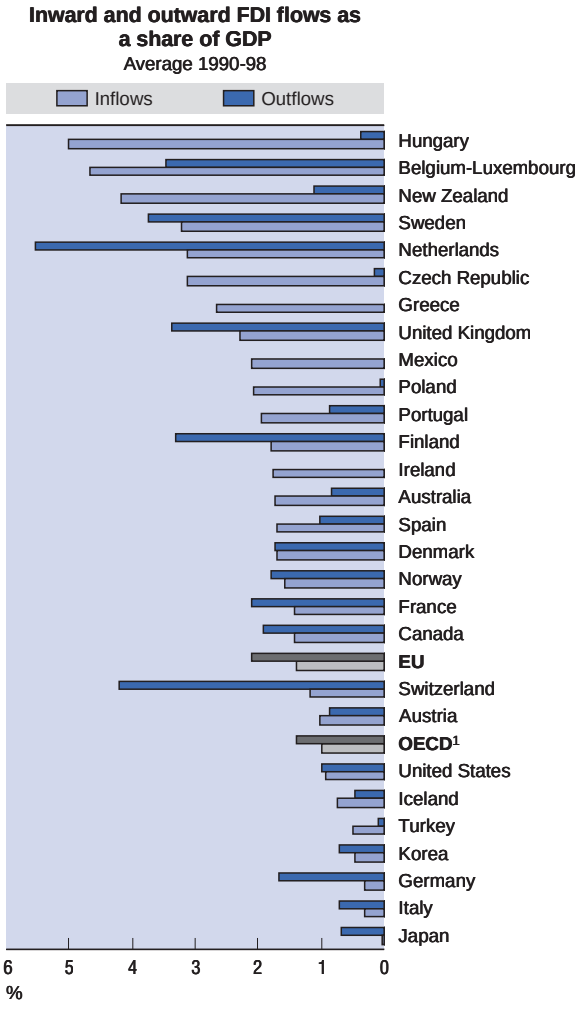
All OECD countries except Turkey have adopted the threshold of 10% of assets or voting rights held in a company as the rule for distinguishing between direct and portfolio investment. However, FDI statistics in some countries (*e.g.* Belgium, Iceland, Japan, Korea, Mexico, Norway, Poland, Portugal, Switzerland) include transactions between a resident enterprise and its direct investor when the investor has an effective voice in management, even though the investor does not own 10% or more of the enterprise's assets.

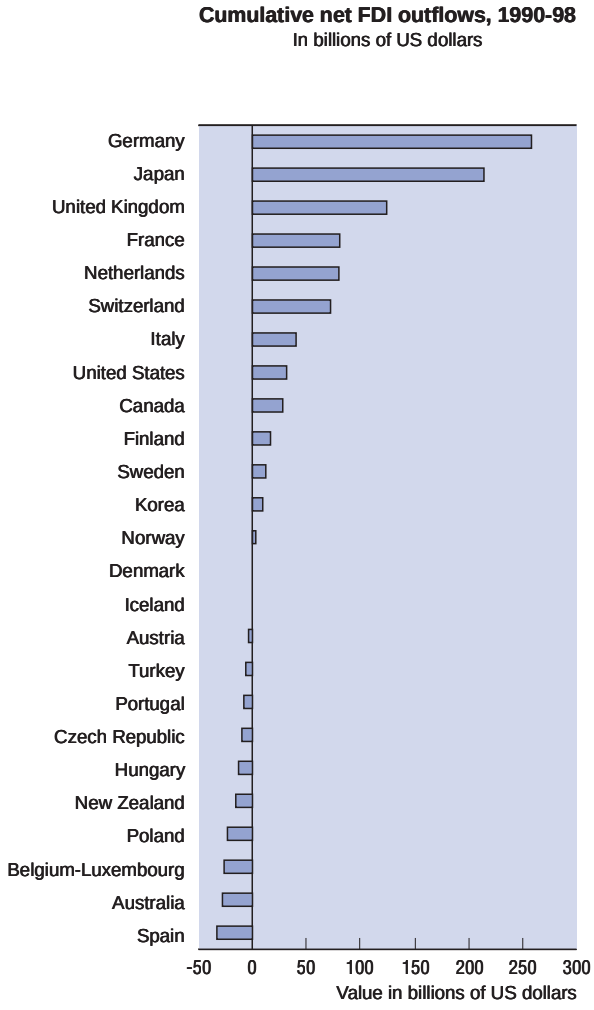
By definition, direct investment flows do not include investment via the host country's capital market or via other financial sources that do not pass through the investor country, although in some cases this may represent over half of the total investment. For this reason, data on the activity of foreign affiliates provide more complete information on the importance of foreign investment in each country.

For more details, see Annex, Table C.3.1.1.

C.3.1. Foreign direct investment flows







1. Excluding the Slovak Republic. For outward flows, excluding Greece, Ireland and Mexico.
Source: OECD, International Direct Investment database, May 2001.

C.3.2. Cross-border mergers and acquisitions

- Mergers and acquisitions are the most common form of foreign direct investment. Firms engage in cross-border mergers and acquisitions for several reasons: to strengthen their market position, expand their businesses, 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 significant between 1995 and 1999.
- The United States was the main target country during the 1995-99 period, attracting on average four times as many deals in terms of number (twice more in terms of value) than the United Kingdom, the second target country for foreign investment. Germany and France were the third and fourth most important countries for mergers and acquisitions.
- During the 1995-99 period, the United States was also the principal acquirer, with deals valued at close to USD 100 billion on average, followed by the United Kingdom, Germany, and France.
- Large-scale cross-border merger and acquisitions 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. The 1998 deal between Amoco (United States) and British Petroleum (United Kingdom) was valued at USD 48.2 billion.
- Cross-border mergers and acquisitions are taking place in manufacturing as well as services, changing the shape of industry worldwide in sectors such as the automotive, chemical and pharmaceutical, telecommunications and financial industries. During the 1990s, the most active sectors at global level were oil, automotive equipment, 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 to the benefit of a third. 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.

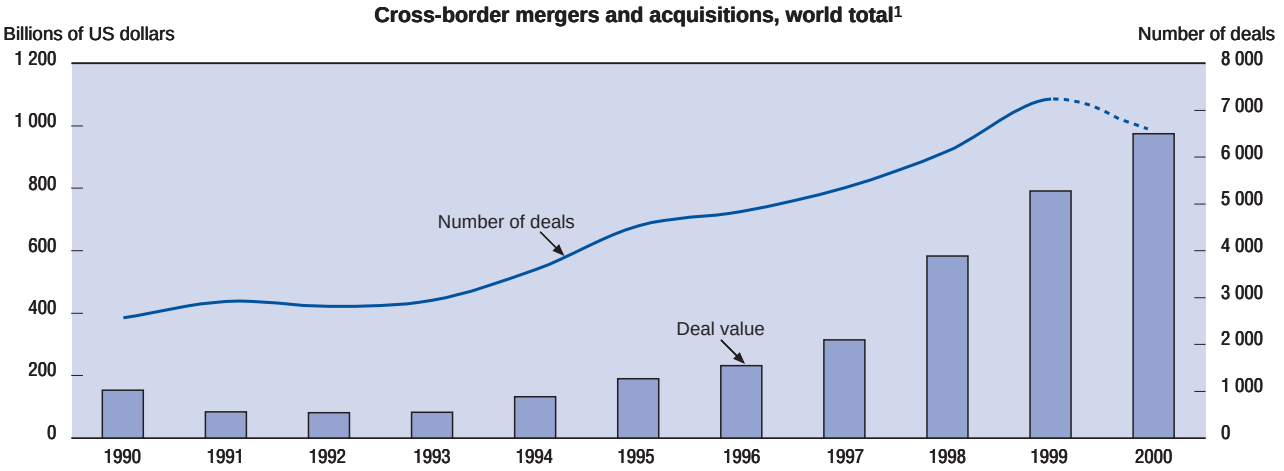
The data are taken from the Thomson Financial Securities database (SDC Platinum). Its Worldwide Merger & Acquisitions database covers more than 273 000 transactions and offers detailed information, including target and acquirer profiles, deal terms and status, etc. The database is updated daily, and the data goes back to 1979 for the United States and 1985 for other countries.

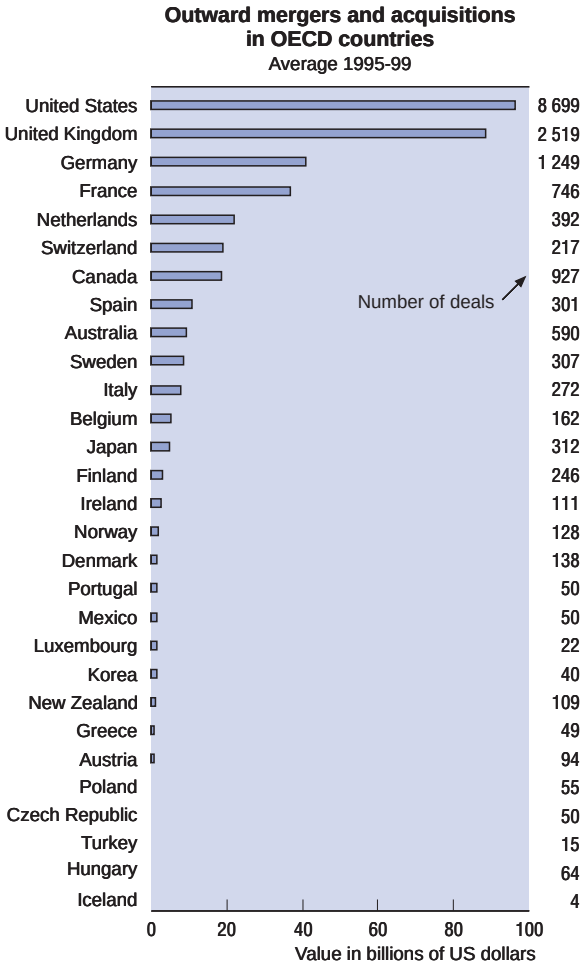
The database incorporates information that firms have announced publicly. It does not include information on undisclosed deals and may under-represent small firms, whose financial transactions are generally not covered by the press. Another limitation of the database is linguistic; data sources include newspapers, trade publications and investment bank surveys that are often in English. The limitations on data collection methods also create a credibility problem, as data collected by different private sources show significant differences in overall merger and acquisition activity across countries.

For detailed analysis of strategic mergers and acquisitions see OECD (2001), *New Patterns of Industrial Globalisation: Cross-border M&As and Strategic Alliances*, Paris; and Nam-Hoon K. and S. Johansson, "Cross-border Mergers and Acquisitions: Their Role in Industrial Globalisation", STI Working Papers No. 2000/1, OECD, Paris.

For more details, see Annex, Table C.3.2.1.

C.3.2. Cross-border mergers and acquisitions





1. For 2000, from January to October.
Source: Thomson Financial, November 2000.

C.4.1. Activity of foreign affiliates in manufacturing

- Firms are increasingly adopting global strategies and establishing overseas sales, marketing, production and research units to cope with new competitive pressures and innovation methods. Foreign direct investment data do not capture this phenomenon. While they indicate the magnitude of financial flows between foreign investment-related firms, they are typically not classified by type of investment activity.
- Indicators for the activity of foreign affiliates are thus an important complement to information on foreign direct investment when analysing the weight and economic contribution of such firms in host countries.
- The share of foreign affiliates in the economy depends on various factors, including the size and attractiveness of the country and the ease, from the institutional standpoint, with which such investments can be made. 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 about 70% in Hungary and Ireland to under 2% in Japan. In the period 1995-98, 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 1% in Japan.
- 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.
- 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 an average national firm.
- In the second half of the 1990s, manufacturing employment in national firms declined in most countries except 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 in foreign affiliates 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 buy-outs and 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.

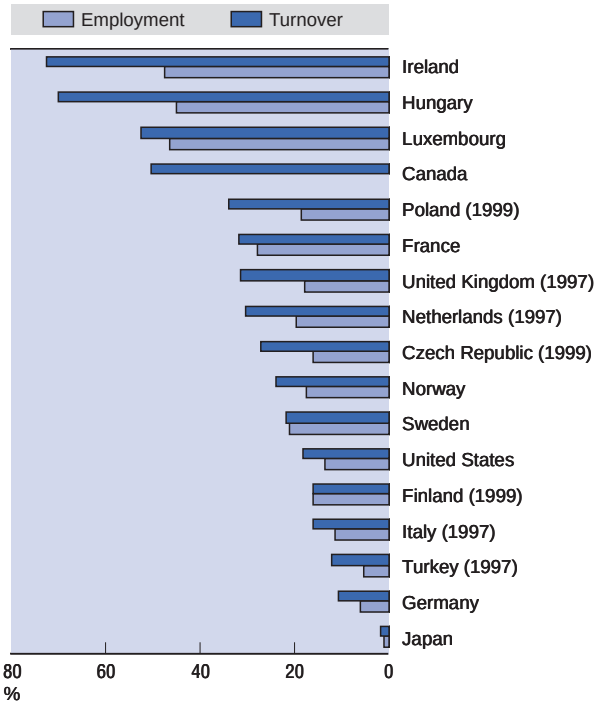
The term foreign affiliate is restricted to foreign affiliates that are majority-owned. Accordingly, the geographical origin of a foreign affiliate is defined as the country of the parent company if it holds, directly or indirectly, more than 50% of the affiliate's voting shares.

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.

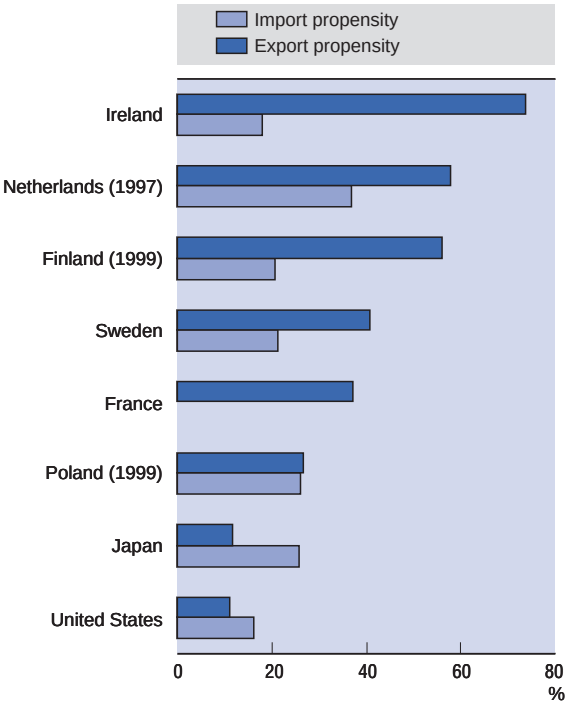
For more details, see Annex, Table C.4.1.1.

C.4.1. Activity of foreign affiliates in manufacturing

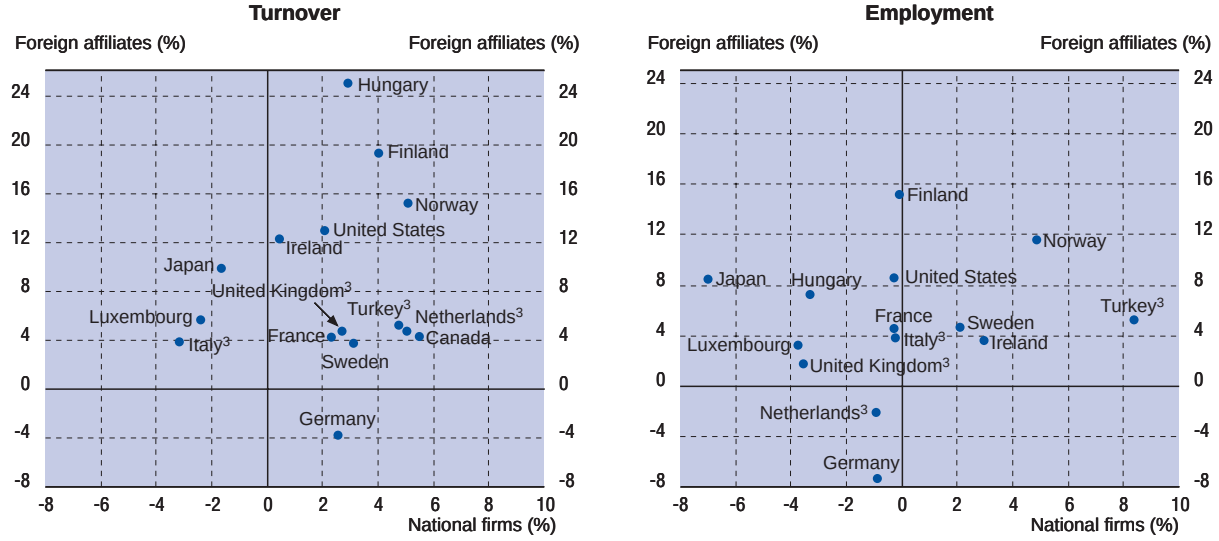
Share of foreign affiliates in manufacturing turnover[1] and employment
1998 or latest available year



Export and import propensity[2] of foreign affiliates in manufacturing
1998 or latest available year



Employment and turnover of foreign affiliates and national firms in manufacturing
Average annual growth rate 1995-98



1. Production instead of turnover for Canada and Ireland.
2. Exports or imports as a share of turnover (except for Ireland for which production is used).
3. 1995-97 instead of 1995-98.

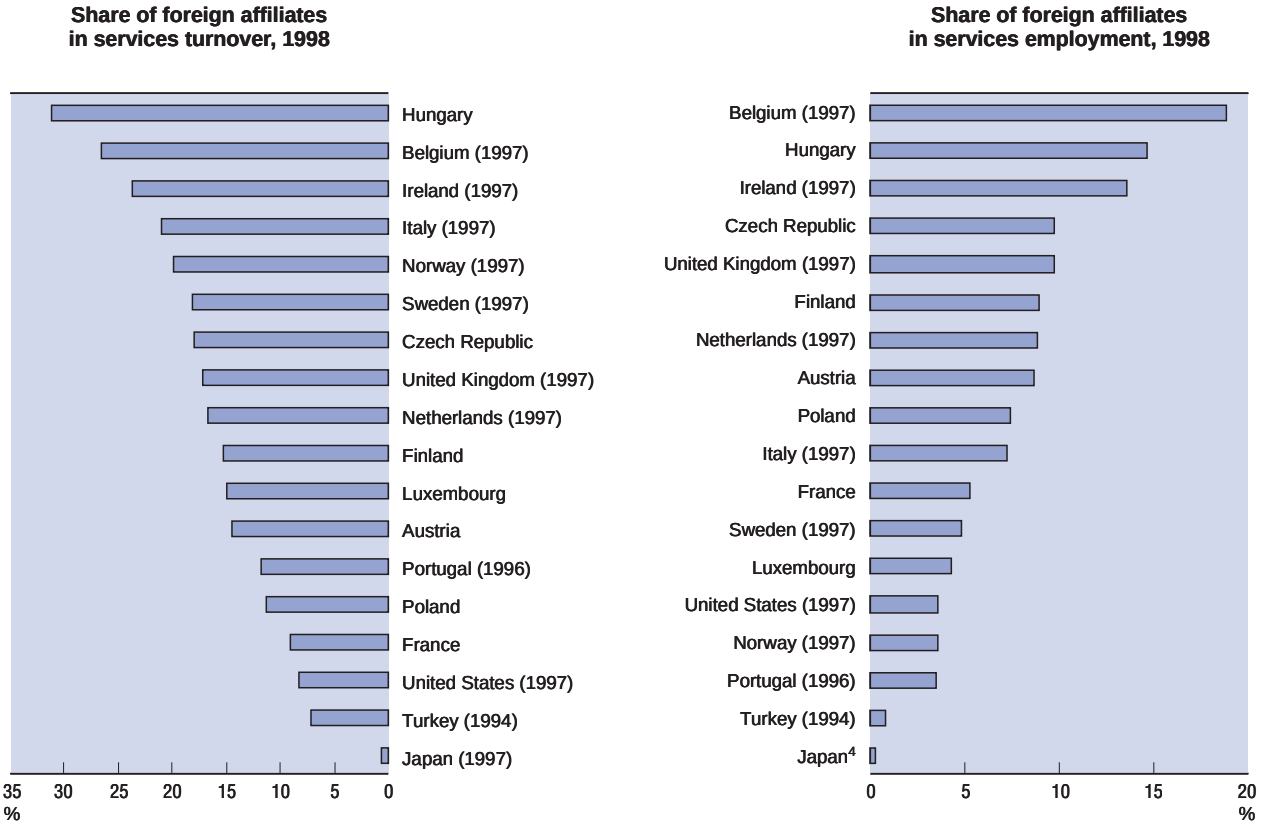
Source: OECD, AFA database, May 2001.

C.4.2. Activity of foreign affiliates in services

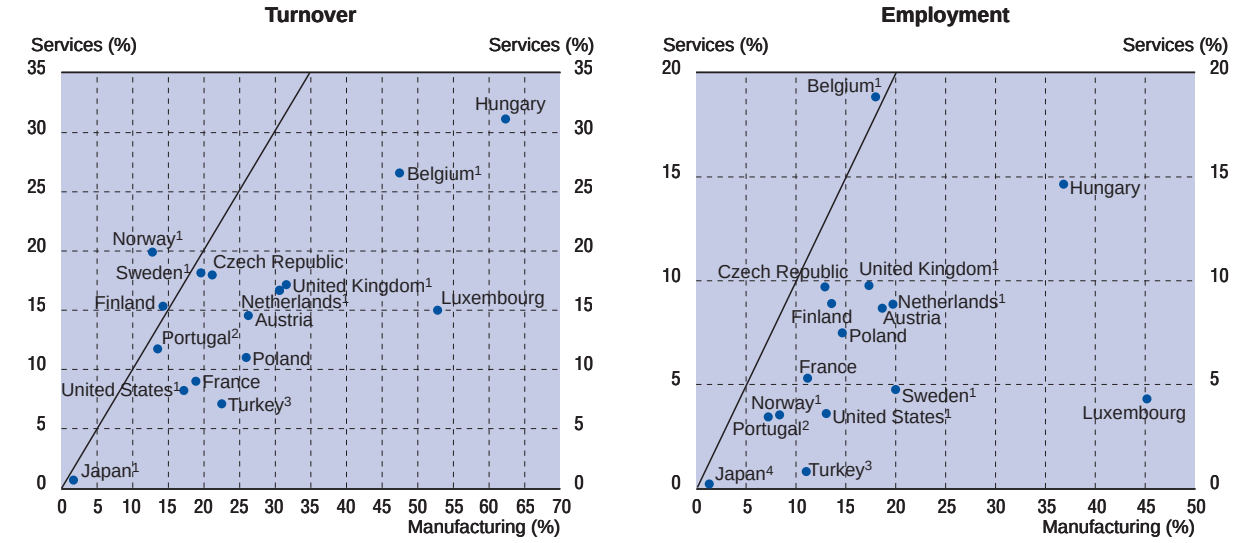
- Collection of data on the activity of foreign affiliates in services did not start until the second half of the 1990s and data are not yet available for all OECD countries. However, the available data confirms the increasing importance of foreign affiliates in the services sector.
- The share of turnover under foreign control in the services sector is relatively high, at over 20%, for Hungary, Belgium, Ireland and Italy. In terms of employment, the share of foreign affiliates ranges from 19% in Belgium and around 14% in Hungary and Ireland to less than 1% in Japan.
- In all countries except Norway and Finland, the share of turnover of foreign affiliates was 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 imbalances are in Hungary 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.

For more details, see Annex, Table C.4.2.1.

C.4.2. Activity of foreign affiliates in services



Comparative penetration of foreign affiliates in services and manufacturing, 1998



1. 1997.
2. 1996.
3. 1994.
4. 1994 for foreign affiliates and 1995 for all firms.

Source: OECD, FATS database, May 2001.

C.5.1. Internationalisation of industrial R&D

- In many OECD countries, R&D activities are less internationalised than production, but this is changing as more and 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 2% in Japan to over 70% in Hungary and 68% in Ireland. At over 30%, the share of R&D conducted by foreign affiliates is also high in Spain, the Netherlands, the United Kingdom, Canada, Australia and the Czech Republic.
- The 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 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 Ireland, for example, foreign affiliates carry out relatively more R&D than national firms. 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 industrial 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 (see C.5.2).

While the first of these trends is restricted to multinationals, the second characterises all categories of firms.

The decentralisation by multinational firms of their R&D activities, *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 were already being used 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 fairly 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 industrial R&D is increasing. In the United Kingdom, Canada and Ireland, this share exceeds 35%.

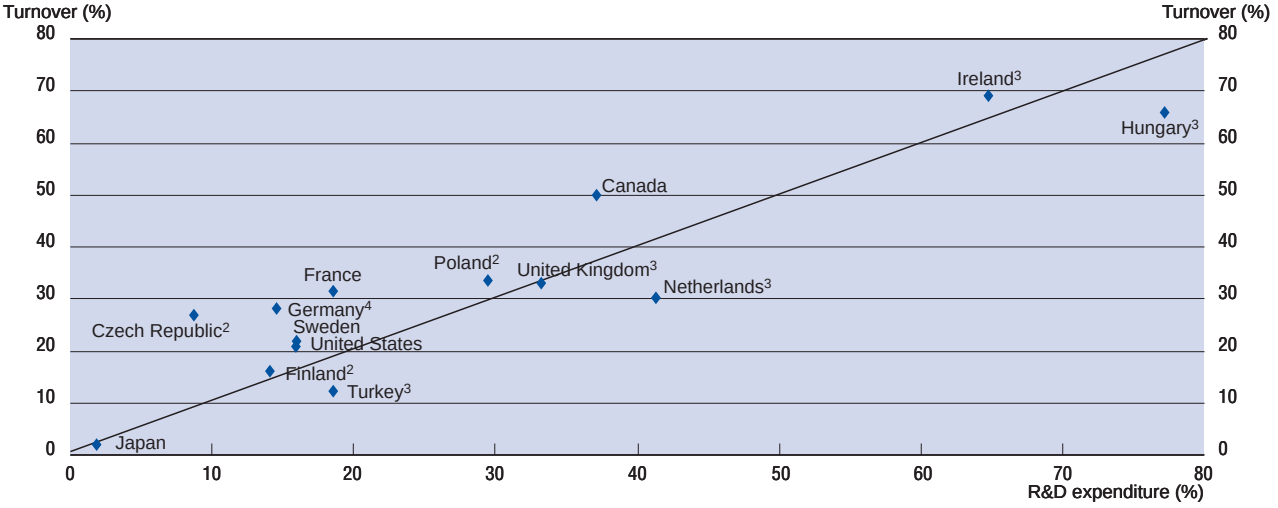
For further information see OECD, *Internationalisation of Industrial* R&D: *Patterns and Trends*, Paris, 1998.

For more details, see Annex, *Table* C.5.1.1.

C.5.1. Internationalisation of industrial R&D

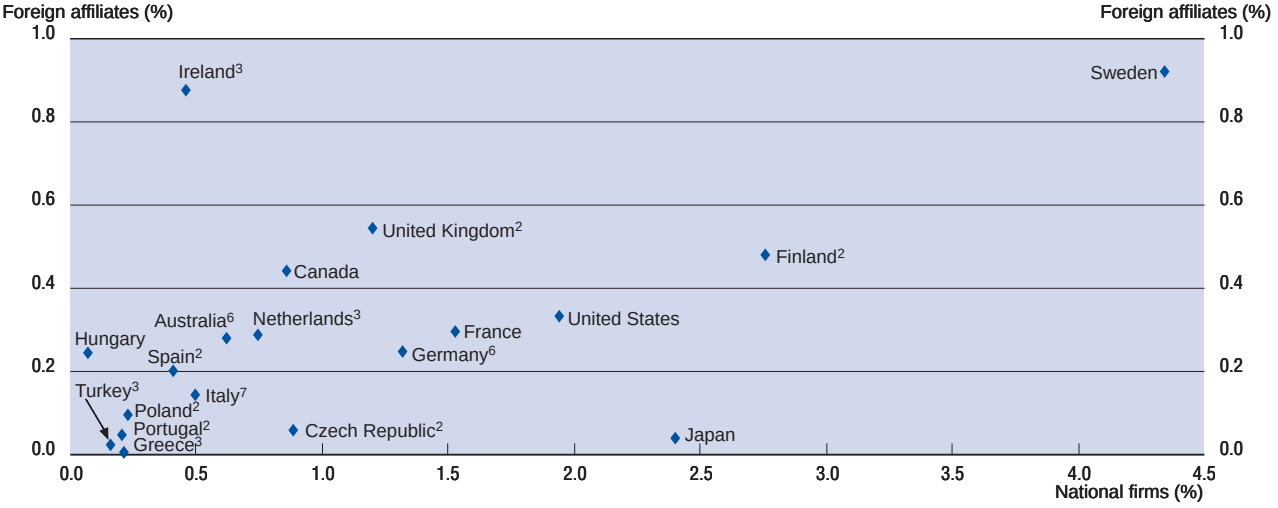
Share of foreign affiliates in manufacturing R&D and turnover[1]

1998 or latest available year



R&D expenditures by foreign affiliates and national firms as a share of domestic product of industry[5]

1998 or latest available year



1. Production instead of turnover for Canada and Ireland.
2. 1999.
3. 1997.
4. 1993.
5. Manufacturing industry rather than total industry for Italy and Poland.
6. 1995.
7. 1992.

Source: OECD, AFA database, 2001.

C.5.2. International strategic alliances between firms

- There has been a significant increase in international strategic alliances and cross-border mergers and acquisitions in the 1990s. This reflects the global restructuring strategy of firms (see C.3.2).
- International strategic alliances accounted for over 60% of all alliances that took place between 1990 and 1999 in the OECD area. For smaller countries, *e.g.* Iceland, Belgium, Luxembourg and Austria, international alliances were generally much more numerous than alliances among domestic firms. Cross-border alliances accounted for over 90% of all their deals.
- The United States accounted for about two-thirds of strategic alliances in the 1990s, half of them with foreign partners. The United States was followed by Japan, the United Kingdom, Canada and Germany.
- Strategic alliances in traditional areas – manufacturing, marketing and R&D – declined significantly over the 1990s, in line with the rapid increase in cross-border strategic alliances in business services.
- The share of services in cross-border strategic alliances increased from 30% in 1990 to around 80% in 2000; the share of manufacturing declined from 55% to 18% over the same period.

International strategic alliances

Strategic alliances can take various forms: agreements on joint production, marketing, research and development, shared sales and distribution networks, standards setting, etc. They can take place at domestic or international level. Cross-border strategic alliances between firms are gaining in importance as national economies globalise.

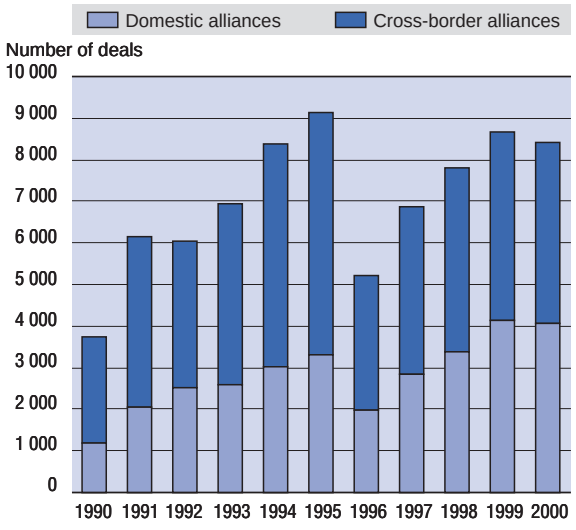
The data for strategic alliances are based on the Thomson Financial Securities database (SDC Platinum). The database contains almost 70 000 alliances, grouped by sector, type, purpose, etc., from 1988 to the present. It is based on public announcements by firms. Thus, it does not include information on undisclosed deals and may under-represent alliances among small and medium-sized enterprises, which tend not to be reported by the press. As in the case of mergers and acquisitions, the data on strategic alliances also have linguistic limitations and comparability problems (see C.3.2).

In addition, the methodology may give rise to certain discrepancies. Each alliance, for example, is recorded just once in the world total, whereas in regional or country distributions, an alliance with multiple partners is recorded for each international partner. Thus, summing the number of alliances by individual countries could result in a higher world total.

For detailed analysis of strategic alliances, see OECD (2001), *New Patterns of Industrial Globalisation: Cross-border Mergers and Acquisitions and Strategic Alliances*, Paris.

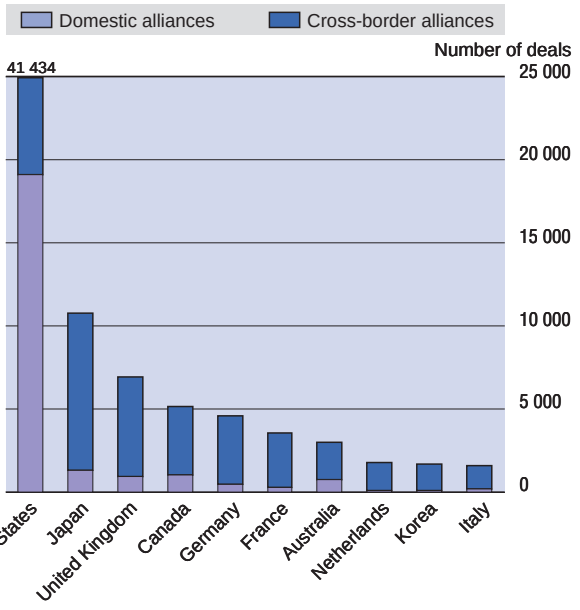
C.5.2. International strategic alliances between firms

Cross-border and domestic strategic alliances worldwide, 1990-2000[1]



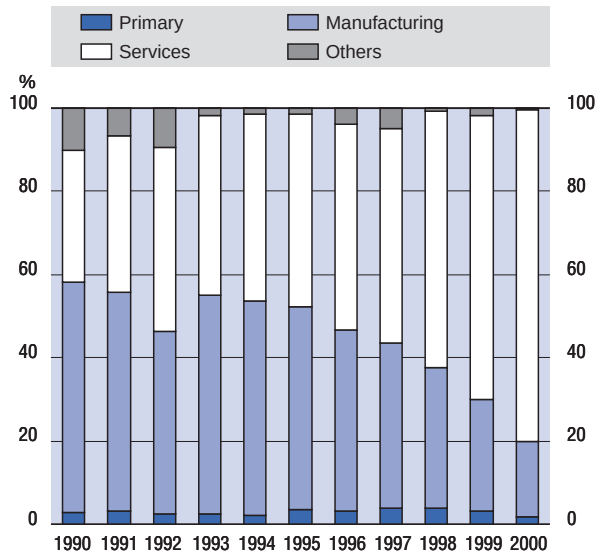
Strategic alliances: top ten OECD countries

Cumulative number of deals, 1990-99



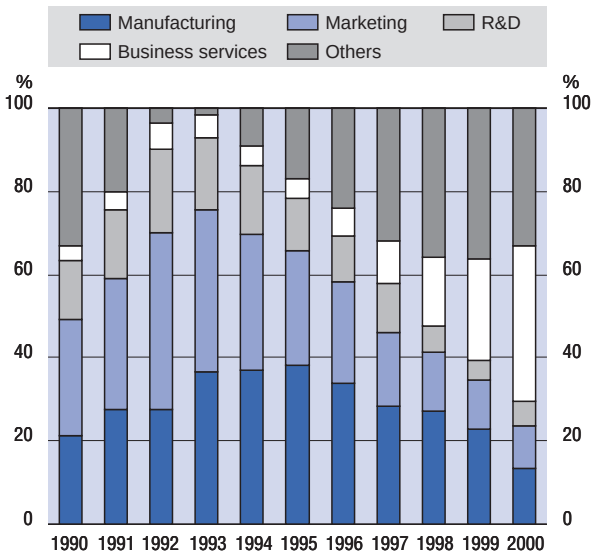
Cross-border strategic alliances worldwide, by sector, 1990-2000[1]

Percentages



Cross-border strategic alliances worldwide, by purpose, 1990-2000[1]

Percentages



1. For 2000, from January to October.

Source: Thomson Financial, November 2000.

C.5.3. Cross-border ownership of inventions

- An increasing share of technology is owned by firms from a country that is not the inventor's country of residence. This is in line with the general internationalisation strategies of firms which progressively relocate their production and research facilities abroad (see C.5.1).
- 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 15% 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. Foreign ownership of domestic inventions is also high in Canada and the United Kingdom, where a large share of inventions is owned by companies from the United States and is related to the inventive activity of foreign affiliates in these countries.
- Domestic ownership of foreign inventions is high in small open countries. For example, 80% of all inventions owned by residents of Luxembourg have been made abroad. This share is also high in Switzerland (39%) and the Netherlands (30%). Even though 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 13%.
- Japan and Korea, on the other hand, seem much less internationalised with respect to cross-border ownership of inventions. Linguistic barriers, low penetration of foreign affiliates and geographical distance from Europe and the United States may help explain the observed differences.

Cross-border ownership of inventions

Patents are increasingly recognised as a rich source of information regarding technological performance. Among the information available from patent files are 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, a university, a public laboratory), and sometimes an individual, whereas inventors are always individuals.

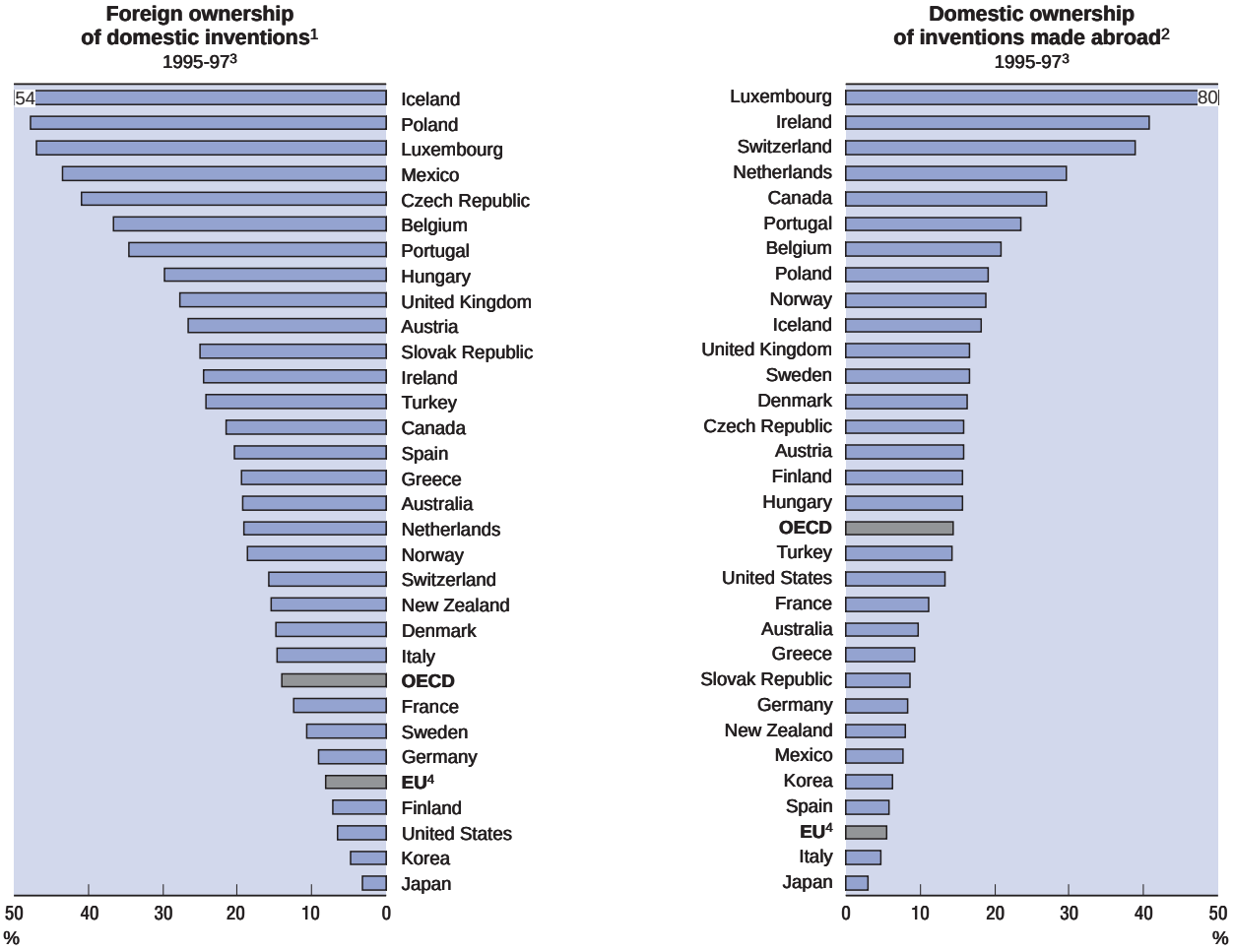
An increasing share of European Patent Office (EPO) patent applications is controlled by applicants whose country of residence is different from the country of residence of the inventor(s). Such cross-border ownership practices are mainly the result of multinational activities; the applicant is a conglomerate 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 consists in evaluating 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 indicator 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 in country B. This indicator will provide the share of patents from its facilities in country B in the total number of patents.

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

For more details, see Annex, Table C.5.3.1.

C.5.3. Cross-border ownership of inventions



1. Share of patent applications to the 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. The European Union is treated as one country; intra-EU cross border ownership has been netted out.

Source: OECD, Patent database, May 2001.

C.5.4. 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 are intended to shed light on this trend.
- In the mid-1990s, 27% of scientific publications in the OECD area were the work of multinational teams and 7% of patents were the result of international co-operative research.
- There are significant differences across OECD countries, however. 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, where the domestic pool of researchers is limited. Over 40% of scientific publications are published with a foreign co-author in Belgium, Denmark and Austria. Likewise, 35% of patents have foreign co-inventors in Luxembourg, and 15% in Iceland and Belgium. International co-operation in science and technology is also relatively high in Hungary, Poland and the Czech Republic.
- When intra-EU co-operation is factored out, researchers in the United States and the European Union have a similar propensity to co-operate with foreign researchers, while international co-operation in science and technology in Japan is rather limited.

International collaboration in science and technology

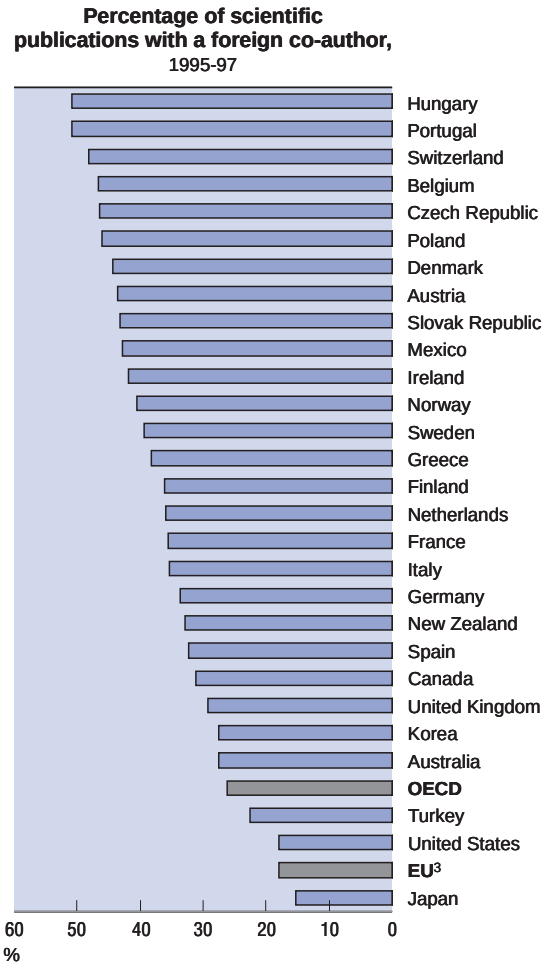
Patent data include the name and address of all inventors (individuals). An increasing share of European Patent Office (EPO) patent applications involves inventors with different countries of residence. International collaboration by researchers can take place either within a multinational corporation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

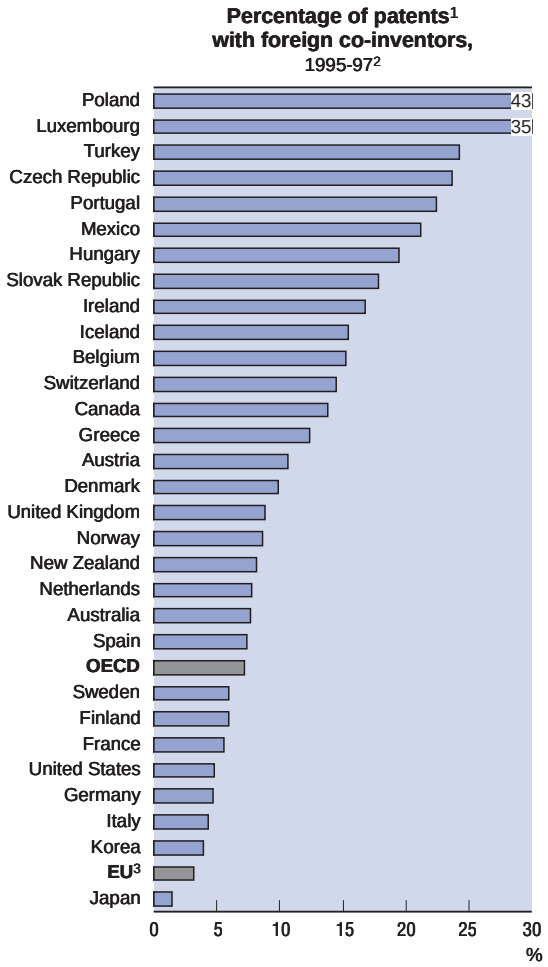
The propensity to collaborate internationally can be derived from the address of the inventors listed in the patent file. Here, it is approximated as the ratio of the number of inventions involving a country's residents and at least one inventor with foreign residence to the total number of inventions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

The indicator on scientific publications is based on data from the National Science Foundation and the Science Citation Index. It is derived from counts of scientific and technical articles with a foreign co-author in a set of major international journals, which could be biased for certain languages. Article counts are derived from fractional assignments; for example, an article with two authors from different countries is counted as one-half article to each country. The OECD total corresponds to an average of OECD countries weighted by the share of each country in total scientific publications. The same is true for the European Union, after netting out intra-EU co-operation.

For more details, see Annex, Table C.5.4.1.

C.5.4. International co-operation in science and technology





Source: OECD, based on data from the National Science Foundation, *Science and Engineering Indicators 2000.*

1. Patent applications to the European Patent Office.
2. Priority years.
3. The European Union is treated as one country; intra-EU co-operation has been netted out.

Source: OECD, Patent database, May 2001.

C.5.5. Technology balance of payments

- The technology balance of payments measures international technology transfers: licenses, patents, know-how, research and technical assistance. Unlike R&D expenditure, these are payments for production-ready technologies.
- In most OECD countries, technological receipts and payments increased sharply during the 1990s. Overall, the OECD area maintained its position as net technology exporter *vis-à-vis* the rest of the world.
- The European Union, on the other hand, continued to run a deficit on its technology balance of payments. This does not necessarily indicate low competitiveness but could be the result of increased imports of foreign technology in the European Union.
- The main technology exporters as a percentage of GDP are Switzerland, Belgium, Denmark, the United States, the United Kingdom, Canada and Japan. Ireland, Korea, Hungary and Portugal are among those that imported the most technology in 1999.
- 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 extensively.

Technology balance of payment

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, 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 position 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.

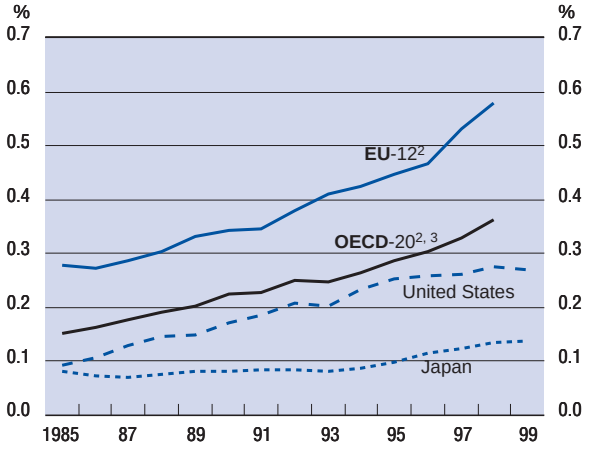
Likewise, if the balance is in surplus, this could be the result of a high degree of technological autonomy, a low level of technology imports or a lack of capacity to assimilate foreign technologies. Most transactions also correspond to operations between parent companies and affiliates. Thus, it is important to have additional qualitative and quantitative information 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.

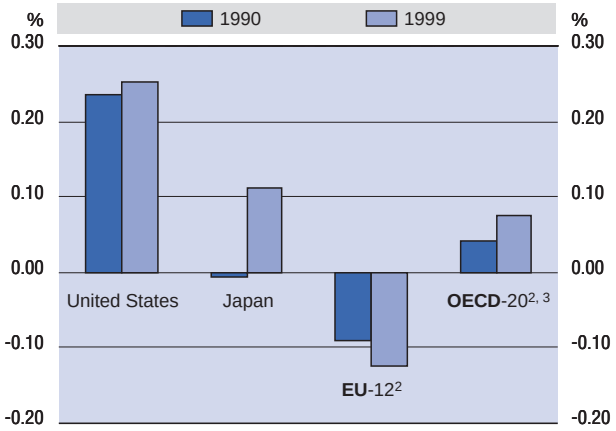
For more details, see Annex, Table C.5.5.1.

C.5.5. Technology balance of payments

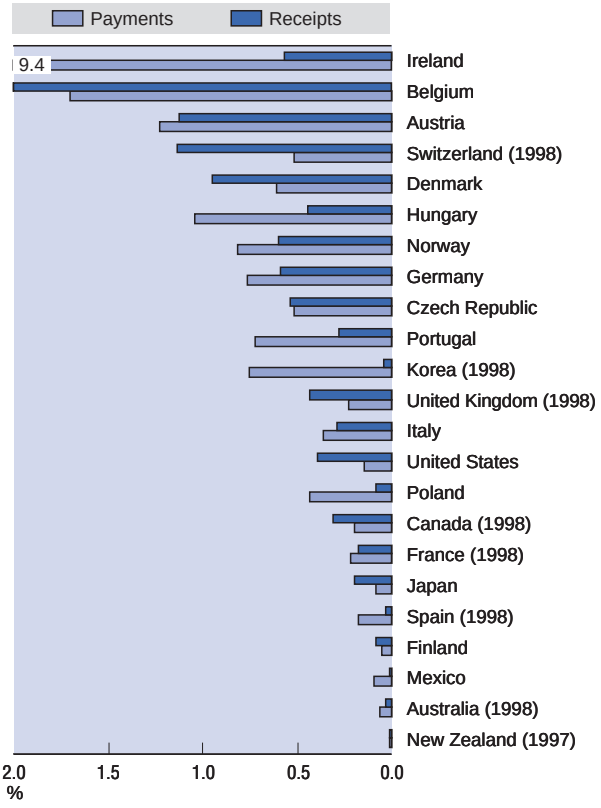
Trends in technology flows[1] as a percentage of GDP



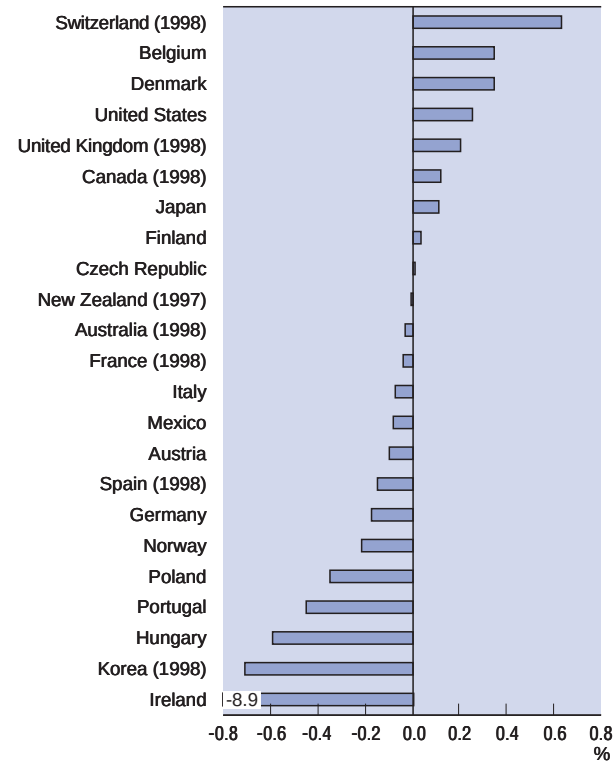
Changes in the balance as a percentage of GDP, 1990 and 1999



Flows as a percentage of GDP
1999 or latest available year



Balance as a percentage of GDP
1999 or latest available year



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

Source: OECD, TBP database, April 2001.

D.1. Differences in income and productivity in the OECD

- Indicators of productivity growth should be complemented by indicators of income and productivity levels. Levels give insight into possible scope for further gains and also place a country's growth with respect to its current level of income and productivity.
- In 1999, the United States had the highest level of GDP per capita in the OECD area, followed by Switzerland and Norway. Most OECD countries, including all other G7 countries, had income levels ranging between 65% and 80% of that of the United States. Next come a number of lower-income economies, including Greece, Korea, Portugal, Spain and New Zealand, some of which have recently experienced high growth. Mexico, Turkey and the former centrally planned economies (Czech Republic, Hungary and Poland) are at the bottom of the OECD area income distribution.
- Differences in GDP per capita among OECD countries can be attributed to differences in labour productivity, or GDP per hour worked, and differences in labour utilisation, or the average number of hours worked by the population. Differences in GDP per capita are clearly not the same as differences in GDP per hour worked. Demographic factors – differences in the ratio of the working-age population to the total population – have only a small impact on cross-country differences in GDP per capita.
- The gap between income and productivity levels is particularly marked for European countries such as France, Italy, Belgium and the Netherlands. These countries have levels of GDP per hour worked that are higher than or comparable to that of the United States, but levels of GDP per capita that are considerably lower, owing to low labour utilisation, *i.e.* low employment rates and short working hours. For most other OECD countries, in particular those at the bottom end of the OECD income distribution, low levels of labour productivity are the most important factor in the low levels of GDP per capita.
- High labour productivity is often associated with strong economic performance. However, some countries with high levels of labour productivity have very low levels of labour utilisation, suggesting that high labour productivity may partly be due to high capital-labour ratios and to difficulties in keeping low-productivity workers in employment. Estimates of GDP per hour worked should therefore be combined with estimates of GDP per capita.

Comparisons of income and productivity levels

Comparisons of income and productivity levels need to address several measurement problems. First, they require comparable data on output. The measurement and definition of GDP are treated systematically across countries in the 1993 System of National Accounts (SNA). Most countries have now implemented this system, Switzerland and Turkey being the main exceptions. Output in these countries is likely to be understated relative to other OECD countries.

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 that are not necessarily consistent with the national accounts. Labour input also requires measures of hours worked, which are typically either derived from labour force surveys or from enterprise surveys. Several OECD countries estimate hours worked from a combination of these sources and may thus counteract their biases. Cross-country comparability of hours worked can therefore be improved, although a margin of uncertainty remains. The estimates of hours worked underlying the productivity levels shown here are based on a mix of sources to improve international comparability, see Scarpetta, S., 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.

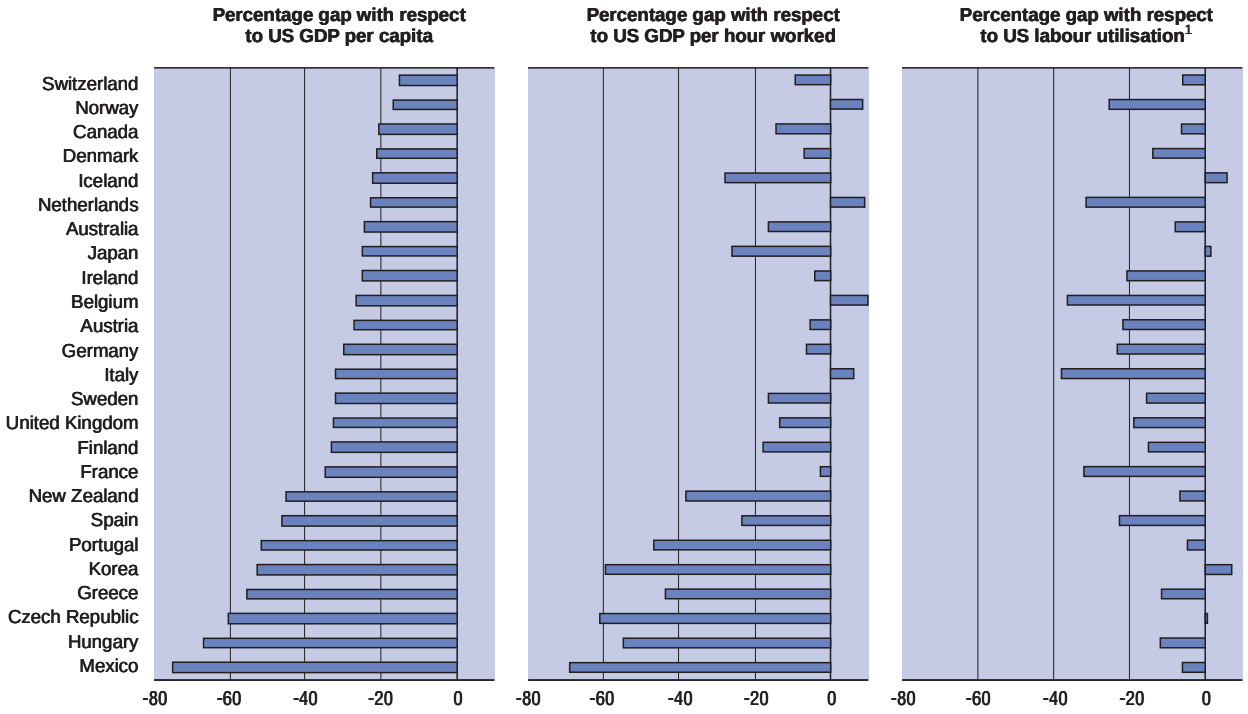
Third, international comparisons require price ratios to convert output expressed in a national currency into a common unit. Exchange rates are of limited use for this purpose because they are volatile and reflect many influences, including capital movements and trade flows. The alternative is to use purchasing power parities (PPPs), which measure the relative prices of the same basket of consumption goods in different countries. Over the past two decades, the OECD has regularly published estimates of PPPs based on a programme with Eurostat. Benchmark estimates of PPPs are currently available for 1980, 1985, 1990, 1993 and 1996, and work is under way for a new comparison for 1999. The estimates shown here apply the 1996 PPPs, the most recent year available and therefore the most likely to reflect current price differences across the OECD.

For more details, see Annex, Table D.1.1.

D.1. Differences in income and productivity in the OECD

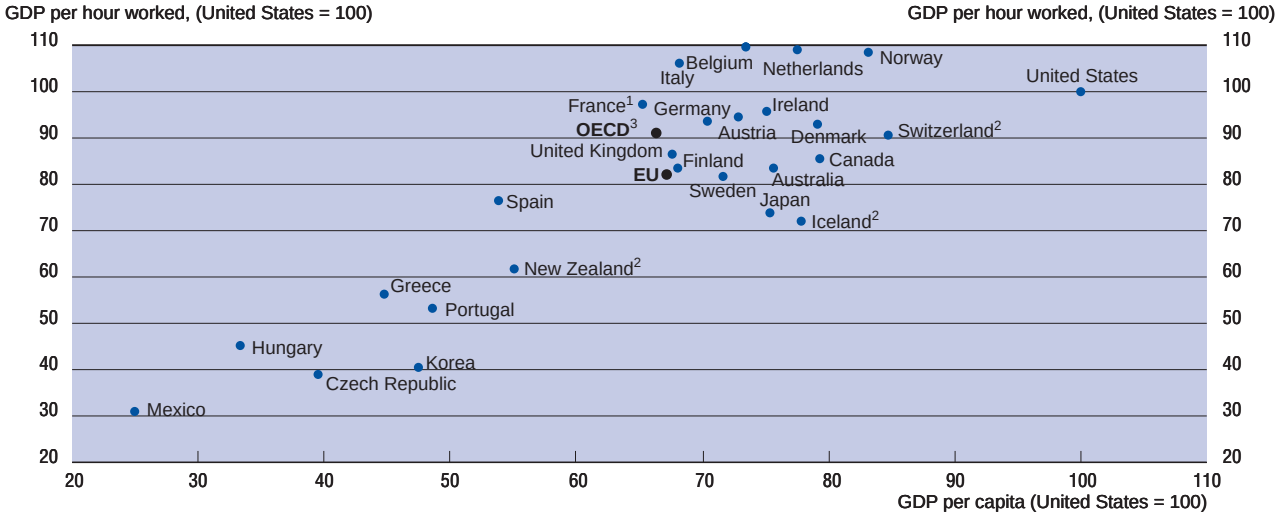
Income and productivity levels, 1999

Percentage point differences in PPP-based GDP per capita with respect to the United States



1. This reflects the joint effect of differences in the demographic structure of countries (the ratio of the working-age population to the total population), in employment rates and in average hours worked per person.

GDP per capita and GDP per hour worked, 1999



4. Includes overseas departments.
5. GDP estimates for Iceland, New Zealand, Switzerland and Turkey are based on SNA68.
6. Excluding Poland, Turkey and the Slovak Republic.

Source: OECD, GDP and population from National Accounts database, May 2001; working-age population, labour force and employment from Labour Force database; hours worked from OECD calculations, see Scarpetta, S., 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.

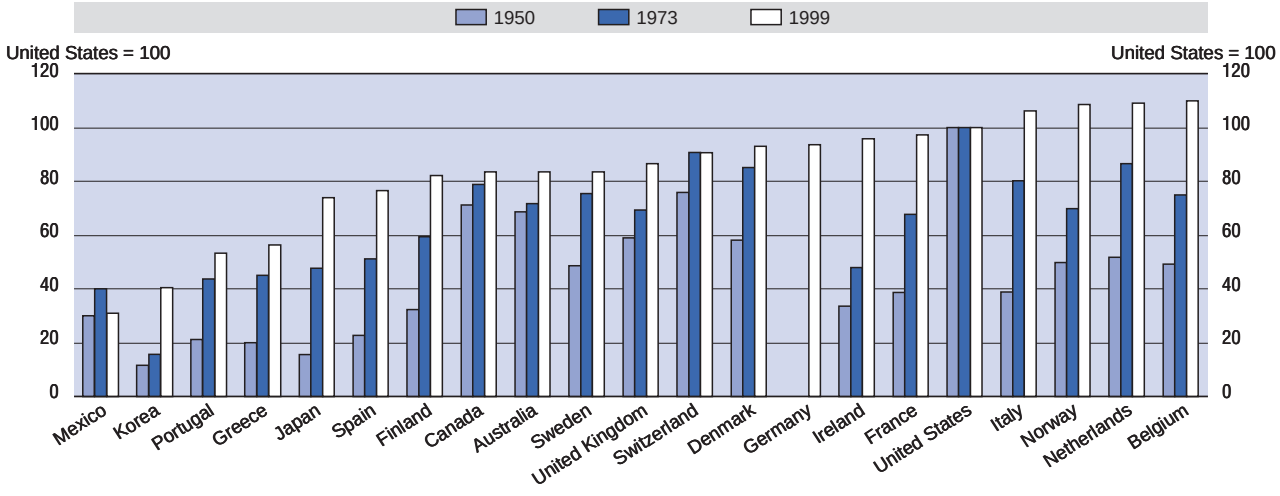
D.2. Income and productivity levels in the OECD, 1950-99

- In the OECD area, cross-country differences in GDP per capita and labour productivity have eroded considerably since the 1950s. Over the 1950s and 1960s, income levels of OECD countries except Australia, New Zealand and the United Kingdom were catching up with those of the United States. In the 1970s, this phenomenon was less widespread and the rate of catch-up had fallen, Korea being the main exception. 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 20 OECD countries in the 1990s.
- Japan and Korea had the highest rates of catch-up over the 1950-99 period, with GDP per capita growing more rapidly, by 2.7% and 3.2%, respectively, than in the United States. Most of Western Europe had much lower rates of catch-up, typically below 1% a year. Countries such as Australia, New Zealand, the United Kingdom and Canada were already at relatively high income levels in 1950 and have since done little catching up with the United States. Switzerland had a marked decline in relative income levels. A final group of countries started with low income levels in the 1950s and have caught up little or not at all. It includes Eastern European countries, Mexico and Turkey.
- Changes in levels of GDP per hour worked show a slightly different pattern. Out of 21 OECD countries for which data are available, only Mexico and Switzerland have not been catching up with US productivity levels almost continuously 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 it.

Income and productivity levels over time

Comparisons of income and productivity levels for a particular year (see D.1) can easily be updated over time by applying time series for GDP, population, employment and hours worked. Time series for GDP, population and employment are all derived from OECD's ADB database, which underlies the OECD *Economic Outlook*. Time series for hours worked are taken from the OECD *Employment Outlook*. The OECD databases covering these variables typically only date back to the early 1960s or 1970s. For earlier years, estimates were extrapolated by using estimates for GDP, population, employment and hours worked from Angus Maddison, *Monitoring the World Economy*, 1820-1992, OECD Development Centre, 1995. The OECD Internet site also provides estimates of comparative income levels of OECD Member countries. See *www.oecd.org/std/nadata.htm*

GDP per hour worked in the OECD area, 1950, 1973 and 1999, United States = 100

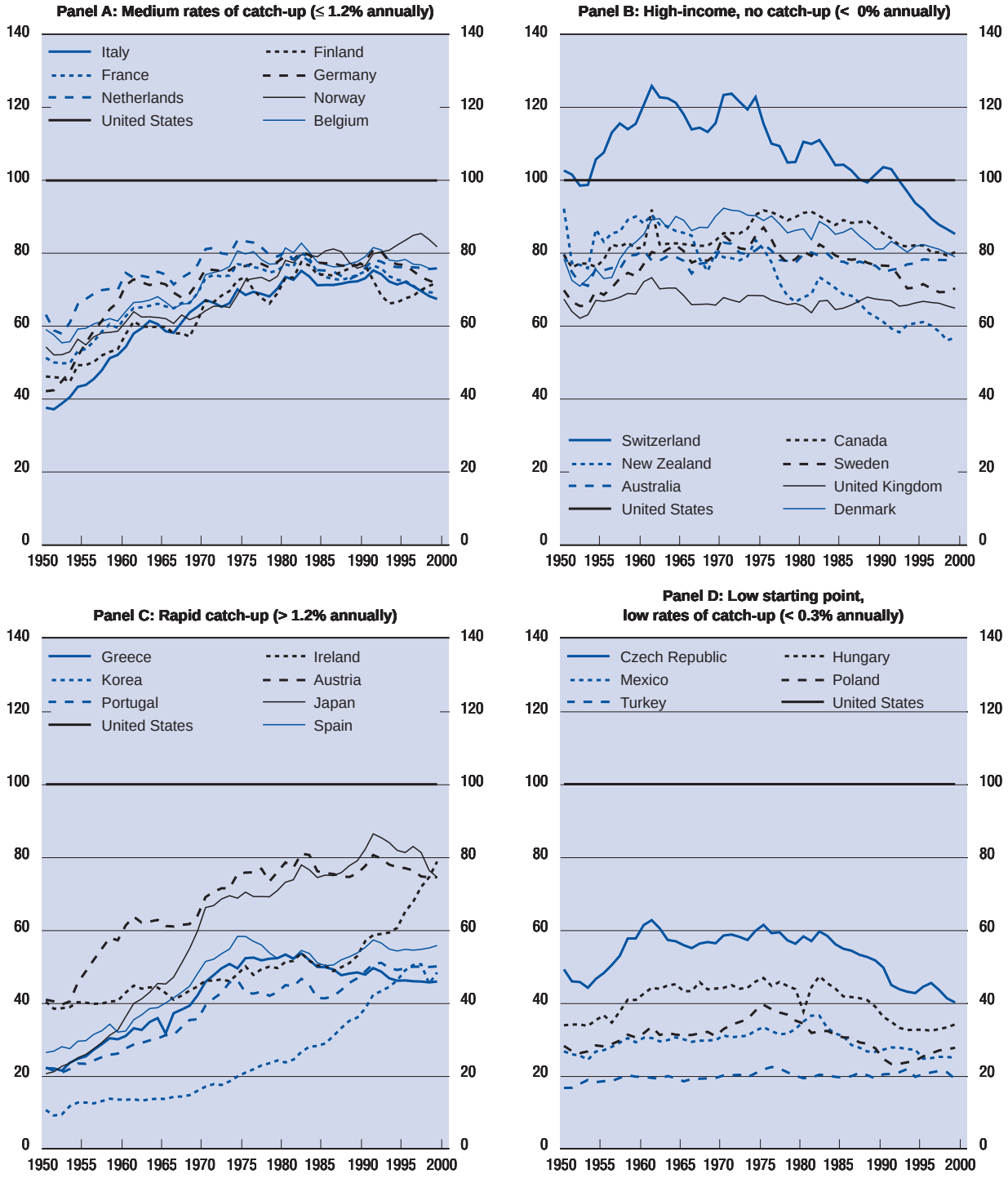


Source: 1999 productivity levels from Annex Table D.1.1; previous years based on GDP, employment and hours worked from OECD, ADB database and Angus Maddison (1995), *Monitoring the World Economy: 1820-1992*, Development Centre Studies, OECD, Paris.

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

D.2. Income and productivity levels in the OECD, 1950-99

Catch-up and convergence in OECD income levels, 1950-99, United States = 100



Source: 1999 productivity levels from Annex Table D.1.1; previous years based on GDP and population data from OECD, ADB database and Angus Maddison (1995), *Monitoring the World Economy: 1820-1992*, Development Centre Studies, OECD, Paris.

D.3. Recent changes in productivity growth, 1990-99

- Productivity ratios relate a measure of output to one or several inputs to production. The most common productivity measure is labour productivity, which links output to labour input. It is a key economic indicator as it is closely associated with standards of living. Ideally, estimates of labour productivity growth should incorporate changes in hours worked.
- Estimates of the increase in GDP per hour worked for OECD countries – adjusted for the business cycle – show that Korea, Ireland and Luxembourg had the highest rates of productivity growth in the 1990s. Switzerland, New Zealand, Spain and Mexico had the lowest. In countries such as Ireland, Australia, the United States, Greece and Germany, labour productivity growth in the second half of the 1990s was substantially higher than in the first half.
- Labour productivity is a partial measure of productivity; it relates output to only one input in the production process, albeit an important one. More complete measures of productivity at the economy-wide level relate output growth to the combined use of labour and capital inputs. This measure is called multi-factor productivity (MFP). Growth in MFP is key to long-term economic growth, as it indicates rising efficiency in the use of all available resources. It is also a better reflection of technological progress than the increase in labour productivity, since the latter can also be achieved through greater use of capital in the production process and the dismissal of low-productivity workers.
- Estimates of MFP growth are available for fewer countries than estimates of labour productivity growth, primarily because of the limited availability of data on capital stock. The estimates show that Ireland and Finland experienced the most rapid MFP growth over the 1990s. In countries such as Ireland, Finland, Belgium, Australia, Canada, the United States, France and the United Kingdom, MFP growth accelerated during the 1990s. In other countries, such as the Netherlands, Norway, Spain and Japan, MFP growth declined.

OECD measures of productivity

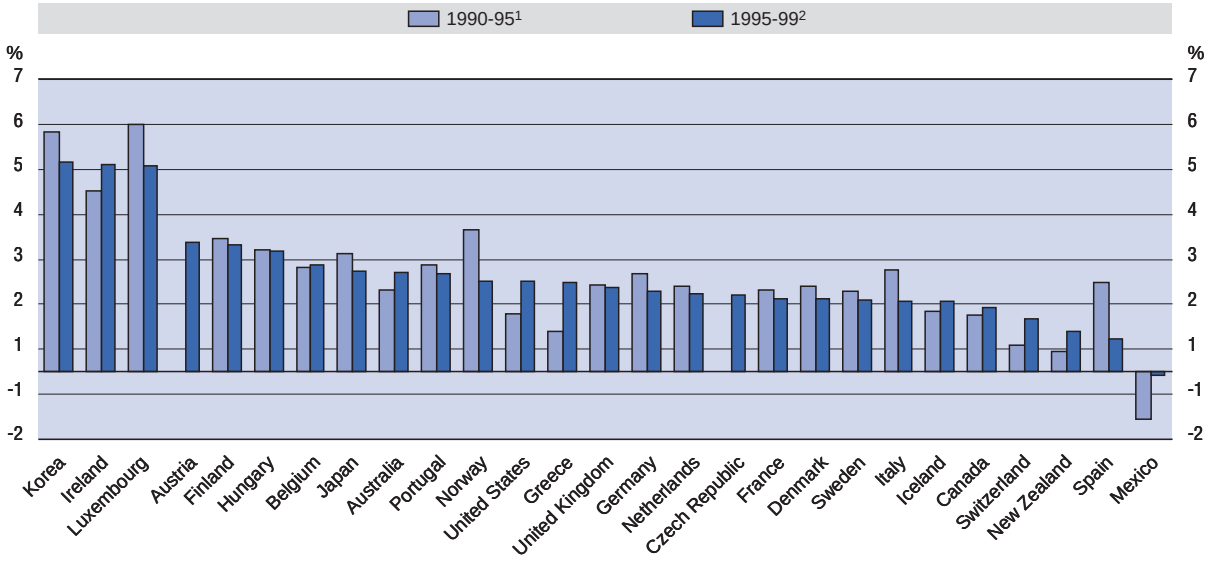
The OECD *Productivity* Manual: There are many different approaches to the measurement of productivity. The calculation and interpretation of the different measures are not straightforward, particularly for international comparisons. To give guidance to statisticians, researchers and analysts that work with productivity measures, the OECD recently released the OECD *Productivity Manual*. 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. More: *www.oecd.org/subject/growth/prod-manual.pdf*

OECD *estimates of productivity adjusted for the business cycle*: For its recent work on economic growth, the OECD 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 due to measurement: variations in volume output tend to be relatively accurately reflected in economic statistics, but variations in the rate of utilisation of inputs are at best only partially picked up. Even if capacity utilisation is accurately measured, 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 of time or to adjust productivity estimates for cyclical fluctuations. The estimates shown here are adjusted for the business cycle according to a method explained in more detail in Scarpetta, S., 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.

For more details, see Annex, Table D.3.

D.3. Recent changes in productivity growth, 1990-99

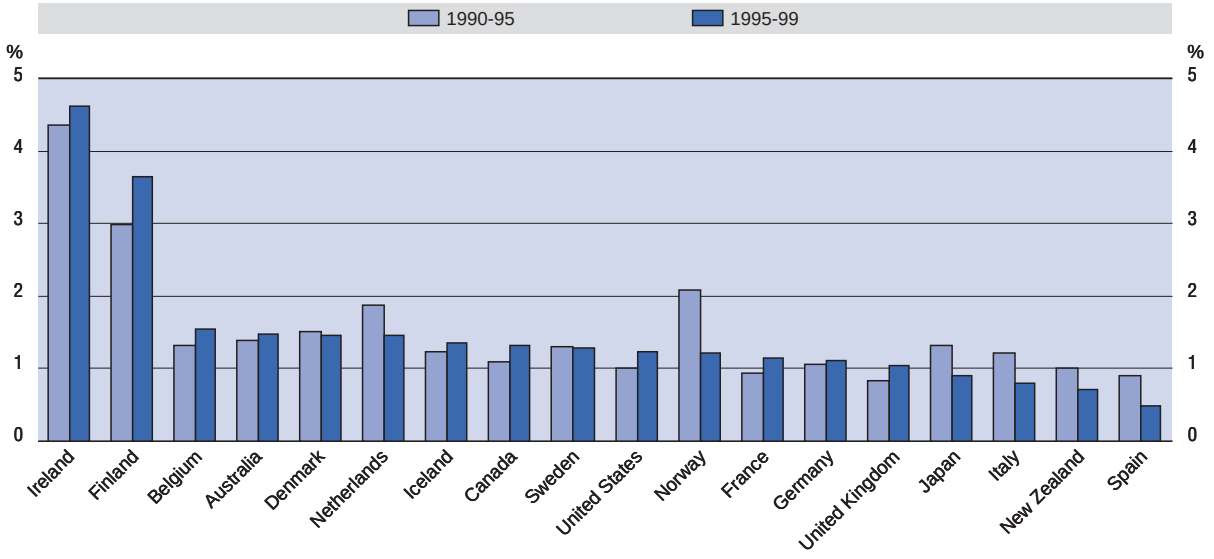
Trend growth in GDP per hour worked
Total economy, percentage change at annual rate



1. Data for Germany, Hungary, Iceland, Mexico and Switzerland refer to 1991-95.
2. Data for Austria refer to 1996-99; data for France, Japan, Korea, Portugal and Switzerland refer to 1995-98.

Source: OECD calculations, based on data from the *OECD Econoic Outlook No. 68.* See Scarpetta, S., A. Bassanini, D. Pilat and P. Schreyer (2000), "Economic Growth in the OECD area: Recent Trends at the Aggregate and sectoral Level", Economic Department Working Paper No. 248, OECD, Paris.

Trends in multi-factor productivity growth,[1, 2] 1990-95 and 1995-99
Business sector, percentage change at annual rates



1. Adjusted for hours worked, based on trend series and time-varying factor shares.
2. Series end in 1997 for Austria, Belgium, Italy and New Zealand; 1998 for Australia, Denmark, France, Ireland, Japan, Netherlands and United Kingdom. Data for Germany start in 1991.

Source: OECD calculations, based on data from the OECD *Economic Outlook 68.* See Scarpetta, S., 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.

D.4. Labour productivity by industry

- The ratio of value added to employment provides an indication of which industries yield relatively high value added per unit of labour input. Although total employment is not the best measure of labour input for this purpose (see box), a reasonably clear pattern emerges.
- By the end of the 1990s, industries predominantly involved in the extraction, processing and supply of fuel and energy goods produced the highest value added per labour unit. These industries were more than twice as productive as the average industry. They account for about 5% of total OECD value added and are typically highly capital-intensive.
- Besides the energy-producing industries, those that yield the most value added per labour unit are those considered technology and/or knowledge intensive (see D.5). In manufacturing, the chemical industry has the highest relative labour productivity level, while in services, finance, insurance and telecommunications lead the way.
- Construction, wholesale and retail trade, hotels and restaurants and textiles show relatively low levels of labour productivity in all three major OECD regions. These industries are typically highly labour-intensive, have a high proportion of low-skilled jobs and are not considered high-technology sectors.
- OECD economies are also characterised by considerable differences in labour productivity growth. In the second half of the 1990s, labour productivity growth in the three major OECD regions was typically highest in manufacturing of machinery and equipment, in telecommunications and in finance and insurance. Labour productivity growth in some sectors of the economy was negative over the most recent period. This may reflect cyclical or structural patterns, but may also be due to measurement difficulties.

Measuring labour productivity by industry

Labour productivity by industry can be measured in several ways. For the measurement of output, total production or value added are the typical yardsticks. If production (gross output) is used, productivity measures need to cover a combination of inputs, including intermediate inputs (such as materials and energy), labour and capital. If value added is used as the output measure, labour and capital suffice as indicators of factor inputs. The indicators shown here are determined by data availability and simply measure value added per person employed. Further adjustments to labour input, including adjustment for part-time work and hours worked per worker, can be made for certain OECD countries but international comparisons are not yet feasible. A few other notes apply to the indicators:

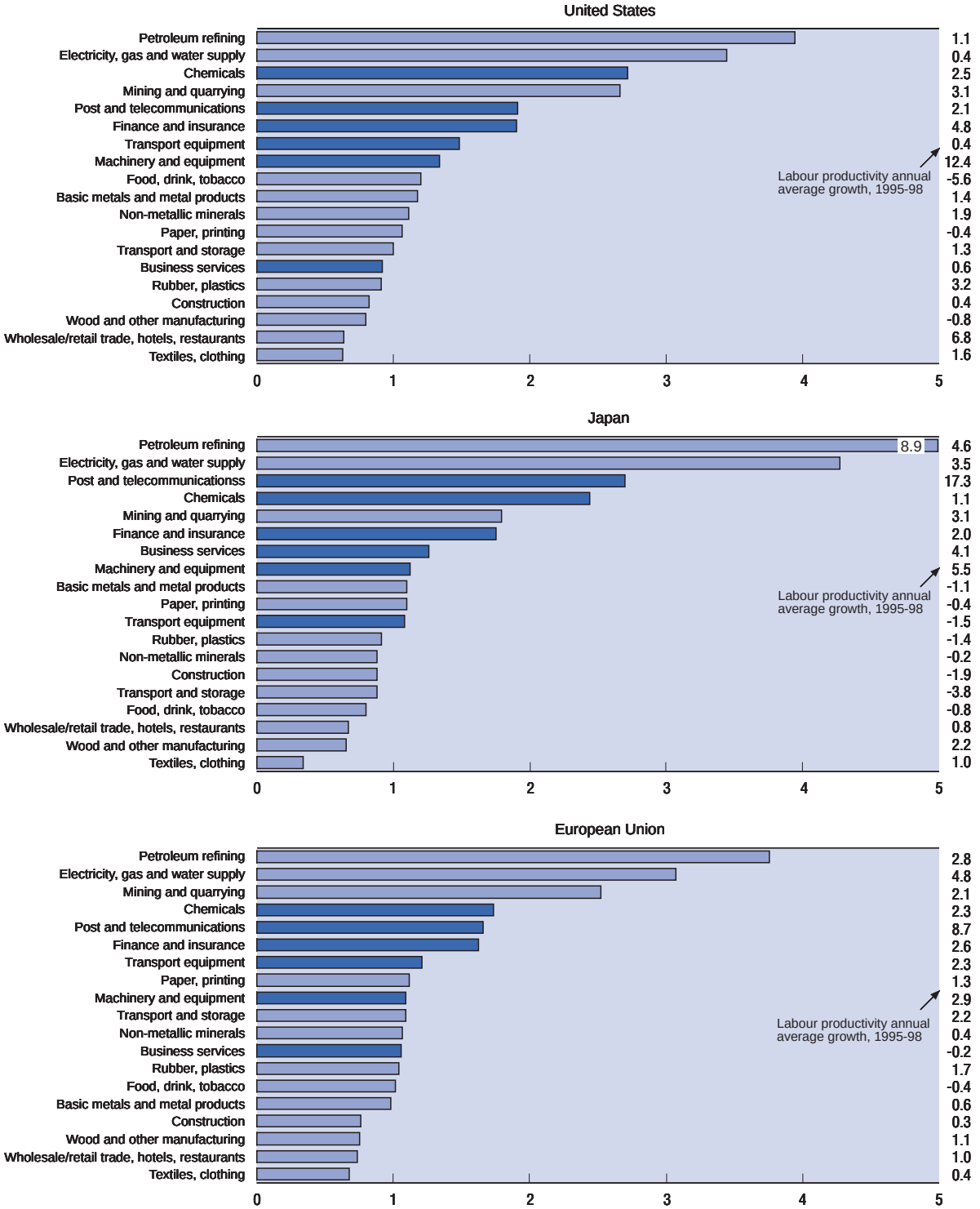
- For the labour productivity levels, 1998 value added at current prices was used. For the European Union, member countries' value added data were aggregated after applying 1998 US dollar GDP PPPs – industry-specific PPPs are preferable, but are not available for all sectors and countries.
- For value-added volumes (used to estimate labour productivity growth), the European Union series were derived by aggregating member countries' value-added volumes after applying 1995 US dollar GDP PPPs, the reference year for the volume series being 1995. This is not an ideal practice since some countries, such as France and Sweden, now use annually reweighted chained (rather than fixed-weight) Laspeyres aggregation methods to derive their value-added volumes by industry. Volumes calculated in this manner are generally non-additive.
- The labour productivity levels by industry are relative to the total non-agriculture business sector. This consists of all industries except agriculture, hunting, forestry and fishing (ISIC 01-05), real estate activities (ISIC 70) and community, social and personal services (ISIC 75-99; includes mainly non-market activities such as public administration, education and health).
- Productivity growth in some services sectors may be low because estimates of real output are based on input measures (such as employment). Much effort is currently being undertaken in Member countries to improve the measurement of real output in the services sectors.
- Sectors that are considered technology- and/or knowledge-intensive (see D.5) are highlighted in the graphs.

Further discussion of productivity measurement at industry level can be found in OECD (2001), *The* OECD *Productivity Manual*, Paris.

For more details, see Annex, Tables D.4.1 *and* D.4.2.

D.4. Labour productivity by industry

Labour productivity levels relative to the total non-agriculture business sector, 1998



Source: OECD, STAN and National Accounts databases, May 2001.

D.5. 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, attention is focused on the leading *producers* of high-technology goods and those 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.
- At the end of the 1990s, high- and medium-high-technology manufacturing accounted for about 9% of total OECD value added. Knowledge-based "market" services (see box) accounted for 18% (including education and health, about 29%).
- In Ireland, high- and medium-high-technology manufacturing has been a driving force behind the recent economic expansion and now accounts for more than 16% of total value added, significantly higher than the OECD average. Switzerland's high share of knowledge-intensive services (nearly 25% of total value added) is due to its strong financial sector. In most other countries, business services account for largest proportion of knowledge-intensive services.
- In the United States, 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 technology intensity (see Annex 1), capturing the "knowledge-intensive" services sectors has proved more challenging. In the 1999 STI Scoreboard (Chapter 2.2), this difficulty was reflected in the use of relatively broad ISIC Rev. 2 categories to maximise comparability across countries. Recently, as countries have revised their national accounts in line with the latest recommendations (SNA93 and ESA95), the availability of data for relatively detailed service sectors (particularly in Europe) has improved significantly. The graphs presented opposite reflect the following new features:

- Use of an industry breakdown based on ISIC Rev. 3.
- A first update of the technology classification of manufacturing industries based on ISIC Rev. 3 R&D intensities (see Annex 1). The main feature is the transfer of "Medical, precision and optical instruments" (ISIC Rev. 3, division 33) from the medium-high- to the high-technology group.
- A narrower definition of knowledge-based services owing to improved data availability. The 1999 Scoreboard used the broad group "Finance, insurance, real estate and business services" (ISIC Rev. 2, division 8). Here, "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. Previously, "Producers of government services" were excluded from the denominator.

Based on previous analyses of users of embodied technology (based on input-output tables), recently available (though limited) R&D intensities for service 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 for most countries).
- Divisions 65-67: Finance and insurance.
- Divisions 71-74: Business activities (not including real estate).

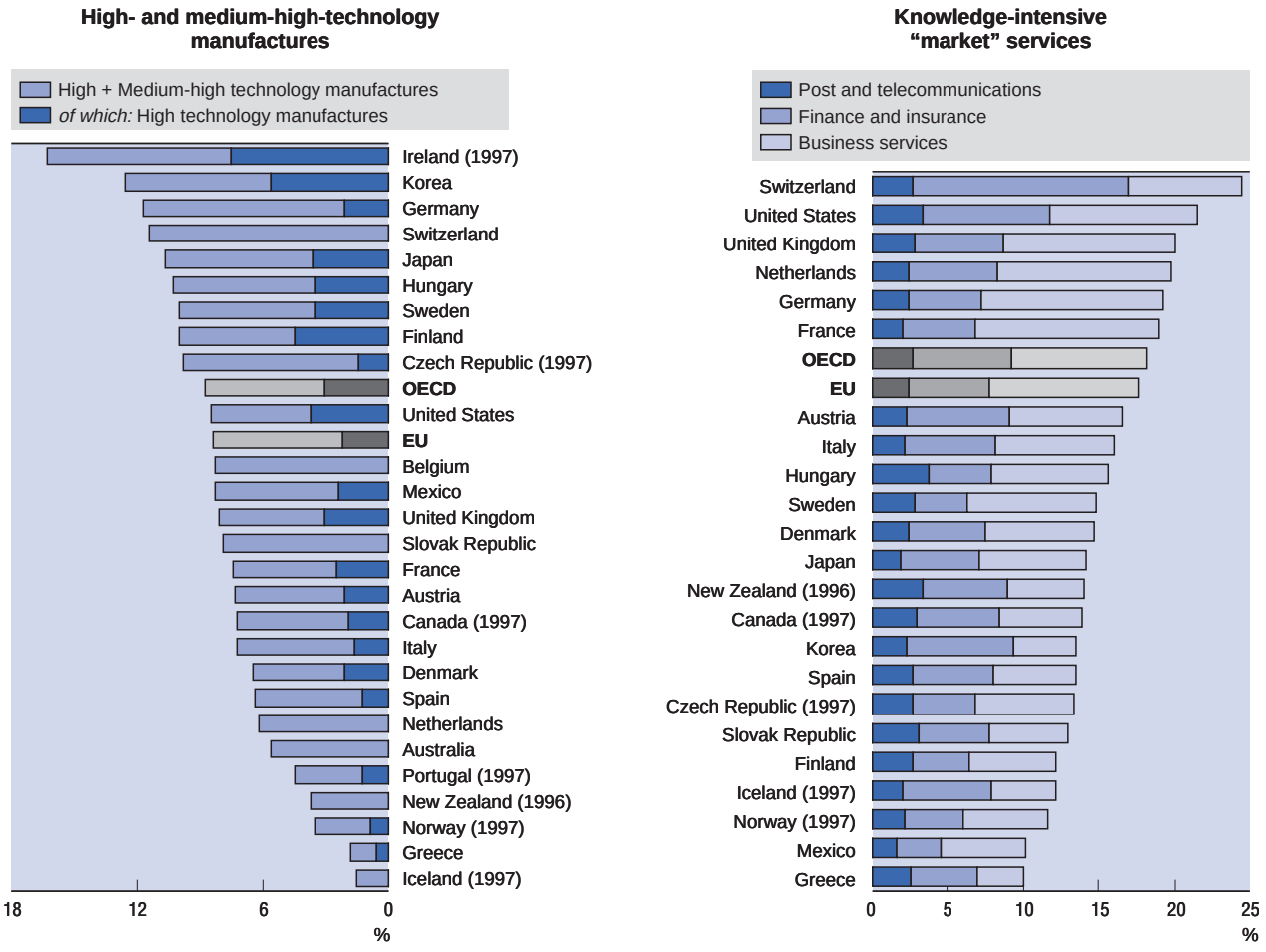
Education and health (about 11% of total OECD area value added) can now be presented separately for most countries. Although not shown in the graphs, the value added shares of these activities are included in Annex Table D.5.1.

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 across countries. In particular, some countries use quality-adjusted or "hedonic" prices for ICT goods. For further discussion see Schreyer, P., "Computer Price Indices and International Growth and Productivity Comparisons", STD/DOC(2001)1, OECD.

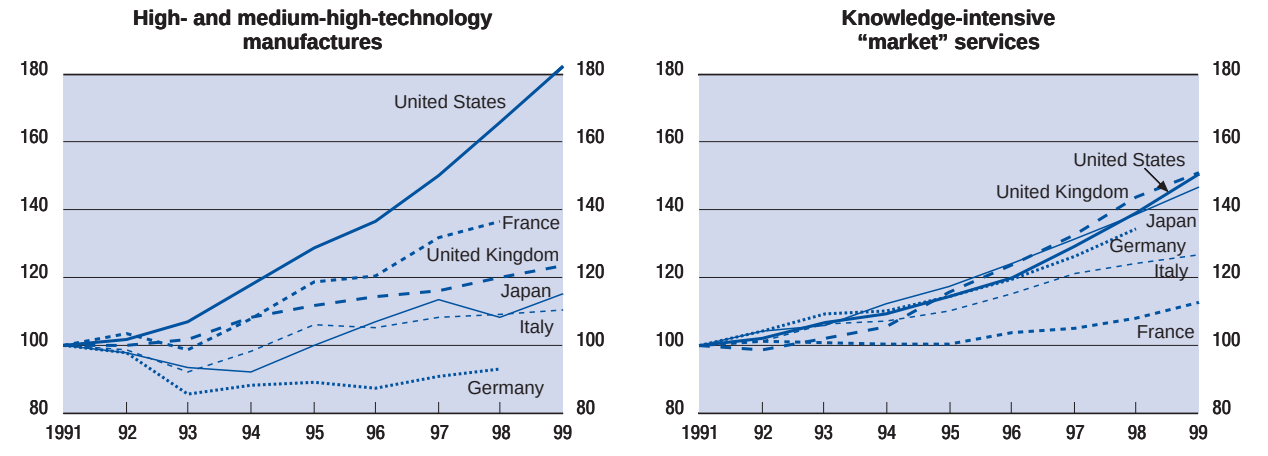
For more details, see Annex, Tables D.5.1 *and* D.5.2.

D.5. Technology- and knowledge-intensive industries

Share of total gross value added, 1998



Real value added (1991 = 100)



Source: OECD, STAN and National Accounts databases, May 2001.

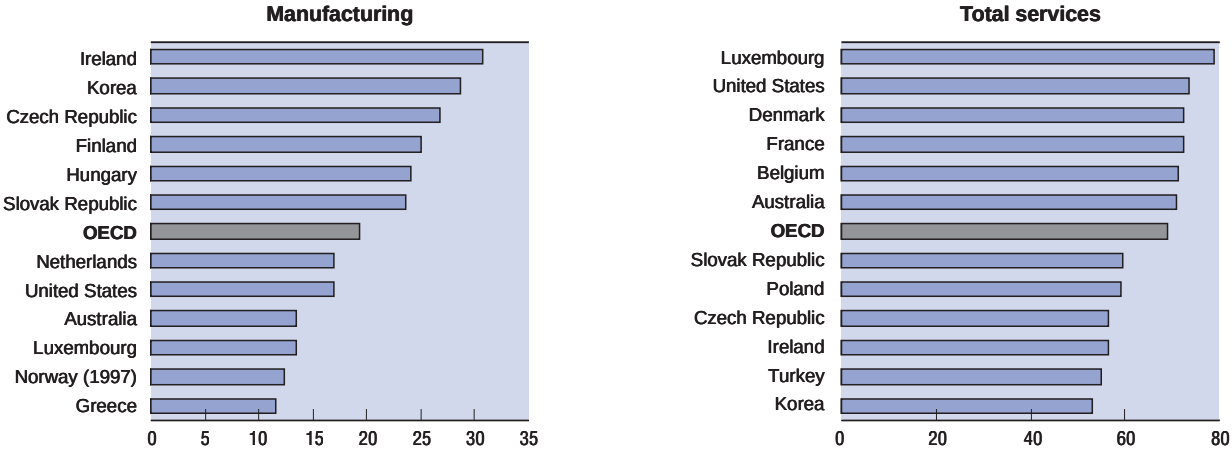
D.6. The structure of OECD economies

- Sectoral value-added shares provide a good perspective on the structure of OECD economies. Some are heavily oriented towards services (*e.g.* the United States), while others have a significant manufacturing sector (*e.g.* Ireland) or a large agricultural sector (*e.g.* Turkey).
- By the end of the 1990s, services (including the public sector) accounted for 69% of OECD value added, while manufactures accounted for about 19%. The gap has been increasing steadily for many years as demand for services has increased. Also, productivity growth is low in many services, and this tends to increase their share in economic activity.
- Countries that have industrialised very rapidly in recent years or that are still at relatively early stages of economic development typically have the largest manufacturing sectors (*e.g.* Ireland, Korea, eastern European countries). A significant proportion of the goods produced in these countries are high- and medium-high-technology manufactures (see D.5).
- Large services sectors in countries such as Denmark, France, and the United States are primarily due to a high proportion of value added in finance, insurance, real estate and business services, and a large community, social and personal services sector.
- Agriculture accounts for less than 3% of OECD value added. Only Turkey still has a share of more than 15%. The construction sector is also relatively small in most OECD countries; Korea and Japan are the main exceptions. Wholesale and retail trade, restaurants and hotels is a more important sector for economic activity and is particularly large in countries with a strong tourism industry (*e.g.* Greece).

Monitoring 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 also experienced 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 manufacturing typically experiences more rapid productivity growth, 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 will therefore experience an increase in relative prices. This typically implies that their share in value added will increase.

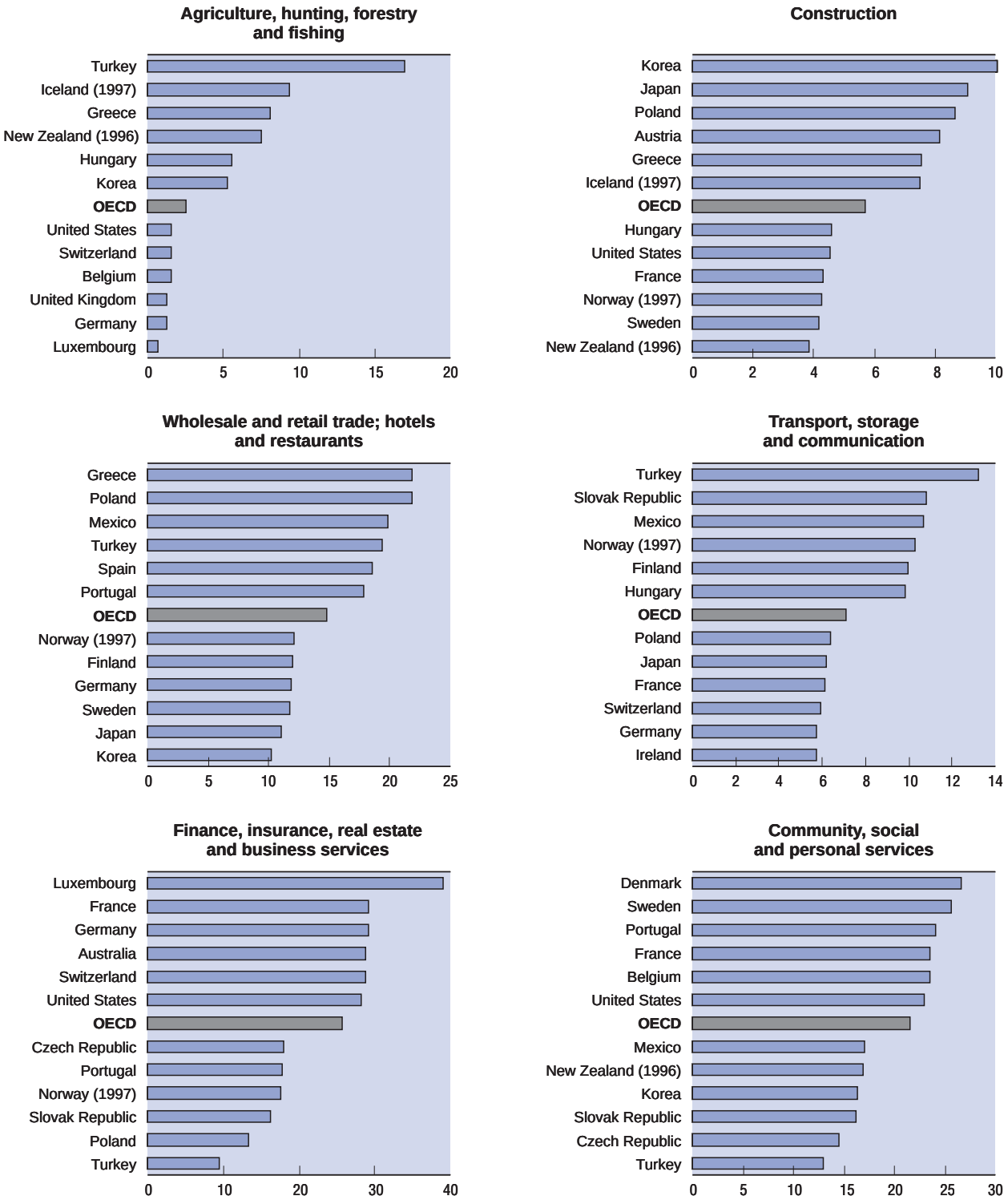
Share of total gross value added in the top six and bottom six countries in OECD, 1998



For more details, see Annex, Table D.6.

D.6. The structure of OECD economies

Share of total gross value added in the top six and bottom six countries in OECD, 1998 *(cont.)*



Source: OECD, STAN and National Accounts databases, May 2001.

D.7.1. International trade by technology intensity

- In the past decade, there has been a significant change in the composition of international trade in manufactured goods. The growth rate of trade in high-technology industries has accelerated, and their share in total OECD trade has increased.
- The shares of medium-low- and low-technology industries have gradually declined in spite of an increase of over 30% in the average value of exports and imports of these industries in the 1990s.
- As of 1999, high-technology industries accounted for one-quarter of OECD manufacturing trade, compared with 18% in 1990. The three industries with the highest growth rates in OECD manufacturing trade between 1990 and 1999 are all classified as high-technology industries: pharmaceuticals, radio, television and communication equipment and computers.
- Medium-high technology industries have the highest share (39%) in OECD manufacturing trade. This share has remained steady over the past decade.
- The growth rate of trade in most medium-low- and low-technology industries remained below the average growth rate of total manufacturing during the 1990s.

Measuring trade by industry and technology intensity

Few OECD Member countries provide estimates of international trade in goods by detailed industrial activity. To overcome this, estimates of exports and imports at current prices by industry are derived from the OECD's International Trade in Commodity Statistics (ITCS) database using a common conversion key (based on work by UN classification experts) which maps products classified according to the Harmonised System Rev.1 (HS1) to ISIC Rev. 3 activities. This conversion regime provides estimates by industry from 1988.

Since a single conversion key is used for all countries, the resulting estimates may not match trade by industrial activity published by some national authorities.

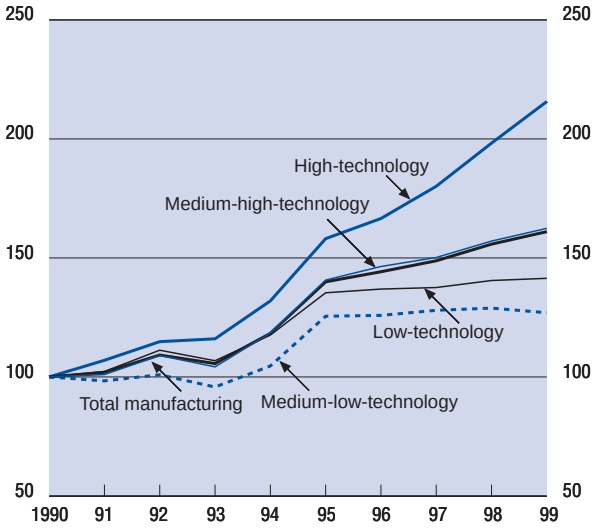
Once converted to ISIC Rev.3, estimates of trade in manufactured goods according to technology intensity are generated by using the technology classification of manufacturing industries outlined in Annex 1.

It should be noted that an alternative approach would be to classify individual products according to their technology content.

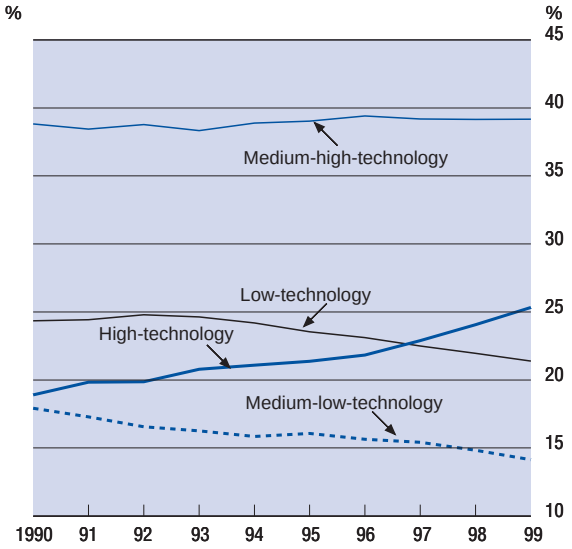
For more details, see Annex, Table D.7.1.

D.7.1. International trade by technology intensity

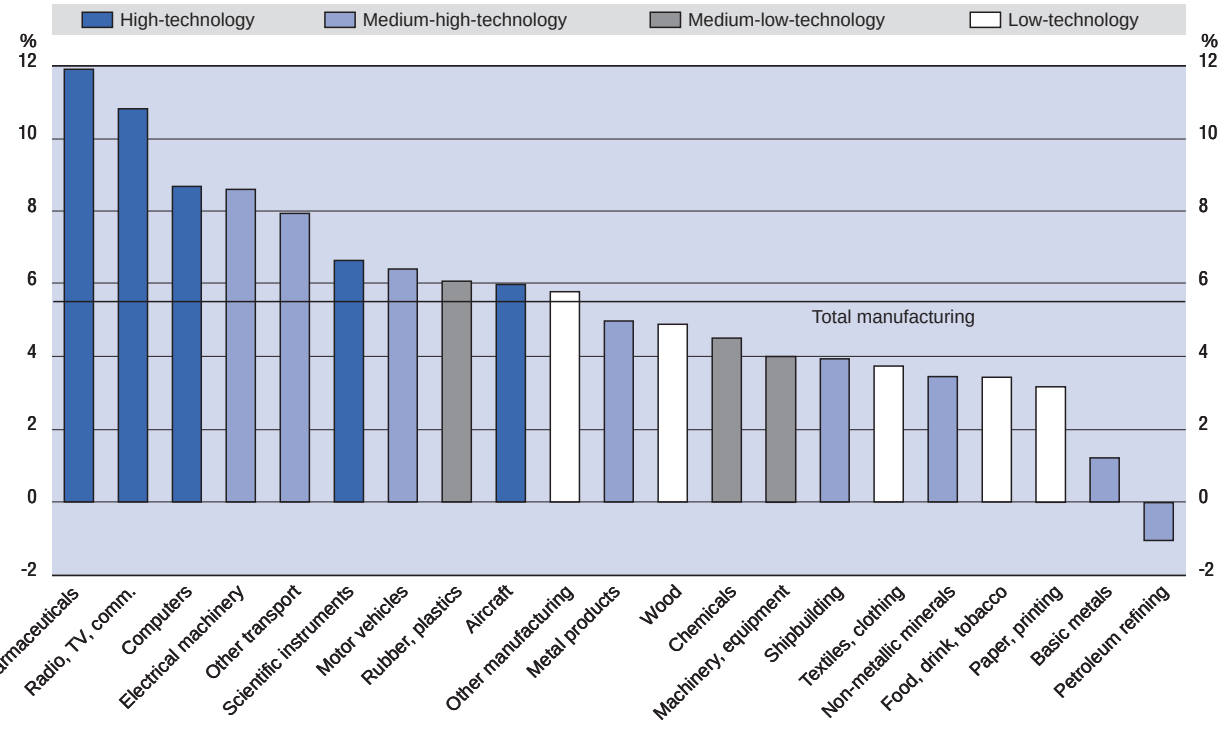
OECD[1] manufacturing trade[2] by technology intensity
1990 = 100



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 technology intensity
Average annual growth rate, 1990-1999



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

Source: OECD, STAN database, May 2001.

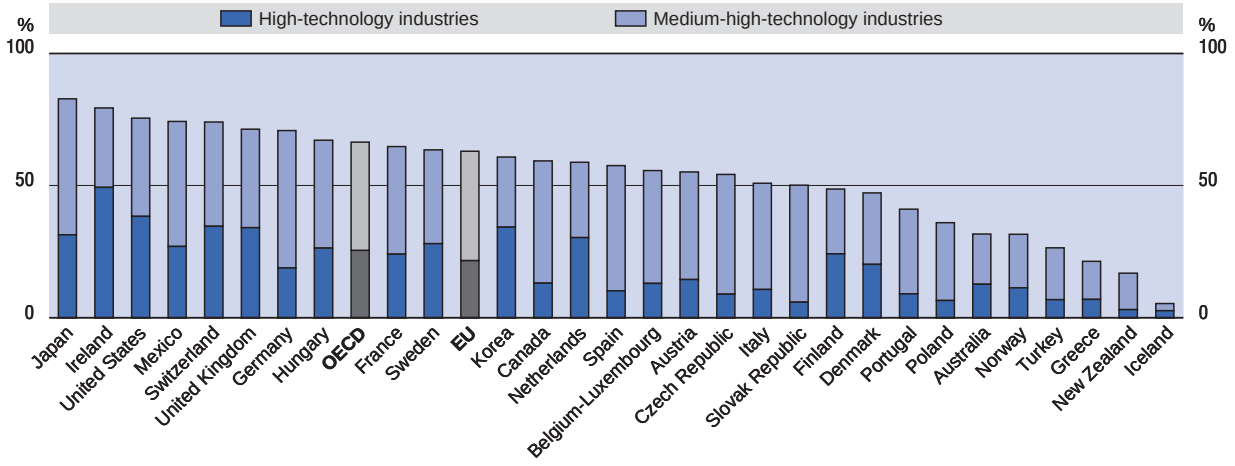
D.7.2. International trade in high- and medium-high-technology industries

- Technology-intensive industries play an increasingly important role in the international manufacturing trade of OECD countries (see D.7.1). In the 1990s, OECD exports of high- and medium-high-technology industries grew at an annual rate of around 7%, and their shares in manufacturing exports reached 25% and 40%, respectively, in 1999.
- Substantial differences in the shares of high- and medium-high-technology industries in manufacturing exports are found across the OECD area, ranging from over 75% in Japan, Ireland, and the United States to less than 20% in Greece, New Zealand and Iceland.
- Between 1990 and 1999, the annual growth rate of exports in technology-intensive industries was highest in Mexico (29%), followed by Ireland (18%). A catch-up effect can also be seen in Iceland and Turkey, which still have a relatively low share of high- and medium-high-technology industries in manufacturing exports; they experienced annual growth of trade in technology-intensive industries of 17% and 15%, respectively.
- High-technology industries represent around 50% of manufacturing exports in Ireland and 27% in Mexico, compared with 38% in the United States, 35% in Switzerland and 32% in Japan.
- The relatively high export share of technology-intensive goods in Ireland and Mexico does not appear to be the result of domestic R&D efforts; rather, it points to the role of foreign affiliates and technological transfers. Both countries import many intermediate goods for assembly, mainly from the United States, and then export finished goods.

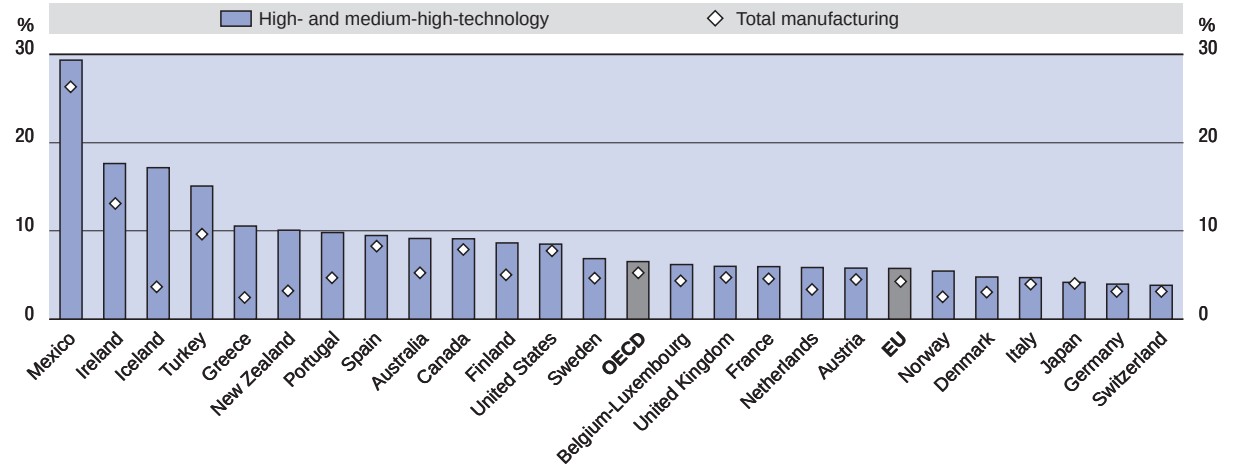
For more details, see Annex, Tables D.7.2.1 *to* D.7.2.3.

D.7.2. International trade in high- and medium-high-technology industries

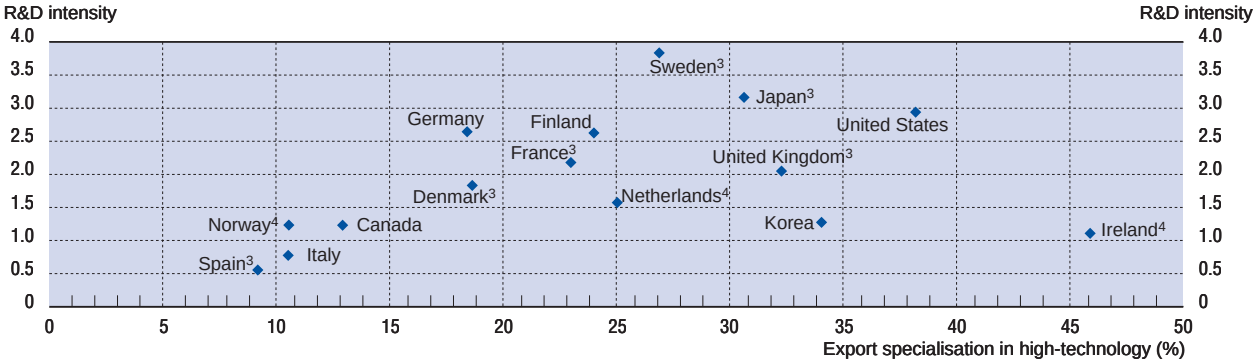
Share of high- and medium-high-technology industries in manufacturing exports, 1999



Annual average growth rate of exports in high- and medium-high-technology industries, 1990-99



R&D intensity[1] and export specialisation[2] in high-technology industries, 1999



1. Manufacturing R&D expenditures/manufacturing production.
2. High-technology exports/manufacturing exports.
3. 1998.
4. 1997.

Source: OECD, STAN and ANBERD databases, May 2001.

D.7.3. Comparative advantage by technology intensity

- An assessment of countries' strengths and weaknesses in terms of technology intensity must not focus solely on exports (see D.7.2), but must also gauge the role of imports, as exports may depend heavily on imports in the same industry. To gain a better understanding of countries' specialisation profiles, indicators of revealed comparative advantage can be calculated; they are based on the contribution of different industries to the trade balance.
- The indicator shows that few OECD countries are specialised in high- and medium-high-technology industries. In 1999, the structural surplus in these industries represented more than 15% of total manufacturing trade for Japan, about 7.5% for Switzerland and around 5% for Germany, Mexico and 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 of Turkey, New Zealand and Iceland in these industries accounted for more than 20% of total manufacturing trade and for over 10% in Norway, Poland, Greece and Australia.
- For most OECD countries, these specialisation patterns have changed only little over the past decade. There are exceptions, however. Japan and Ireland's comparative advantage in high-technology industries declined considerably over the 1990s, and Mexico and Sweden moved from a comparative disadvantage in high-technology industries in 1990 to a comparative advantage. The growing importance of high-technology industries can also be observed for Finland and Iceland, countries whose comparative disadvantage declined considerably over the past decade.

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, no matter 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:

$$\underbrace{(X_i - M_i)}_{\text{Observed industry trade balance}} - \underbrace{(X - M)\frac{(X_i + M_i)}{(X + M)}}_{\text{Theoretical trade balance}}$$

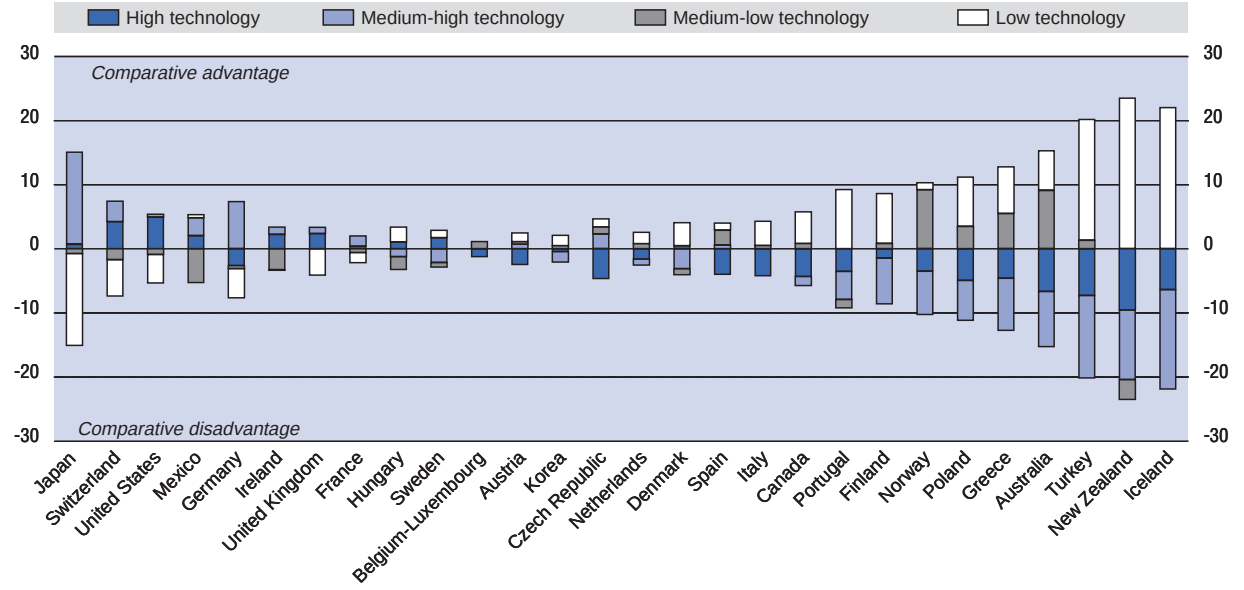
A positive value for an industry indicates a structural surplus, and a negative one a structural deficit. The indicator is additive, and individual industries can be grouped together by summing their respective values: by construction, the sum over all industries is zero. To allow comparisons across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

* See G. Lafay, "La mesure des avantages comparatifs révélés", *Économie prospective internationale*, No. 41, 1987.

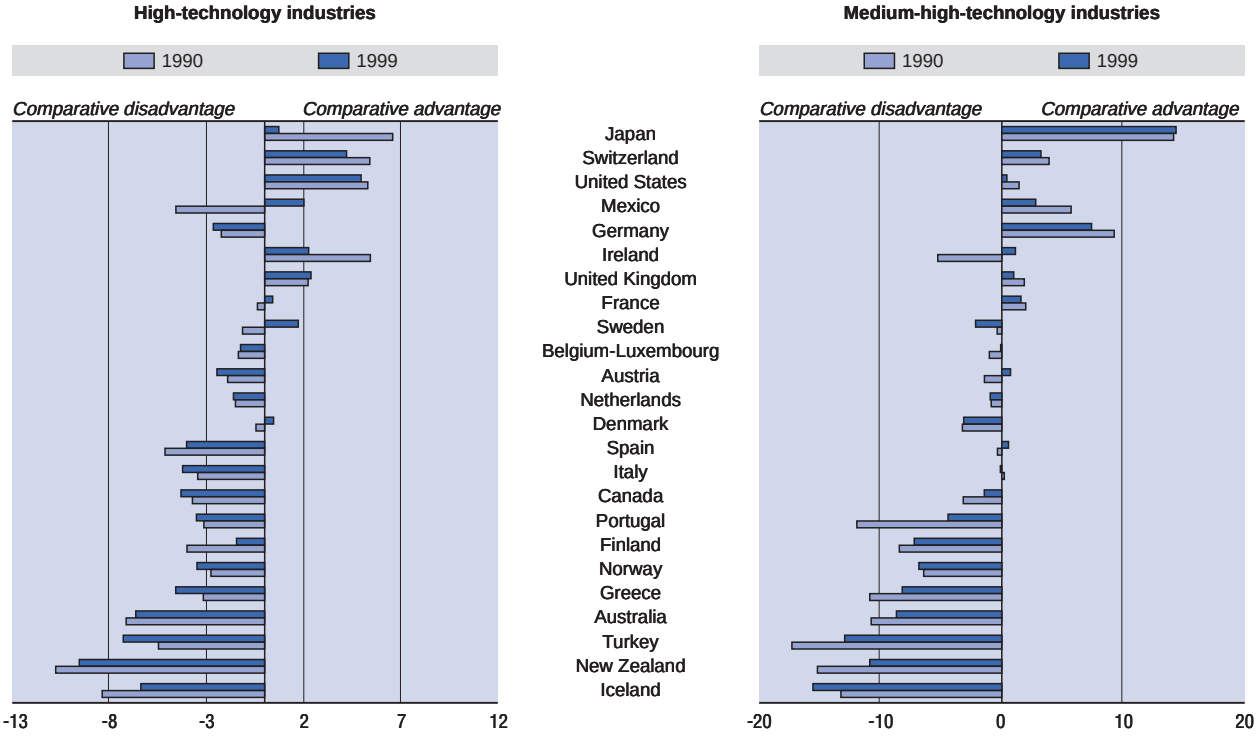
For more details, see Annex, Table D.7.3.

D.7.3. Comparative advantage by technology intensity

Contribution to the manufacturing trade balance, 1999
As a percentage of manufacturing trade



Change in contribution to the manufacturing trade balance between 1990 and 1999
As a percentage of total manufacturing trade



Source: OECD, STAN database, May 2001.

ANNEXES

Annex I

CLASSIFICATION OF MANUFACTURING INDUSTRIES BASED ON TECHNOLOGY

Annex table 1.1. presents a first attempt to classify manufacturing industries according to technology intensity using an ISIC Rev. 3 activity breakdown.

Until recently, a technology classification using ISIC Rev. 2 based industries was widely used. The methodology adopted was based on the evaluation of industry ranks of three indicators of technology intensity reflecting, to different degrees, the "technologyproducer" 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 10 OECD countries for which a measure of embodied technology was available, using 1990 US dollars purchasing power parities (see STI Working Paper 1997/2).

To reflect the increasing use of ISIC Rev. 3 (NACE Rev. 1 in Europe) for collecting and presenting industrial activity data both in national accounts (in the context of SNA93/ESA95) and industrial surveys, an updated technology classification has been generated. This was achieved by evaluating the R&D intensities for 13 OECD countries for the period 1991-97 based on available ISIC Rev. 3 R&D expenditure and output data. In the absence of updated ISIC Rev. 3 input-output tables (required for estimating embodied technology), only the first two indicators cited above could be calculated.

The division of manufacturing industries into high-technology, medium-high-technology, medium-low-technology, low-technology groups was determined after ranking the industries according to their average over 1991 to 1997 of aggregate OECD R&D intensities. Industries classified to a superior category have a higher average OECD intensity for both indicators than industries in an inferior category. Also considered were: *i*) time stability: for adjacent years, industries classified to a superior category have a higher average OECD intensity than industries in an inferior category; and *ii*) country-median-stability: industries classified to a superior category have a higher median-intensity, than industries in an inferior category.

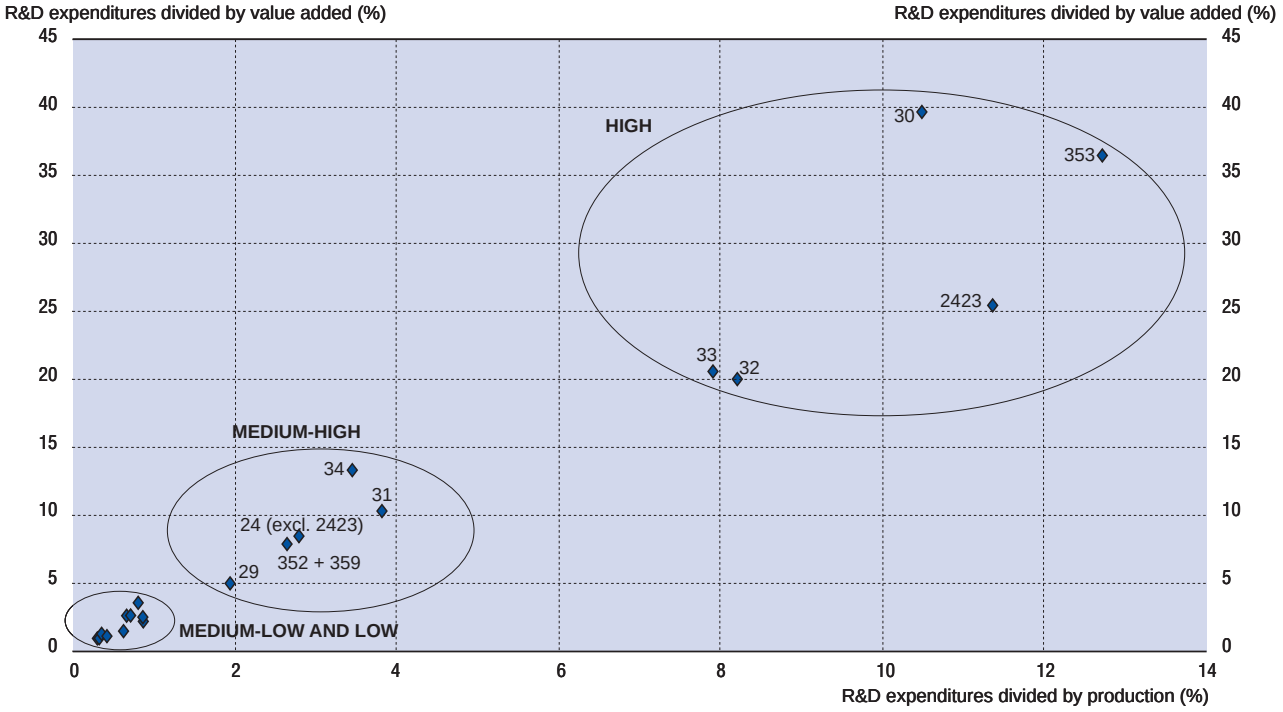
Points to note:

- This new classification generally matches the previous ISIC Rev. 2 based classification with one important exception: "Medical, precision and optical instruments" (ISIC Rev. 3, division 33) is now classified as a high-technology industry. Previously, this sector (ISIC Rev. 2, division 385 – often labelled "professional goods" or "scientific instruments") appeared in the medium-high technology group. The R&D intensity of this sector has been steadily rising over recent years and its inclusion in high-technology complements the definition of the ICT sector (see "Measuring the ICT Sector", OECD, 2000) which includes some of its sub-divisions (notably 3312 and 3313)
- The cut-off points are reasonably clear cut except possibly the distinction between the medium-low and low technology groups where the classification of "Fabricated metal products" is less obvious.
- The low-technology group consists of relatively aggregate sectors, this is a consequence of limited R&D expenditure data across countries at detailed levels. The few cases where R&D intensities are available for more detailed (2-digit) breakdowns confirms the allocation of these industries to low technology.
- The classification is for the OECD as a whole. Annex Table 1.2. illustrates that for individual countries, allocation to the technology groups may differ.
- R&D intensity in "Office, accounting and computing machinery" (ISIC Rev. 3, division 30) remained high in North America and Japan throughout the 1990s while declining in Europe.

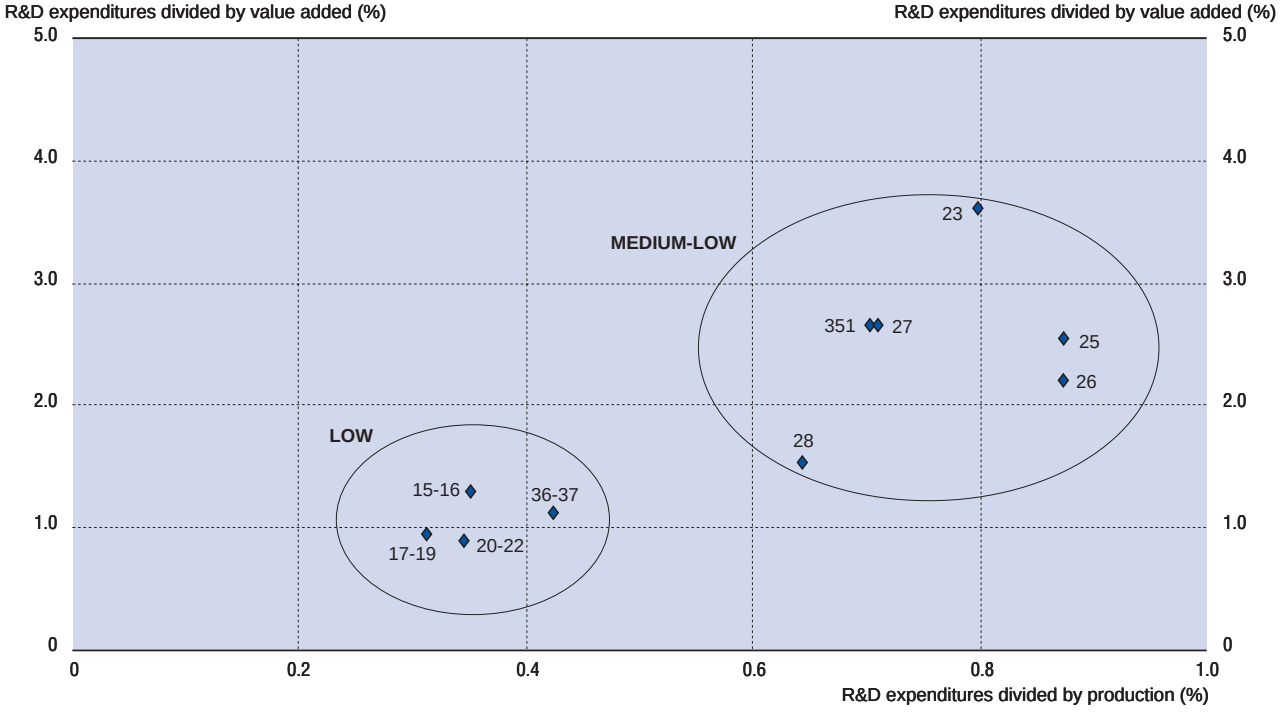
Finally, this classification is a first step in a wider project to formally group ISIC Rev. 3 activities (including services) according to "knowledge-intensity". In addition to further refining the R&D intensity tables, as data becomes available, this may involve ranking industries according to indicators based on the following:

- The use of *acquired* technology (or embodied R&D) based on input-output tables, a follow up to earlier work;
- Investment in ICT goods and services;
- Patents allocated to ISIC Rev. 3. from International Patents Classification (IPC) to reflect innovative output;
- "knowledge intensity" of the workforce based on occupation by industry matrices.

Annex 1.1. **Aggregate R&D intensity of selected OECD countries, 1997**[1]



Annex 1.2. **Aggregate R&D intensity of selected OECD countries, 1997: zoom on medium-low and low groups**[1]



1. See Annex Table 1.1. for a description of ISIC Rev. 3 codes shown in the above graphs.
Source: OECD, ANBERD and STAN databases, May 2001.

Annex 1.1. **Classification of manufacturing industries based on technology**

		1997				1991			
		R&D divided by production		R&D divided by value added		R&D divided by production		R&D divided by value added	
	ISIC Rev. 3	Aggregate intensity	Median intensity	Aggregate intensity	Median intensity	Aggregate intensity	Median intensity	Aggregate intensity	Median intensity
High-technology industries									
Aircraft and spacecraft	353	12.7	9.3	36.5	28.2	14.0	13.0	34.4	28.6
Pharmaceuticals	2423	11.3	9.3	25.4	26.7	9.8	9.3	21.8	21.5
Office, accounting and computing machinery	30	10.5	4.6	39.7	16.2	10.4	6.7	31.3	17.0
Radio, television and communications equipment	32	8.2	9.3	19.9	31.0	7.8	9.2	17.7	25.5
Medical, precision and optical instruments	33	7.9	5.5	20.6	12.5	6.6	5.0	15.8	12.9
Medium-high-technology industries									
Electrical machinery and apparatus, n.e.c.	31	3.8	2.0	10.3	6.7	4.3	2.4	9.9	6.8
Motor vehicles, trailers and semi-trailers	34	3.5	2.8	13.4	11.6	3.7	3.1	14.5	12.3
Chemicals excluding pharmaceuticals	24 excl. 2423	2.6	2.1	7.9	6.1	3.4	2.8	10.3	9.2
Railroad equipment and transport equipment, n.e.c.	352 + 359	2.8	1.6	8.5	5.6	2.5	1.5	7.5	4.7
Machinery and equipment, n.e.c.	29	1.9	1.9	5.0	5.6	1.8	1.9	4.4	5.3
Medium-low-technology industries									
Coke, refined petroleum products and nuclear fuel	23	0.8	0.5	3.6	4.2	1.2	0.7	5.5	5.3
Rubber and plastic products	25	0.9	1.0	2.6	2.6	1.0	0.5	2.7	1.9
Other non-metallic mineral products	26	0.9	0.7	2.2	1.6	1.1	0.7	2.7	1.9
Building and repairing of ships and boats	351	0.7	0.7	2.7	1.8	0.9	0.9	3.1	2.7
Basic metals	27	0.7	0.5	2.7	1.9	0.9	0.8	3.3	3.3
Fabricated metal products, except machinery and equipment	28	0.6	0.5	1.6	1.2	0.5	0.5	1.3	1.1
Low-technology industries									
Manufacturing, n.e.c. and recycling	36-37	0.4	0.5	1.1	1.2	0.5	0.3	1.2	1.0
Wood, pulp, paper, paper products, printing and publishing	20-22	0.3	0.1	0.9	0.5	0.3	0.2	0.8	0.7
Food products, beverages and tobacco	15-16	0.4	0.3	1.3	1.4	0.3	0.3	1.2	1.2
Textiles, textile products, leather and footwear	17-19	0.3	0.4	1.0	1.0	0.3	0.3	0.7	0.7
Total manufacturing	15-37	2.5	1.9	7.6	6.9	2.5	1.8	7.2	5.8

Source: OECD, ANBERD and STAN databases, May 2001.

Annex 1.2. **Classification of manufacturing industries based on technology**

R&D intensity[1] for 13 OECD countries, 1991-97 average

	ISIC Rev. 3	Total[2]	United States	Canada	Japan	Europe[2]	Germany	France	Italy	United Kingdom	Spain	Sweden	Denmark	Norway	Finland	Ireland[3]
High-technology industries																
Aircraft and spacecraft	353	14.2	14.6	10.1	9.9	14.6	28.1	14.1	11.9	9.3	16.0	15.3	.. (4)	0.9	0.9	.. (4)
Pharmaceuticals	2423	10.8	12.4	7.4	9.6	10.0	8.4	8.7	6.0	18.6	3.1	21.5	14.8	11.8	14.0	5.2
Office, accounting and computing machinery	30	9.3	14.7	6.8	7.5	4.3	7.5	5.6	7.2	2.0	2.6	12.0	5.4	7.8	3.1	0.6
Radio, television and communication equipment	32	8.0	8.6	12.7	6.0	10.2	13.0	10.3	11.7	5.2	6.3	17.8	7.7	25.7	11.4	8.6
Medical, precision and optical instruments	33	7.3	7.9	.. (5)	8.1	5.9	6.1	11.1	1.0	3.5	2.1	8.2	6.1	3.1	7.0	2.0
Medium-high-technology industries																
Electrical machinery and apparatus, n.e.c.	31	3.9	4.1	0.9	6.8	2.4	2.4	2.6	1.0	4.8	0.9	2.6	1.5	2.0	4.5	1.7
Motor vehicles, trailers and semi-trailers	34	3.5	4.5	0.2	3.1	3.6	4.6	3.2	3.3	2.9	0.8	6.1	.. (6)	1.8	1.8	1.2
Chemicals excluding pharmaceuticals	24 excl. 2423	3.1	3.1	0.8	4.7	2.5	4.4	2.4	0.8	2.5	0.6	2.2	1.7	2.2	2.8	0.4
Railroad equipment and transport equipment, n.e.c.	352 + 359	2.4	.. (7)	0.2	2.6	2.6	5.5	2.6	1.2	1.5	1.2	2.5	0.3	0.8	9.4	0.0
Machinery and equipment, n.e.c.	29	1.9	1.8	1.2	2.2	1.8	2.3	2.0	0.5	2.1	1.0	4.0	3.2	2.6	2.4	1.1
Medium-low-technology industries																
Coke, refined petroleum products and nuclear fuel	23	1.0	1.3	0.6	0.7	0.9	0.3	0.9	0.3	2.9	0.4	0.4	.. (4)	0.8	0.8	.. (4)
Rubber and plastic products	25	0.9	1.0	0.4	.. (8)	0.8	0.9	1.6	0.5	0.4	0.5	1.5	0.8	0.7	1.7	0.8
Other non-metallic mineral products	26	0.9	0.8	0.2	2.2	0.5	0.7	0.8	0.1	0.5	0.2	0.9	0.4	0.5	1.4	0.9
Building and repairing of ships and boats	351	0.9	.. (7)	0.0	0.8	0.9	1.4	0.4	1.2	0.7	1.5	2.0	0.8	0.5	0.7	1.2
Basic metals	27	0.8	0.4	0.6	1.3	0.6	0.6	1.1	0.3	0.4	0.2	0.8	0.6	1.5	0.7	0.4
Fabricated metal products, except machinery and equipment	28	0.6	0.7	0.4	0.8	0.4	0.5	0.5	0.2	0.4	0.2	0.8	0.2	0.5	1.1	0.9
Low-technology industries																
Manufacturing, n.e.c. and recycling	36-37	0.4	0.6	.. (5)	0.4	0.3	0.5	0.4	0.1	0.2	0.2	0.3	2.3	0.4	0.7	0.4
Wood, pulp, paper, paper products, printing and publishing	20-22	0.3	0.5	0.2	0.4	0.2	0.1	0.1	0.0	0.1	0.1	0.7	0.1	0.3	0.5	0.2
Food products, beverages and tobacco	15-16	0.3	0.3	0.2	0.7	0.2	0.2	0.3	0.1	0.4	0.1	0.4	0.4	0.3	0.6	0.4
Textiles, textile products, leather and footwear	17-19	0.3	0.2	0.4	0.7	0.2	0.5	0.3	0.0	0.2	0.1	0.5	0.1	0.6	0.6	1.0
Total manufacturing	15-37	2.5	3.1	1.2	2.8	1.9	2.5	2.4	0.8	2.1	0.6	3.7	1.6	1.4	1.9	1.0

1. R&D intensity defined as direct R&D expenditures as a percentage of production (gross output).
2. Aggregate R&D intensities calculated after converting countries' R&D expenditures and production using 1995 GDP PPPs.
3. Production from industrial surveys.
4. ISIC 23 and 353 not available for Denmark and Ireland.
5. ISIC 36-37 production includes ISIC 33 for Canada.
6. ISIC 34 included in ISIC 35 for Denmark.
7. R&D expenditures in "Shipbuilding" (351) is included in "Other Transport" (352+359) for the United States.
8. ISIC 25 production does not include plastics for Japan.

Source: OECD, ANBERD and STAN databases, May 2001.

Annex II

MAIN OECD DATABASES USED
DATABASES MAINTAINED BY THE DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY (DSTI)

Industrial structure and performance

STAN: The database for **Industrial Analysis** provides analysts and researchers with a comprehensive tool for analysing industrial performance at a detailed level of activity. It includes annual measures of output, labour input, investment and trade which allow users to construct a wide range of indicators focused on areas such as productivity growth, competitiveness and general structural change and to make cross-country comparisons. It is primarily based on Member countries' annual National Accounts tables and uses data from other sources, such as national industrial surveys/censuses, to estimate missing detailed data.

The latest version of STAN is based on ISIC Rev. 3 (compatible with NACE Rev. 1) and covers all activities (including services) and includes a wider range of variables. It has effectively been merged with the OECD's International Sectoral Database (ISDB) which is no longer updated. The industry list provides sufficient detail to allow users to highlight high-technology sectors and is compatible with those used in other databases (such as ANBERD; see below).

Publication: STAN is currently available on line on SourceOECD (*www.sourceoecd.org*). It is now 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 (2001), *Basic Science and Technology Statistics*: 2000 *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 countries expressed in the form of ratios, percentages, growth rates, etc. Of the 89 indicators included, 70 deal with resources devoted to R&D, and 19 are measures of output and the impact of S&T activities (patents, technology balance of payments and trade of high-technology industries).

Publication: OECD (2001), *Main Science and Technology Indicators* 2001/1. 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 1987-99, by industry (ISIC Rev. 3), for 19 OECD countries.

Publication: OECD (forthcoming), *Research and Development Expenditure in Industry*, 1987-99. 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).

This database is under development in order to establish nowcasts of the number of patents filed in the recent past but not yet published and to convert the IPC to International Standard Industrial Classification (ISIC), by industry.

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 (forthcoming), *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 (forthcoming), *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 USD thousands and cover the period 1980-98. The data have been derived from OECD *Foreign Trade Statistics* database by means of standard conversion matrices. The database covers 22 manufacturing sectors (currently based on ISIC Rev. 2), following the classification previously used for the input-output and STAN databases.

Publication: OECD (2000), *Bilateral Trade Database* 2000. 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 1980-99. It contains both telecommunication and economic indicators.

Publication: OECD (2001), *Telecommunications Database* 2001. 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 based on ISIC Rev. 3. A second pilot collection to update and improve the quality of data for the ICT sector was launched in March 2001 and preliminary results are contained in this publication. A pilot collection of indicators of ICT usage and electronic commerce was launched in May 2001 and the first results are also presented here.

Publication: The first pilot collection of statistics for the ICT sector was published in *Measuring the* ICT *Sector* (October 2000). Freely available at: http://www.oecd.org/dsti/sti/it/prod/measuring_ict.pdf).

Further details on these databases are available on the Internet at: *www.oecd.org/dsti/sti/stat-ana/stats/cont-e.htm*

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*

STATISTICAL ANNEX

Table A.1.1. **Investment in knowledge and gross fixed capital formation**

	Investment in knowledge					Gross fixed capital formation			
	As a percentage of GDP, 1998				Average annual growth rate 1991-98	As a percentage of GDP, 1998			Average annual growth rate 1991-98
	Total	R&D	Software	Public and private spending on higher education		Total	Machinery and Equipment	Other	
Canada	4.7	1.6	1.6	1.5	2.6	19.6	9.4	10.2	3.0
Mexico	1.5	0.4	0.4	0.7	..	20.9	11.1	9.8	4.6
United States[1]	6.0	2.6	1.5	1.9	3.9	19.2	9.1	10.2	6.2
Australia	3.9	1.5	1.2	1.2	4.0	23.8	8.7	15.1	6.2
Japan	4.7	3.0	1.1	0.6	2.6	26.8	10.5	16.3	-1.2
Korea	5.2	2.6	0.4	2.2	..	29.8	8.9	20.9	0.7
Austria	3.5	1.8	0.9	0.8	6.3	23.5	9.0	14.5	1.4
Belgium	3.7	1.9	1.4	0.4	..	20.9	10.7	10.1	1.3
Czech Republic	3.3	1.3	1.2	0.8	..	28.1	16.6	11.5	3.7
Denmark	4.6	1.9	1.5	1.1	5.9	20.5	8.5	12.0	3.5
Finland	5.2	2.9	1.2	1.1	6.8	18.7	7.0	11.7	-1.2
France	4.1	2.2	1.2	0.8	3.0	18.3	6.7	11.7	-1.1
Germany	4.2	2.3	1.2	0.7	2.2	21.3	7.8	13.6	-0.2
Greece	1.7	0.6	0.2	0.9	10.1	21.6	8.0	13.6	1.2
Hungary	2.6	0.7	1.0	0.8	1.6	23.6	..	23.6	2.6
Ireland	3.1	1.4	0.5	1.1	10.2	21.9	7.6	14.3	10.7
Italy	2.1	1.0	0.5	0.6	-0.6	18.5	8.9	9.7	-0.4
Netherlands	4.3	2.0	1.7	0.7	3.8	21.7	7.9	13.8	2.6
Norway	4.0	1.7	1.2	1.0	5.6	25.0	8.7	16.3	5.8
Portugal	1.8	0.6	0.4	0.8	5.4	26.2	9.4	16.7	3.7
Spain	2.2	0.9	0.5	0.8	4.3	22.9	7.1	15.8	0.8
Sweden	6.5	3.8	1.9	0.8	7.6	16.0	7.9	8.1	-2.2
Switzerland[2]	4.8	2.8	1.5	0.5	3.2	20.0	9.9	10.0	-2.8
United Kingdom	3.9	1.8	1.3	0.8	3.6	17.4	8.6	8.8	2.2
European Union[3]	3.6	1.8	1.0	0.7	3.1	19.9	8.0	11.9	0.4
Total OECD[4]	4.7	2.2	1.2	1.2	3.4	21.0	9.0	12.0	2.2

1. Education data includes post-secondary non-tertiary education (ISCED 4).
2. Average annual growth rate refers to 1992-98.
3. Average annual growth rate excludes Belgium.
4. OECD total refers to the available countries and the average annual growth rate excludes Belgium, Czech Republic, Korea, Mexico and Switzerland.
5. 1995 US dollars using purchasing power parities.

Source: OECD, National Accounts database; Education database; MSTI database and International Data Corporation, March 2001.

Table A.2.1.1. **Gross domestic expenditure on R&D (GERD)**

As a percentage of GDP

	1981	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	1.24	1.44	1.54 [10]	1.60	1.66	1.71	1.77	1.74	1.70	1.71	1.71	1.66
Mexico	..	..	..	..	..	0.22	0.29	0.31	0.31	0.34	0.46	0.40
United States	2.37	2.78	2.65 [10]	2.72	2.65	2.52	2.42	2.50	2.54	2.57	2.60	2.64
Australia[1]	0.95	..	1.31	..	1.52	..	1.57	..	1.65	..	1.49	..
Japan[2]	2.13	2.58	2.85	2.82	2.76	2.68	2.63	2.77	2.83 [10]	2.90	3.04	3.04
Korea	..	..	..	1.92	2.03	2.22	2.44	2.50	2.60	2.69	2.55	2.46
New Zealand	..	..	1.00	0.99	1.01 [10]	1.02	..	0.97	..	1.13	..	..
Austria	1.13	1.24	1.39	1.47	1.45	1.47	1.54	1.56 [10]	1.60	1.69	1.80	1.80
Belgium[3]	1.57	1.63 [10]	1.64 [10]	1.62	..	1.75 [10]	1.74	1.74	1.82	1.83	..	..
Czech Republic	..	..	..	2.02	1.72	1.21	1.10	1.01 [10]	1.03	1.17	1.27	1.29
Denmark	1.06	1.21	1.57 [10]	1.64	1.68	1.74	..	1.84	1.85	1.94	1.92	2.00
Finland	1.17 [10]	1.55	1.88	2.04 [10]	2.13	2.17	2.29	2.29	2.54	2.72	2.89	3.19
France	1.93 [10]	2.22	2.37	2.37	2.38	2.40	2.34	2.31	2.30	2.22 [10]	2.18	2.17
Germany[4]	2.47	2.75	2.75	2.53 [10]	2.41 [10]	2.35	2.26	2.26	2.26	2.29	2.31	2.44
Greece[5]	0.17 [10]	0.27 [10]	0.37 [10]	0.36	..	0.47	..	0.49 [10]	..	0.51	..	..
Hungary	..	..	1.46	1.06	1.04	0.97	0.88 [10]	0.73 [10]	0.65	0.72	0.68	0.68
Iceland	0.63	0.73	0.98	1.16	1.33	1.33	1.38	1.54	..	1.84	2.04	2.32
Ireland	0.68	0.77	0.83 [10]	0.93	1.04	1.17	1.31	1.34	1.40	1.39	..	..
Italy	0.88	1.12	1.29	1.23 [10]	1.18	1.13	1.05	1.00	1.01	0.99	1.02	1.04
Netherlands	1.78	1.97 [10]	2.07 [10]	1.97	1.90	1.92	1.95 [10]	1.99 [10]	2.01	2.04	1.95	..
Norway[6]	1.18	1.49 [10]	1.69	1.65	..	1.73	..	1.71 [10]	..	1.66	..	1.70
Poland	..	..	..	..	..	..	0.76	0.69	0.71	0.71	0.72	0.75
Portugal[7]	0.30	0.34	0.51	..	0.61	..	..	0.57 [10]	..	0.62	..	0.77
Slovak Republic	..	..	1.75	2.25	1.88 [10]	1.45	0.96 [10]	0.98	0.97	1.13	0.82	0.68
Spain	0.41	0.53	0.81	0.84	0.88 [10]	0.88	0.81	0.81 [10]	0.83	0.82	0.90	0.89
Sweden	2.21 [10]	2.78	2.84	2.79	..	3.27 [10]	..	3.46 [10]	..	3.67	..	3.80
Switzerland[8]	2.18	2.82 [10]	2.83 [10]	..	2.66	..	..	..	2.73	..	..	..
Turkey	..	..	0.32	0.53	0.49	0.44	0.36	0.38	0.45	0.49	..	..
United Kingdom	2.38 [10]	2.24 [10]	2.16	2.08	2.09	2.12	2.07	1.98	1.91	1.84	1.83	1.87
European Union	1.69	1.87	1.96	1.90 [10]	1.89 [10]	1.88	1.83	1.81	1.81	1.80	1.81	1.85
Total OECD[9]	1.97	2.28	2.30 [10]	2.24 [10]	2.20	2.15	2.10	2.11 [10]	2.14	2.16	2.18	2.21

1. 1996 instead of 1995.
2. Adjusted by OECD up to 1995.
3. 1983 instead of 1981; 1989 instead of 1990.
4. Figures for Germany from 1991 onwards refer to unified Germany.
5. 1986 instead of 1985; 1989 instead of 1990.
6. 1989 instead of 1990.
7. 1982 instead of 1981; 1984 instead of 1985.
8. 1986 instead of 1985; 1989 instead of 1990.
9. Includes Mexico and Korea 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 2001.

Table A.2.1.2. **Gross domestic expenditure on R&D (GERD)**

	Millions of 1995 PPP dollars									Average annual growth rate	
	1991	1992	1993	1994	1995	1996	1997	1998	1999		
Canada	9 679.4	10 129.5	10 685.7	11 573.5	11 700.0	11 591.8	12 148.9	12 606.4	12 815.0	1991-99	3.57
Mexico	..	..	1 395.4	1 943.2	1 923.1	2 024.8	2 404.6	3 356.0	3 041.8	1993-99	13.87
United States	176 645.8	176 986.4	172 991.1	172 953.9	183 694.0	193 231.0	204 202.4	215 331.8	226 428.2	1991-99	3.15
Australia	..	5 264.2	..	5 942.4	..	6 760.3	..	6 690.1	..	1992-98	4.08
Japan[1]	64 452.4	63 731.8	62 055.6	61 415.5	65 418.3	84 511.0 [4]	88 090.3	90 027.0	90 003.4	1996-99	2.12
Korea	8 983.3	10 013.6	11 535.2	13 747.1	15 345.7	17 020.6	18 485.2	16 368.4	17 496.9	1991-99	8.69
New Zealand	523.9	543.0 [4]	581.7	..	606.2	..	736.8	..	..	1992-97	6.29
Austria	2 368.2	2 393.1	2 429.8	2 607.9	2 686.7	2 825.3	3 015.2	3 313.0	3 414.2	1991-99	4.68
Belgium	3 398.5	..	3 673.9 [4]	3 763.5	3 853.1	4 066.3	4 247.4	..	..	1993-97	3.69
Czech Republic	2 391.1	2 028.5	1 424.4	1 323.5	1 293.3 [4]	1 385.2	1 546.8	1 648.0	1 665.0	1995-99	6.52
Denmark	1 809.0	1 857.5	1 930.3	..	2 203.1	2 278.9	2 456.4	2 498.9	2 656.2	1991-99	4.92
Finland	1 902.2 [4]	1 926.3	1 934.5	2 121.2	2 203.6	2 545.4	2 893.9	3 244.4	3 732.2	1991-99	8.79
France	27 235.9	27 733.0	27 799.8	27 630.5	27 722.6	27 860.4	27 427.7 [4]	27 759.3	28 415.3	1997-99	1.78
Germany[2]	42 019.3 [4]	40 864.9 [4]	39 464.8	38 773.2	39 451.5	39 727.0	40 828.6	42 055.0	45 083.4	1992-99	1.41
Greece	470.3	..	604.1	..	652.0	..	720.0	..	..	1991-97	7.35
Hungary	976.0	931.1	859.4	805.6 [4]	680.4	611.8	710.4	700.8	735.3	1994-99	-1.81
Iceland	67.7	75.0	75.9	81.9	91.7	..	120.6	139.7	166.1	1991-99	11.88
Ireland	494.0	567.1	659.1	776.7	877.2	980.9	1 079.2	..	..	1991-97	13.91
Italy	13 449.5 [4]	13 083.7	12 347.5	11 780.1	11 522.8	11 735.8	11 711.6	12 255.5	12 747.8	1991-99	-0.67
Netherlands	5 956.3	5 861.7	5 987.2	6 271.5 [4]	6 528.9	6 816.1	7 172.5	7 102.4	..	1994-98	3.16
Norway	1 511.3	..	1 631.5	..	1 739.6 [4]	..	1 896.0	..	2 001.8	1995-99	3.57
Poland	..	..	..	1 935.6	1 875.6	2 045.5	2 183.7	2 328.0	2 496.7	1994-99	5.22
Portugal	..	805.0	..	..	774.6	..	912.4	..	1 202.1	1992-99	5.90
Slovak Republic	967.0	755.5 [4]	594.1	412.6 [4]	451.7	474.9	584.3	441.8	374.0	1994-99	-1.95
Spain	4 772.9	5 030.1 [4]	4 977.0	4 706.6	4 838.7	5 072.3	5 202.8	5 938.9	6 115.6	1992-99	2.83
Sweden	4 715.6	..	5 338.5 [4]	..	6 095.4 [4]	..	6 667.3	..	7 448.4	1993-99	5.71
Switzerland	..	4 770.9	..	..	..	4 949.7	..	..	..	1992-96	0.92
Turkey	1 582.8	1 555.2	1 518.7	1 172.7	1 321.3	1 680.0	1 966.3	..	..	1991-97	3.68
United Kingdom	20 624.9	20 748.7	21 552.4	22 019.2	21 672.5	21 429.8	21 272.4	21 766.7	22 759.2	1991-99	1.24
European Union	129 940.6 [4]	130 129.0 [4]	129 485.6	129 633.6	131 081.7	133 249.0	135 607.2	140 344.5	147 711.7	1991-99	1.62
Total OECD[3]	417 151.9 [4]	418 916.0	414 763.0	417 909.5	441 988.0 [4]	462 094.3	482 364.0	499 672.0	519 482.9	1991-99	2.78

1. Adjusted by OECD up to 1995.
2. Figures for Germany from 1991 onwards refer to unified Germany.
3. Includes Mexico and Korea from 1991, and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
4. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

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

	Business enterprise						Government						Other national sources						Abroad					
	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999
Canada	40.8	38.3 [11]	38.2	45.5	46.9	44.5	50.6	46.6 [11]	45.6	35.9	32.7	31.2	4.8	6.2 [11]	6.7	7.0	8.1	7.7	3.8	8.9 [11]	9.4	11.5	12.2	16.7
Mexico	..	..	..	17.6	16.9	23.6	..	..	..	66.2	71.1	65.3	..	..	..	9.5	9.5	5.4	..	..	..	6.7	2.5	5.7
United States	48.8 [10]	52.2 [10]	57.3 [10,11]	60.4 [10]	64.3 [10]	66.8 [10]	49.3	45.6	38.9 [10,11]	35.6 [10]	31.8 [10]	29.2 [10]	1.9 [10]	2.2 [10]	3.8 [10,11]	4.0 [10]	3.9 [10]	4.0 [10]	..	..	..	..	..	..
Australia[1]	20.2	41.1	44.0	47.8	45.0	..	72.8	54.9	..	45.8	47.8	..	2.1	2.7	3.9	..	4.7	..	1.0	1.2	1.8	2.1	..	..
Japan[2]	67.7 [9]	77.1 [9]	77.4 [9]	72.3	74.0 [11]	72.2	24.9 [10]	16.8 [10]	16.4 [10]	20.9 [10]	18.2 [11]	19.5	7.3 [10]	6.1 [10]	6.1 [10]	6.7 [10]	7.5 [11]	7.9	0.1 [10]	0.1 [10]	0.1 [10]	0.1	0.3 [11]	0.4
Korea	..	..	..	76.3	72.5	70.0	..	..	..	19.0	22.9	24.9	..	..	..	4.7	4.5	5.1	..	..	..	0.0	0.1	0.1
New Zealand	..	33.2	27.4	33.7 [11]	30.5	..	..	64.7	61.8	52.3 [11]	52.3	..	..	0.1	8.2	10.1 [11]	12.0	..	..	2.0	2.5	3.9 [11]	5.2	..
Austria	50.2	53.0	50.2	45.2	42.6	39.7	46.9	43.4	46.5	47.3	41.5	39.3	0.4	0.3	0.3	0.4	0.4	0.4	2.5	3.2	3.0	7.1	15.5	20.7
Belgium	..	63.9 [11]	64.8	68.9 [11]	69.4	..	..	32.0 [11]	31.3	26.3 [11]	24.9	..	0.8	1.5 [11]	0.9	1.2 [11]	1.4	..	..	2.7 [11]	3.0	3.6 [11]	4.3	..
Czech Republic	..	..	..	63.1	59.8	52.6	..	..	..	32.3 [10]	30.8 [10]	42.6 [10,11]	..	..	..	1.3	7.5	0.8	..	..	..	3.3	1.9	4.0
Denmark	42.5 [11]	46.8	51.4	45.2	53.4	..	53.5	45.5	39.7	39.6	36.1	..	2.0 [11]	4.6	4.6	4.2	4.1	..	2.1	3.1	4.4	11.0	6.4	..
Finland	54.5 [11]	62.2	56.3 [11]	59.5 [11]	62.9	66.9 [11]	43.4 [11]	35.3	40.9 [11]	35.1	30.9	29.2	1.1 [11]	1.6	1.5 [11]	1.0	0.9	0.9	1.0 [11]	0.9	1.3 [11]	4.5 [11]	5.3	3.0
France[3]	40.9 [11]	43.9	42.5	48.3 [11]	51.6 [11]	53.5	53.4 [11]	48.1	48.8	41.9	38.8 [11]	37.3	0.6 [11]	0.6	0.7	1.7 [11]	1.6 [11]	1.8	5.0 [11]	7.4	8.0	8.0	7.9 [11]	7.4
Germany[4]	56.8	63.5	61.9 [11]	61.1 [11]	61.4	64.3	41.8	33.9	35.7 [11]	36.8	35.9	33.0	0.4	0.5	0.5 [11]	0.3 [11]	0.3	0.3	1.0	2.1	1.9 [11]	1.8 [11]	2.4	2.3
Greece	21.4 [11]	19.4 [11]	21.7	25.5	21.6	..	78.6 [11]	68.9 [11]	57.7	52.3	53.5	..	..	0.1	0.7	2.5	1.6	..	..	11.6 [11]	19.9	19.8	23.3	..
Hungary[5]	..	70.1	56.0	38.4 [11]	36.6	38.5	..	28.9	40.0	53.1 [11]	54.8	53.2	..	..	0.1	0.5 [11]	0.5	0.3	..	1.0	1.8	4.8 [11]	4.3	5.6
Iceland	5.7	23.9	24.5	34.6	41.9	43.4	85.6	65.8	69.7	57.3	50.9	41.2	5.0	7.3	1.7	3.7	0.9	1.5	4.3	3.0	4.1	4.4	6.2	13.9
Ireland	37.7	55.4	60.6	68.7	69.2	..	56.5	34.0	27.8	21.4	22.2	..	1.1	2.2	2.2	1.8	2.0	..	4.8	8.4	9.4	8.1	6.7	..
Italy	50.1 [9]	46.4 [9]	44.4 [11]	41.7 [11]	43.3	43.9	47.2 [9]	49.5 [9]	49.6 [11]	53.0	51.2	51.1	0.0	0.0	0.0	0.0	0.0	0.0	2.7 [9]	4.1 [9]	6.1 [11]	5.3 [11]	5.5	5.0
Netherlands[3]	46.3	53.4 [11]	47.8 [11]	46.0 [11]	45.6	48.6	47.2	41.8 [11]	48.6 [11]	42.2 [11]	39.1	37.9	1.3	1.7 [11]	1.8 [11]	2.6 [11]	2.6	3.0	5.2	3.0 [11]	1.9 [11]	9.3 [11]	12.8	10.5
Norway	40.1	45.6 [11]	44.5	49.9 [11]	49.4	51.4	57.2	50.8 [11]	49.5	44.0 [11]	42.9	42.5	1.4	1.3	1.3	1.2 [11]	1.2	1.6	1.4	2.3	4.6	4.9 [11]	6.5	4.4
Poland	..	..	..	36.0	35.1	38.1	..	..	..	60.2	61.7	58.5	..	..	..	2.1	1.6	1.7	..	..	..	1.7	1.6	1.7
Portugal[6]	30.0	27.0	20.2	19.5	21.2	21.3	61.9	61.8	59.4	65.3 [11]	68.2	69.7	4.8	6.5	5.4	3.3	4.4	3.7	..	4.6	14.9	11.9 [11]	6.1	5.3
Slovak Republic[5]	..	67.2	68.3	60.4 [11]	63.5	49.9	..	32.8	31.7	37.8 [11]	34.5	47.9	..	..	..	0.1 [11]	0.1	0.0	..	..	..	1.6 [11]	1.9	2.3
Spain	42.8	47.8	48.1	44.5 [11]	44.7	48.9	56.0	46.8	45.7	43.6 [11]	43.6	40.8	0.1	0.7	0.6	5.2 [11]	4.9	4.7	1.1	4.7	5.6	6.7 [11]	6.7	5.6
Sweden	54.9 [10,11]	58.6 [10]	61.9 [10]	65.6 [10,11]	67.9 [10]	67.8 [10]	42.3 [10,11]	38.1 [10]	34.0 [10]	28.8 [10,11]	25.8 [10]	24.5 [10]	1.4 [10,11]	1.7 [10]	2.7 [10]	2.2 [10,11]	2.8 [10]	4.2 [10]	1.5 [10,11]	1.6 [10]	1.5 [10]	3.4 [10,11]	3.5 [10]	3.5 [10]
Switzerland[7]	75.1	73.9 [11]	67.4	67.5	..	..	24.9	23.2 [11]	28.4	26.9	..	..	..	1.3 [11]	2.3	2.5	..	..	..	1.6 [11]	1.9	3.1	..	..
Turkey[5]	..	27.4	28.5	32.9	41.8	..	..	71.4	70.1	62.4	53.7	..	..	0.9	1.3	2.7	2.6	..	..	0.2	0.2	2.0	1.8	..
United Kingdom	42.0 [11]	50.6 [11]	49.6	48.0	49.7	49.4	48.1 [11]	36.4 [11]	35.0	33.2	31.1	27.9	3.0 [11]	2.9 [11]	3.5	4.4	4.7	5.1	6.9 [11]	10.1	11.9	14.4	14.5	17.6
European Union	48.4	53.2	51.9 [11]	52.6 [11]	54.1	..	47.0	40.5	41.2 [11]	38.9	36.9	36.0	1.1	1.1	1.3 [11]	1.8	1.9	1.5	3.5	5.1	5.7 [11]	6.7	7.2	7.4
Total OCDE[8]	51.1	56.6	58.8 [11]	59.8 [11]	62.3	63.2	45.1	38.9	35.7 [11]	33.8 [11]	31.1	29.8	2.5	2.6	3.5 [11]	3.9 [11]	4.1	4.3	..	..	..	..	..	..

1. 1990 instead of 1989; 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
2. Adjusted by OECD up to 1995.
3. 1998 instead of 1999.
4. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
5. 1990 instead of 1989.
6. 1982 instead of 1981; 1990 instead of 1989; 1992 instead of 1991.
7. 1992 instead of 1991;1996 instead of 1995.
8. Includes Mexico and Korea from 1991; and Czech Republic, Hungary, 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 2001.

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

	Business enterprise						Government						Other national sources						Abroad					
	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999
Canada	0.51	0.56 [11]	0.61	0.79	0.80	0.74	0.63	0.69 [11]	0.73	0.62	0.56	0.52	0.06	0.09 [11]	0.11	0.12	0.14	0.13	0.05	0.13	0.15	0.20	0.21	0.28
Mexico	..	..	..	0.05	0.06	0.09	..	..	0.16	0.21	0.24	0.26	..	..	..	0.03	0.03	0.02	..	..	0.01	0.02	0.01	0.02
United States	1.16 [10]	1.38 [10]	1.56 [10,11]	1.51 [10]	1.65 [10]	1.76 [10]	1.17	1.20	1.06 [10,11]	0.89 [10]	0.82 [10]	0.77 [10]	0.05 [10]	0.06 [10]	0.10 [10,11]	0.10 [10]	0.10 [10]	0.11 [10]	..	..	..	..	..	..
Australia[1]	0.19	0.54	0.67	0.79	0.67	..	0.69	0.72	0.76	0.76	0.71	..	0.02	0.04	0.06	0.07	0.07	..	0.01	0.02	0.03	0.03	0.04	..
Japan[2]	1.44 [9]	2.14 [9]	2.18 [9]	2.00 [9]	2.15 [11]	2.19	0.53 [10]	0.47 [10]	0.46 [10]	0.58 [10]	0.53 [10]	0.59	0.16 [10]	0.17 [10]	0.17 [10]	0.19 [10]	0.22 [11]	0.24	0.00 [10]	0.00 [10]	0.00 [10]	0.00 [10]	0.01 [11]	0.01
Korea	..	..	..	1.91	1.95	1.72	..	..	..	0.48	0.62	0.61	..	..	..	0.12	0.12	0.13	..	..	..	0.00	0.00	0.00
New Zealand	..	0.29	0.27	0.33 [11]	0.34	..	..	0.57	0.61	0.51 [11]	0.59	..	..	0.00	0.08	0.10	0.14	..	..	0.02	0.02	0.04 [11]	0.06	..
Austria	0.57	0.72	0.74	0.71	0.72	0.71	0.53	0.59	0.68	0.74	0.70	0.71	0.00	0.00	0.00	0.01	0.01	0.01	0.03	0.04	0.04	0.11	0.26	0.37
Belgium	..	1.05 [11]	1.05	1.20 [11]	1.27	..	..	0.52 [11]	0.51	0.46 [11]	0.46	..	..	0.02 [11]	0.01	0.02 [11]	0.03	..	..	0.04 [11]	0.05	0.06 [11]	0.08	..
Czech Republic	..	..	..	0.64	0.70	0.68	..	..	..	0.33 [10]	0.36 [10]	0.55	..	..	..	0.01	0.09	0.01 [11]	..	..	..	0.03	0.02	0.05
Denmark	0.45 [11]	0.71	0.84	0.83	1.04	..	0.57	0.69	0.65	0.73	0.70	..	0.02 [11]	0.07	0.08	0.08	0.08	..	0.02	0.05	0.07	0.20	0.12	..
Finland	0.64 [11]	1.12	1.15 [11]	1.36	1.71	2.13 [11]	0.51 [11]	0.64 [11]	0.83 [11]	0.80	0.84	0.93	0.01 [11]	0.03	0.03 [11]	0.02	0.02	0.03	0.01 [11]	0.02	0.03 [11]	0.10	0.14	0.10 [11]
France[3]	0.79 [11]	1.01	1.01	1.12 [11]	1.15 [11]	1.17	1.03 [11]	1.10	1.16	0.97 [11]	0.86 [11]	0.81	0.01 [11]	0.01	0.02	0.04 [11]	0.04 [11]	0.04	0.10 [11]	0.17	0.19	0.18	0.18 [11]	0.16
Germany[4]	1.40	1.82	1.57 [11]	1.38 [11]	1.41	1.57	1.03	0.97	0.90 [11]	0.83 [11]	0.82	0.81	0.01	0.01	0.01 [11]	0.01 [11]	0.01	0.01	0.02	0.06	0.05 [11]	0.04 [11]	0.05	0.06
Greece	0.04 [11]	0.07 [11]	0.08	0.12	0.11	..	0.13 [11]	0.25 [11]	0.21	0.26	0.27	..	..	0.00	0.00	0.01	0.01	..	..	0.04 [11]	0.07	0.10	0.12	..
Hungary[5]	..	1.02	0.59	0.28 [11]	0.26	0.26	..	0.42	0.42	0.39 [11]	0.39	0.36	..	0.00	0.00	0.00	0.00	0.00	..	..	0.02	0.04 [11]	0.03	0.04
Iceland	0.04	0.24	0.28	0.53	0.77	1.01	0.54	0.66	0.81	0.88	0.94	0.96	0.03	0.07	0.02	0.06	0.02	0.03	0.03	0.03	0.05	0.07	0.11	0.32
Ireland	0.26	0.44	0.56	0.92	0.96	..	0.38	0.27	0.26	0.29	0.31	..	0.01	0.02	0.02	0.02	0.03	..	0.03	0.07	0.09	0.11	0.09	..
Italy	0.44 [9]	0.58 [9]	0.55 [11]	0.42	0.43	0.46	0.42 [9]	0.61 [9]	0.61 [11]	0.53	0.51	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.02 [9]	0.05 [9]	0.08 [11]	0.05	0.05	0.05
Netherlands[3]	0.82	1.08	0.94 [11]	0.92	0.93	0.95	0.84	0.85 [11]	0.96	0.84 [11]	0.80	0.74	0.02	0.03	0.04	0.05 [11]	0.05	0.06	0.09	0.06	0.04 [11]	0.19 [11]	0.26	0.20
Norway	0.47	0.77 [11]	0.73	0.85 [11]	0.82	0.87	0.67	0.86 [11]	0.82	0.75 [11]	0.71	0.72	0.02	0.02	0.02	0.02 [11]	0.02	0.03	0.02	0.04	0.08	0.08 [11]	0.11	0.07
Poland	..	..	..	0.25	0.25	0.29	..	..	..	0.42	0.44	0.44	..	..	..	0.01	0.01	0.01	..	..	..	0.01	0.01	0.01
Portugal[6]	0.09	0.14	0.12	0.11	0.13	0.16	0.19	0.32	0.36	0.37 [11]	0.42	0.54	..	0.03	0.03	0.02	0.03	0.03	0.01	0.02	0.09	0.07 [11]	0.04	0.04
Slovak Republic[5]	..	1.18	1.54	0.59 [11]	0.72	0.34	..	0.57	0.71	0.37 [11]	0.39	0.33	..	..	..	0.00 [11]	0.00	0.00	..	..	..	0.02 [11]	0.02	0.02
Spain	0.18	0.34	0.40	0.36	0.37	0.44	0.23	0.34	0.38	0.35 [11]	0.36	0.36	0.00	0.01	0.01	0.04 [11]	0.04	0.04	0.00	0.03	0.05	0.05 [11]	0.05	0.05
Sweden	1.21 [10,11]	1.66 [10]	1.73 [10]	2.27 [10,11]	2.49 [10]	2.58 [10]	0.93 [10,11]	1.08 [10]	0.95 [10]	1.00 [10,11]	0.95 [10]	0.93 [10]	0.03 [10,11]	0.05 [10]	0.08 [10]	0.08 [10,11]	0.10 [10]	0.16 [10]	0.03 [10,11]	0.05 [10]	0.04 [10]	0.12 [10,11]	0.13 [10]	0.13 [10]
Switzerland[7]	1.64	2.09 [11]	1.79	1.84	..	..	0.54	0.66 [11]	0.76	0.73	..	..	..	0.04 [11]	0.06	0.07	..	..	..	0.05 [11]	0.05	0.08	..	..
Turkey[5]	..	0.09	0.15	0.13	0.20	..	..	0.23	0.37	0.24	0.26	..	..	0.00	0.01	0.01	0.01	..	..	0.00	0.00	0.01	0.01	..
United Kingdom	1.00 [11]	1.09 [11]	1.03	0.95	0.91	0.92	1.14 [11]	0.79 [11]	0.73	0.66	0.57	0.52	0.07 [11]	0.06	0.07	0.09	0.09	0.10	0.16 [11]	0.22 [11]	0.25	0.29	0.27	0.33
European Union	0.82	1.03	0.99 [11]	0.95	0.97	0.99	0.79	0.79 [11]	0.78 [11]	0.70 [11]	0.66	0.65	0.02	0.02	0.02 [11]	0.03 [11]	0.03	0.03	0.06	0.10	0.11 [11]	0.12 [11]	0.13	0.13
Total OECD[8]	1.01	1.29	1.32 [11]	1.26 [11]	1.35	1.40	0.89	0.89 [11]	0.80 [11]	0.71 [11]	0.67	0.66	0.05	0.06	0.08 [11]	0.08 [11]	0.09	0.10	..	..	..	..	..	..

1. 1990 instead of 1989; 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
2. Adjusted by OECD up to 1995.
3. 1998 instead of 1999.
4. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
5. 1990 instead of 1989.
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8. Includes Mexico and Korea from 1991 and Czech Republic, Hungary, 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 2001.

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

Percentages

	Business enterprise						Higher education						Government						Private non-profit					
	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999
Canada	48.1	50.2 [12]	49.8	57.9	59.1	59.6	26.7	29.9 [12]	30.6	26.7	26.7	26.7	24.4	19.0	18.6	14.2	13.0	12.5	0.8	0.9 [12]	1.0	1.1	1.1	1.2
Mexico[1]	..	..	10.4	20.8	19.7	27.2	..	..	53.7	45.8	39.9	38.6	..	..	35.5	33.0	38.7	32.5	..	..	0.4	0.4	1.6	1.7
United States	70.3 [11]	71.0 [11]	72.4 [11,12]	71.9 [11]	74.2 [11]	75.7 [11]	14.5	15.5	14.5 [11,12]	15.3 [11]	14.5 [11]	14.1 [11]	12.1	10.7	9.8 [12]	9.6	8.2	7.2	3.1 [11]	2.8 [11]	3.3 [11,J]	3.3 [11]	3.1 [11]	2.9
Australia[2]	25.0	40.2	44.1	48.2	45.1	..	28.5	25.5	26.1	26.2	29.4	..	45.1	32.6	28.1	23.6	23.4	..	1.3	1.6	1.6	2.0	2.1	..
Japan[3]	66.0 [10]	74.3 [10]	75.4 [10]	70.3 [10]	72.0 [12]	70.7	17.6 [11]	12.5 [11]	12.1 [11]	14.5 [11]	14.3 [12]	14.8	12.0 [11]	8.6 [11]	8.1 [11]	10.4 [11]	8.8 [12]	9.9	4.5 [11]	4.5 [11]	4.4 [11]	4.8 [11]	4.8 [12]	4.6
Korea	..	..	..	73.7	72.6	71.4	..	..	..	8.2	10.4	12.0	..	..	..	17.0	15.8	14.5	..	..	..	1.1	1.2	2.1
New Zealand	..	32.2	26.8	27.0 [12]	28.2	..	..	19.2	28.6	30.7 [12]	36.4	..	..	48.6	44.6	42.2 [12]	35.3 [12]	..	..	..	..	..	..	..
Austria[1]	55.8	58.6	55.9	..	..	..	32.8	32.4	35.0	..	..	..	9.0	7.5	8.9 [12]	.. [12]	.. [12]	..	2.3	1.6	0.3 [12]	..	..	..
Belgium	..	67.0 [12]	66.5	70.4 [12]	71.4	..	..	25.7 [12,E]	26.2	24.8 [12]	24.2	..	..	6.1 [12]	6.1	3.4 [12]	3.1 [12]	..	..	1.2 [12]	1.2	1.4 [12]	1.3	..
Czech Republic	..	..	69.4	65.1 [12]	62.8	62.9	..	..	1.6	8.5 [12]	9.1	12.3	..	..	29.0	26.4 [12]	26.6 [12]	24.3	..	..	..	..	1.4	0.5
Denmark	49.7	55.0	58.5	57.4	61.4	62.3	26.7	24.8	22.6	24.5	22.2	20.9	22.7	19.1	17.7	17.0	15.4	15.6	0.9	1.1	1.2	1.1	1.0	1.2
Finland	54.7 [12]	61.6 [12]	57.0 [12]	63.2	66.0	68.2	22.2 [12]	19.3	22.1 [12]	19.5	20.0 [12]	19.7	22.5 [12]	18.5 [12]	20.2 [12]	16.6	13.6	11.4	0.6 [12]	0.5	0.7 [12]	0.6	0.5	0.7
France	58.9 [12]	60.3 [12]	61.5	61.0 [12]	62.5 [12]	63.1	16.4 [12]	14.9	15.1	16.7	17.4 [12]	17.6	23.6 [12]	23.9 [12]	22.7	21.0 [12]	18.7 [12]	17.9	1.1 [12]	0.9	0.8	1.3 [12]	1.4 [12]	1.5
Germany[4]	69.0	72.3	69.5 [12]	66.4 [12]	67.5	69.4	17.1	14.2	16.2 [12]	18.1 [12]	17.9	16.6	13.4	13.0	14.0 [12]	15.4	14.6	14.0	0.5	0.5	0.4 [12]	..	..	..
Greece	22.5 [12]	22.3 [12]	26.1	29.5	25.6	..	14.5 [12]	35.3 [12]	33.8 [12]	44.3	50.6	..	63.1 [12]	42.4 [12]	40.1	25.5	23.4	..	..	..	..	0.7	0.4	..
Hungary[5]	..	38.1	41.4	43.4 [12]	41.5	40.2	..	..	20.3	24.8 [12]	23.0	22.3	..	..	24.5	25.6 [12]	25.1 [12]	32.3	..	..	..	..	..	..
Iceland	9.6	19.4	21.8	31.9	40.6	46.7	26.0	25.0	29.4	27.5	28.3	20.9	60.7	49.2	44.5	37.4	29.8	30.2	3.7	6.4	4.4	3.2	1.3	2.2
Ireland	43.6	58.3	63.6	71.4	73.1	..	16.0	22.6	23.2	19.4	19.2	..	39.3	17.5	11.6	8.5 [12]	7.0 [12]	..	1.1	1.6	1.7	0.7	0.7	..
Italy	56.4 [10]	58.8 [10]	55.8 [12]	53.4 [12]	53.2	53.8	17.9 [10]	19.8 [10]	21.5 [12]	25.5	26.1	25.1	25.7 [10]	21.5 [10]	22.7 [12]	21.1	20.7	21.2	..	..	..	..	..	..
Netherlands[6]	53.3	59.2 [12]	49.7 [12]	52.1 [12]	54.6	54.2	23.2	21.4 [12]	29.7	28.8 [12]	27.3	27.1	20.8	17.3 [12]	18.3 [12]	18.1 [12]	17.1 [12]	17.7	2.8	2.1	2.3 [12]	1.0 [12]	1.0	1.0
Norway	52.9	56.6 [12]	54.6	56.7 [12]	56.9	56.0	29.0	24.0 [12]	26.7	26.0 [12]	26.6	28.6	17.7	19.4 [12]	18.8	17.3 [12]	16.4 [12]	15.4	0.5	..	..	..	..	..
Poland	..	..	..	38.7	39.4	41.3	..	..	..	26.3	28.6	27.8	..	..	..	35.0	32.0	30.8	..	..	..	0.0	0.0	0.1
Portugal[7]	31.2	26.1	21.7	20.9 [12]	22.5	22.6	20.6	36.0	43.0	37.0 [12]	40.0	38.5	43.6	25.4	22.1	27.0	24.2	28.1	4.6	12.4	13.1	15.0 [12]	13.3	10.8
Slovak Republic[5]	..	64.1	74.6	53.9 [12]	75.6 [12]	62.6	..	4.4	3.9	5.9 [12]	6.7	9.9	..	31.5	21.5	40.2 [12]	17.7 [12]	27.5	..	..	..	0.0 [12]	0.0	0.0
Spain	45.5	56.3	56.0	48.2 [12]	48.8	52.0	22.9	20.4	22.2	32.0	32.7	30.1	31.6	22.7	21.3	18.6 [12]	17.4 [12]	16.9	..	0.5 [12]	0.5	1.1 [12]	1.1	1.0
Sweden	63.7 [10,12]	65.4 [11]	68.5 [11]	74.3 [11,12]	74.9 [11]	75.1 [11]	30.0 [10,12]	30.6 [10]	27.4 [10]	21.9 [10,11]	21.4 [10,12]	21.4 [10]	6.1 [10,12]	3.9 [11]	4.1 [11]	3.7 [11,12]	3.5 [11,12]	3.4 [11]	0.3 [10,12]	0.1 [10]	0.1 [10]	0.2 [10,12]	0.1 [10]	0.1
Switzerland[8]	74.2	74.9 [12]	70.1	70.7	..	..	19.9	19.9 [12]	25.0	24.3	..	..	5.9	4.3 [12]	3.7	2.5 [11,12]	..	..	..	0.8 [12]	1.2	2.5	..	..
Turkey[5]	..	20.4	21.1	23.6	32.3	..	..	69.8	71.1	69.0	57.2	..	..	9.8	7.9	7.4	10.5	..	..	..	..	..	..	..
United Kingdom	63.0 [12]	69.1 [12]	67.1	65.3	65.5	67.8	13.6 [12]	15.3 [12]	16.7	19.0	19.6	20.0	20.6 [12]	13.9 [12]	14.5 [12]	14.4	13.6	10.7	2.8 [12]	1.8 [12]	1.8	1.3	1.3	1.4
European Union	62.0	65.2 [10]	63.5 [10]	62.2 [12]	63.3	64.7	17.8 [12]	17.3 [12]	18.7 [12]	20.8 [12]	21.0	20.4	18.8	16.6 [12]	17.0 [12]	16.2 [12]	14.9 [12]	14.0	1.4	0.9	0.9 [12]	0.9 [12]	0.9	..
Total OECD[9]	65.7	68.8	68.8 [12]	67.4 [12]	69.1	69.9	16.7	16.2	16.2 [12]	17.4 [12]	17.1	17.0	15.0	12.6	12.4 [12]	12.6 [12]	11.2 [12]	10.6	2.6	2.4	2.6 [12]	2.6 [12]	2.6	2.5

1. 1993 instead of 1990.
2. 1990 instead of 1989; 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
3. Adjusted by OECD up to 1995.
4. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
5. 1990 instead of 1989.
6. 1998 instead of 1999.
7. 1982 instead of 1981; 1990 instead of 1989; 1992 instead of 1991.
8. 1992 instead of 1991; 1996 instead of 1995.
9. Includes Mexico and Korea from 1991 and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
10. Overestimated.
11. Underestimated.
12. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

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	
	1981	1991	1995	1997	1998	1999	1981	1991	1995	1997	1998	1999		
Canada	2 881.1	4 819.0	6 776.0	7 180.0	7 555.9	7 639.4	1.7	1.7	2.3	2.2	2.2	2.1	1991-99	5.93
Mexico	..	539.9	399.1	474.5	779.0	828.0	..	0.2	0.1	0.1	0.2	0.2	1992-99	43.20
United States	81 676.1	127 943.8	132 103.0	151 568.7	160 729.5	171 418.4	48.4	44.6	44.4	45.5	46.6	47.2	1991-99	3.72
Australia	607.0	1 947.4	3 392.0	3 186.6	3 017.6	..	0.4	0.7	1.1	1.0	0.9	..	1991-98	6.46
Japan	25 966.0	58 410.4	55 288.9	63 464.6 [5]	64 096.8	63 644.8	15.4	20.3	18.6	19.1	18.6	17.5	1996-99	1.96
Korea	..	..	11 314.0	13 417.8	11 510.5	12 491.4	..	..	3.8	4.0	3.3	3.4	1995-99	2.51
New Zealand	101.3	140.6	163.8	207.9	..	..	0.1	0.0	0.1	0.1	..	..	1991-97	6.74
Austria	779.3	..	..	..	..	..	0.5	..	..	..	..	..	1989-93	3.59
Belgium	1 691.1	2 259.8	2 713.3	3 032.1	3 158.1	..	1.0	0.8	0.9	0.9	0.9	..	1991-98	4.90
Czech Republic	..	1 659.7	841.6 [5]	971.4	1 063.8	1 046.5	..	0.6	0.3	0.3	0.3	0.3	1995-99	5.60
Denmark	479.6	1 059.0	1 264.3	1 509.4	1 713.6	1 654.9	0.3	0.4	0.4	0.5	0.5	0.5	1991-99	5.74
Finland	480.2	1 084.3	1 393.1	1 909.4	2 178.9	2 544.0	0.3	0.4	0.5	0.6	0.6	0.7	1991-99	11.25
France	10 255.3	16 745.0	16 905.5	17 151.8 [5]	17 293.6	17 933.7	6.1	5.8	5.7	5.1	5.0	4.9	1997-99	2.25
Germany[1]	19 632.3	29 197.3 [5]	26 212.6	27 540.4	28 571.9	31 272.9	11.6	10.2	8.8	8.3	8.3	8.6	1991-99	0.86
Greece	41.2	122.8	192.2	184.0	..	..	0.0	0.0	0.1	0.1	..	..	1991-97	6.98
Hungary	..	404.0	295.5 [5]	294.8	269.4	295.8	..	0.1	0.1	0.1	0.1	0.1	1994-99	0.81
Iceland	2.8	14.7	29.2	48.9	51.1	77.5	0.0	0.0	0.0	0.0	0.0	0.0	1991-99	23.08
Ireland	110.9	314.0	626.1	788.7	..	..	0.1	0.1	0.2	0.2	..	..	1991-97	16.59
Italy	4 318.1	7 505.5 [5]	6 154.1	6 227.1	6 580.7	6 854.8	2.6	2.6	2.1	1.9	1.9	1.9	1991-99	-1.13
Netherlands	2 251.1	2 958.0	3 402.8 [5]	3 913.5	3 847.0	4 274.0	1.3	1.0	1.1	1.2	1.1	1.2	1994-99	5.77
Norway	497.2	824.7 [5]	986.6 [5]	1 079.2	..	1 120.2	0.3	0.3	0.3	0.3	..	0.3	1995-99	3.23
Poland	..	..	726.5	860.9	965.5	1 031.9	..	..	0.2	0.3	0.3	0.3	1994-99	5.26
Portugal[2]	89.2	167.9	162.0 [5]	204.9	..	272.0	0.0	0.1	0.1	0.1	..	0.1	1990-99	5.51
Slovak Republic	..	721.6	243.5 [5]	441.7 [5]	290.7	233.9	..	0.3	0.1	0.1	0.1	0.1	1997-99	-27.23
Spain	772.1	2 672.7	2 333.7	2 538.8	3 095.0	3 179.5	0.5	0.9	0.8	0.8	0.9	0.9	1991-99	2.19
Sweden	1 974.3 [5]	3 229.2	4 526.0 [5]	4 996.5	..	5 595.5	1.2	1.1	1.5	1.5	..	1.5	1991-99	7.11
Switzerland[3]	2 436.6	3 343.3 [5]	3 498.0	..	..	..	1.4	1.2	1.1	..	..	..	1992-96	1.14
Turkey	..	333.8	311.9	634.5	..	..	..	0.1	0.1	0.2	..	..	1991-97	11.30
United Kingdom	11 433.5	13 829.8 [5]	14 151.8	13 930.5	14 333.5	15 435.9	6.8	4.8	4.8	4.2	4.2	4.3	1991-99	1.38
European Union	56 970.0	82 500.6	81 553.5	85 766.9	89 409.6	95 570.4	33.3	28.7	27.4	25.7	25.9	26.3	1992-99	2.18
Total OECD[4]	168 598.8	287 123.3 [5]	297 843.6 [5]	333 134.9	345 278.7	362 894.9	100.0	100.0	100.0	100.0	100.0	100.0	1991-99	2.97

1. Figures for Germany from 1991 onwards refer to unified Germany.
2. 1982 instead of 1981; 1990 instead of 1991.
3. 1992 instead of 1991; 1996 instead of 1995.
4. Includes Mexico and Korea from 1991 and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
5. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2000.

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

	1981	1985	1989	1991	1993	1995	1996	1997	1998	1999
Canada	0.8	1.0	1.0	1.1	1.2	1.3	1.3	1.3	1.3	1.3
Mexico	..	..	0.1	0.1	0.0 [7]	0.1	0.1	0.1	0.1	0.1
United States	2.0	2.4	2.2	2.3	2.1	2.1	2.2	2.3	2.3	2.4
Australia	0.3	0.4	0.6	0.6	0.8	0.9	0.9	0.8	0.7	..
Japan	1.6	2.1	2.3	2.4	2.1	2.2	2.2 [7]	2.3	2.4	2.4
Korea	..	..	..	..	..	2.3	2.4	2.5	2.2	2.1
New Zealand	..	..	0.4	0.3	0.4	0.3	..	0.4	..	..
Austria	0.8	0.9	1.1	..	1.1	..	..	..	..	..
Belgium	1.4	1.5	1.4	1.4	1.6 [7]	1.6	1.6	1.7	1.7	..
Czech Republic	..	..	..	1.7	1.1 [7]	0.8 [7]	0.7	0.9	1.0	1.0
Denmark	0.9	1.1	1.3	1.5	1.6	1.7	1.8	1.9	2.1	2.0
Finland	0.9	1.3	1.6	1.8	1.9	2.2	2.5	2.7	2.9	3.2
France	1.6	1.8	1.9	1.9	2.0 [7]	1.9	1.9	1.9 [7]	1.8	1.9
Germany[1]	2.2	2.5	2.6	2.3 [7]	2.1	2.0	1.9	2.0	2.0	2.2
Greece	0.1	..	0.1	0.2	0.2	0.3	0.2	0.2	..	..
Hungary[2]	..	..	0.8	0.5	0.4	0.4 [7]	0.4	0.4	0.3	0.3
Iceland	0.1	0.2	0.3	0.4	0.7	0.8	..	1.2	1.2	1.7
Ireland	0.4	0.6	0.6 [7]	0.8	1.1	1.3	1.3	1.3	..	..
Italy	0.6	0.8	0.9	0.9 [7]	0.8	0.7	0.7	0.7	0.7	0.7
Netherlands	1.3	1.5	1.6	1.3	1.2	1.3 [7]	1.4	1.4	1.4	1.5
Norway	0.8	1.3 [7]	1.3	1.3	1.3	1.4 [7]	..	1.3	..	1.3
Poland[3]	..	..	..	..	0.4	0.4	0.4	0.4	0.4	0.4
Portugal[4]	0.1	0.1 [7]	0.2 [7]	0.2 [7]	..	0.2 [7]	..	0.2	..	0.3
Slovak Republic[5]	..	..	..	1.7 [7]	1.3 [7]	0.7 [7]	0.7	1.1 [7]	0.7	..
Spain	0.2	0.4 [7]	0.5	0.6	0.6	0.5	0.5	0.5	0.6	0.6
Sweden	2.3	3.0	2.9	3.1	3.6	4.0 [7]	..	4.4	..	4.7
Switzerland[5]	1.9	2.0 [7]	2.5 [7]	2.2	..	..	2.3	..	..	..
Turkey[2]	..	..	0.1	0.1	0.1	0.1	0.1	0.2	..	..
United Kingdom	2.1	2.0	2.1 [7]	2.0	2.0	1.8	1.7	1.6	1.7	1.8
European Union	1.4	1.6	1.7 [7]	1.6 [7]	1.6 [7]	1.5	1.5	1.5	1.5	1.6
Total OECD[6]	1.6	1.9	1.9	1.9 [7]	1.8	1.7 [7]	1.8	1.8	1.9	1.9

1. Figures for Germany from 1991 onwards refer to unified Germany.
2. 1990 instead of 1989.
3. 1994 instead of 1993.
4. 1982 instead of 1981; 1986 instead of 1985; 1990 instead of 1989; 1992 instead of 1991.
5. 1992 instead of 1991.
6. Includes Mexico and Korea from 1991 and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
7. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

Table A.4.2.1. **Business R&D by industries**

	Share of services in business R&D[1]		Increase in R&D in selected services and manufacturing industries Average annual growth rate 1991-99				
	1991	1999	Services	Communications	Computers and related activities	Manufacturing	Period
Canada	25.5	27.8	7.1	-5.3	11.0	6.2	
Australia[2]	27.1	27.1	6.4	..	3.0	5.3	1991-98
United States	24.3	31.2	6.9	..	8.7	2.1	
Japan[3]	2.3	2.7	15.8	..	15.9	1.8	1996-99
Korea[4]	7.6	13.3	18.0	..	..	2.0	1995-99
Belgium[5]	13.3	18.0	9.6	29.9	11.3	4.1	1992-99
Czech Republic[5]	38.8	27.8	-9.6	4.0	27.6	-2.9	1992-99
Denmark[2]	28.5	36.7	9.5	-2.4	19.9	4.1	1991-98
Finland	7.6	11.7	17.3	29.3	..	11.2	
France[2]	4.2	8.9	5.5	..	-2.4	-0.7	1992-98
Germany	3.2	5.4	7.8	..	..	0.6	
Ireland[6]	9.5	12.8	18.4	12.2	25.0	15.2	1993-97
Italy	8.1	12.2	4.1	4.6	5.4	-1.7	
Netherlands[2]	6.7	16.9	18.5	..	..	1.2	1991-98
Norway[2]	41.8	48.0	4.1	21.4	19.1	0.8	1991-97
Poland[4]	15.4	14.0					
Spain	16.4	18.3	3.6	19.8	13.7	2.1	
Sweden	9.0	12.8	11.9	..	..	6.7	
United Kingdom	15.1	17.4	3.2	4.6	1.9	1.4	
European Union[7]	8.6	10.9	..	..	..	..	
Total OECD[7,8]	15.1	17.3	..	..	..	..	

1. Share of services in total services and manufacturing industries.
2. 1991 and 1998.
3. 1996 and 1999.
4. 1995 and 1999.
5. 1992 and 1999.
6. 1991 and 1997.
7. 1992 and 1998.
8. Excludes Korea, Ireland and Poland.

Source: OECD, ANBERD database, May 2001.

Table A.4.2.2. **R&D expenditures in manufacturing by level of technology, 1991-99**

Percentage share in total manufacturing

	High-technology industries			Medium-high-technology industries			Medium-low- and low-technology industries		
	1991	1995	1999	1991	1995	1999	1991	1995	1999
Canada	68.7	69.0	78.1	11.5	13.9	10.1	19.9	17.1	11.8
United States	60.9	60.7	59.9	28.3	30.1	31.2	10.8	9.2	8.9
Australia[1]	31.7	27.4	34.7	30.5	28.8	28.2	37.8	43.8	37.0
Japan	37.4	39.3	43.3	43.6	43.7	41.8	19.0	17.0	15.0
Korea	..	44.4	58.8	..	41.8	28.1	..	13.8	13.1
Belgium[2]	36.0	39.1	42.7	41.1	39.0	36.8	22.9	21.9	20.5
Czech Republic	..	18.2	16.2	..	63.6	66.9	..	18.2	16.9
Denmark[1]	49.5	48.9	50.5	26.8	32.2	34.4	23.7	18.9	15.2
Finland	33.0	48.1	63.4	31.8	29.9	21.4	35.1	22.1	15.2
France[1]	57.4	55.7	54.5	30.6	31.7	31.6	12.1	12.6	13.8
Germany	..	34.5	32.4	..	57.1	59.4	..	8.4	8.2
Ireland[3]	55.1	53.9	63.5	18.4	13.9	13.8	26.5	32.2	22.6
Italy	49.2	52.4	49.5	41.3	36.8	37.7	9.5	10.7	12.9
Netherlands[1]	30.4	42.3	51.4	54.1	39.9	33.6	15.4	17.8	15.0
Norway[1]	42.0	41.1	39.4	30.9	27.0	28.9	27.1	31.9	31.7
Poland	..	21.8	20.6	..	54.4	58.5	..	23.8	20.9
Spain	48.3	45.9	39.3	34.8	33.2	36.1	16.9	20.9	24.6
Sweden	53.7	54.3	57.6	36.1	35.5	34.1	10.2	10.1	8.4
United Kingdom	50.7	51.5	58.1	36.0	35.5	32.0	13.2	13.0	10.0
European Union[1,4]	..	45.5	46.0	..	42.6	42.3	..	11.9	11.8
Total OECD[1,5]	..	50.7	52.2	..	36.9	35.5	..	12.4	12.3

1. 1998 instead of 1999.
2. 1992 instead of 1991.
3. 1997 instead of 1999.
4. European Union excludes Austria, Greece, Ireland, Luxembourg and Portugal.
5. Total OECD includes all the 19 above countries except Ireland.

Source: OECD, ANBERD database, May 2001.

Table A.4.3.1. **R&D expenditure in selected ICT industries**

	ICT-related R&D expenditure in manufacturing industries[1]						ICT-related R&D expenditure in services industries[2]					
	As a % of GDP			As a % of business enterprise sector R&D expenditure			As a % of GDP			As a % of business enterprise sector R&D expenditure		
	1991	1995	1999	1991	1995	1999	1991	1995	1999	1991	1995	1999
Canada[3]	0.24	0.28	0.35	29.5	28.0	35.7	0.06	0.1	0.08	7.2	9.5	7.8
United States[4]	0.51	0.49	0.50	25.9	27.3	25.5	..	..	0.16	..	..	8.1
Australia[5]	..	0.10	0.09	13.7	11.1	13.5	..	..	..	..	..	..
Japan	0.61	0.59	0.71	28.8	30.4	33.2		..	..		..	..
Korea	..	0.63	0.81	..	34.1	46.0	..	..	0.18	..	..	10.1
Belgium[3]	..	0.22	0.25	..	17.7	17.0	..	0.06	0.11	..	4.9	7.4
Czech Republic	..	0.03	0.03	..	3.9	4.0	..	..	0.02		..	1.9
Denmark[5]	0.16	0.14	0.14	16.6	13.2	11.4	0.07	0.11	0.14	7.0	10.0	11.7
Finland	0.27	0.54	1.08	23.1	37.2	49.8	..	0.1	0.19	..	7.3	8.7
France[5]	0.38	0.34	0.30	26.3	24.0	22.3	..	..	..	..	..	..
Germany	0.35	0.30	0.29	20.1	19.9	17.4	..	..	..	..	..	..
Ireland[6]	0.22	0.33	0.41	37.6	34.6	40.5	..	0.07	0.1	..	7.7	9.7
Italy	0.16	0.14	0.13	22.9	27.0	24.0	0.01	0.01	0.01	1.6	2.8	2.6
Netherlands[5]	0.17	0.26	0.31	17.9	25.4	29.4	..	..	..	..	..	..
Norway[7]	0.17	0.16	0.15	19.3	19.0	16.6	0.07	0.12	0.17	7.8	13.3	19.7
Poland	..	0.02	0.02	..	6.3	7.0	..	0.01	0.01	..	3.3	1.6
Spain	0.11	0.06	0.06	22.5	16.1	13.4	0.02	0.03	0.06	4.0	6.6	12.2
Sweden	0.57	0.73	0.85	29.7	28.2	29.7	..	0.1	0.2	..	4.1	7.2
United Kingdom	0.19	0.15	0.16	13.4	11.4	12.8	0.14	0.15	0.14	10.0	11.8	11.3

1. ISIC, Rev. 3 divisions: 30 (manufacture of office, accounting and computing machinery; 32 (manufacture of radio, television and communication equipment and apparatus) and 33 (manufacture of medical, precision and optical instruments, watches and clocks).
2. ISIC, Rev. 3 divisions: 64 (post and telecommunications) and 72 (computer and related activities).
3. 2000 instead of 1999.
4. Due to unavailability of data for division 64, class 642 (telecommunication) is included in services ICT R&D as a proxy. Available information shows that in the United States class 642 accounts for about 97-98% of division 64 total.
5. 1998 instead of 1999.
6. 1997 instead of 1999.
7. 1998 for manufacturing industries and 1997 for services industries instead of 1999.

Source: OECD, ANBERD database, May 2001.

Table A.4.3.2. **ICT[1] patent applications to the EPO[2] by priority year and by inventor's country of residence**

	Share in total EPO patent applications			Average annual growth rate
	1990	1995	1997	1990-97[3]
Canada	7.8	13.7	16.4	23.6
Mexico	0.0	0.0	1.3	..
United States	13.3	15.9	16.3	7.9
Australia	4.6	6.2	9.7	18.8
Japan	19.3	17.5	19.3	1.1
Korea	42.2	30.2	35.0	22.8
New Zealand	0.0	1.6	5.9	..
Austria	3.4	6.5	4.3	9.1
Belgium	7.1	10.6	7.0	11.5
Czech Republic	0.0	0.0	4.8	..
Denmark	3.8	3.9	7.1	19.2
Finland	9.0	27.1	38.1	38.5
France	7.8	8.6	11.8	9.6
Germany	5.1	5.8	8.0	13.0
Greece	3.8	13.0	7.7	..
Hungary	0.0	8.0	6.2	..
Iceland	0.0	9.8	17.3	..
Ireland	12.8	13.6	15.4	12.3
Italy	3.9	5.2	4.6	7.1
Luxembourg	0.0	7.3	6.6	..
Netherlands	11.3	15.3	19.1	14.7
Norway	3.9	6.7	14.6	36.8
Poland	0.0	3.7	2.1	..
Portugal	6.5	3.6	0.0	..
Slovak Republic	..	0.0	0.0	..
Spain	2.7	2.7	5.0	22.3
Sweden	6.5	14.1	18.4	29.5
Switzerland	2.8	3.1	4.6	10.6
Turkey	0.0	0.0	12.5	..
United Kingdom	9.3	12.7	12.4	7.3
European Union	6.5	8.6	10.6	13.4
Total OECD	11.1	12.4	13.8	7.9
World	11.1	12.4	13.8	8.1

1. International Patent Classification: G06, G11 and H04.
2. European Patent Office.
3. For those countries with fewer than ten patent applications to the EPO, no growth rate was calculated.

Source: OECD, Patent database, May 2001.

Table A.4.4.1. **Total business R&D broken down by size classes of firms**

1999 percentages; total in millions of PPP dollars

	Employees						
	Fewer than 100	100 to 499	500 to 999	1 000 or more	Fewer than 500	500 or more	Average
Canada[1]	16.8	15.8	10.1	57.4	32.5	67.5	7 826
Mexico[2,3]	13.8	24.5	61.6	→	38.4	61.6	399
United States[4]	10.4	8.3	3.8	77.5	18.6	81.4	182 823
Australia[5]	29.2	20.7	12.3	37.8	49.9	50.1	3 053
Japan[6]	←	7.2	10.7	82.1	7.2	92.8	66 291
Korea[7,8]	4.1	8.8	8.2	78.9	12.9	87.1	13 791
Belgium[3]	19.0	17.3	12.3	51.4	36.3	63.7	2 273
Czech Republic	10.5	24.3	12.5	52.6	34.9	65.1	1 112
Denmark[1,9,10]	16.1	23.4	13.2	47.4	39.4	60.6	1 795
Finland	14.0	15.0	9.6	61.4	29.0	71.0	2 555
France[1]	6.8	14.3	9.2	69.7	21.1	78.9	17 277
Germany[8,9]	5.8	9.3	5.7	79.2	15.0	85.0	27 910
Hungary	16.3	13.7	15.2	54.7	30.0	70.0	312
Iceland	38.6	56.8	2.8	1.8	95.4	4.6	63
Italy[1]	5.4	18.9	12.3	63.4	24.3	75.7	6 612
Netherlands[1,11]	10.6	18.2	71.2	→	28.8	71.2	4 093
Norway[3,9,12]	25.8	29.4	44.8	→	55.2	44.8	471
Poland	11.2	50.6	8.4	29.8	61.8	38.2	1 030
Portugal	25.7	41.2	9.9	23.3	66.9	33.1	288
Spain	18.0	26.2	16.5	39.3	44.2	55.8	3 311
Sweden[13]	3.8	14.0	9.6	72.6	17.8	82.2	5 821
Switzerland[10,14,15]	10.1	20.3	11.3	58.3	30.4	69.6	3 299
Turkey[14]	6.0	31.5	13.2	49.2	37.5	62.5	415
United Kingdom	8.0	17.2	13.3	61.5	25.2	74.8	17 254

1. 1998.
2. 51 to 100 employees.
3. 1995.
4. Lower cut-off point is 5 employees.
5. Excludes agriculture.
6. Fewer than 300 and 300 to 999.
7. Companies only.
8. 1997.
9. Excludes institutes.
10. Lower cut-off point is 6 employees.
11. 10 to 99 employees.
12. Total manufacturing and mining only.
13. 50 to 99 employees.
14. 1996.
15. Excludes banks.

Source: OECD, STI/EAS Division, May 2001.

Table A.4.4.2. **Government-financed share of business R&D broken down by size classes of firms**

1999 percentages; total in millions of PPP dollars

	Employees						
	Fewer than 100	100 to 499	500 to 999	1 000 or more	Fewer than 500	500 or more	Average
Canada[1]	33.4	14.6	7.0	45.0	48.0	52.0	283
Mexico[2,3]	9.6	48.6	41.8	→	58.2	41.8	11
United States[4]	7.0	5.1	2.6	85.2	12.2	87.8	22 535
Australia[5]	78.0	12.3	9.6	0.0	90.4	9.6	94
Japan	..	..	..	..	..	..	..
Korea[6,7]	19.7	18.5	7.8	54.1	38.1	61.9	671
Belgium[3]	58.8	12.8	7.1	21.4	71.6	28.4	84
Czech Republic	20.9	50.1	6.1	22.8	71.0	29.0	157
Denmark[1,8,9]	24.3	36.0	0.6	38.9	60.3	39.6	75
Finland	38.4	20.1	10.7	30.8	58.5	41.5	107
France[1]	6.0	6.7	5.1	82.3	12.7	87.3	1 551
Germany[7,8,10]	7.3	6.5	4.9	81.3	13.8	86.2	2 450
Hungary	36.5	37.5	17.3	8.7	74.0	26.0	18
Iceland	40.0	60.0	→		..	..	2
Italy[1]	10.7	26.2	10.9	52.1	37.0	63.0	726
Netherlands[1,11]	12.0	23.5	64.4	0.0	35.6	64.4	178
Norway[3,8,12]	23.5	11.2	65.3	0.0	34.7	65.3	35
Poland	11.7	77.5	7.2	3.6	89.3	10.7	273
Portugal	38.5	33.1	19.3	9.1	71.5	28.5	23
Spain	34.4	33.9	4.4	27.2	68.4	31.6	284
Sweden[13]	9.0	14.7	18.4	57.9	23.7	76.3	454
Switzerland[9,14,15]	76.4	13.9	9.7	→	90.3	9.7	80
Turkey[14]	12.9	46.1	4.7	36.2	59.1	40.9	8
United Kingdom	6.5	11.7	13.1	68.8	18.2	81.8	1 766

1. 1998.
2. 51 to 100 employees.
3. 1995.
4. Lower cut-off point is 5 employees.
5. Excludes agriculture.
6. Companies only.
7. 1997.
8. Excludes institutes.
9. Lower cut-off point is 6 employees.
10. Breakdown by size class according to the percentage of government-financed intra- and extramural R&D expenditure of enterprises.
11. 10 to 99 employees.
12. Total manufacturing and mining only.
13. 50 to 99 employees.
14. 1996.
15. Excludes banks.

Source: OECD, STI/EAS Division, May 2001.

Table A.4.5. **Co-operation between business and the public sector**

	Percentage of business in the funding of research performed by government and university, 1999		Percentage of firms with co-operation arrangements with university or government research institutions, 1994-96	
	Government	Higher education	All firms	Firms with fewer than 50 employees
Canada	2.2	10.5	..	..
Mexico[1]	8.6	2.7	16.3	..
United States	0.0	6.3	..	..
Australia[2]	6.3	5.2	..	..
Japan	1.8	2.3	..	..
Korea	6.9	10.8	..	..
New Zealand[1]	18.1	4.6	..	..
Austria[3]	2.0	2.0	11.9	4.4
Belgium[1]	12.3	13.9	11.9	2.0
Czech Republic	6.9	1.3	..	..
Denmark	5.5	2.1	..	..
Finland	14.2	4.7	38.2	8.6
France[2]	9.4	3.4	9.9	2.7
Germany	2.0	10.6	12.3	4.3
Greece[1]	1.8	5.6	..	..
Hungary	7.3	6.1	..	..
Iceland	22.1	4.0	..	..
Ireland[2]	16.3	6.6	10.5	3.8
Italy	2.3	4.8	..	..
Luxembourg	..	..	5.6	0.0
Netherlands[2]	18.4	5.0	11.2	2.4
Norway	10.3	5.1	19.0	4.2
Poland	18.1	9.8	12.3	3.6
Portugal	3.7	1.2	..	..
Slovak Republic	13.0	0.9		
Spain	7.3	7.7	13.0	1.0
Sweden	3.8	3.9	44.5	5.9
Switzerland[2]	..	7.1	9.8	5.1
Turkey[1,4]	1.9	19.0	9.0	6.4
United Kingdom	21.1	7.2	10.7	3.7
European Union[2]	7.1	6.7	..	..
Total OECD[2]	4.1	6.1	..	..

1. 1997 instead of 1999.
2. 1998 instead of 1999.
3. 1993 instead of 1999.
4. 1995-97 instead of 1994-96.

Source: OECD, R&D database, May 2001; Eurostat, May 1999; OECD, STI/EAS Division, May 2001.

Table A.5.1.1. **R&D expenditures by main sectors of performance as a percentage of GDP**

	Business enterprise							Higher education							Government						
	1981	1989	1991	1993	1995	1997	1999	1981	1989	1991	1993	1995	1997	1999	1981	1989	1991	1993	1995	1997	1999
Canada	0.60	0.74	0.80	0.90	1.01	1.01	0.99	0.33	0.44 [11]	0.49	0.51	0.47	0.46	0.44	0.30	0.28	0.30	0.28	0.25	0.22	0.21
Mexico	..	0.08 [9]	0.09 [9]	0.02 [11]	0.06	0.07	0.11	..	..	..	0.12	0.14	0.14	0.15	..	..	0.15	0.08 [11]	0.10 [11]	0.13	0.13
United States	1.67 [10]	1.88 [10]	1.97 [10]	1.78 [10]	1.80 [10]	1.91 [10]	2.00 [10]	0.34	0.41	0.39 [10,1]	0.39 [10]	0.38 [10]	0.37 [10]	0.37 [10]	0.29	0.28	0.27 [11]	0.26	0.24	0.21	0.19
Australia[1]	0.24	0.51	0.53	0.67	0.74	0.80	0.67	0.27	0.3	0.34	0.40	0.39	0.43	0.44	0.43	0.38	0.43	0.43	0.42	0.39	0.35
Japan[2]	1.41 [9]	2.06 [9]	2.13 [9]	1.90 [9]	1.94 [9]	2.09 [11]	2.15	0.37	0.35	0.34	0.38	0.40	0.41 [11]	0.45	0.26	0.24	0.23	0.27	0.29	0.26	0.30
Korea	..	..	..	..	1.84	1.95	1.76	..	..	..	..	0.20	0.28	0.30	..	..	..	..	0.42	0.42	0.36
New Zealand	..	0.28	0.27	0.31	0.26	0.32	..	..	0.17	0.28	0.29 [11]	0.30	0.41	..	..	0.43	0.44	0.42	0.41	0.40	..
Austria	0.63	0.79	..	0.82	..	..	..	0.37	0.44	..	0.51	..	..	..	0.10	0.10	0.13 [11]	0.13 [11]	..	..	..
Belgium[3]	1.01	1.10	1.08	1.23 [11]	1.23	1.31	1.33	..	0.42 [11]	0.43	0.44 [11]	0.43	0.44	..	..	0.10 [11]	0.10	0.06 [11]	0.06 [11]	0.06	..
Czech Republic	..	..	1.40	0.88	0.66 [11]	0.73	0.81	..	..	0.03	0.04	0.09 [11]	0.11	0.16	..	..	0.58	0.28	0.27 [11]	0.31	0.31
Denmark	0.53	0.83 [11]	0.96	1.02	1.05	1.19	1.25	0.28	0.37 [11]	0.37	0.40	0.45	0.43	0.42	0.24	0.29 [11]	0.29	0.31	0.31	0.30	0.31
Finland	0.64	1.11	1.16	1.27	1.45	1.79	2.18	0.26	0.35	0.45 [11]	0.44	0.45	0.54 [11]	0.63	0.26	0.33	0.41 [11]	0.44	0.38	0.37	0.36
France	1.14	1.38	1.46	1.48 [11]	1.41 [11]	1.39 [11]	1.37	0.32	0.34	0.36	0.38	0.39	0.39 [11]	0.38	0.46	0.55	0.54	0.51 [11]	0.48	0.41 [11]	0.39
Germany[4]	1.71	2.07	1.76 [11]	1.58	1.50	1.54	1.69	0.42	0.41	0.41 [11]	0.41	0.41 [11]	0.41	0.41	0.33	0.37	0.35 [11]	0.36 [9,11]	0.35 [9]	0.33 [9]	0.34 [9]
Greece	0.04	0.08	0.09	0.13	0.14 [11]	0.13	..	0.02	0.13 [11]	0.12	0.19	0.22 [11]	0.26	..	0.11	0.16	0.15	0.15	0.12 [11]	0.12	..
Hungary[5]	..	0.56	0.44	0.31	0.32 [11]	0.30	0.28	..	0.21	0.22	0.22	0.18 [11]	0.17	0.15	..	0.29	0.26	0.25	0.19 [11]	0.18	0.22
Iceland	0.06	0.20	0.25	0.42	0.49	0.75	1.08	0.16	0.25	0.34	0.32	0.42	0.52	0.49	0.38	0.50	0.51	0.55	0.58	0.55	0.70
Ireland	0.29	0.47	0.59 [11]	0.80	0.96	1.01	..	0.11	0.18	0.22 [11]	0.25	0.26	0.27	..	0.27	0.14	0.11 [11]	0.12 [11]	0.11	0.10	0.07
Italy	0.49 [9]	0.73 [9,11]	0.68 [11]	0.60	0.53	0.52	0.56	0.16	0.24 [11]	0.26	0.28	0.25	0.26	0.26	0.23 [9]	0.27 [9,11]	0.28 [11]	0.24	0.21	0.20	0.22
Netherlands	0.95	1.20	0.98	0.95	1.04 [11]	1.11	1.13	0.41	0.44 [11]	0.58 [11]	0.58	0.57 [11]	0.56	0.53	0.37	0.35	0.36	0.35	0.36 [11]	0.35	0.35
Norway	0.62	0.96 [11]	0.90	0.93	0.97 [11]	0.94	0.95	0.34	0.41	0.44	0.47	0.45	0.44	0.49	0.21	0.33 [11]	0.31 [9]	0.33 [9]	0.30 [9]	0.27 [9]	0.26 [9]
Poland	..	..	..	..	0.27	0.28	0.31	..	..	..	..	0.18	0.20	0.21	..	..	..	..	0.24	0.23	0.23
Portugal[6]	0.09	0.1	0.13	0.13	0.12 [11]	0.14	0.17	0.06	0.14	0.19	0.26	0.21 [11]	0.25	0.30	0.13	0.14	0.13	0.14	0.15 [11]	0.15	0.22
Slovak Repulic[5]	..	1.12	1.68	1.04 [11]	0.53 [11]	0.85 [11]	0.43	..	0.08	0.09	0.04 [11]	0.06 [11]	0.08	0.07	..	0.55	0.48	0.37 [11]	0.40 [11]	0.20 [11]	0.19
Spain	0.18	0.41	0.47	0.42	0.39 [11]	0.40	0.46	0.09	0.15	0.19	0.27	0.26 [11]	0.27	0.27	0.13	0.16	0.18	0.18	0.15 [11]	0.14	0.15
Sweden	1.41	1.86 [10]	1.91 [10]	2.28 [10,11]	2.57 [10,11]	2.75 [10]	2.86 [10]	0.66	0.87	0.76	0.84 [11]	0.76 [10,11]	0.79 [11]	0.81	0.13	0.11 [10]	0.11 [10]	0.13 [10,11]	0.13 [10,11]	0.13 [10]	0.13 [10]
Switzerland[7]	1.62	2.12 [11]	1.86	..	..	1.93	..	0.43	0.56 [11]	0.66	..	0.65	0.66	0.63	0.13	0.12 [11]	0.10	..	0.08	0.07	0.05
Turkey[5]	..	0.07	0.11	0.10	0.09	0.16	..	..	0.23	0.38	0.30	0.26	0.28	..	..	0.03	0.04	0.04	0.03	0.05	..
United Kingdom	1.50	1.49 [11]	1.39	1.42	1.30	1.20	1.27	0.32	0.33 [11]	0.35	0.36 [11]	0.38	0.36	0.37	0.49	0.30 [11]	0.30 [11]	0.30	0.29	0.25	0.20
European Union	1.05	1.27 [11]	1.21 [11]	1.18 [11]	1.13	1.14	1.20	0.30	0.34 [11]	0.36 [11]	0.38 [11]	0.38 [11]	0.38	0.38	0.32	0.32 [11]	0.32 [11]	0.31 [11]	0.29 [11]	0.27	0.26
Total OECD[8]	1.29	1.57	1.54 [11]	1.44	1.42 [11]	1.49	1.54	0.33	0.37	0.36 [11]	0.37	0.37 [11]	0.37	0.38	0.29	0.29	0.28 [11]	0.27	0.27 [11]	0.24	0.23

1. 1988 instead of 1989; 1990 instead of 1991; 1992 instead of 1993; 1994 instead of 1995; 1996 instead of 1997; 1998 instead of 1999.
2. Adjusted by OECD up to 1995.
3. 1998 instead of 1999.
4. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
5. 1990 instead of 1989.
6. 1982 instead of 1981; 1988 instead of 1989; 1990 instead of 1991; 1992 instead of 1993.
7. 1992 instead of 1993; 1994 instead of 1995; 1996 instead of 1997; 1998 instead of 1999.
8. Includes Mexico and Korea from 1991 and Czech Republic, Hungary and Poland from 1995.
9. Overestimated.
10. Underestimated
11. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

Table A.5.1.2. **Researchers[1] per 10 000 labour force by sector of employment**

	Business enterprise						Government						Higher education					
	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999	1981	1989	1991	1995	1997	1999
Canada	12.1	20.4	20.9	33.1	33.9	31.4	4.5	5.9 [13]	5.8	5.2	4.8	4.7	14.8	18.6 [13]	19.9	20.8	22.3	21.1
Mexico	..	..	..	0.6	..	..	..	..	..	1.8	..	..	..	..	..	3.3	..	..
United States[2]	45.0	58.1	60.4	58.9	66.7	70.0	5.3 [12]	4.7 [12,13]	4.5 [12]	4.0 [12]	3.6 [12]	..	8.9	9.8 [13]	9.1	10.0	9.9	..
Australia[3]	5.1	14.9	14.9	17.0	16.8	15.1	9.9	10.5	11.0	10.1	10.0	9.5	19.9	24.3	24.4	38.8	..	40.9
Japan[4]	33.8 [11]	50.1 [11]	52.4 [11]	57.6 [11]	59.6 [13]	64.0	5.1	4.7	4.6	4.6	4.5	4.6	14.3	16.4	16.5	18.2	25.7	26.3
Korea	..	..	..	32.2	32.3	30.3	..	..	..	6.1	5.7	5.4	..	..	..	9.3	9.0	10.0
New Zealand	..	9.5	8.3	8.8	9.1	..	..	9.0	9.3	8.4	9.4	..	..	11.8	11.4	16.9 [13]	25.7	..
Austria	9.1	11.6	..	..	..	..	1.7	1.5	..	2.4 [13]	..	..	9.6	11.5	..	13.0	..	..
Belgium	12.6	20.2 [13]	20.8	27.3 [13]	27.2	..	1.5	2.0 [13]	1.9	2.3	2.4	..	16.1	19.9 [13]	20.0	23.2 [13]	23.8	..
Czech Republic[5]	..	..	21.1	9.5 [13]	9.9	11.1	..	..	16.6	8.3 [13]	8.9	8.2	..	..	2.4	5.2 [13]	5.5	6.5
Denmark	8.7	15.3	17.7	23.9	26.3	28.1	6.6	8.5	8.8	12.8	12.9	13.7	9.8	13.7	14.2	19.7	21.5	20.0
Finland	11.1	19.7	20.1	26.6	34.6	40.9	9.4	12.4	12.6	13.9	15.0	16.0	..	..	21.2	25.8	34.0 [13]	40.3
France[2]	14.8	22.0	23.8	26.3 [13]	27.9	28.1	6.6	9.8	10.4	10.7 [13]	9.4 [13]	9.3	13.8	16.1	16.9	21.2	21.3 [13]	21.7
Germany[6]	27.2	38.2	35.6 [13]	32.8	33.3	34.0	6.3	7.8	9.4 [13]	9.5 [11,13]	9.4 [11]	9.6 [11]	10.1	13.1 [13]	15.7 [13]	16.3	16.5	16.5
Greece	..	1.9 [13]	2.6	3.7	4.2	..	..	5.3 [13]	4.9	4.7	4.6	..	..	6.6 [13]	8.3	14.3	16.6	..
Hungary	..	..	..	7.1	7.6	8.0	..	..	8.5	8.6	9.8	11.1	..	..	10.5	9.9	10.5	11.6
Iceland	3.1	10.5	12.0	24.1	32.1	34.3	15.6	23.2	20.6	21.7	26.4	26.4	11.5	14.4	15.3	25.5	31.3	31.3
Ireland	4.7	11.7	15.7	23.2	33.1	..	5.0	3.4	2.6	1.9 [13]	2.0	1.8	6.4	15.0	18.3	13.1 [13]	14.6	15.0
Italy[2]	8.6	12.6	12.0	11.9	12.0	..	3.5	5.8	5.1	6.1	5.9	..	10.9	13.0	13.4	15.1	15.0	..
Netherlands[2]	14.9	16.0	..	17.9 [13]	22.5	23.3	8.0	10.1	..	10.6 [13]	10.2	10.3	10.8	12.8 [13]	17.8 [13]	16.8	16.2	15.9
Norway	15.9	28.1 [13]	31.6	36.2 [13]	40.9	41.7	10.0	10.0 [11,13]	10.0 [11]	10.0 [11]	10.0 [11]	10.0 [11]	14.7	17.0	19.5	22.8	22.3	23.7
Poland[2]	..	..	..	6.5	6.4	5.9	..	..	..	6.5	6.8	6.7	..	..	..	16.3	19.1	19.9
Portugal[7]	1.5	1.0 [13]	0.9	2.2 [13]	2.4	..	2.3	2.3	2.2	5.7 [13]	5.9	..	2.9	6.9	7.6	12.2 [13]	15.0	..
Slovak Republic	..	..	..	8.5	13.4 [13]	9.8	..	..	..	14.8	9.8 [13]	9.4	..	..	..	16.0	16.4	16.5
Spain	2.4	6.2	7.6	6.8	7.4	9.1	2.7	3.9	5.3	5.3	6.4	7.2	9.2	11.6	13.5	17.5	18.8	20.4
Sweden	22.1	27.2 [12]	29.4 [12]	43.4 [13]	47.9	52.1	3.3	3.4 [12]	3.8 [12]	6.2 [13]	5.6	5.5	15.7	25.7	25.3	27.0 [13]	30.9	33.4
Switzerland[8]	..	25.3 [13]	24.8 [13]	..	31.5	..	2.4	1.6 [12,13]	1.4 [12]	1.4 [12,13]	1.4 [12]	1.1 [12]	..	16.9 [13]	18.4 [13]	19.5 [13]	21.6	22.5
Turkey[9]	..	0.6	0.6	1.0	1.4	..	..	0.8	0.9	0.8	1.0	..	..	4.1	4.2	5.3	6.0	..
United Kingdom	28.8	29.6 [13]	27.8	29.1 [13]	29.0	31.6	7.5	5.2 [13]	5.2 [13]	4.8 [13]	4.3	5.1	9.3	9.4	10.1	16.5 [13]	16.5	17.0
European Union[2]	16.6	21.7	22.2 [13]	23.2 [13]	24.3	25.3	5.3	6.4	7.1 [13]	7.4 [13]	7.2 [13]	7.4	10.6	13.0 [13]	14.5 [13]	17.4	18.0 [13]	..
Total OECD[2]	27.0	36.5	35.0 [13]	34.5 [13]	37.3	38.7	5.2	5.3 [13]	5.3 [13]	5.4 [13]	4.7	..	10.7	12.5 [13]	12.4 [13]	14.1 [13]	15.5	..

1. Or university graduates.
2. 1998 instead of 1999.
3. 1988 instead of 1989; 1990 instead of 1991; 1994 instead of 1995; 1996 instead of 1997; 1998 instead of 1999.
4. Adjusted by OECD up to 1995.
5. 1992 instead of 1991.
6. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
7. 1982 instead of 1981; 1988 instead of 1989; 1990 instead of 1991; 1992 instead of 1993.
8. 1992 instead of 1991; 1996 instead of 1997.
9. 1990 instead 1989.
10. Includes Mexico from 1991 and Czech Republic, Hungary, Korea, Poland and Slovak Republic from 1995.
11. Overestimated.
12. Underestimated
13. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

Table A.6.1.1. **Government-funded biotechnology R&D, 1997**
Percentages and millions of US dollars PPP

	Biotechnology R&D	Total GBAORD[1]	Biotechnology R&D over total GBAORD
	Millions of PPP dollars		%
Canada	261.4	2 581.0	10.1
Australia (1998)	196.3	2 532.5	7.8
Austria	16.8	1 146.5	1.5
Belgium	181.7	1 314.0	13.8
Czech Republic (1999)	7.8	749.1	1.0
Denmark	45.2	945.6	4.8
Finland	94.5	1 165.0	8.1
France	560.0	12 683.1	4.4
Germany	1 048.2	15 595.7	6.7
Greece	6.5	430.9	1.5
Iceland	0.9	68.5	1.3
Ireland	15.0	229.9	6.5
Italy	32.1	7 329.6	0.4
Netherlands	78.0	3 069.9	2.5
Norway[2]	26.8-32.2	880.3	3-3.7
Portugal	19.2	781.9	2.5
Spain	15.5	3 202.6	0.5
Sweden[3]	65.6	1 795.2	3.7
Switzerland[3]	16.4	1 379.7	1.2
United Kingdom	705.1	9 055.7	7.8

1. Total government budget appropriations or outlays for R&D.
2. National estimates.
3. GBAORD has been estimated.

Source: OECD, based on data from the European Commission (*Inventory of Public Biotechnology R&D Programmes in Europe, 2000*), Eurostat, Statistics Canada, and national sources, May 2001.

Table A.6.1.2. **Biotechnology[1] patent applications to the EPO[2] by priority year and by inventor's country of residence**

	Share in total EPO patent applications			Average annual growth rate
	1990	1995	1997	1990-97[3]
Canada	1.9	7.2	8.3	37.2
Mexico	5.8	7.3	1.9	..
United States	4.1	4.4	6.0	10.8
Australia	7.1	8.9	6.2	4.7
Japan	1.7	2.1	2.0	3.0
Korea	2.5	1.8	3.6	32.3
New Zealand	0.0	0.2	3.2	..
Austria	2.2	1.9	1.5	0.3
Belgium	3.6	3.9	3.9	13.3
Czech Republic	0.0	2.0	0.3	..
Denmark	6.5	9.3	9.8	15.4
Finland	2.9	2.1	1.3	0.3
France	1.4	2.3	2.2	9.7
Germany	1.2	1.4	1.6	10.8
Greece	3.8	0.0	2.1	..
Hungary	3.7	0.0	3.3	..
Iceland	8.5	0.0	0.8	..
Ireland	5.2	4.2	3.6	..
Italy	1.1	1.2	1.4	7.8
Luxembourg	0.0	0.0	0.0	..
Netherlands	3.0	3.5	4.2	11.8
Norway	0.9	2.7	2.5	..
Poland	1.7	0.0	4.1	..
Portugal	0.0	0.0	13.2	..
Slovak Republic	..	14.5	9.8	..
Spain	2.0	1.5	2.2	13.9
Sweden	1.4	1.5	1.4	11.5
Switzerland	1.7	2.0	2.3	7.7
Turkey	0.0	0.0	0.0	..
United Kingdom	2.7	4.2	5.8	15.1
European Union	1.7	2.2	2.5	11.5
Total OECD	2.4	3.0	3.5	10.4
World	2.4	3.0	3.5	10.5

1. International Patent Classification: C12M, C12N, C12P, C12Q and C12S.
2. European Patent Office.
3. For those countries with fewer than ten patent applications to the EPO, no growth rate was calculated.

Source: OECD, Patent database, May 2001.

Table A.6.2. **Environment R&D in the government budget (GBAORD[1])**

	As a percentage of civil GBAORD					Millions of current PPP dollars					Millions of constant 1995 PPP dollars					Average annual growth rates (1991-99)[2]
	1991	1993	1995	1997	1999	1991	1993	1995	1997	1999	1991	1993	1995	1997	1999	
Canada[3]	1.9	2.4	3.4	3.9	4.1	63.7	87.9	126.0	138.3	152.0	73.8	97.2	126.0	135.2	146.8	10.3
Mexico	1.1	0.3	0.6	0.8	1.0	11.8	4.3	7.4	15.8	21.0	14.0	4.6	7.4	15.6	19.4	4.1
United States	1.7	1.8	1.7	1.8	1.5	440.0	509.0	549.0	570.0	552.8	481.4	530.9	549.0	548.4	513.9	0.8
Australia[3]	3.8	3.4	3.1	2.9	2.9	59.1	63.2	66.4	65.4	68.3	66.6	68.7	66.4	65.5	67.5	0.2
Japan	0.6	0.6	0.6	0.6	0.7	55.7	65.7	82.2	103.5	141.3	64.4	71.0	82.2	101.7	134.3	9.6
Korea	..	..	..	..	..	..	..	..	..	166.7	..	..	..	..	157.3	
New Zealand	3.4	3.4	3.4	..	..	8.9	10.1	10.2	2.9	..	10.2	10.7	10.2	2.9	..	0.0
Austria	2.4	3.2	2.5	2.1	1.9	20.7	33.5	28.4	24.1	24.0	24.0	35.7	28.4	23.3	22.8	-0.6
Belgium	3.0	1.8	1.8	2.5	2.8	27.8	18.8	20.4	32.3	41.6	33.0	19.8	20.4	32.1	39.9	2.4
Denmark	3.4	4.6	4.4	2.9	3.4	22.8	30.6	34.9	27.0	35.3	26.9	33.1	34.9	26.2	32.6	2.5
Finland	2.7	3.1	2.6	2.3	2.2	20.3	25.9	24.0	26.8	27.0	23.9	28.5	24.0	27.1	26.9	1.5
France	1.1	1.9	2.8	2.8	2.1	98.5	172.9	259.3	254.6	203.5	107.2	181.8	259.3	257.8	200.6	8.2
Germany	3.8	4.1	3.9	3.9	3.8	479.3	561.7	563.0	548.1	557.8	567.1	612.9	563.0	536.0	528.1	-0.9
Greece	2.1	4.1	3.7	3.4	3.4	4.4	9.5	14.0	14.6	15.1	5.6	10.5	14.0	14.6	14.3	12.3
Iceland	1.3	2.8	3.4	4.6	3.6	0.3	1.3	2.1	3.1	3.4	0.4	1.5	2.1	3.1	3.3	13.7
Ireland	1.0	0.6	1.4	1.6	1.4	1.3	1.1	3.0	3.7	4.0	1.5	1.1	3.0	3.7	3.9	12.2
Italy[3]	3.1	2.6	2.5	2.5	3.5	207.8	166.6	160.5	178.6	251.8	231.6	179.1	160.5	175.6	237.7	0.4
Netherlands	3.9	4.8	4.1	4.0	4.1	80.9	105.4	103.3	118.0	127.8	94.7	115.7	103.3	114.7	117.6	2.7
Norway	3.8	3.5	3.0	3.1	3.2	24.9	28.1	23.0	25.9	28.7	28.6	28.8	23.0	25.1	26.9	-0.8
Portugal	3.0	2.4	4.5	4.4	4.4	12.2	13.9	27.0	33.9	43.3	14.8	15.3	27.0	32.7	40.9	13.6
Slovak Republic	..	3.3	2.0	2.0	1.4	..	7.4	3.7	4.5	3.5	..	7.8	3.7	4.4	3.3	-3.2
Spain	4.3	2.6	2.9	2.7	3.5	97.1	59.5	76.4	69.2	106.4	106.8	62.1	76.4	68.0	102.2	-0.6
Sweden	4.3	4.4	3.0	..	1.7	58.0	64.8	47.2	..	24.8	65.2	69.4	47.2	..	23.9	..
Switzerland[4]	1.1	1.2	0.9	..	..	13.9	16.7	12.2	..	..	15.7	17.6	12.4	..	..	..
United Kingdom	2.6	3.5	3.7	3.8	3.8	113.2	170.6	201.6	209.3	224.4	122.2	173.0	201.6	196.0	200.8	6.4
European Union[3]	3.0	3.5	3.4	3.4	3.5	1 346.6	1 647.9	1 757.2	1 779.5	1 876.1	1 545.4	1 769.9	1 757.2	1 749.5	1 813.4	2.3
Total OECD[3]	2.3	2.5	2.5	2.4	2.5	2 033.4	2 441.6	2 651.6	2 739.2	2 868.0	2 311.8	2 609.4	2 651.6	2 681.2	2 764.8	2.6

1. Government budget appropriations or outlays for R&D.
2. 1991-98 for Australia, Canada, Italy, EU, OECD; 1993-99 for Slovak Republic; 1991-95 for New Zealand.
3. 1998 instead of 1999.
4. Data for Switzerland refer to 1992, 1994 and 1996.

Source: OECD, MSTI database, May 2001.

Table A.6.3.1. **Health R&D in the government budget (GBAORD[1])**

	As a percercentage of GDP			Millions of current PPP dollars			Millions of constant 1995 PPP dollars			Annual average growth rate	
	1991	1995	2000	1991	1995	2000	1991	1995	2000		
Canada[2]	0.05	0.04	0.04	265.7	289.2	342.7	307.8	289.2	330.9	1991-1998	1.0
Mexico[3]	0.01	0.01	0.02	57.0	65.9	131.0	67.9	65.9	120.7	1991-1999	7.5
United States	0.16	0.16	0.19	9 445.0	11 664.0	18 417.2	10 332.7	11 664.0	16 748.3	1991-2000	5.5
Australia[2]	0.04	0.04	0.04	113.1	159.0	189.5	127.3	159.0	187.3	1991-1998	5.7
Japan	0.01	0.01	0.03	290.8	416.7	833.3	336.6	416.7	766.4	1991-2000	9.6
Korea[3]	..	..	0.03	..	..	251.6	..	..	237.4	-	..
New Zealand[4]	0.03	0.03	0.03	13.2	18.2	23.0	15.1	18.2	22.6	1991-1997	6.9
Austria	0.02	0.02	0.01	21.5	28.9	30.1	25.0	28.9	27.7	1991-2000	1.2
Belgium[3]	0.01	0.01	0.01	19.0	31.2	20.3	22.5	31.2	19.5	1991-1999	-1.8
Denmark	0.01	0.01	0.01	12.7	13.1	20.5	14.9	13.1	18.6	1991-2000	2.4
Finland	0.04	0.03	0.07	28.7	33.3	86.1	33.9	33.3	83.2	1991-2000	10.5
France[3]	0.05	0.06	0.05	495.6	665.6	702.4	539.1	665.6	692.6	1991-1999	3.2
Germany	0.03	0.03	0.03	453.0	505.0	554.3	536.0	505.0	515.6	1991-2000	-0.4
Greece[3]	0.01	0.02	0.01	14.6	20.6	22.2	18.6	20.6	21.0	1991-1999	1.6
Iceland	0.03	0.04	0.04	1.3	2.4	3.0	1.7	2.4	2.9	1991-2000	6.3
Ireland[3]	0.01	0.01	0.01	5.3	4.7	8.0	6.3	4.7	7.8	1991-1999	2.8
Italy[2]	0.05	0.05	0.03	443.3	584.1	410.9	494.1	584.1	387.9	1991-1998	-3.4
Netherlands[3]	0.03	0.02	0.03	73.3	50.9	120.3	85.8	50.9	110.8	1991-1999	3.2
Norway	0.05	0.06	0.05	43.2	56.0	63.8	49.7	56.0	65.5	1991-2000	3.1
Portugal	0.02	0.02	0.03	16.7	30.5	59.7	20.2	30.5	54.9	1991-2000	11.7
Slovak Republic	..	0.03	0.02	..	13.5	12.3	..	13.5	11.3	-	..
Spain[3]	0.03	0.03	0.03	153.5	170.6	207.4	168.8	170.6	199.1	1991-1999	2.1
Sweden	0.01	0.02	0.01	11.3	30.2	21.9	12.6	30.2	20.3	1991-2000	5.4
Switzerland[5]	0.01	0.01	0.00	9.2	9.7	5.1	10.5	9.9	5.0	1992-1998	-11.8
United Kingdom[3]	0.05	0.11	0.10	469.7	1 166.1	1 426.2	507.3	1 166.1	1 275.9	1991-1999	12.2
European Union[2]	0.04	0.05	0.05	2 261.4	3 500.2	3 705.9	2 536.0	3 500.2	3 538.7	1991-1998	4.9
Total OECD[2]	0.08	0.08	0.08	12 513.1	16 209.5	19 312.6	13 801.7	16 209.5	18 396.8	1991-1998	4.2

1. Government budget appropriations or outlays for R&D.
2. 1998 instead of 2000.
3. 1999 instead of 2000.
4. 1997 instead of 2000.
5. 1992, 1996 and 1999 instead of 1991, 1995 and 2000.

Source: OECD, MSTI database, May 2001.

Table A.6.3.2. **R&D expenditure of the pharmaceutical industry, 1999**

	Pharmaceuticals R&D expenditure as a % of GDP					Pharmaceuticals R&D expenditure as a % of business enterprise sector R&D				
	1991	1993	1995	1997	1999	1991	1993	1995	1997	1999
Canada	0.0	0.0	0.1	0.1	0.1	4.8	5.5	5.5	5.8	6.3
United States	0.1	0.1	0.1	0.1	0.1	6.0	7.8	7.7	7.6	6.7
Australia[1]	0.0	0.0	0.0	0.0	0.0	5.0	5.1	5.7	5.8	6.5
Japan	0.1	0.1	0.1	0.1	0.1	6.1	6.9	6.8	6.0	6.5
Korea	..	..	0.0	0.0	0.0	..	..	1.4	1.4	2.0
Belgium	..	0.1	0.2	0.2	0.2	..	12.1	13.6	17.6	17.4
Czech Republic	..	0.0	0.0	0.0	0.0	..	1.0	1.9	1.4	2.1
Denmark[1]	0.2	0.2	0.2	0.2	0.2	17.8	16.7	20.0	19.9	20.2
Finland	0.1	0.1	0.1	0.1	0.1	4.9	5.6	5.1	3.5	4.1
France[1]	0.1	0.2	0.2	0.2	0.2	7.7	10.8	12.0	12.6	12.7
Germany	0.1	0.1	0.1	0.1	0.1	5.6	5.4	4.6	6.5	6.4
Ireland	0.1	0.1	0.1	0.1		11.0	17.1	13.8	14.4	..
Italy	0.1	0.1	0.1	0.0	0.0	10.8	10.4	9.6	8.3	8.9
Netherlands[1]	0.1	0.1	0.1	0.1	0.1	7.7	8.2	6.8	8.3	8.8
Norway[1]	0.1	0.1	0.1	0.0	0.0	7.0	7.1	6.3	4.6	4.4
Poland	..	..	0.0	0.0	0.0	..	..	4.8	4.5	4.8
Spain	0.0	0.0	0.0	0.0	0.0	8.8	10.5	11.0	11.2	9.5
Sweden	0.3	0.3	0.4	0.4	0.5	13.1	13.0	14.3	15.2	16.5
United Kingdom	0.2	0.3	0.3	0.3	0.3	14.7	18.5	19.6	22.2	22.4

	Pharmaceuticals R&D expenditure in millions of current PPP dollars					Pharmaceuticals R&D expenditure in millions of constant 1995 PPP dollars				
	1991	1993	1995	1997	1999	1991	1993	1995	1997	1999
Canada	200.5	278.9	372.5	422.3	502.6	232.2	308.5	372.5	412.9	480.2
United States	7 060.8	9 146.0	10 215.0	11 898.7	12 304.5	7 724.4	9 538.8	10 215.0	11 447.8	11 439.6
Australia[1]	86.6	118.3	191.8	186.2	197.8	97.4	128.5	191.8	186.4	195.5
Japan	3 056.6	3 413.8	3 778.9	3 897.5	4 344.3	3 537.7	3 685.1	3 778.9	3 830.4	4 127.9
Korea	..	..	157.4	190.5	260.8	..	..	157.4	185.3	246.1
Belgium	..	296.2	369.6	550.5	624.6	..	311.7	369.6	547.5	599.5
Czech Republic	..	9.6	16.3	14.0	23.3	..	10.5	16.3	13.8	21.9
Denmark[1]	159.7	174.4	253.3	310.5	328.0	188.1	188.4	253.3	301.0	313.2
Finland	45.5	57.2	70.9	66.8	104.9	53.6	63.1	70.9	67.6	104.4
France[1]	1 178.8	1 758.8	2 026.4	2 126.7	2 201.3	1 282.1	1 849.9	2 026.4	2 153.6	2 203.4
Germany	1 377.6	1 327.7	1 213.0	1 843.9	2 100.9	1 630.1	1 448.7	1 213.0	1 803.1	1 988.8
Ireland	29.1	71.0	86.1	113.9	..	34.7	76.8	86.1	113.4	..
Italy	725.7	640.3	588.9	527.2	663.7	808.8	688.5	588.9	518.2	610.1
Netherlands[1]	194.1	220.2	231.0	333.2	359.9	227.2	241.6	231.0	324.0	338.3
Norway[1]	50.2	60.4	55.5	45.7	45.4	57.8	61.7	55.5	44.4	43.9
Poland	..	..	35.2	35.6	49.4	..	..	35.2	38.7	49.5
Spain	214.3	239.2	256.9	290.7	315.1	235.7	249.8	256.9	285.5	302.5
Sweden	376.9	452.3	645.0	780.4	960.1	423.5	484.5	645.0	761.1	922.9
United Kingdom	1 887.4	2 634.3	2 772.5	3 306.0	3 870.1	2 038.3	2 672.3	2 772.5	3 095.5	3 462.2

1. 1998 instead of 1999.

Source: OECD, ANBERD database, May 2001.

Table A.6.4.1. **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						
	1981	1985	1989	1991	1995	1997	1999	1981	1985	1989	1991	1995	1997	1999
Mexico[2]	..	..	..	27.7	35.8	..	..	..	..	..	0.1	0.1	..	..
United States[3]	13.3	12.5	15.0	16.6	15.7	15.5	15.2	0.3	0.3	0.4	0.4	0.4	0.4	0.4
Australia[4]	34.7	27.7	28.0	28.4	25.7	26.9	..	0.3	0.3	0.4	0.4	0.4	0.4	..
Japan	12.1	11.6	12.3 [12]	12.3	14.2	12.0 [12]	12.3	0.3	0.3	0.4 [12]	0.4	0.4	0.3 [12]	0.4
Korea[3]	..	..	..	..	12.5	13.3	14.0	..	..	..	..	0.3	0.4	0.4
Austria	..	21.1	21.7	21.3	..	..	..	..	0.2	0.3	0.3	..	..	..
Czech Republic	..	..	..	..	17.0	18.0	20.5	..	..	..	..	0.2	0.2	0.3
France[5]	..	19.9	20.3	20.3	22.2	22.0	25.1	..	0.4	0.5	0.5	0.5	0.5	0.5
Germany[6]	21.9	19.1	19.6 [12]	20.9 [12]	..	..	..	0.5	0.5	0.5 [12]	0.5 [12]	..	..	..
Hungary[7]	..	..	..	25.0	27.9 [12]	27.6	..	..	..	..	0.2	0.2 [12]	0.2	..
Iceland	28.4	20.7 [12]	23.5 [12]	24.9	24.4	21.4	17.8	0.2	0.1 [12]	0.2 [12]	0.3	0.4	0.4	0.4
Ireland	12.0	14.4	11.2	10.5	..	..	..	0.1	0.1	0.1	0.1	..	..	..
Italy	15.5	16.4	18.3 [12]	20.3 [12]	22.1	23.9	23.7	0.1	0.1	0.2 [12]	0.2 [12]	0.2	0.2	0.2
Netherlands[8]	27.3	14.5 [12]	15.1	14.0 [12]	9.6	..	..	0.5 [12]	0.3 [12]	0.3	0.3 [12]	0.2	..	..
Norway	17.5	13.7	15.1	14.8	16.1	16.3	16.6	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Poland	..	..	..	..	38.4	35.5	36.2	..	..	..	..	0.2	0.2	0.2
Portugal[9]	17.3	18.8	20.6	23.8	24.9	27.8	..	0.1	0.1	0.1	0.1	0.1	0.2	..
Slovak Republic	..	..	..	..	24.3	19.5	28.8	..	..	..	..	0.2	0.2	0.2
Spain	18.2	19.3	18.7	18.3	25.3 [12]	22.8	22.0	0.1	0.1	0.1	0.1	0.2 [12]	0.2	0.2
Sweden	24.6	22.8	23.0	20.0	..	..	..	0.5 [12]	0.6	0.6	0.5	..	..	..
Switzerland[10]	..	..	..	..	27.9	..	..	..	..	..	..	0.8	..	..

1. No corresponding data are available during the 1990s for Belgium, Canada, Denmark, Finland, Greece, New Zealand, Turkey and United Kingdom.
2. 1993 instead of 1991.
3. 1998 instead of 1999.
4. 1986 instead of 1985; 1990 instead of 1989; 1992 instead of 1991; 1996 instead of 1995; 1998 instead of 1997.
5. 1986 instead of 1985; 1998 instead of 1999.
6. Figures for Germany from 1991 onwards refer to unified Germany.
7. 1992 instead of 1991.
8. 1983 instead of 1981.
9. 1982 instead of 1981; 1986 instead of 1985; 1990 instead of 1989; 1992 instead of 1991.
11. 1996 instead of 1995.
12. Break in series from previous year for which data are available.

Source: OECD, R&D database, May 2001.

Table A.6.4.2. **Basic research by main sectors of performance**

As a percentage of GDP

	Business enterprise				Government				Higher education				Private non-profit			
	1993	1995	1997	1999	1993	1995	1997	1999	1993	1995	1997	1999	1993	1995	1997	1999
Mexico	0.00	0.00	..	..	0.02	0.04	..	..	0.03	0.05	..	..	0.00	0.00	..	..
United States[1]	0.11	0.08	0.10	0.10	0.04	0.04	0.03	0.03	0.25	0.24	0.23	0.23	0.03	0.03	0.03	0.03
Australia[2]	0.04	0.05	0.04	0.02	0.12	0.12	0.11	0.10	0.25	0.23	0.26	0.26	0.02	0.02	0.02	0.02
Japan	0.13 [7]	0.13 [7]	0.13	0.12	0.05	0.06	0.05	0.07	0.19 [7]	0.21 [7]	0.14 [8]	0.16	0.02	0.02	0.02	0.02
Korea[1,3]	..	0.15	0.16	0.12	..	0.07	0.09	0.13	..	0.11	0.11	0.11	..	0.01	0.01	0.00
Austria	0.04	..	..	..	0.03	..	..	..	0.25	..	..	..	0.00	..	..	..
Czech Republic	..	0.01	0.01	0.01	..	0.13	0.15	0.16	..	0.04	0.05	0.09	..	..	0.00	0.00
France[1]	0.06	0.06	0.06	0.06	0.11	0.11	0.08	0.14	0.33	0.33	0.33	0.33	0.01	0.01	0.01	0.01
Germany[4]	0.07	0.07	0.07	..	0.10	..	..	..	0.27	..	..	..	..	..	..	..
Hungary	0.01	0.01	0.01	..	0.12	0.10	0.09	..	0.08	0.07	0.07	..	..	..	..	..
Iceland[5]	0.00	..	..	0.00	0.11	0.12	0.12	0.16	0.19	0.23	0.26	0.23	0.03	0.02	0.01	0.02
Ireland	0.04	..	..	..	0.00	..	..	..	0.07	..	..	..	0.00	..	..	..
Italy[1,5]	0.02	0.02	0.01	0.02	0.09	0.08	0.08	0.09	0.14	0.13	0.14	0.14	..	..	..	..
Netherlands	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Norway	0.01	0.02 [8]	0.02	0.02	0.04	0.04	0.04	0.03	0.20	0.19	0.18	0.20	..	..	..	..
Poland	..	0.01 [7]	0.01 [7]	0.01		0.11 [7]	0.10 [7]	0.11	..	0.10 [7]	0.09 [7]	0.10	..	..	..	0.00
Portugal[5]	0.00	0.00	0.01	..	0.01	0.01	0.02	..	0.11	0.10	0.12	..	0.02	0.03	0.03	..
Slovak Republic	..	0.03	0.03 [8]	0.03	..	0.13	0.10 [8]	0.09	..	0.05	0.06	0.05	..	..	..	..
Spain	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.11	0.11	0.10	0.10	0.00	0.00	0.00	0.00
Sweden	..	..	..	..	0.01	0.08	0.08	0.08	..	..	..	..	..	..	..	..
Switzerland[6]	0.17	0.19	..	..	0.00	0.00	0.00	0.00	..	0.57	0.53	0.53	0.00	..	..	..

1. 1998 instead of 1999.
2. 1992 instead of 1993; 1994 instead of 1995; 1996 instead of 1997; 1998 instead of 1999.
3. 1996 instead of 1995.
4. Figures for Germany and zone totals from 1991 onwards refer to unified Germany.
5. 1992 instead of 1993.
6. 1992 instead of 1993; 1996 instead of 1995.
7. Overestimated.
8. Break in series from previous year for which data are available.

Source: OECD, R&D database, May 2001.

Table A.6.5. **Government budget appropriations or outlays for R&D (GBAORD) for defence**

	Defence as a percentage of total R&D budget					Defence as a percentage of GDP					Variation of defence budget as a percentage of GDP	
	1991	1995	1997	1998	1999	1991	1995	1997	1998	1999	Average annual growth rate	
Canada	5.1	4.7	5.6	5.6	..	0.03	0.03	0.03	0.03	..	1991-98	0.00
Mexico	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
United States	59.7	54.1	55.3	54.1	53.2	0.66	0.51	0.48	0.46	0.45	1991-99	-0.21
Australia	10.3	9.0	7.4	7.2	..	0.06	0.05	0.04	0.04	..	1991-98	-0.02
Japan	5.7	6.2	5.8	4.8	4.6	0.03	0.03	0.03	0.03	0.03	1991-99	0.00
Korea	..	..	..	..	22.4	..	..	..	..	0.15	-	..
New Zealand	1.5	1.2	0.7	..	..	0.01	0.01	0.00	..	..	1991-97	-0.01
Austria	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
Belgium	0.2	0.4	0.5	0.5	0.6	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
Denmark	0.6	0.6 [4]	0.6	0.6	0.6	0.00	0.00 [4]	0.00	0.00	0.00	1993-99	0.00
Finland	1.4 [4]	2.1 [4]	1.5 [4]	1.4	1.4	0.01 [4]	0.02 [4]	0.02	0.01	0.01	1995-99	-0.01
France	36.1	30.0 [4]	25.2 [4]	23.2	22.7	0.49	0.33 [4]	0.25 [4]	0.23	0.22	1992-99	-0.20 [5]
Germany	11.0 [4]	9.1	9.6	8.8	8.4	0.11 [4]	0.08	0.08	0.07	0.07	1991-99	-0.04
Greece	1.4	1.3	1.2	1.3	1.4	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
Iceland	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
Ireland	0.0	0.0	0.0	0.0	..	0.00	0.00	0.00	0.00	0.00	1991-99	0.00
Italy	7.9	4.7	4.4	2.6	..	0.06	0.03	0.03	0.02	..	1991-98	-0.04
Netherlands	3.5 [4]	3.3	3.1	3.4	3.1	0.03 [4]	0.03	0.03	0.03	0.02	1991-99	-0.01
Norway	6.2	5.7	5.6	5.5	5.3	0.05	0.05	0.04	0.04	0.04	1991-99	-0.01
Portugal	0.7	2.6	1.4	1.3	2.0	0.00	0.01	0.01	0.01	0.01	1991-99	0.01
Slovak Republic[1]	..	3.3	..	..	..	..	0.01	..	..	..	-	..
Spain	16.8	10.4	19.6 [4]	28.9	26.2	0.09	0.05	0.10	0.16	0.15	1991-99	0.06
Sweden[2]	27.3	20.9 [4]	20.9	7.3 [4]	7.4	0.33	0.24 [4]	0.23	0.06 [4]	0.06	1993-99	-0.23
Switzerland[1,2,3]	4.6	2.9	1.9	1.9	..	0.04	0.02	0.02	0.01	..	1992-98	-0.03
United Kingdom	43.9	36.5	39.2	36.8	38.0	0.38	0.29	0.29	0.25	0.26	1991-99	-0.12
European Union	20.9 [4]	16.1 [4]	15.3	14.5	..	0.20 [4]	0.13 [4]	0.12	0.11	..	1991-98	-0.09
Total OECD	37.1 [4]	31.3 [4]	31.1	30.3	..	0.32 [4]	0.23 [4]	0.22	0.21	..	1991-98	-0.11

1. 1994 instead of 1995.
2. 1996 instead of 1997.
3. 1992 instead of 1991.
4. Break in series from previous year for which data are available.
5. OECD estimate.

Source: OECD, MSTI database, May 2001.

Table A.8.1. **Human resources**

	Distribution of the population aged 25-64 by level of educational attainment, 1999				Expenditure per student on public and private institutions, 1998 (PPP dollars)
	Below upper secondary education	Upper secondary education	Non-university tertiary education	University level education[1]	All tertiary level[2]
Canada	21	28	33	19	14 579.2
Mexico	80	7	1	12	3 799.9
United States	13	51	8	27	18 493.1
Australia	43	31	9	18	11 539.1
Japan	19	49	13	18	9 870.6
Korea	34	44	6	17	6 919.5
New Zealand	26	39	21	13	..
Austria[3] (1998)	26	57	11	6	11 278.8
Belgium[4]	43	31	14	12	7 784.3
Czech Republic	14	75	..	11	5 397.1
Denmark	20	53	20	7	9 562.0
Finland	28	40	17	14	7 327.0
France	38	40	10	11	7 004.8
Germany[5]	19	53	15	13	9 466.0
Greece[4]	50	27	11	12	4 156.9
Hungary	33	33	20	14	5 047.7
Iceland	37	30	15	18	..
Ireland (1998)	49	30	10	11	8 521.7
Italy[3]	56	30	4	9	6 294.9
Luxembourg	38	44	7	12	..
Netherlands	35	42	2	20	10 756.5
Norway[3] (1998)	15	56	3	25	10 917.7
Poland (1998)	22	64	3	11	4 223.7
Portugal	79	11	3	7	..
Spain	65	14	6	15	5 037.8
Sweden	23	48	16	13	13 223.5
Switzerland[3]	18	58	9	15	16 563.3
Turkey[3,5]	78	14	..	8	2 397.0
United Kingdom[4]	18	57	8	17	9 421.9
European Union[6]	39	39	10	12	..
Total OECD[6]	36	40	11	14	11 463.6

1. Tertiary type A and advanced research programmes (ISCED 5A and 6).
2. Data refer to total tertiary education (ISCED 5A, 5B and 6).
3. Expenditure per student include public institutions only.
4. Expenditure per student include public and government-dependent private institutions only.
5. Expenditure per student data refer to 1997.
6. Average of the available countries.

Source: OECD, Education database, May 2001.

Table A.9.2.1. **Researchers[1] per 10 000 labour force**

	1981	1985	1990	1995	1997	1998	1999
Canada	32	40	46	60	61	58	58
Mexico	..	..	..	6	..	..	..
United States	62	68 [12]	..	74	81 [12]	..	..
Australia[2]	35	41	51	65	67	67	..
Japan[3]	54	64	75	83	92 [12]	96	97
Korea	..	..	..	48	47	43	46
New Zealand	..	..	30	34 [12]	44	..	..
Austria[4]	21	23	25	34	..	..	..
Belgium[5]	31	36	43 [12]	54 [12]	54	..	..
Czech Republic	..	..	..	23 [12]	24	24	26
Denmark	25	31	40	57	61	..	..
Finland[6]	37	..	55	67	84	94	99
France	36	42	50	60	60 [12]	61	..
Germany[7]	44	51	61 [12]	59 [12]	59	60	60
Greece[5]	..	..	16	23	26	..	..
Hungary	..	..	..	26	28 [12]	29	31
Iceland	31	38	53	72 [12]	91	93	..
Ireland	16	21	35	40	51	..	..
Italy	23	27	32	33 [12]	33	..	..
Netherlands	34	42	..	46 [12]	50	50	..
Norway[5]	38	47	63	73 [12]	76	..	78
Poland	..	..	..	29	32	33	..
Portugal[8]	7	10	12 [12]	24 [12]	27	..	..
Slovak Republic	..	..	..	39 [12]	40	40	36
Spain	14	15	25	30	33	37	37
Sweden[5]	41	49	59 [12]	77 [12]	84	..	91
Switzerland[9]	..	43 [12]	44 [12]	55 [12]	..	..	..
Turkey	..	..	5	7	8	..	..
United Kingdom	47	48	46	51 [12]	51	55	..
European Union[10]	33	37	42 [12]	49 [12]	50 [12]	52	..
Total OECD[11]	44	50 [12]	56 [12]	55 [12]	59	61	..

1. Or university graduates.
2. 1994 instead of 1995; 1996 instead of 1997.
3. Adjusted by OECD up to 1995.
4. 1989 instead of 1990; 1993 instead of 1995.
5. 1991 instead of 1990.
6. 1983 instead of1981; 1991 instead of 1990.
7. Figures for Germany from 1991 onwards refer to unified Germany.
8. 1982 instead of 1981; 1986 instead of 1985.
9. 1986 instead of 1985; 1989 instead 1989; 1996 instead of 1995.
10. 1989 instead of 1990.
11. Includes Mexico from 1991, and Czech Republic, Hungary, Korea, Poland and Czech Republic from 1995.
12. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

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]					
	1981	1985	1989	1995	1997	1999	1981	1985	1989	1995	1997	1998
Canada	2.3	2.3	2.3 [7]	2.6	2.5	2.5	2.5	2.8	2.9	3.2	3.1	2.9
Mexico	..	..	..	0.4	0.5	0.6	..	..	..	0.7	..	..
United States	44.6	45.9	43.4	41.6 [7]	42.3	43.6	43.3	43.0 [7]	42.2	35.7	36.7	..
Australia	0.9	1.0	1.1	1.5	1.3	..	1.5	1.6	1.9	2.1	..	2.0
Japan[3]	15.1	16.2	17.9	17.8	18.3 [7]	17.3	19.7	20.4	20.9	19.9	20.6 [7]	20.7
Korea	..	..	2.2	3.5	3.8	3.4	..	..	..	3.6	3.4	2.9
New Zealand	0.2	..	0.1	0.1 [7]	0.2	..	..	..	0.2	0.2 [7]	0.3	..
Austria	0.5	0.5	0.5	0.6	0.6	0.7	0.4	0.4	0.4	0.5	..	..
Belgium	..	0.9 [7]	0.8 [7]	0.9 [7]	0.9	..	0.8	0.8	0.8 [7]	0.8 [7]	0.8	..
Czech Republic	..	..	0.6	0.3 [7]	0.3	0.3	..	..	..	0.4 [7]	0.4	0.4
Denmark	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.5	0.5	0.6	0.6	..
Finland	0.3	0.4	0.5	0.5 [7]	0.6	0.7	0.5	..	0.6	0.6	0.7	0.8
France	6.7	6.4	6.5	6.3	5.7 [7]	5.5	5.4	5.5	5.5	5.5	5.1 [7]	5.0
Germany[4]	10.9	9.9	10.0	8.9 [7]	8.5	8.7	7.9	7.7	8.1 [7]	8.3	7.8	7.5
Greece	0.1	0.1	0.1 [7]	0.1	0.1	..	..	..	0.2 [7]	0.4	0.4	..
Hungary	..	..	0.4	0.2	0.1	0.1	..	..	..	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	0.0
Ireland	0.1	0.1	0.1	0.2	0.2	..	0.1	0.2	0.2	0.2	0.3	..
Italy	2.9	3.1	3.4	2.6 [7]	2.4	2.5	3.3	3.4	3.5	2.7	2.5	..
Netherlands	1.6	1.5 [7]	1.5	1.5 [7]	1.5	1.4	1.2	1.3 [7]	1.2	1.2 [7]	1.3	1.2
Norway	0.4	0.4 [7]	0.4	0.4 [7]	0.4	0.4	0.5	0.5	0.6	0.6 [7]	0.6	..
Poland	..	..	..	0.4	0.5	0.5	..	..	..	1.8	1.8	1.8
Portugal	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3 [7]	0.4 [7]	0.4	..
Slovak Republic	..	..	..	0.1 [7]	0.1	0.1	..	..	..	0.4	0.3	0.3
Spain	0.7	0.7	1.0	1.1 [7]	1.1	1.2	1.2	1.1	1.5	1.7	1.8	1.9
Sweden	1.2	1.3	1.2	1.4 [7]	1.4	1.4	1.1	1.2	1.2	1.2 [7]	1.2	..
Switzerland	1.3	1.3 [7]	1.3 [7]	1.1	..	..	..	0.8 [7]	0.7 [7]	0.7 [7]	..	..
Turkey	..	..	0.2	0.3	0.4	..	..	..	0.5	0.6	0.6	..
United Kingdom	7.0	5.7 [7]	5.5	4.9	4.4	4.4	8.0	7.0	6.1	5.3 [7]	4.8	5.0
European Union	35.0	32.5	33.2	29.7 [7]	28.1	28.4	30.9	30.0	30.0	29.6 [7]	28.2 [7]	28.3
Total OECD[5,6]	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. Adjusted by OECD up to 1995.
4. Figures for Germany from 1991 onwards refer to unified Germany.
5. Includes Mexico from 1991, and Czech Republic, Hungary, Poland and Slovak Republic from 1995.
6. Korea included in expenditures from 1991 and in researchers from 1995.
7. Break in series from previous year for which data are available.

Source: OECD, MSTI database, May 2001.

Table A.11.1. **Innovation expenditure and output**

	Expenditure on innovation as a share of total sales, 1996		Share of firms that introduced new or technologically improved products or processes on the market, 1994-96			
	Manufacturing sector (%)	Services sector (%)	Manufacturing sector (%)		Services sector (%)	
			All firms	Firms with 20-49 employees	All firms	Firms with 10-49 employees
Canada	..	..	67.4	..	46.4	..
Mexico[1]	1.7	..	45.8	25.0	..	..
Australia[1]	1.9	..	59.9	52.6	..	..
Austria	3.5	3.0	66.2	59.3	54.5	48.5
Belgium	2.1	1.2	37.4	32.5	44.1	16.8
Denmark	4.8	4.7	70.4	63.5	..	..
Finland	4.3	2.4	54.2	26.1	42.8	29.4
France	3.9	1.2	50.7	34.1	40.5	25.7
Germany	4.1	3.0	78.9	62.5	76.0	42.3
Iceland[2]	2.2	4.8				
Ireland	3.3	2.1	73.4	68.4	70.8	61.9
Italy	2.6	..	42.7	44.0	..	..
Luxembourg	..	..	76.7	21.0	62.9	45.0
Netherlands	3.8	1.6	75.4	53.7	55.7	31.2
Norway[3]	2.7	3.5	53.4	39.2	33.0	22.9
Poland[4]	4.3	1.6	41.5	16.5	..	..
Portugal[3]	1.7	1.1	25.4	21.6	33.1	30.7
Spain	1.8	..	34.8	21.1	..	..
Sweden	7.0	3.8	60.9	42.9	41.5	28.2
Switzerland[5]	6.3	1.7	73.4	65.1	62.2	62.9
Turkey[6]	..	..	33.3	20.0	..	..
United Kingdom	3.2	4.0	60.1	54.4	44.5	46.7
European Union	3.7	2.8	..	..	..	..

1. Data on innovation expenditures refer to 1997.
2. Data on innovation expenditures refer to 1998.
3. 1997 and 1995-97.
4. Data on innovation expenditures refer to 1998 for manufacturing and 1999 for services.
5. Data on innovation expenditures refer to 1995.
6. 1995-97.

Source: Eurostat; OECD, STI/EAS Division, May 2001.

Table A.12.1. **EPO[1] patent applications by priority year and by inventor's country of residence**

	1990	1995	1997	Average annual growth rate 1990-97	Share in total EPO patent applications			Number of EPO patent applications per million population		
					1990	1995	1997	1990	1995	1997
Canada	552	783	1 153	11.1	0.90	1.15	1.36	19.92	26.68	38.45
Mexico	14	23	40	15.6	0.02	0.03	0.05	0.18	0.26	0.42
United States	17 396	20 579	24 129	4.8	28.44	30.31	28.54	69.59	78.23	90.00
Australia	361	480	571	6.8	0.59	0.71	0.68	21.14	26.56	30.81
Japan	12 976	11 801	13 974	1.1	21.21	17.38	16.53	105.03	93.98	110.76
Korea	118	450	597	26.1	0.19	0.66	0.71	2.75	9.99	12.98
New Zealand	23	61	92	22.0	0.04	0.09	0.11	6.77	16.65	24.40
Austria	656	671	952	5.5	1.07	0.99	1.13	85.00	83.40	117.93
Belgium	514	795	1 120	11.8	0.84	1.17	1.33	51.59	78.41	110.04
Czech Republic	22	19	42	10.0	0.04	0.03	0.05	2.08	1.82	4.07
Denmark	327	477	590	8.8	0.53	0.70	0.70	63.63	91.32	111.78
Finland	431	694	990	12.6	0.70	1.02	1.17	86.42	135.84	192.69
France	4 922	5 083	6 142	3.2	8.05	7.49	7.27	84.64	85.55	102.67
Germany	11 498	12 952	17 222	5.9	18.79	19.07	20.37	181.77	158.60	209.89
Greece	26	27	49	9.1	0.04	0.04	0.06	2.61	2.58	4.63
Hungary	69	53	70	0.3	0.11	0.08	0.08	6.64	5.14	6.94
Iceland	8	10	16	10.3	0.01	0.01	0.02	30.85	38.08	57.52
Ireland	68	95	127	9.4	0.11	0.14	0.15	19.31	26.32	34.64
Italy	2 246	2 459	3 118	4.8	3.67	3.62	3.69	39.60	42.92	54.22
Luxembourg	41	33	53	3.6	0.07	0.05	0.06	107.42	79.56	124.95
Netherlands	1 522	1 714	2 367	6.5	2.49	2.52	2.80	101.84	110.85	151.67
Norway	128	232	307	13.4	0.21	0.34	0.36	30.09	53.30	69.74
Poland	20	13	28	5.5	0.03	0.02	0.03	0.51	0.35	0.74
Portugal	8	14	23	16.6	0.01	0.02	0.03	0.78	1.41	2.29
Slovak Republic	0	7	13	..	0.00	0.01	0.02	0.00	1.29	2.36
Spain	258	386	578	12.2	0.42	0.57	0.68	6.63	9.85	14.69
Sweden	934	1 501	2 003	11.5	1.53	2.21	2.37	109.06	170.03	226.45
Switzerland	1 688	1 664	2 088	3.1	2.76	2.45	2.47	251.44	236.31	294.50
Turkey	4	5	15	21.8	0.01	0.01	0.02	0.07	0.08	0.23
United Kingdom	3 565	3 720	4 378	3.0	5.83	5.48	5.18	61.94	63.48	74.19
European Union	27 016	30 620	39 712	5.7	44.16	45.09	46.98	77.23	82.01	105.79
Total OECD	60 393	66 801	82 846	4.6	98.72	98.38	98.01	71.99	61.76	75.56
World	61 177	67 902	84 530	4.7	100.00	100.00	100.00	..	..	..

Note: The patent data presented here refer to patent applications to the European Patent Office (EPO) by inventor's country of residence and priority date, using a fractional counting procedure.

1. European Patent Office.

Source: OECD, Patent database, May 2001.

Table A.12.2. "**Triadic**"[1] **patent families by priority year and by inventor's country of residence**

	Number of "triadic" patent families			Share in total "triadic" patent families			Number of patents in "triadic" patent families per million population		
	1989	1993	1995	1989	1993	1995	1989	1993	1995
Canada	314	315	345	0.95	1.02	1.08	11.50	10.98	11.75
Mexico	5	6	11	0.02	0.02	0.03	0.06	0.07	0.12
United States	10 743	10 971	11 162	32.62	35.61	34.81	43.43	42.51	42.43
Australia	113	178	148	0.34	0.58	0.46	6.69	10.07	8.21
Japan	9 968	8 031	8 601	30.27	26.07	26.83	80.96	64.42	68.50
Korea	32	169	313	0.10	0.55	0.98	0.76	3.82	6.94
New Zealand	13	12	13	0.04	0.04	0.04	4.05	3.48	3.61
Austria	188	163	194	0.57	0.53	0.60	24.69	20.37	24.06
Belgium	232	326	319	0.71	1.06	0.99	23.38	32.31	31.45
Czech Republic	11	8	3	0.03	0.03	0.01	1.03	0.81	0.26
Denmark	117	167	160	0.35	0.54	0.50	22.76	32.13	30.67
Finland	121	256	253	0.37	0.83	0.79	24.46	50.55	49.63
France	1 917	1 702	1 775	5.82	5.52	5.54	33.15	28.85	29.88
Germany	4 393	3 968	4 267	13.34	12.88	13.31	70.78	48.88	52.25
Greece	3	2	1	0.01	0.00	0.00	0.31	0.14	0.13
Hungary	43	24	15	0.13	0.08	0.05	4.18	2.32	1.44
Iceland	1	2	6	0.00	0.01	0.02	4.74	7.89	21.54
Ireland	24	18	20	0.07	0.06	0.06	6.91	4.98	5.43
Italy	647	615	557	1.96	2.00	1.74	11.41	10.78	9.72
Luxembourg	5	12	11	0.02	0.04	0.03	14.01	31.15	26.84
Netherlands	823	649	719	2.50	2.11	2.24	55.45	42.42	46.53
Norway	76	68	79	0.23	0.22	0.25	17.91	15.87	18.18
Poland	3	11	3	0.01	0.04	0.01	0.08	0.29	0.07
Portugal	0	4	2	0.00	0.01	0.01	0.02	0.40	0.20
Slovak Republic	0	2	2	0.00	0.01	0.01	..	0.37	0.37
Spain	66	71	86	0.20	0.23	0.27	1.71	1.82	2.20
Sweden	445	541	649	1.35	1.76	2.03	52.39	62.10	73.56
Switzerland	821	720	693	2.49	2.34	2.16	123.45	103.79	98.38
Turkey	2	2	1	0.01	0.01	0.00	0.03	0.03	0.02
United Kingdom	1 555	1 447	1 303	4.72	4.70	4.06	27.10	24.87	22.23
European Union	10 537	9 941	10 316	32.00	32.26	32.17	30.31	26.79	27.63
Total OECD	32 682	30 461	31 711	99.24	98.87	98.90	39.30	31.65	29.32
World	32 932	30 810	32 064	100.00	100.00	100.00	..	..	..

Note: The patent data presented here refer to "triadic" patent families by inventor's country of residence and priority date, using a fractional counting procedure.

1. European Patent Office (EPO), US Patent and Trademark Office (USPTO) and the Japanese Patent Office (JPO).

Source: OECD, Patent database, May 2001.

Table B.4.1. **Telecommunication channels per 100 inhabitants in the OECD area**

	1990	1995	1996	1997	1998	1999	Telecom. access paths -- fixed and wireless -- per 100 inhabitants[1] 1999
Canada	55.2	59.8	60.8	62.2	63.8	65.5	88.1
Mexico	6.4	9.8	9.6	9.9	10.4	11.2	19.1
United States	54.6	60.2	62.4	64.9	66.8	69.8	101.4
Australia	45.6	52.2	53.0	54.3	56.5	60.7	100.2
Japan	44.2	49.6	51.1	51.7	52.8	54.6	99.5
Korea	35.7	42.0	43.8	45.4	44.9	46.6	96.6
New Zealand	43.8	47.4	46.8	47.5	47.9	48.0	81.0
Austria	41.8	46.6	48.4	49.2	49.5	47.7	99.6
Belgium	39.3	46.1	47.3	48.8	49.6	50.2	81.3
Czech Republic	15.7	23.2	27.3	31.9	36.7	37.5	56.4
Denmark	56.6	61.1	61.8	63.2	65.9	68.4	117.8
Finland	53.5	55.5	57.1	59.9	55.4	55.1	120.2
France	49.5	56.1	56.9	57.5	57.5	57.8	92.7
Germany	50.6	51.4	54.0	55.1	56.7	58.8	87.4
Greece	39.1	49.4	50.9	51.7	52.7	53.3	91.4
Hungary	9.6	21.1	26.1	31.5	34.2	41.4	57.6
Iceland	51.4	55.6	58.3	60.7	65.2	68.0	130.2
Ireland	28.1	36.5	38.3	41.0	44.1	46.4	89.1
Italy	39.4	43.8	44.4	45.1	45.6	46.4	99.1
Luxembourg	47.8	56.7	62.1	66.4	68.7	71.9	120.1
Netherlands	46.4	52.5	54.3	56.8	59.5	60.8	103.7
Norway	50.3	56.8	58.2	62.1	66.2	70.5	132.0
Poland	8.6	14.8	16.9	19.4	21.9	24.7	34.8
Portugal	24.1	36.7	38.5	40.2	41.3	42.3	89.1
Spain	32.4	38.6	39.8	41.5	42.6	45.0	82.8
Sweden	68.3	68.7	69.4	70.1	71.0	73.8	131.3
Switzerland	58.7	62.6	64.6	66.1	68.7	71.6	112.8
Turkey	12.3	21.4	22.8	24.7	26.2	27.4	39.3
United Kingdom	44.1	50.4	52.4	53.3	55.0	56.5	96.6
Total OECD	39.8	45.7	47.5	49.4	50.9	52.8	84.1

1. Telecommunication access paths include the total of fixed access lines and cellular mobile subscribers.

Source: OECD, *Communications Outlook 2001,* April 2001.

Table B.4.2. **ISDN subscribers in the OECD area**[1]

	ISDN Channels (64Kbit/s voice equivalents)						ISDN Basic						ISDN Primary					
	Thousands					CAGR 1995-99 (%)	Thousands					CAGR 1995-99 (%)	Thousands					CAGR 1995-99 (%)
	1995	1996	1997	1998	1999		1995	1996	1997	1998	1999		1995	1996	1997	1998	1999	
Canada	..	..	451	757	999	..	..	..	50	70	81	..	..	..	12	21	28	..
Mexico	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
United States	..	..	..	1 554	2 016	..	..	..	..	705	876	..	..	..	..	5	9	..
Australia	270	360	488	722	1 049	40.5	..	..	..	..	..	..	..	..	..	..	..	..
Japan	1 172	2 830	4 999	8 259	13 758	85.1	455	1 085	2 034	3 480	5 802	89.0	9	22	31	43	72	69.2
Korea	9	17	42	102	640	193.6	4	8	21	38	171	151.1	..	..	..	1	3	..
New Zealand	..	19	34	53	72	..	..	..	..	..	..	..	..	..	..	..	..	..
Austria	..	123	244	427	662	..	..	41	83	152	247	..	..	1	3	4	6	..
Belgium	78	146	270	507	870	82.7	27	53	96	180	311	83.8	1	1	3	5	8	80.1
Czech Republic	..	..	10	17	58	..	..	..	..	2	10	..	..	..	..	..	1	..
Denmark	42	90	176	346	662	99.6	14	29	58	113	241	105.2	..	1	2	4	6	87.7
Finland	13	54	116	329	467	145.7	6	26	54	95	151	124.5	..	1	4	5	5	86.4
France	..	1 600	2 128	2 638	3 600	..	259	391	556	..	..	..	30	..	..	..	..	..
Germany	2 744	5 203	7 341	10 093	13 320	48.4	864	1 981	2 831	4 031	5 549	59.2	35	46	56	72	88	26.0
Greece	1	5	9	90	173	311.3	..	1	2	24	44	248.0	..	..	..	1	3	..
Hungary	5	11	40	74	120	121.2	3	6	20	37	60	121.2	..	..	..	..	..	..
Iceland	..	4	13	27	41	..	..	1	3	7	12	..	..	..	..	..	..	..
Ireland	..	..	..	98	152	..	..	..	..	49	76	..	..	..	..	..	..	..
Italy	159	341	897	1 735	3 049	109.2	46	98	449	868	1 525	128.4	3	7	13	..	19	52.6
Luxembourg	5	10	24	74	121	127.2	1	2	5	9	17	117.1	..	..	..	2	3	131.9
Netherlands	104	321	810	1 570	2 280	116.4	22	30	270	..	..	..	2	12	9	..	..	..
Norway	46	149	410	769	1 262	129.0	14	42	146	305	525	146.4	1	2	4	5	7	86.9
Poland	..	..	..	..	..	..	..	..	..	6	..	..	..	..	..	..	..	..
Portugal	57	98	183	314	477	70.2	7	18	45	86	133	108.0	1	2	3	4	7	71.5
Spain	28	219	457	505	979	143.1	11	96	228	177	355	140.6	..	1	..	5	9	150.4
Sweden	49	100	187	319	645	90.5	19	..	70	120	..	..	1	..	2	3	..	..
Switzerland	237	399	612	952	1 416	56.4	66	121	201	332	528	68.2	4	5	7	10	12	36.1
Turkey	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
United Kingdom	..	..	1 100	1 700	2 400	..	103	155	200	350	550	52.2	30	..	23	33	43	9.6

1. ISDN: Integrated services digital network, a system of digital phone connections that allows data to be transmitted simultaneously across the world using end-to-end digital connectivity. A basic ISDN connection can provide two channels and a primary connection can provide 30.

Source: OECD, Telecommunications database, June 2001.

Table B.4.3. **Internet hosts by country, 1997-2000**

	Hosts					OECD share Oct. 2000	Increase July 1999-July 2000	Hosts per 1000 inhabitants				
	July 1997	July 1998	July 1999	July 2000	Oct. 2000			July 1997	July 1998	July 1999	July 2000	Oct. 2000
	Thousands					(%)	(%)					
Canada	911.8	1 548.9	2 254.2	3 434.8	3 879.2	4.3	52.4	30.4	51.2	73.9	112.6	127.2
Mexico	19.5	71.7	157.0	337.4	372.6	0.4	114.9	0.2	0.7	1.6	3.5	3.8
United States	15 131.0	23 638.0	38 744.0	58 672.0	63 907.0	70.7	51.4	56.5	87.5	142.0	215.0	234.2
Australia	572.5	790.8	992.2	1 286.3	1 422.3	1.6	29.6	30.9	42.2	52.3	67.8	75.0
Japan	1 059.5	1 613.6	2 314.0	3 579.5	4 116.4	4.6	54.7	8.4	12.8	18.3	28.3	32.5
Korea	98.6	178.6	318.8	445.3	504.4	0.6	39.7	2.1	3.8	6.8	9.5	10.8
New Zealand	112.0	199.5	210.8	329.3	352.9	0.4	56.2	29.8	52.6	55.3	86.4	92.6
Austria	58.4	143.7	225.8	393.0	465.7	0.5	74.0	7.2	17.8	27.9	48.6	57.6
Belgium	80.7	166.4	267.1	369.4	406.0	0.4	38.3	7.9	16.3	26.1	36.1	39.7
Czech Republic	45.7	72.3	99.3	132.2	132.6	0.1	33.1	4.4	7.0	9.7	12.9	12.9
Denmark	137.5	196.7	314.7	362.0	385.5	0.4	15.0	26.0	37.1	59.2	68.1	72.5
Finland	349.9	511.1	623.1	762.1	822.5	0.9	22.3	68.1	99.2	120.5	147.4	159.1
France	308.4	451.4	711.6	1 070.7	1 134.2	1.3	50.5	5.3	7.7	12.0	18.1	19.2
Germany	842.8	1 212.5	1 646.1	2 297.5	2 600.1	2.9	39.6	10.3	14.8	20.1	28.0	31.7
Greece	29.1	37.7	71.5	114.1	137.0	0.2	59.6	2.8	3.6	6.8	10.8	13.0
Hungary	32.3	80.7	109.8	151.1	154.8	0.2	37.6	3.2	8.0	10.9	15.0	15.4
Iceland	10.9	19.6	26.8	32.1	36.3	0.0	19.8	40.2	71.6	96.5	115.6	130.8
Ireland	47.5	47.5	61.3	105.1	116.6	0.1	71.5	13.0	12.8	16.4	28.1	31.1
Italy	209.6	285.0	512.0	1 435.7	1 861.1	2.1	180.4	3.7	5.0	9.0	25.2	32.6
Luxembourg	1.3	6.2	8.4	14.4	13.2	0.0	71.4	3.1	14.5	19.4	33.3	30.5
Netherlands	341.2	554.1	800.4	1 190.1	1 290.2	1.4	48.7	21.9	35.3	50.6	75.3	81.6
Norway	180.3	335.0	382.2	476.1	519.7	0.6	24.6	40.9	75.6	85.7	106.7	116.5
Poland	78.8	100.4	159.0	265.3	318.8	0.4	66.9	2.0	2.6	4.1	6.9	8.2
Portugal	31.0	50.5	63.0	105.0	133.4	0.1	66.7	3.1	5.1	6.3	10.5	13.4
Spain	157.5	246.9	368.5	583.4	620.4	0.7	58.3	4.0	6.3	9.3	14.8	15.7
Sweden	309.6	400.1	560.0	869.8	941.7	1.0	55.3	35.0	45.2	63.2	98.2	106.3
Switzerland	146.6	237.3	310.8	414.1	453.2	0.5	33.2	20.7	33.4	43.5	58.0	63.5
Turkey	16.4	35.0	71.4	196.5	216.2	0.2	175.2	0.3	0.5	1.1	3.0	3.3
United Kingdom	923.8	1 397.4	1 979.4	2 848.3	3 124.0	3.5	43.9	15.7	23.6	33.3	47.9	52.5
European Union	3 828.3	5 707.2	8 212.9	12 520.6	14 051.6	..	52.5	10.2	15.2	21.9	33.4	37.4
Total OECD	22 244.2	34 628.6	54 363.2	82 272.6	90 438.0	100.0	51.3	20.3	31.4	49.0	74.2	81.5
World	23 035.8	36 262.2	56 901.4	86 050.5	94 588.2	..	51.2	4.0	6.1	9.5	14.4	15.8
OECD Share of World	96.6	95.5	95.5	95.6	95.6	..	..	..	..	..	..	..

Note: gTLDs are distributed to country of location.

Source: OECD, *Communications Outlook 2001* , from Netsizer (www.netsizer.com), April 2001.

Table B.5.1. **Internet subscribers, 1st January 2000**

	Largest Public Telecommunication Operator (PTO)	Largest PTO's Subscribers	Largest PTO's share (%)	Total national subscribers	Subscribers per 100 inhabitants (%)
Canada	All PTOs	800 000	13	6 169 500	20.2
Mexico	Telmex	402 754	22	1 822 198	1.9
United States[1]		3 965 000	8	49 723 100	18.2
Australia	Telstra	650 000	27	2 407 407	12.7
Japan[2]	NTT	1 098 000	10	10 590 000	8.4
Korea	Korea Telecom	1 970 021	18	10 860 000	23.2
New Zealand	Telecom NZ	245 000	46	535 000	14.0
Austria	Telekom Austria	107 000	22	486 364	6.0
Belgium	Belgacom	325 000	30	1 083 333	10.6
Czech Republic	Czech Telecom	45 000	23	199 000	1.9
Denmark	Tele Danmark	393 000	35	1 135 393	21.3
Finland	Sonera (Telecom Finland)	252 500	45	564 224	10.9
France	France Telecom	1 124 000	37	3 030 000	5.1
Germany	Deutsche Telekom (T-Online)	3 300 000	37	14 400 000	17.5
Greece	OTE	85 983	43	199 960	1.9
Hungary	Matav	51 315	45	114 033	1.1
Iceland	Telecom Iceland (PTI)	19 650	40	49 125	17.7
Ireland	Eircom	243 000	60	405 000	10.8
Italy	Telecom Italia	1 990 000	40	4 930 000	8.6
Luxembourg	P&T Luxembourg	11 411	..	..	..
Netherlands	KPN Telecom	907 000	32	2 834 375	17.9
Norway	Telenor	400 000	58	695 303	15.6
Portugal	Portugal Telecom	261 000	55	474 389	4.7
Spain	Telefonica	659 000	35	3 625 000	9.2
Sweden	Telia	613 000	30	2 040 000	23.0
Switzerland	Swisscom	322 852	33	898 000	12.6
United Kingdom	BT	1 300 000	18	7 400 000	12.4
European Union		11 571 894	..	42 608 038	9.9
Total OECD[3]		21 541 486	33	126 670 705	10.9

1. The telecommunication carriers used for the United States are the traditional Bell system operators, AT&T and the RBOCs, plus GTE.
2. March 2000.
3. The OECD average is a simple average.

Source: OECD, Telecommunications database, June 2001.

Table B.6.1. **OECD Basket of national leased line charges, August 2000**

Excluding tax

	US dollars M1020	PPP dollars M1020	US dollars 64 k	PPP dollars 64 k	US dollars 1.5/2 M	PPP dollars 1.5/2 M	Index 2 Mbit/s
Canada	..	..	366 902	452 965	3 237 256	3 996 613	123
Mexico	..	..	362 598	503 609	3 854 641	5 353 668	164
United States	..	..	994 235	994 235	2 065 200	2 065 200	63
Australia	287 606	368 726	334 118	428 356	3 346 856	4 290 841	132
Japan			1 265 787	776 556	7 853 933	4 818 364	148
Korea	331 315	534 380	677 555	1 092 830	4 517 032	7 285 536	224
New Zealand	300 837	423 714	617 239	869 351	3 027 381	4 263 916	131
Austria	429 843	467 220	447 993	486 949	1 965 581	2 136 501	66
Belgium	562 682	646 761	388 132	446 129	2 422 023	2 783 935	86
Czech Republic	320 997	844 730			3 015 207	7 934 754	244
Denmark	117 773	103 310	187 171	164 185	777 967	682 427	21
Finland	..	..	..	..	638 389	613 836	19
France	477 838	519 389	402 318	437 302	1 954 095	2 124 016	65
Germany	404 182	439 329	353 410	384 141	1 966 920	2 137 956	66
Greece	252 165	355 162	415 288	584 913	2 520 782	3 550 397	109
Hungary	160 413	401 033	560 571	1 401 428	3 080 236	7 700 589	237
Iceland	148 749	118 999	154 892	123 914	728 391	582 713	18
Ireland	236 558	278 303	264 800	311 530	1 590 558	1 871 245	57
Italy	373 948	473 353	466 538	590 555	3 060 511	3 874 065	119
Luxembourg	160 163	179 959	240 380	270 089	2 365 572	2 657 946	82
Netherlands	188 909	217 137	418 593	481 142	2 456 371	2 823 415	87
Norway	270 448	233 145	347 621	299 673	1 482 892	1 278 355	39
Poland	214 842	413 158	325 767	626 475	2 363 864	4 545 893	140
Portugal	396 527	610 042	313 990	483 061	2 329 747	3 584 227	110
Spain	867 291	1 188 070	475 499	651 369	3 661 083	5 015 182	154
Sweden	74 670	67 882	264 982	240 893	928 994	844 540	26
Switzerland	417 498	350 839	308 797	259 493	1 612 880	1 355 361	42
Turkey	70 189	129 979	150 337	278 401	1 240 950	2 298 055	71
United Kingdom	326 301	299 359	481 995	442 198	2 236 164	2 051 527	63
Total OECD	307 989	402 666	429 167	521 546	2 493 154	3 259 347	100

Source: OECD, *Communications Outlook 2001*, April 2001.

Table B.6.2. **OECD Internet access basket for 40 hours using discounted PSTN rates**

PPP dollars, including VAT

	1999		September 2000		Variation (%)	
	Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
Canada	31.45	31.45	35.53	35.53	13	13
Mexico	60.91	60.91	37.40	37.40	- 39	- 39
United States	37.30	37.30	23.76	23.76	- 36	- 36
Australia	49.33	49.33	42.94	42.94	- 13	- 13
Japan	54.64	54.64	49.01	49.01	- 10	- 10
Korea	44.31	34.04	44.62	43.78	1	29
New Zealand	47.23	47.23	38.45	38.45	- 19	- 19
Austria	128.15	64.87	70.51	45.73	- 45	- 29
Belgium	147.00	66.23	81.35	51.79	- 45	- 22
Czech Republic	187.90	110.77	173.92	84.51	- 7	- 24
Denmark	91.53	42.25	48.09	41.98	- 47	- 1
Finland	43.73	32.97	41.18	36.97	- 6	12
France	95.73	62.07	59.50	59.50	- 38	- 4
Germany	76.78	76.78	50.71	50.71	- 34	- 34
Greece	88.46	88.46	52.16	41.90	- 41	- 53
Hungary	332.04	184.69	150.17	82.84	- 55	- 55
Iceland	63.44	36.87	45.34	34.44	- 29	- 7
Ireland	83.22	41.82	75.38	41.80	- 9	0
Italy	67.91	44.04	45.71	38.79	- 33	- 12
Luxembourg	152.06	91.93	99.94	58.56	- 34	- 36
Netherlands	85.66	47.77	81.63	50.08	- 5	5
Norway	64.28	50.76	63.90	51.05	- 1	1
Poland	120.46	120.46	134.54	73.88	12	- 39
Portugal	124.27	82.27	77.24	57.75	- 38	- 30
Spain	85.87	85.87	77.02	31.27	- 10	- 64
Sweden	64.09	39.48	58.36	35.98	- 9	- 9
Switzerland	95.28	50.02	65.44	46.63	- 31	- 7
Turkey	57.75	51.19	33.74	25.76	- 42	- 50
United Kingdom	105.61	49.31	60.41	27.13	- 43	- 45
European Union	96.00	61.07	65.52	44.15	- 32	- 28
Total OECD	92.63	63.30	66.14	46.20	- 29	- 27

Source: OECD, *Communications Outlook 2001*, April 2001.

Table C.1.1. **Main components of international transactions,[1] total OECD[2]**

Index 1985 = 100

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Trade in goods	100	114	135	155	167	192	195	206	198	225	270	281	289	293	304
Trade in services	100	120	145	164	177	212	222	244	241	259	292	308	316	329	337
Investment income	100	110	132	167	206	249	256	257	257	257	310	327	344	361	369
Direct investment	100	137	276	325	345	450	342	336	413	459	703	755	816	1 331	1 844
Portfolio investment	100	160	122	180	233	155	290	275	446	229	402	649	569	707	1 038
Other investment	100	162	235	148	247	277	41	216	162	73	321	426	615	214	467

1. Average of imports and exports (current account), average of assets and liabilities (financial account).
2. For Other investment : excluding Switzerland and Luxembourg from 1985 to 1999, Czech Republic and Slovak Republic from 1985 to 1992, Hungary from 1985 to 1993, Poland from 1985 to 1994, Turkey from 1985 to 1991, and Japan from 1985 to 1990. For other components: excluding Hungary and Poland from 1985 to 1990, Czech Republic and Slovak Republic from 1985 to 1992, Luxembourg from 1985 to 1999, and Greece in 1998 and 1999.

Source: OECD, ADB database, May 2001 and IMF, Balance of Payments Statistics.

Table C.1.2. **Main components of international transactions as a share of GDP,[1] total OECD[2]**

Percentages

	1993	1994	1995	1996	1997	1998	1999	Average 1993-99
Current account								
Trade in goods	13.2	14.0	15.4	15.9	16.7	16.7	16.4	15.5
Trade in services	3.8	3.8	3.9	4.1	4.2	4.4	4.2	4.0
Investment income	4.0	3.7	4.0	4.2	4.5	4.7	4.5	4.2
Financial account								
Direct investment	0.9	0.9	1.1	1.2	1.5	2.4	3.1	1.6
Portfolio investment	2.9	1.5	2.0	3.0	3.3	4.0	5.6	3.2
Other investment	1.9	1.0	2.5	2.8	4.9	1.7	1.6	2.3

1. Imports + Exports divided by 2 and by GDP, or Assets + Liabilities divided by 2 and by GDP.
2. Total OECD excludes Greece 1993-99, Poland 1993-94, Norway and New Zealand 1999

Source: IMF, Balance of Payments Statistics, and OECD, ADB database, May 2001.

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	1998	1999	1990-95	1995-99	1990-99	1990	1995	1998	1999	1990-95	1995-99	1990-99	1990	1995	1998	1999	1990-95	1995-99	1990-99
Canada	21.6	30.7	34.7	35.9	7.3	4.0	5.8	4.1	5.1	5.8	5.7	4.4	3.1	3.8	25.7	35.7	40.5	41.6	6.8	3.9	5.5
Mexico	15.8	26.5	28.9	29.0	10.9	2.2	7.0	3.5	3.3	2.8	2.6	-1.2	-5.3	-3.0	19.3	29.8	31.7	31.6	9.1	1.5	5.6
United States	7.6	9.0	9.0	9.2	3.2	0.7	2.1	2.3	2.4	2.5	2.5	1.3	0.5	0.9	9.9	11.4	11.6	11.7	2.8	0.7	1.8
Australia	12.8	15.2	16.1	15.4	3.5	0.3	2.1	3.9	4.6	4.6	4.5	3.2	-0.4	1.6	16.7	19.8	20.7	19.9	3.4	0.2	2.0
Japan	8.1	6.9	7.9	7.6	-3.3	2.6	-0.7	2.1	1.8	2.2	2.0	-2.9	2.4	-0.6	10.2	8.6	10.1	9.6	-3.2	2.5	-0.7
Korea	25.7	25.9	35.1	32.2	0.2	5.6	2.5	3.9	5.0	7.9	6.6	4.8	7.3	5.9	29.6	30.9	43.0	38.8	0.8	5.9	3.0
New Zealand	20.1	21.9	22.4	23.7	1.7	2.0	1.8	6.7	7.7	7.8	8.2	2.9	1.4	2.3	26.8	29.6	30.2	31.9	2.0	1.8	1.9
Austria	27.0	25.9	30.6	31.6	-0.8	5.0	1.7	11.5	11.4	13.4	13.9	-0.2	5.0	2.1	38.5	37.4	44.0	45.5	-0.6	5.0	1.8
Belgium	53.4	52.6	57.7	58.1	-0.3	2.5	0.9	12.1	10.8	11.9	12.4	-2.2	3.6	0.3	65.5	63.3	69.6	70.5	-0.7	2.7	0.8
Czech Republic	31.8	44.8	49.7	51.3	7.1	3.5	5.5	4.9	11.1	11.8	12.0	17.8	2.0	10.5	36.7	55.9	61.5	63.4	8.8	3.2	6.3
Denmark	25.7	26.3	26.4	26.6	0.5	0.2	0.4	8.2	7.5	8.9	9.2	-1.8	5.0	1.2	33.9	33.9	35.3	35.7	0.0	1.3	0.6
Finland	19.1	26.5	28.8	28.0	6.8	1.3	4.3	4.5	6.6	5.6	5.4	8.0	-4.7	2.1	23.6	33.1	34.4	33.4	7.0	0.2	3.9
France	17.7	17.6	20.0	20.0	-0.2	3.3	1.4	5.0	4.6	5.3	5.1	-1.8	2.7	0.2	22.8	22.2	25.3	25.2	-0.5	3.2	1.1
Germany	24.4	20.0	23.4	24.0	-3.9	4.7	-0.2	4.7	4.3	5.0	5.3	-1.9	5.6	1.3	29.1	24.3	28.5	29.4	-3.6	4.9	0.1
Greece	15.7	12.8	12.3	14.0	-4.0	2.4	-1.2	6.0	6.1	6.4	10.3	0.4	14.0	6.2	21.7	18.9	18.7	24.4	-2.7	6.6	1.3
Hungary	24.8	31.5	46.6	47.4	4.9	10.8	7.4	7.4	8.8	10.7	10.3	3.7	3.8	3.7	32.2	40.3	57.3	57.7	4.6	9.4	6.7
Iceland	24.5	24.4	25.8	25.0	-0.1	0.6	0.2	8.8	9.5	11.7	11.3	1.6	4.4	2.8	33.3	33.9	37.6	36.3	0.4	1.7	1.0
Ireland	45.2	56.7	60.1	58.8	4.7	0.9	3.0	9.1	12.3	21.2	21.8	6.2	15.5	10.2	54.3	69.0	81.3	80.6	4.9	4.0	4.5
Italy	15.5	19.6	19.0	19.0	4.7	-0.7	2.3	4.1	4.9	5.2	4.9	4.0	0.0	2.2	19.6	24.5	24.2	23.9	4.6	-0.6	2.3
Luxembourg	..	55.0	54.6	49.9	..	-2.4	..	..	39.6	52.2	56.2	..	9.1	..	..	94.6	106.8	106.1	..	2.9	..
Netherlands	42.0	44.3	47.2	47.3	1.1	1.6	1.3	10.0	11.2	12.9	13.3	2.3	4.4	3.2	52.0	55.5	60.1	60.6	1.3	2.2	1.7
Norway	27.8	25.9	27.1	26.4	-1.4	0.4	-0.6	9.7	9.0	9.8	9.5	-1.4	1.4	-0.2	37.5	35.0	36.9	35.9	-1.4	0.7	-0.5
Poland	9.1	20.4	24.5	24.2	17.6	4.4	11.6	3.2	7.0	5.6	5.0	17.0	-8.1	5.1	12.2	27.4	30.1	29.2	17.5	1.6	10.1
Portugal	27.7	26.3	28.6	28.9	-1.0	2.4	0.5	6.2	6.8	7.1	6.7	1.6	-0.2	0.8	33.9	33.0	35.7	35.6	-0.5	1.9	0.5
Slovak Republic	..	47.3	55.8	54.7	..	3.7	..	..	11.5	10.7	9.5	..	-4.6	..	..	58.8	66.6	64.1	..	2.2	..
Spain	13.8	17.6	20.9	20.9	5.0	4.5	4.8	4.3	5.3	6.5	7.0	4.2	7.3	5.6	18.1	22.8	27.4	27.9	4.8	5.2	5.0
Sweden	23.1	30.2	32.1	31.8	5.5	1.3	3.6	6.5	6.9	8.5	9.0	1.2	6.9	3.7	29.6	37.1	40.6	40.8	4.6	2.4	3.6
Switzerland	30.4	27.4	31.4	32.2	-2.1	4.2	0.6	6.2	6.4	7.6	8.0	0.4	5.7	2.8	36.7	33.8	39.0	40.2	-1.6	4.5	1.0
Turkey	11.8	16.7	19.0	18.4	7.3	2.5	5.1	3.7	5.7	8.2	6.8	9.4	4.2	7.0	15.4	22.5	27.2	25.2	7.8	2.9	5.6
United Kingdom	20.1	22.3	20.5	20.1	2.1	-2.6	0.0	5.3	6.2	6.5	6.6	3.3	1.8	2.6	25.4	28.5	26.9	26.8	2.3	-1.6	0.6
European Union[2]	21.9	22.9	24.6	24.7	0.9	2.0	1.4	5.5	5.9	6.7	6.9	1.2	4.4	2.6	27.4	28.7	31.3	31.7	0.9	2.5	1.6
Total OECD[3]	14.7	15.3	16.6	16.4	0.9	1.8	1.3	3.8	3.9	4.4	4.3	0.6	2.6	1.5	18.4	19.2	21.0	20.7	0.8	2.0	1.3

1. Average of imports and exports as a share of nominal GDP.
2. Excluding Luxembourg in 1990 and in growth rates 1990-95 and 1990-99.
3. Excluding Luxembourg and Slovak Republic in 1990 and in growth rates 1990-95 and 1990-99.

Source: OECD, ADB database, May 2001 and IMF, Balance of Payments Statistics.

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.	
	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998
Canada[c]	36	55	49	70	65	81	7	24	81	102	45	66	..	..	57	75	22	60	76	77	36	57	43	82	53	100
United States	11	16	22	31	28	45	8	11	39	42	21	32	13	23	17	21	19	31	15	17	16	20	9	11	20	24
Japan[3]	12	15	25	29	13	32	4	6	30	38	25	26	42	57	18	23	15	21	25	30	14	21	..	..	14	19
Denmark[4]	54	59	101	115	..	..	90	100	193	243	88	128	102	98	74	72	48	68	107	109	62	69	237	111	74	68
Finland	33	47	55	61	18	37	41	47	50	98	61	59	64	65	42	58	39	82	65	148	34	47	38	26	44	48
France	27	37	36	59	50	71	22	37	54	107	38	65	28	38	39	51	33	51	39	45	44	57	29	43	38	54
Germany[5]	33	41	52	79	101	116	40	57	47	95	49	92	49	65	41	50	24	34	45	49	47	58	21	32	45	54
Italy	22	31	35	57	46	61	16	50	76	87	28	61	36	46	28	44	15	23	34	50	16	26	26	43	40	60
Spain	17	26	24	42	109	66	11	25	52	53	16	58	19	33	30	44	20	32	44	57	19	31	7	39	31	39
Sweden	37	51	65	73	50	101	61	74	87	125	66	74	63	51	47	58	42	84	49	56	38	43	16	37	52	59
United Kingdom	30	38	61	76	86	79	43	56	72	91	46	81	53	63	42	50	36	50	40	47	42	50	16	24	49	55
EU-8 (non-intra)[6]	11	16	21	32	45	51	16	25	14	26	16	31	21	29	15	20	10	17	12	16	15	20	8	14	20	28
EU-8[7]	28	38	47	69	70	82	30	50	60	94	43	75	43	55	39	49	25	38	42	50	37	48	25	38	43	55
Total OECD-11[8]	19	25	31	42	40	57	16	26	42	53	28	40	27	37	28	34	21	32	31	36	25	32	20	26	29	36

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. 1991 instead of 1990.
6. Excludes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
7. Includes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
8. Calculated with all the above countries.

Source: OECD, STAN database, May 2001.

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	
	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998
Canada[c]	26	40	20	27	25	47	14	29	10	45	47	60	11	24	26	42	28	70	45	67	41	49	12	21	7	34
United States	6	8	4	5	7	10	5	6	8	10	8	11	4	6	5	7	7	13	5	4	5	6	5	6	6	11
Japan[3]	7	10	2	1	24	35	5	7	55	58	6	9	4	5	2	2	4	5	0	0	2	2	1	1	6	8
Denmark[4]	38	37	36	18	49	56	26	25	44	44	56	58	32	32	45	52	56	56	40	40	18	17	49	56	73	126
Finland	26	38	12	32	25	33	10	24	53	57	41	51	18	25	29	40	17	29	35	48	47	53	4	10	34	46
France	20	23	15	14	25	33	16	20	18	27	40	40	10	14	19	24	18	22	12	17	12	15	19	24	29	43
Germany[5]	23	27	14	19	26	34	18	19	28	32	39	43	15	18	20	24	27	29	11	13	16	20	12	17	46	69
Italy	16	22	13	13	21	30	17	26	18	62	20	25	10	15	18	25	30	44	5	8	8	12	8	13	29	39
Spain	17	20	37	18	16	26	10	18	36	33	22	27	9	13	9	15	11	18	6	9	8	12	7	13	15	26
Sweden	32	40	36	38	38	52	14	27	57	57	44	56	21	25	26	36	31	42	25	45	40	44	6	12	45	95
United Kingdom	20	23	22	22	21	23	14	19	16	17	32	40	11	16	15	18	25	23	3	6	12	13	12	16	29	38
EU-8 (non-intra)[6]	7	10	8	9	6	10	6	9	19	30	11	13	5	7	6	9	11	14	3	5	5	6	4	6	11	19
EU-8[7]	21	25	17	18	24	31	16	21	27	36	33	38	13	16	19	24	25	31	12	17	17	19	13	18	32	44
Total OECD-11[8]	13	16	9	9	17	22	11	14	26	35	17	21	8	11	11	14	13	18	10	13	10	11	8	10	19	27

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. 1991 instead of 1990.
6. Excludes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
7. Includes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
8. Calculated with all the above countries.

Source: OECD, STAN database, May 2001.

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.	
	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998
Canada[c]	37	56	60	78	59	78	25	46	90	101	59	76	..	..	62	78	45	78	73	74	37	64	37	79	76	100
United States	14	20	20	31	11	22	7	14	42	54	31	35	11	19	21	25	24	39	30	30	10	15	16	18	19	23
Japan[3]	7	9	9	17	50	55	8	9	8	23	4	11	23	44	5	7	4	10	4	4	9	12	..	..	3	5
Denmark[4]	52	59	101	117	..	..	81	99	123	133	89	123	104	97	77	76	55	67	104	103	76	78	169	106	67	62
Finland	30	37	67	55	71	84	58	69	77	99	59	38	72	60	51	59	42	79	83	120	47	53	36	35	45	41
France	28	35	39	56	41	59	17	33	67	105	45	63	31	40	38	46	28	45	35	38	43	53	34	44	43	53
Germany[5]	27	35	52	79	101	115	29	45	57	97	54	93	38	55	26	34	16	27	26	32	37	49	23	42	24	32
Italy	20	27	46	65	43	61	25	53	80	93	47	72	47	52	27	38	13	19	41	57	29	39	16	29	22	34
Spain	23	30	50	60	104	74	17	38	79	75	44	71	57	62	39	48	29	36	40	53	32	43	28	36	51	51
Sweden	36	44	66	66	61	102	48	52	92	105	60	60	63	48	46	54	49	85	40	46	51	62	22	38	48	51
United Kingdom	34	41	61	75	82	76	30	47	77	93	55	81	53	62	45	52	37	52	51	56	40	48	30	44	47	52
EU-8 (non-intra)[6]	10	13	27	35	44	47	9	14	36	52	28	35	22	29	8	12	7	15	6	8	11	14	16	22	9	14
EU-8[7]	28	35	51	69	68	79	25	43	70	96	51	74	43	53	34	43	22	34	37	44	37	48	28	41	34	42
Total OECD-11[8]	19	24	28	40	31	46	15	24	43	61	27	37	23	33	23	30	18	31	27	32	22	29	24	30	21	27

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. 1991 instead of 1990.
6. Excludes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
7. Includes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
8. Calculated with all the above countries.

Source: OECD, STAN database, May 2001.

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	
	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998	1990	1998
Canada[2]	23	38	12	15	35	51	24	36	18	44	31	50	18	31	21	35	49	78	11	19	17	29	11	19	33	55
United States	10	12	11	11	9	11	9	12	2	7	15	20	6	8	11	15	25	34	8	12	5	5	5	6	26	37
Japan[3]	7	6	16	8	9	18	3	4	8	2	7	6	2	3	8	10	6	6	16	21	3	3	9	10	14	27
Denmark[4]	44	43	49	31	46	56	23	27	36	34	80	78	29	31	36	46	35	43	50	51	28	28	27	37	78	117
Finland	25	27	24	26	36	35	14	21	23	15	32	37	20	19	13	18	28	32	5	7	7	9	6	15	53	66
France	22	23	21	16	26	32	16	18	11	11	42	42	11	13	21	25	26	29	18	20	18	19	15	18	37	51
Germany[5]	21	24	28	28	20	26	15	18	9	10	39	42	10	13	25	29	27	35	20	20	16	18	15	19	59	79
Italy	16	18	20	15	14	19	7	9	17	14	34	39	4	6	13	17	9	15	14	16	11	14	16	17	13	21
Spain	16	19	32	14	17	28	7	9	13	21	24	33	10	13	12	17	14	18	13	15	13	16	9	13	15	26
Sweden	33	36	39	37	48	52	25	31	70	22	38	49	21	20	21	27	37	40	8	13	12	14	13	21	76	98
United Kingdom	23	26	23	15	25	25	16	18	8	6	36	52	13	16	25	27	36	34	33	32	20	17	18	21	44	56
EU-8 (non-intra)[6]	7	8	12	8	5	7	2	4	8	9	14	18	2	4	7	10	10	15	9	9	4	4	4	5	16	26
EU-8[7]	21	23	24	19	22	27	13	15	15	14	37	43	10	13	20	25	23	29	19	20	16	17	15	18	35	47
Total OECD-11[8]	14	16	16	13	16	20	10	12	10	10	20	24	7	10	14	18	18	25	14	16	9	10	11	12	28	40

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. 1991 instead of 1990.
6. Excludes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
7. Includes Intra-EU trade. European Union includes Denmark, Finland, France, Germany, Italy, Spain, Sweden and United Kingdom.
8. Calculated with all the above countries.

Source: OECD, STAN database, May 2001.

Table C.3.1. **Outward and inward direct investment flows in OECD countries**

Billions of US dollars

	Outward direct investment flows									Inward direct investment flows									Cumulative net outflows 1990-98
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1990	1991	1992	1993	1994	1995	1996	1997	1998	
Canada	5.2	5.8	3.6	5.9	9.3	11.5	12.9	22.0	26.6	7.6	2.9	4.7	4.7	8.2	9.3	9.4	11.5	16.5	28.0
Mexico	..	..	..	..	..	..	..	..	..	2.6	4.8	4.4	4.4	11.0	9.5	9.2	12.5	10.2	..
United States	31.0	32.7	42.6	78.2	73.3	92.1	84.4	99.5	121.6	48.4	22.8	19.2	50.7	45.1	58.8	84.5	105.5	189.0	31.5
Australia	0.3	3.0	1.0	1.8	5.3	3.8	5.9	5.9	0.7	6.5	4.0	5.0	3.0	4.0	12.7	5.1	8.7	6.5	-28.0
Japan	50.8	31.7	17.3	13.9	18.1	22.6	23.4	26.0	24.2	1.8	1.3	2.8	0.2	0.9	0.0	0.2	3.2	3.2	214.4
Korea	1.1	1.5	1.2	1.3	2.5	3.6	4.7	4.4	4.8	0.8	1.2	0.7	0.6	0.8	1.2	2.3	2.8	5.1	9.3
New Zealand	2.4	1.5	0.4	-1.4	2.0	1.8	-1.3	-1.6	0.3	1.7	1.7	1.1	2.2	2.7	2.7	3.7	1.8	1.9	-15.4
Austria	1.7	1.3	1.9	1.5	1.2	1.1	1.9	1.9	3.0	0.6	0.4	0.9	1.0	1.3	1.9	4.4	2.7	5.9	-3.6
Belgium-Luxembourg	6.1	6.5	10.4	4.7	1.2	11.7	8.1	7.7	23.1	8.0	9.3	11.3	10.8	8.3	10.8	14.1	12.5	20.9	-26.3
Czech Republic	..	..	0.0	0.1	0.1	0.0	0.2	0.0	0.1	..	..	1.0	0.7	0.9	2.6	1.4	1.3	2.5	-9.8
Denmark	1.5	1.8	2.2	1.4	4.0	3.1	2.5	4.2	3.9	1.2	1.5	1.0	1.7	4.9	4.2	0.8	2.8	6.5	0.2
Finland	2.7	-0.1	-0.8	1.4	4.3	1.5	3.6	5.3	18.6	0.8	-0.2	0.4	0.9	1.6	1.1	1.1	2.1	12.1	16.7
France	36.2	25.1	30.4	19.7	24.4	15.8	30.4	35.6	40.6	15.6	15.2	17.9	16.4	15.6	23.7	22.0	23.2	28.0	80.7
Germany	24.2	22.9	18.6	17.2	18.9	39.1	50.8	40.3	86.6	3.0	4.7	-2.1	0.4	7.1	12.0	5.6	9.6	19.9	258.4
Greece	..	..	..	..	..	..	..	..	..	1.0	1.1	1.1	2.6	3.1	4.3	5.9	3.6	3.7	..
Hungary	..	..	..	0.0	0.0	0.0	0.0	0.4	0.5	0.3	1.5	1.5	2.3	1.1	4.5	2.0	2.1	1.9	-12.9
Iceland	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	..	..	0.0	0.1	0.1	0.1	-0.1
Ireland	..	..	..	..	..	..	..	..	..	0.3	1.2	1.2	0.9	0.4	0.6	1.9	1.7	2.2	..
Italy	7.6	7.3	5.9	7.2	5.1	5.7	6.5	10.6	15.6	6.3	2.5	3.2	3.7	2.2	4.8	3.5	3.7	1.2	40.3
Netherlands	15.3	13.6	14.4	12.3	17.7	20.0	31.6	20.0	35.9	12.2	6.6	7.8	8.6	7.3	12.2	14.8	9.2	22.5	79.8
Norway	1.5	1.8	-0.1	0.8	2.1	3.1	5.9	5.0	2.5	1.8	0.7	-0.4	2.2	2.7	2.2	3.3	3.6	3.6	3.0
Poland	..	..	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.1	0.4	0.7	1.7	1.9	3.7	4.5	4.9	6.4	-23.2
Portugal	0.2	0.5	0.7	0.1	0.3	0.7	0.7	1.9	2.9	2.6	2.5	1.9	1.6	1.3	0.7	1.3	2.5	1.8	-8.1
Slovak Republic	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spain	3.4	4.4	2.2	2.6	3.9	3.6	5.2	10.1	15.4	13.8	12.4	13.4	8.1	9.4	6.2	6.5	5.5	8.7	-33.1
Sweden	14.7	7.1	0.4	1.4	6.7	11.2	4.7	12.6	21.2	2.0	6.4	0.0	3.8	6.3	14.4	5.1	10.9	18.9	12.2
Switzerland	6.7	6.2	6.1	8.8	10.8	12.2	16.2	18.0	14.2	5.5	2.6	0.4	-0.1	3.4	2.2	3.1	5.0	4.8	72.2
Turkey	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.3	0.4	0.8	0.9	0.9	0.7	0.6	0.9	0.9	0.9	1.0	-6.1
United Kingdom	18.6	16.0	19.2	25.6	28.3	44.3	34.1	63.7	115.0	32.9	16.0	16.2	15.5	10.5	22.7	26.1	37.1	63.5	124.2
European Union	132 349	106 389	105 481	95 154	115 969	157 796	180 234	214 076	381 925	100 262	79 353	74 314	75 759	79 412	119 613	112 980	126 981	215 864	53 790.3
Total OECD	231 287	190 754	177 659	204 707	239 593	308 771	332 720	394 229	578 163	178 158	124 035	116 299	149 190	162 628	229 885	242 621	290 989	468 608	38 015.0

Source: OECD, International Direct Investment database, May 2000.

Table C.3.2. **Top ten industries for cross-border mergers and acquisitions**

Shares of the different sectors in industry total

	Deal value		
	1990-99	1990-94	1995-99
Telecommunications	10.0	5.5	11.1
Insurance	6.2	5.9	6.3
Electricity, gas and water distribution	5.6	1.5	6.6
Oil and gas, petroleum refining	5.4	3.8	5.8
Business services	4.7	4.4	4.7
Pharmaceuticals	4.6	4.2	4.7
Electronic and electrical equipment	4.4	4.8	4.3
Food and kindred products	4.4	9.0	3.2
Chemicals	4.3	4.8	4.1
Commercial banks, bank holding companies	4.2	3.3	4.4
	Number of deals		
	1990-99	1990-94	1995-99
Business services	13.3	9.0	15.6
Machinery	5.2	5.9	4.9
Food and kindred products	5.0	6.2	4.4
Electronic and electrical equipment	4.9	5.4	4.6
Wholesale trade (durable goods)	4.7	4.9	4.6
Investment and commodity firms, dealers, exchanges	4.2	3.7	4.4
Metal and metal products	4.1	4.3	3.9
Chemicals	3.8	4.5	3.4
Transportation and shipping (except air)	3.2	3.3	3.1
Oil and gas, petroleum refining	3.0	3.4	2.8

Source: Thomson Financial, November 2000.

Table C.4.1. **Share of foreign affiliates in manufacturing employment and turnover,[1] 1995 and 1998**

	Employment			Turnover[1]		
	Share of affiliates		Average annual growth rate	Share of affiliates		Average annual growth rate
	1995	1998		1995	1998	
Canada	..	..	..	51.2	50.3	4.2
United States	10.7	13.4	8.5	14.2	18.3	12.8
Japan	0.7	1.1	8.4	1.3	1.8	9.8
Czech Republic [2]	..	16.2	..	..	27.1	..
Finland [2]	9.7	15.9	15.2	10.1	16.2	19.2
France	25.1	27.8	4.5	31.0	31.7	4.2
Germany	7.2	6.0	-7.4	13.1	10.8	-3.9
Hungary [2]	37.4	44.9	7.2	56.6	70.0	25.0
Ireland	47.1	47.5	3.5	65.2	72.3	12.3
Italy [3]	10.7	11.5	4.0	14.4	16.2	3.7
Luxembourg	41.2	46.3	3.2	46.5	52.4	5.7
Netherlands [3]	20.1	19.7	-2.1	30.3	30.4	5.2
Norway	15.0	17.4	11.5	19.5	24.1	15.2
Poland [2]	..	18.6	13.7	..	33.8	35.5
Sweden	19.9	21.1	4.5	21.6	21.9	3.7
Turkey [3]	5.6	5.3	5.2	12.4	12.3	4.6
United Kingdom [3]	16.3	17.8	1.7	30.6	31.4	4.7

1. Production instead of turnover for Canada and Ireland. National currency, 1995 prices.
2. 1999 instead of 1998.
3. 1997 instead of 1998.

Source: OECD, AFA database, May 2001.

Table C.4.2.1. **Share of foreign affiliates in services[1] turnover and employment, 1998**

Percentages

	Turnover		Employment	
	Services[1]	Manufacturing	Services[1]	Manufacturing
United States[2]	8.3	17.3	3.6	13.1
Japan[3]	0.7	1.6	0.2	1.3
Austria	14.5	26.1	8.7	18.6
Belgium[2]	26.6	47.5	18.9	18.0
Czech Republic	18.0	21.0	9.7	13.0
Finland	15.3	14.3	8.9	13.6
France	9.0	18.9	5.3	11.1
Hungary	31.1	62.4	14.6	36.8
Ireland[2]	23.8	..	13.6	..
Italy[2]	21.0	..	7.2	..
Luxembourg	15.0	52.8	4.8	45.2
Netherlands[2]	16.8	30.4	8.9	19.7
Norway[2]	19.9	12.7	3.5	8.2
Poland	11.2	26.1	7.4	14.8
Portugal[4]	11.7	13.4	3.4	7.3
Sweden[2]	16.3	19.6	4.8	20.0
Turkey[5]	7.1	22.6	0.8	11.0
United Kingdom[2]	17.2	31.4	9.7	17.3

1. The coverage of services activities may differ from one country to another.
2. 1997.
3. Turnover: 1997; employment: 1994 for foreign affiliates and 1995 for all domestic firms.
4. 1996.
5. 1994.

Source: OECD, FATS database, May 2001.

Table C.5.1. **R&D expenditure of foreign affiliates and national firms**

	Total R&D expenditures as a percentage of domestic product of industry[1]				Share of foreign affiliates in manufacturing R&D	
	Foreign affiliates		National firms			
	1990	1998	1990	1998	1990	1998
Canada[2,3]	0.38	0.45	0.81	0.86	45.0	37.1
United States	0.24	0.34	2.02	1.94	11.4	16.0
Australia[4]	..	0.28	..	0.62	..	37.6
Japan[3]	0.02	0.04	2.33	2.40	0.9	1.8
Czech Republic[5]	..	0.06	..	0.88	..	8.6
Finland[5]	..	0.48	..	2.75	..	14.1
France	..	0.30	..	1.53	..	18.6
Germany[4]	..	0.25	..	1.32	..	14.5
Greece[3,6]	0.01	0.01	0.14	0.21	11.1	4.9
Hungary[6]	..	0.25	..	0.07	..	77.1
Ireland[3,6]	0.52	0.88	0.24	0.46	65.7	64.8
Italy[7]	0.15	..	0.50	..	23.1	
Netherlands[6]	..	0.29	..	0.75	..	41.2
Poland[5]	..	0.10	..	0.23	..	29.5
Portugal[5]	..	0.04	..	0.20	..	26.9
Spain[5]	0.24	0.20	0.37	0.41	46.4	39.5
Sweden	0.46	0.92	2.44	4.35	14.5	16.0
Turkey[6,7]	..	0.03	..	0.15	2.8	18.6
United Kingdom[5,8]	..	0.54	..	1.20	16.4	31.5

1. Total manufacturing instead of total industry for Italy and Poland.
2. 1993 instead of 1990 for R&D as a percentage of domestic product of industry.
3. 1991 instead of 1990.
4. 1995 instead of 1998.
5. 1999 instead of 1998.
6. 1997 instead of 1998.
7. 1992 instead of 1990.
8. 1989 instead of 1990.

Source: OECD, AFA database, May 2001.

Table C.5.3. **Cross-border ownership of inventions, 1995-97**[1]
Percentages

	Foreign ownership of domestic inventions[2]	Domestic ownership of inventions made abroad[3]
Canada	21.5	26.9
Mexico	43.5	7.7
United States	6.5	13.3
Australia	19.3	9.7
Japan	3.1	3.0
Korea	4.8	6.2
New Zealand	15.4	8.1
Austria	26.5	15.8
Belgium	36.6	20.8
Czech Republic	40.9	15.9
Denmark	14.9	16.3
Finland	7.2	15.7
France	12.4	11.1
Germany	9.0	8.3
Greece	19.5	9.2
Hungary	29.7	15.7
Iceland	53.8	18.2
Ireland	24.5	40.7
Italy	14.7	4.7
Luxembourg	46.9	79.9
Netherlands	19.2	29.5
Norway	18.6	18.9
Poland	47.8	19.0
Portugal	34.5	23.5
Slovak Republic	25.0	8.7
Spain	20.3	5.8
Sweden	10.6	16.6
Switzerland	15.8	38.9
Turkey	24.2	14.3
United Kingdom	27.7	16.7
European Union[4]	8.2	5.5
Total OECD	14.1	14.5

1. Priority years.

2. Share of patent applications to the EPO owned by foreign residents in total patents invented domestically.

3. Share of patent applications to the EPO invented abroad in total patents owned by country residents.

4. The European Union is treated as one country; intra-EU cross border ownership has been netted out.

Source : OECD, Patent database, May 2001.

Table C.5.4. **International co-operation in science and technology, 1995-97**

	Percentage of scientific publications with a foreign co-author	Percentage of patents[1] with foreign co-inventors[2]
Canada	31.2	13.8
Mexico	42.8	21.2
United States	18.0	4.8
Australia	27.6	7.7
Japan	15.2	1.5
Korea	27.6	3.9
New Zealand	32.9	8.1
Austria	43.6	10.6
Belgium	46.6	15.2
Czech Republic	46.4	23.7
Denmark	44.3	9.9
Finland	36.1	5.9
France	35.6	5.6
Germany	33.7	4.7
Greece	38.3	12.4
Hungary	50.9	19.5
Iceland	..	15.4
Ireland	41.9	16.8
Italy	35.3	4.3
Luxembourg	..	35.4
Netherlands	36.0	7.8
Norway	40.5	8.6
Poland	46.1	43.3
Portugal	50.8	22.4
Slovak Republic	43.2	17.9
Spain	32.2	7.4
Sweden	39.4	6.0
Switzerland	48.1	14.4
Turkey	22.6	24.2
United Kingdom	29.3	8.9
European Union[3]	18.0	3.2
Total OECD	26.7	7.2

1. Patent applications to the European Patent Office (EPO).
2. Priority years.
3. The European Union is treated as one country; intra-EU co-operation has been netted out.

Source: OECD, based on data from the NSF (National Science Foundation) and the SCI (Science Citation Index); OECD, Patent database, May 2001.

Table C.5.5. **Technology balance of payments**

	Millions of US dollars						As a percentage of GDP						Receipts/payments ratio (%)	
	Receipts		Payments		Balance		Receipts		Payments		Balance			
	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Canada[1]	845.8	1 874.0	846.6	1 151.6	- 0.9	722.4	0.15	0.31	0.15	0.19	0.00	0.12	100	163
Mexico	74.7	63.5	386.8	452.2	- 312.1	- 388.7	0.03	0.01	0.15	0.09	-0.12	-0.08	19	14
United States	16 634.0	36 467.0	3 135.0	13 275.0	13 499.0	23 192.0	0.29	0.40	0.05	0.14	0.23	0.25	531	275
Australia[1]	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	2 343.7	8 435.0	2 568.6	3 602.0	- 224.8	4 832.9	0.08	0.19	0.09	0.08	-0.01	0.11	91	234
Korea[1]	21.8	140.9	1 087.0	2 386.5	- 1 065.2	- 2 245.6	0.01	0.04	0.43	0.75	-0.42	-0.71	2	6
New Zealand[2]	21.5	5.3	20.3	9.3	1.2	- 4.0	0.05	0.01	0.05	0.01	0.00	-0.01	106	57
Austria[3]	89.9	2 348.3	284.8	2 553.2	- 194.9	- 204.9	0.06	1.13	0.18	1.23	-0.12	-0.10	32	92
Belgium-Luxembour	1 885.4	5 099.0	2 522.5	4 238.0	- 637.1	861.1	0.96	2.05	1.28	1.71	-0.32	0.35	75	120
Czech Republic	..	287.4	..	279.9	..	7.5	..	0.53	..	0.52	..	0.01	..	103
Denmark	..	1 657.4	..	1 055.3	..	602.1	..	0.95	..	0.61	..	0.35	..	157
Finland	49.9	108.9	315.4	63.1	- 265.4	45.9	0.04	0.08	0.23	0.05	-0.19	0.04	16	173
France[1]	1 896.1	2 590.3	2 507.4	3 123.9	- 611.4	- 533.6	0.16	0.18	0.21	0.22	-0.05	-0.04	76	83
Germany	6 334.8	12 512.5	6 941.2	16 217.9	- 606.4	- 3 705.3	0.42	0.59	0.46	0.77	-0.04	-0.18	91	77
Greece	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hungary	..	216.1	..	503.7	..	- 287.6	..	0.45	..	1.04	..	-0.59	..	43
Iceland	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ireland	..	527.7	..	8 820.0	..	- 8 292.3	..	0.56	..	9.44	..	-8.87	..	6
Italy[3]	705.5	3 367.3	1 226.1	4 235.6	- 520.6	- 868.3	0.06	0.29	0.11	0.36	-0.05	-0.07	58	79
Netherlands	4 209.2	..	4 057.1	..	152.1	..	1.48	..	1.43	..	0.05	..	104	..
Norway	450.6	917.2	545.0	1 240.7	- 94.4	- 323.5	0.39	0.60	0.47	0.81	-0.08	-0.21	83	74
Poland	..	129.1	..	668.3	..	- 539.2	..	0.08	..	0.43	..	-0.35	..	19
Portugal	..	310.7	..	808.8	..	- 498.1	..	0.28	..	0.72	..	-0.44	..	38
Slovak Republic	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spain[1,3]	400.1	190.9	2 176.4	1 025.4	- 1 776.3	- 834.5	0.08	0.03	0.44	0.18	-0.36	-0.14	18	19
Sweden	208.1	..	75.3	..	132.8	..	0.19	..	0.07	..	0.12	..	276	..
Switzerland[1]	1 867.5	2 984.8	733.6	1 337.9	1 133.9	1 646.9	0.82	1.14	0.32	0.51	0.50	0.63	255	223
Turkey	..	..	..	..	..	..	..	..	..	..	..	..	..	..
United Kingdom[1,3]	2 063.9	6 081.1	2 728.2	3 172.2	- 664.3	2 908.9	0.21	0.43	0.28	0.22	-0.07	0.21	76	192
European Union[4]	18 837.4	41 675.2	24 608.7	51 787.2	- 5 771.3	- 10 112.1	0.30	0.52	0.39	0.64	-0.09	-0.13	77	80
Total OECD[4,5]	41 201.6	90 983.5	34 223.6	73 623.9	6 978.0	17 359.5	0.24	0.40	0.20	0.32	0.04	0.08	120	124

1. 1998 instead of 1999.
2. 1997 instead of 1999.
3. Break in series between the two years shown.
4. Including intra-zone flows. Excluding Denmark, Greece and Portugal. Data partially estimated.
5. Excluding Czech Republic, Hungary, Iceland, Poland, Slovak Republic and Turkey.

Source: OECD, TBP database, May 2001.

Table D.1.1. **Breakdown of GDP[1] per capita into its components, 1999**

		Effect of (%)						
	GDP per capita (US = 100)	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)	(3)	(4)	(5)	(6)	(2) (3) + (4) + (5) + (6)	(7) (1) - (2)	(8) (1) - (3) - (4) - (5)
Canada	79	3	-2	-3	-4	-6	86	82
Mexico	25	-2	-5	1	1	-6	31	32
United States	100	0	0	0	0	0	100	100
Australia	76	1	-4	-2	-3	-8	84	81
Japan	75	3	0	0	-1	1	74	73
Korea	47	4	-9	-1	14	7	40	54
New Zealand[2]	55	0	-2	-2	-3	-7	62	59
Austria	73	2	-6	0	-17	-22	95	77
Belgium	73	0	-15	-7	-14	-36	110	96
Czech Republic	40	2	-3	-2	3	1	39	42
Denmark	79	1	2	-1	-16	-14	93	77
Finland	67	1	-3	-5	-8	-15	82	74
France[3]	65	-2	-10	-6	-14	-32	97	84
Germany	70	2	-6	-4	-16	-23	94	78
Greece	45	1	-11	-4	2	-12	56	59
Hungary	33	1	-10	-1	-2	-12	45	43
Iceland[2]	78	-2	9	1	-2	6	72	70
Ireland	75	1	-11	-1	-9	-21	96	87
Italy	68	1	-19	-7	-13	-38	106	93
Luxembourg	122	1	13	2	-14	2	120	106
Netherlands	78	2	-4	1	-30	-32	109	79
Norway	83	-1	3	1	-27	-25	108	81
Poland	26	1	-5	-3	..	-7	..	32
Portugal	49	1	-2	0	-3	-5	53	50
Slovak Republic	32	1	-4	-5	..	-8	..	40
Spain	54	2	-14	-9	-2	-23	76	75
Sweden	68	-2	-1	-2	-10	-15	84	73
Switzerland[2]	85	2	5	1	-14	-6	91	77
Turkey[2]	19	0	-8	-1	..	-9	..	28
United Kingdom	68	-1	-3	-1	-14	-19	87	72
European Union	66	1	-9	-4	-13	-25	91	79
Total OECD[4]	72	1	-6	-2	-3	-10	82	78

1. GDP converted to common currency by 1999 OECD purchasing power parities (PPP).
2. GDP estimates for Iceland, New Zealand, Switzerland and Turkey are based on the SNA68.
3. Includes overseas departments.
4. Excludes Poland, the Slovak Republic and Turkey.

Source: OECD, GDP and population from National Accounts database; working-age population, labour force and employment from Labour Force database; hours worked from OECD calculations based on Economics Department Working Paper No. 248, 2000; May 2001.

Table D.2.1. **Income and productivity levels in the OECD, 1950-99**

	GDP per capita, United States = 100						GDP per hour worked, United States = 100					
	1950	1960	1973	1987	1992	1999	1950	1960	1973	1987	1992	1999
Canada	80	82	87	89	82	80	71	75	79	87	79	84
Mexico	27	30	31	28	28	25	30	..	40	..	36	31
United States	100	100	100	100	100	100	100	100	100	100	100	100
Australia	80	81	80	78	76	78	69	71	72	80	79	84
Japan	20	36	69	76	85	74	16	21	48	63	71	74
Korea	10	13	18	33	43	48	12	..	16	26	33	40
New Zealand[1]	92	88	79	66	58	57	..	..	..	..	..	..
Austria	41	61	71	75	80	74	..	..	..	..	..	..
Belgium	59	64	76	76	81	76	49	53	75	101	108	110
Czech Republic	49	61	57	53	44	40	..	..	..	..	..	..
Denmark	78	85	90	85	82	79	58	62	85	92	90	93
Finland	46	58	70	75	68	72	32	37	59	70	73	82
France[2]	51	63	74	73	76	69	39	47	68	91	96	97
Germany	42	71	75	77	80	72	..	..	..	..	92	94
Greece	22	31	51	47	48	46	20	..	45	57	57	56
Hungary	34	42	44	41	33	34	..	..	..	..	..	..
Iceland[1]	..	..	77	95	83	82	..	..	..	..	..	..
Ireland	40	43	46	50	59	79	34	..	48	67	80	96
Italy	38	54	66	72	74	67	39	48	80	99	103	106
Luxembourg	..	..	95	94	114	126	..	..	..	..	..	..
Netherlands	63	75	80	74	78	76	52	61	87	103	109	109
Norway	54	61	65	80	80	82	50	..	70	94	103	108
Poland	28	32	35	29	23	28	..	..	..	..	..	..
Portugal	22	27	45	43	51	50	21	..	44	47	50	53
Slovak Republic	..	..	..	..	..	32	..	..	..	..	..	..
Spain	26	32	55	52	56	56	23	..	51	74	77	76
Sweden	70	77	81	78	74	70	49	54	75	81	80	84
Switzerland[1]	103	121	119	100	100	85	76	80	91	92	94	91
Turkey[1]	16	20	19	21	21	19	..	..	..	..	..	..
United Kingdom	67	72	68	67	65	65	59	58	69	83	82	87

1. GDP estimates for Iceland, New Zealand, Switzerland and Turkey are based on the SNA68.
2. Includes overseas departments.

Source: 1999 levels from Annex Table D.1.1; GDP, population and employment from ADB database; hours worked from *OECD Employment Outlook*, various issues; earlier years based on Angus Maddison (1995), *Monitoring the World Economy, 1820-1992*, Development Centre Studies, OECD, Paris.

Table D.3.1. **Recent trends in productivity growth, 1980-99**

	Trend growth in GDP per hour worked				Trend growth in multi-factor productivity			
	Total economy, percentage change at annual rate				Business sector, percentage change at annual rate[4]			
	1980-90[1]	1990-99[2,3]	1990-95[2]	1995-99[3]	1980-90[5]	1990-99[6,7]	1990-95[6]	1995-99[7]
Canada	1.1	1.3	1.3	1.4	0.5	1.2	1.1	1.3
Mexico	..	-0.6	-1.0	-0.1	..	..	..	..
United States	1.3	1.6	1.3	2.0	0.9	1.1	1.0	1.2
Australia	1.2	2.0	1.8	2.2	0.5	1.4	1.4	1.5
Japan	3.2	2.5	2.6	2.2	2.1	1.2	1.3	0.9
Korea	6.3	5.1	5.3	4.7	..	..	..	..
New Zealand	..	0.7	0.5	0.9	0.7	0.9	1.0	0.7
Austria	..	..	..	2.9	..	..	..	..
Belgium	2.4	2.3	2.3	2.4	1.7	1.4	1.3	1.6
Czech Republic	..	..	..	1.7	..	..	..	..
Denmark	1.7	1.8	1.9	1.6	0.9	1.5	1.5	1.5
Finland	2.8	2.9	3.0	2.8	2.3	3.3	3.0	3.6
France	2.7	1.8	1.8	1.6	1.8	1.0	0.9	1.1
Germany	2.3	2.0	2.2	1.8	1.5	1.1	1.1	1.1
Greece	1.3	1.4	0.9	2.0	..	..	..	..
Hungary	..	2.7	2.7	2.7	..	..	..	..
Iceland	..	1.5	1.3	1.6	..	1.3	1.2	1.4
Ireland	3.6	4.3	4.0	4.6	3.6	4.5	4.4	4.6
Italy	2.6	2.0	2.3	1.6	1.5	1.1	1.2	0.8
Luxembourg	..	5.1	5.5	4.6	..	..	..	..
Netherlands	2.9	1.8	1.9	1.7	2.3	1.7	1.9	1.5
Norway	2.6	2.6	3.1	2.0	1.2	1.7	2.1	1.2
Portugal	..	2.3	2.4	2.2	..	..	..	..
Spain	3.2	1.4	2.0	0.7	2.3	0.7	0.9	0.5
Sweden	1.2	1.7	1.8	1.6	0.7	1.3	1.3	1.3
Switzerland	..	0.8	0.6	1.2	..	..	..	..
United Kingdom	2.3	1.9	1.9	1.9	2.2	0.9	0.8	1.0

1. Data for Belgium, Denmark, Greece and Ireland refer to 1983-90.
2. Data for Germany, Hungary, Iceland, Mexico and Switzerland start in 1991.
3. Data for France, Japan, Korea, Portugal and Switzerland end in 1998.
4. Adjusted for hours worked, based on trend series and time-varying factor shares.
5. Data for Belgium, Denmark, Ireland refer to 1983-90, for New Zealand to 1987-90.
6. Data for Germany and Iceland start in 1991.
7. Data for Austria, Belgium, Italy and New Zealand end in 1997. Data for Australia, Denmark, France, Ireland, Japan, Netherlands and United Kingdom end in 1998.

Source: OECD calculations, based on data from the *OECD Economic Outlook No. 68*. See Economics Department Working Paper No. 248, 2000 for details; May 2001.

Table D.4.1. **Value added and employment by industry, 1998**

Identifying high value added industries

		United States			Japan			European Union[1]		
	ISIC Rev. 3	Employment share	Value added share	Relative labour productivity[2]	Employment share	Value added share	Relative labour productivity[2]	Employment share	Value added share	Relative labour productivity[2]
Total non-agriculture business sector[3]	10-67,71-74	100.0	100.0	1.0	100.0	100.0	1.0	100.0	100.0	1.0
Mining and quarrying	10-14	0.7	1.8	2.7	0.2	0.3	1.8	0.4	1.0	2.5
Manufacturing :										
Food, drink, tobacco	15-16	1.9	2.3	1.2	4.1	3.3	0.8	3.7	3.7	1.0
Textiles, clothing	17-19	1.6	1.0	0.6	3.2	1.1	0.3	2.7	1.9	0.7
Paper, printing	21-22	2.6	2.7	1.1	2.7	3.0	1.1	2.5	2.8	1.1
Petroleum refining	23	0.1	0.6	3.9	0.1	0.9	8.9	0.2	0.6	3.8
Chemicals	24	1.1	3.1	2.7	1.2	2.9	2.4	1.7	2.9	1.7
Rubber, plastics	25	1.1	1.0	0.9	0.5 [4]	0.4 [4]	0.9 [4]	1.4	1.4	1.0
Non-metallic minerals	26	0.6	0.7	1.1	1.3	1.2	0.9	1.3	1.4	1.1
Basic metals and metal products	27-28	2.4	2.8	1.2	3.9	4.2	1.1	4.0	4.0	1.0
Machinery and equipment	29-33	5.2	7.0	1.3	9.7	10.9	1.1	6.3	6.9	1.1
Transport equipment	34-35	2.1	3.0	1.5	3.4	3.6	1.1	2.7	3.3	1.2
Wood and other manufacturing	20,36-37	2.1	1.7	0.8	3.7 [4]	2.4 [4]	0.7 [4]	2.6	1.9	0.8
Electricity, gas and water supply	40-41	0.9	3.2	3.4	1.0	4.5	4.3	1.1	3.4	3.1
Construction	45	8.4	6.9	0.8	16.4	14.5	0.9	10.7	8.2	0.8
Services :										
Wholesale and retail trade, hotels, restaurants	50-55	38.4	24.4	0.6	26.2 [5]	17.6 [5]	0.7 [5]	30.4	22.3	0.7
Transport and storage	60-63	5.1	5.1	1.0	7.8	6.9	0.9	6.4	7.0	1.1
Post and telecommunications	64	2.7	5.1	1.9	1.1	3.0	2.7	2.2	3.7	1.7
Finance and Insurance	65-67	6.7	12.8	1.9	4.7	8.2	1.8	5.0	8.1	1.6
Business services	71-74	16.3	14.9	0.9	8.9	11.2	1.3	14.6	15.5	1.1

1. European Union does not include Belgium, Ireland, Luxembourg and Portugal. Value added aggregated after applying 1998 US dollar purchasing power parities.
2. Industry labour productivity level (defined as value added at current prices/employment) relative to labour productivity for total non-agriculture business sector (equals value added share/employment share).
3. Non-agriculture business sector consists of all industries except "Agriculture, hunting, forestry and fishing" (ISIC 01-05), "Real estate activities" (ISIC 70) and "Community, social and personal services" (includes mainly non-market activities such as public administration, education and health, ISIC 75-99).
4. Plastics included in other manufacturing.
5. Hotels and restaurants not included.

Source: OECD, STAN and National Accounts databases, 2001; *Services: Statistics on Value Added and Employment : 2001 Edition* (forthcoming), May 2001.

Table D.4.2. **Labour productivity growth by industry, 1995-98**

Annual average growth rate

		United States			Japan			European Union[1]		
	ISIC Rev. 3	Employment	Real value added	Labour productivity	Employment	Real value added	Labour productivity	Employment	Real value added	Labour productivity
All industries	01-95	2.1	4.6	2.4	0.3	1.5	1.2	1.0	2.4	1.4
Total non-agriculture business sector[2]	10-67,71-74	2.5	5.9	3.3	-0.3	1.4	1.7	1.2	2.6	1.4
Mining and quarrying	10-14	0.7	3.7	3.1	-3.9	-0.9	3.1	-3.5	-1.5	2.1
Manufacturing :										
Food, drink, tobacco	15-16	0.2	-5.4	-5.6	-1.3	-2.1	-0.8	0.3	0.0	-0.4
Textiles, clothing	17-19	-5.3	-3.9	1.6	-4.8	-3.8	1.0	-1.7	-1.4	0.4
Paper, printing	21-22	0.0	-0.4	-0.4	-1.7	-2.1	-0.4	0.1	1.5	1.3
Petroleum refining	23	-1.4	-0.4	1.1	-0.7	3.9	4.6	-1.9	0.9	2.8
Chemicals	24	0.1	2.6	2.5	-0.5	0.7	1.1	-0.9	1.3	2.3
Rubber, plastics	25	1.3	4.6	3.2	-2.1 [3]	-3.4 [3]	-1.4 [3]	1.6	3.3	1.7
Non-metallic minerals	26	1.1	3.1	1.9	-1.9	-2.1	-0.2	-0.5	-0.1	0.4
Basic metals and metal products	27-28	1.2	2.5	1.4	-1.6	-2.7	-1.1	0.4	1.0	0.6
Machinery and equipment	29-33	1.8	14.5	12.4	-0.7	4.7	5.5	0.1	3.0	2.9
Transport equipment	34-35	2.2	2.5	0.4	-0.4	-1.9	-1.5	2.0	4.3	2.3
Wood and other manufacturing	20,36-37	1.3	0.5	-0.8	-2.1 [3]	0.1 [3]	2.2 [3]	-0.1	1.0	1.1
Electricity, gas and water supply	40-41	-2.0	-1.6	0.4	0.8	4.3	3.5	-2.6	2.1	4.8
Construction	45	4.5	4.9	0.4	-0.1	-2.0	-1.9	-0.6	-0.4	0.3
Services :										
Wholesale and retail trade, hotels, restaurants	50-55	1.6	8.5	6.8	0.3 [4]	1.1 [4]	0.8 [4]	1.4	2.4	1.0
Transport and storage	60-63	3.2	4.5	1.3	0.4	-3.4	-3.8	0.8	3.0	2.2
Post and telecommunications	64	2.4	4.5	2.1	0.4	17.7	17.3	-1.1	7.6	8.7
Finance and Insurance	65-67	2.6	7.5	4.8	-1.4	0.6	2.0	0.5	3.1	2.6
Business services	71-74	6.3	7.0	0.6	2.2	6.4	4.1	5.8	5.6	-0.2

1. European Union does not include Belgium, Ireland, Luxembourg and Portugal. Real value added levels aggregated after applying 1995 US dollar purchasing power parities.
2. Non-agriculture business sector consists of all industries except "Agriculture, hunting, forestry and fishing" (ISIC 01-05), "Real estate activities" (ISIC 70) and "Community, social and personal services" (includes mainly non-market activities such as public administration, education and health, ISIC 75-99).
3. Plastics included in other manufacturing.
4. Hotels and restaurants not included.

Source: OECD, STAN and National Accounts databases, 2001 ; *Services: Statistics on Value Added and Employment : 2001 Edition* (forthcoming), May 2001.

Table D.5.1. **Share of value added in total gross value added,[1] current prices**

Percentages

		Technology- and knowledge-intensive industries							
		High-technology manufactures	Medium-high-technology manufactures	Post and telecommunications services	Finance and insurance services	Business services (excluding real estate activities)[2]	Total	Education and health	Total including education and health
	ISIC Rev. 3	2423, 30, 32, 33, 353	24 less 2423, 29, 31, 34, 352+359	64	65-67	71-74		80, 85	
Canada	1997	2.0	5.3	3.0	5.4	5.5	21.1	12.2	33.3
Mexico	1998	2.4	5.9	1.5	3.0	5.7	18.5	8.7	27.1
United States	1998	3.7	4.8	3.4	8.3	9.8	30.0	11.6	41.6
Australia	1998	5.7 [3]	→	3.1	6.8	..	..	10.8	..
Japan	1998	3.6	7.1	1.9	5.2	7.0	24.8	..	..
Korea	1998	5.6	7.0	2.3	7.0	4.2	26.1	7.8	33.9
New Zealand	1996	3.7 [3,4]	→	3.3	5.7	5.1	17.8	..	..
Austria	1998	2.1	5.2	2.3	6.8	7.5	23.9	9.7	33.6
Belgium	1998	8.3 [3,4]	→	1.6	6.9	..	..	12.6	..
Czech Republic	1997	1.4	8.3	2.7	4.1	6.5	23.1	7.0	30.1
Denmark	1998	2.0	4.4	2.4	5.0	7.3	21.2	15.4	36.6
Finland	1998	4.5	5.5	2.7	3.7	5.8	22.1	12.7	34.9
France	1998	2.5	4.9	2.1	4.7	12.3	26.4	11.7	38.1
Germany	1998	2.1	9.6	2.4	4.8	12.1	31.0	10.3	41.2
Greece	1998	0.6	1.2	2.5	4.4	3.0	11.8	10.4	22.1
Hungary	1998	3.5	6.8	3.8	4.1	7.7	25.9	9.1	35.0
Iceland	1997	1.6 [3]	→	2.0	5.9	4.3	13.7	..	..
Ireland	1997	7.6	8.8	2.6	3.9	..	..	10.7	..
Italy	1998	1.6	5.6	2.1	6.0	7.9	23.3	9.5	32.8
Netherlands	1998	6.2 [3,4]	→	2.4	5.9	11.5	25.9	11.3	37.2
Norway	1997	0.9	2.6	2.1	3.9	5.7	15.1	12.9	28.0
Portugal	1997	1.2	3.2	2.9	5.8	..	..	11.9	..
Slovak Republic	1998	7.9 [3,4]	→	3.0	4.8	5.1	20.8	7.6	28.5
Spain	1998	1.3	5.1	2.7	5.3	5.5	19.9	10.1	30.1
Sweden	1998	3.5	6.5	2.8	3.5	8.5	24.8	..	..
Switzerland	1998	11.5 [3,4]	→	2.7	14.3	7.5	36.0	..	..
United Kingdom	1998	3.0	5.1	2.8	5.9	11.2	28.1	11.6	39.8
European Union[5]	1998	2.2	6.2	2.4	5.3	10.0	26.1	10.9	37.0
Total OECD[5]	1998	3.1	5.7	2.7	6.5	9.0	27.0	..	..

1. Value added measured at basic prices; for Canada, United States, Japan, Korea and Iceland measured 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. European Union does not include Luxembourg; OECD does not include Luxembourg, Poland and Turkey.

Source: OECD, STAN and National Accounts databases, 2001; *Services: Statistics on Value Added and Employment : 2001 Edition* (forthcoming), May 2001.

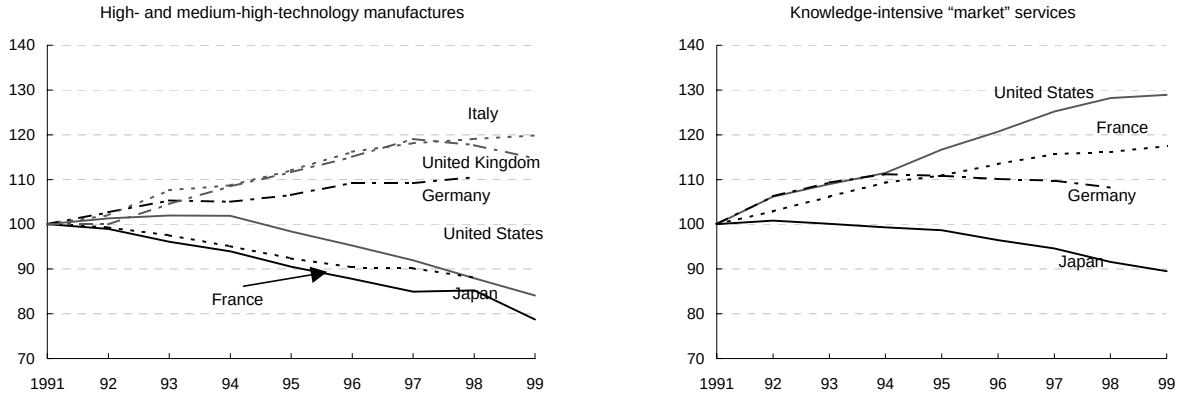
Table D.5.2. **Real value added in technology and knowledge-intensive industries**

1995 = 100

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Real value added										
High- and medium-high-technology manufactures										
United States[1]	80.1	77.7	79.2	83.1	91.4	100.0	105.9	116.6	128.6	141.7
Japan[2]	91.7	99.9	97.5	93.4	92.2	100.0	107.1	113.4	108.3	115.3
Germany[2]	..	112.2	109.6	96.0	99.1	100.0	98.1	101.9	104.5	..
France[3]	..	84.4	87.3	83.2	90.8	100.0	101.6	111.2	115.3	..
Italy[2]	96.8	94.4	93.1	86.8	92.6	100.0	99.4	102.4	103.1	104.2
United Kingdom[2]	93.4	89.4	89.4	90.8	96.8	100.0	102.3	103.7	107.4	110.3
Knowledge-intensive "market" services										
United States[1]	87.1	87.4	89.3	93.2	95.7	100.0	104.7	113.2	121.7	131.6
Japan[2]	79.8	85.2	89.0	90.5	95.9	100.0	105.9	112.1	118.1	125.0
Germany[2]	..	87.3	91.0	95.3	96.1	100.0	104.5	110.4	117.3	..
France[3]	100.1	99.6	100.8	100.6	100.0	100.0	103.4	104.5	107.6	112.1
Italy[2]	..	90.7	91.8	96.7	97.4	100.0	104.7	110.0	112.6	115.1
United Kingdom[2]	87.7	86.4	85.2	88.2	91.3	100.0	107.0	114.6	124.3	130.6
Implicit deflators										
High- and medium-high-technology manufactures										
United States[4]	98.3	101.6	103.0	103.7	103.6	100.0	96.8	93.4	89.4	85.5
Japan[4]	113.6	110.5	109.3	106.2	103.8	100.0	97.0	93.9	94.2	87.0
Germany	..	93.9	96.4	98.9	98.6	100.0	102.6	102.5	103.8	..
France[4]	..	108.3	107.5	105.6	102.9	100.0	97.8	97.6	95.4	..
Italy	86.6	89.2	91.1	96.0	97.0	100.0	103.7	105.4	106.2	106.9
United Kingdom	89.7	89.6	89.6	93.6	97.1	100.0	103.0	106.6	105.4	102.7
Knowledge-intensive "market" services										
United States	81.2	85.7	91.0	93.4	95.5	100.0	103.4	107.3	109.9	110.5
Japan	100.0	101.4	102.2	101.4	100.6	100.0	97.8	95.9	92.8	90.7
Germany	..	90.2	95.9	98.7	100.4	100.0	99.3	99.1	97.6	..
France	86.6	90.2	92.8	95.7	98.6	100.0	102.3	104.3	104.7	105.9
Italy	..	..	94.3	95.5	93.6	100.0	105.7	108.1	110.4	111.3
United Kingdom	..	..	..	..	..	..	..	..	..	..

1. Based on annually reweighted chained Fisher volumes.
2. Based on fixed-weight Laspeyres volumes, 1995 base year.
3. Based on annually reweighted 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 2001.

Table D.6. **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	1997	2.5	4.5	18.9	3.4	5.4	13.7	7.5	21.7	22.3
Mexico	1998	5.2	1.3	21.1	1.2	4.6	19.8	10.7	19.1	17.1
United States	1998	1.6	1.1	16.9	2.1	4.5	15.9	6.7	28.1	23.0
Australia	1998	3.3	4.3	13.5	2.0	6.1	13.7	9.2	28.8	19.1
Japan	1998	1.7	0.2	21.2	2.8	9.1	11.0 [2]	6.2	26.1	21.8
Korea	1998	5.2	0.5	28.7	2.5	10.0	10.2	7.2	19.2	16.4
New Zealand	1996	7.5	1.2	18.9	2.7	3.8	16.6	8.7	23.7	16.9
Austria	1998	2.3	0.3	20.2	2.6	8.2	16.6	7.3	22.1	20.4
Belgium	1998	1.5	..	19.6 [3]	2.9	4.7	13.2	6.9	27.6	23.5
Czech Republic	1998	4.2	1.7	26.8	4.0	6.9	15.6	8.4	18.0	14.5
Denmark	1998	2.8	0.8	17.1	2.2	4.8	14.7	8.0	23.0	26.6
Finland	1998	3.7	0.3	25.0	2.3	5.0	12.0	10.0	20.5	21.3
France	1998	3.2	0.2	17.9	2.2	4.3	13.3	6.1	29.2	23.6
Germany	1998	1.2	0.3	22.5	2.3	5.6	11.9	5.7	29.2	21.4
Greece	1998	8.1	0.6	11.6	2.2	7.5	21.8	6.5	21.4	20.3
Hungary	1998	5.5	0.3	24.1	3.9	4.6	13.5	9.9	19.0	19.3
Iceland	1997	9.4	0.0	17.0	3.8	7.5	13.2	8.0	19.8	21.3
Ireland	1998	4.7	0.6	30.7	1.5	6.1	13.2	5.7	19.9	17.6
Italy	1998	3.0	0.4	21.3	2.2	4.8	16.8	7.4	24.7	19.3
Luxembourg	1998	0.7	0.1	13.4	1.3	5.7	12.4	9.8	39.0	17.4
Netherlands	1998	3.0	2.4	17.0	1.7	5.4	14.9	7.5	25.5	22.6
Norway	1997	2.2	17.7	12.4	2.7	4.3	12.0	10.3	17.5	21.0
Poland	1998	4.8	2.9	21.5	3.2	8.7	21.8	6.4	13.3	17.5
Portugal	1998	4.0	0.3	19.3	2.7	7.3	17.9	6.6	17.8	24.1
Slovak Republic	1998	5.1	0.9	23.5	3.6	7.4	16.4	10.8	16.2	16.1
Spain	1998	4.1	0.4	18.9	2.7	7.4	18.5	8.3	19.0	20.5
Sweden	1998	2.0	0.3	21.5	2.5	4.1	11.7	7.9	24.3	25.6
Switzerland	1998	1.6	0.2	21.7	2.3	4.8	15.1	5.9	28.7	19.7
Turkey	1998	17.0	..	22.3 [3,4]	..	5.8	19.4	13.2	9.4	13.0
United Kingdom	1998	1.2	1.9	19.3	2.0	5.0	14.8	7.9	26.3	21.6
European Union	1998	2.5	0.7	20.1	2.2	5.4	14.6	7.0	26.0	21.6
Total OECD	1998	2.6	1.1	19.3	2.3	5.7	14.8	7.1	25.7	21.5

1. Value added measured at basic prices except for Canada, United States, Japan, Korea and Iceland -- measured at factor costs.
2. Hotels and restaurants is included in Community, social and personal services.
3. Includes Mining and quarrying.
4. Includes Electricity, gas and water.

Source: OECD, STAN and National Accounts databases, May 2001.

Table D.7.1. **Manufacturing trade[1] by industry, total OECD[2]**

	Share in total manufacturing[3]													Index[4] 1990=100
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average annual growth 1990-95	Average annual growth 1995-99	Average annual growth 1990-99	1999
High-technology industries	18.8	19.8	19.8	20.7	21.0	21.3	21.8	22.8	24.0	25.3	2.5	4.4	3.3	216
Aircraft and spacecraft	1.7	1.9	2.1	2.2	2.2	2.3	2.4	2.5	2.7	2.9	5.9	6.5	6.2	275
Pharmaceuticals	5.0	5.1	5.1	5.5	5.6	5.9	6.0	6.3	6.4	6.6	3.3	2.8	3.1	212
Office, accounting and computing machinery	5.4	5.6	5.7	6.3	6.9	7.4	7.3	7.5	7.7	8.5	6.4	3.5	5.1	252
Radio, television and communication equipment	3.3	3.6	3.4	3.0	2.7	2.2	2.4	2.9	3.4	3.4	-7.4	11.4	0.5	169
Medical, precision and optical instruments	3.5	3.6	3.6	3.7	3.6	3.5	3.7	3.7	3.7	3.9	0.3	2.3	1.2	179
Medium-high-technology industries	38.7	38.3	38.6	38.2	38.8	38.9	39.3	39.1	39.1	39.1	0.1	0.1	0.1	162
Electrical machinery and apparatus, n.e.c.	9.4	9.3	9.1	9.1	9.3	9.6	9.3	9.2	8.9	8.7	0.4	-2.3	-0.8	149
Motor vehicles, trailers and semi-trailers	11.9	11.6	11.4	11.0	11.0	11.2	11.4	11.2	11.1	10.5	-1.1	-1.6	-1.3	142
Chemicals excluding pharmaceuticals	3.7	3.8	4.1	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.1	1.7	3.0	210
Railroad equipment and transport equipment, n.e.c.	13.2	13.1	13.5	13.2	13.4	13.0	13.4	13.4	13.8	14.4	-0.3	2.6	1.0	175
Machinery and equipment, n.e.c.	0.5	0.6	0.6	0.7	0.7	0.6	0.5	0.5	0.6	0.6	2.9	1.8	2.4	199
Medium-low-technology industries	17.9	17.2	16.5	16.2	15.8	16.0	15.6	15.4	14.8	14.1	-2.2	-3.1	-2.6	127
Coke, refined petroleum products and nuclear fuel	3.2	2.9	2.5	2.6	2.2	1.9	2.2	2.2	1.6	1.8	-9.8	-1.4	-6.1	91
Rubber and plastic products	2.8	2.8	3.0	2.9	2.9	2.9	2.9	2.9	3.0	2.9	1.2	-0.1	0.6	170
Other non-metallic mineral products	1.8	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.5	1.5	-1.3	-2.6	-1.9	136
Building and repairing of ships and boats	6.9	6.4	5.9	5.8	5.9	6.3	5.7	5.6	5.6	4.8	-1.6	-6.9	-4.0	112
Basic metals	2.7	2.7	2.8	2.6	2.6	2.6	2.6	2.6	2.6	2.6	-0.4	-0.4	-0.4	155
Fabricated metal products, except machinery and equipment	0.6	0.6	0.6	0.7	0.5	0.5	0.5	0.5	0.5	0.5	-2.1	-0.5	-1.4	142
Low-technology industries	24.3	24.3	24.7	24.5	24.1	23.5	23.1	22.4	21.9	21.3	-0.7	-2.3	-1.4	141
Manufacturing, n.e.c. and recycling	7.5	7.7	7.9	7.8	7.6	7.3	7.2	6.9	6.6	6.3	-0.4	-3.7	-1.9	136
Pulp, paper, paper products, printing and publishing	7.8	7.9	8.0	7.9	7.7	7.3	7.3	7.2	7.1	6.8	-1.5	-1.7	-1.6	139
Textiles, textile products, leather and footwear	1.4	1.3	1.4	1.5	1.5	1.4	1.4	1.4	1.3	1.3	0.3	-1.4	-0.5	154
Food products, beverages and tobacco	4.3	4.1	4.1	3.9	3.9	4.3	3.9	3.6	3.6	3.5	0.1	-4.8	-2.1	132
Wood and products of wood and cork	3.3	3.3	3.4	3.5	3.4	3.2	3.3	3.3	3.3	3.4	-0.7	1.7	0.4	166
Total manufacturing[3]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	..	..	..	161

1. Average value of exports and imports.
2. Total OECD excludes Korea, Czech Republic, Hungary, Poland and Slovak Republic.
3. Total may not add to 100% because of residual category.
4. Index of the average value of exports and imports at current prices.

Source: OECD, STAN database, May 2001.

Table D.7.2.1. **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.	
	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Canada	100.0	100.0	11.3	13.0	3.7	3.7	0.3	0.6	2.5	2.4	3.9	4.8	0.9	1.5	42.8	46.2	1.6	2.2	29.2	31.4	6.4	5.5	0.6	0.8	5.0	6.3
Mexico	100.0	100.0	7.0	26.9	1.0	0.5	0.8	0.7	3.8	8.0	0.7	14.7	0.8	3.0	53.0	47.2	3.0	15.3	31.2	21.7	13.1	3.6	0.2	0.6	5.5	6.0
United States	100.0	100.0	32.7	38.3	11.2	9.6	1.5	2.1	7.7	7.7	7.0	12.8	5.3	6.1	39.3	37.1	3.9	4.9	10.4	10.6	11.4	9.5	0.3	0.4	13.2	11.8
Australia	100.0	100.0	8.8	12.6	2.0	1.6	1.2	2.9	2.6	2.9	1.3	2.1	1.8	3.2	14.3	18.9	1.4	2.2	4.1	6.1	4.1	5.2	0.1	0.1	4.5	5.4
Japan	100.0	100.0	30.4	31.3	0.2	0.6	0.6	0.8	8.8	8.2	15.7	16.0	5.1	5.5	51.4	51.4	5.2	6.7	23.8	21.0	6.9	8.3	1.3	1.6	14.2	13.9
Korea	..	100.0	..	34.2	..	0.4	..	0.4	..	7.4	..	23.3	..	2.7	..	26.5	..	2.2	..	9.4	..	8.3	..	0.2	..	6.4
New Zealand	100.0	100.0	1.5	3.1	0.1	0.2	0.4	0.6	0.1	0.3	0.4	1.1	0.5	0.9	8.0	13.8	1.3	2.2	0.5	0.7	3.0	6.4	0.0	0.0	3.2	4.4
Austria	100.0	100.0	10.6	14.4	0.2	1.5	1.9	3.2	1.8	1.7	3.6	5.4	3.1	2.6	39.1	40.6	6.2	6.1	9.6	14.4	6.3	4.7	0.7	1.3	16.3	14.2
Belgium-Luxembourg	100.0	100.0	7.7	12.9	0.7	0.8	1.8	4.6	1.3	2.3	2.8	3.4	1.1	1.8	40.1	42.7	2.5	2.7	18.1	16.1	12.7	16.3	0.3	0.3	6.5	7.3
Czech Republic	..	100.0	..	8.8	..	2.0	..	0.9	..	1.1	..	3.4	..	1.4	..	45.3	..	9.0	..	16.3	..	6.0	..	1.5	..	12.5
Denmark	100.0	100.0	14.8	20.2	1.7	1.2	3.8	6.7	1.9	2.3	3.4	5.6	4.0	4.4	26.3	27.0	2.5	5.0	3.0	2.7	5.1	5.3	0.2	0.2	15.5	13.7
Finland	100.0	100.0	8.8	24.1	0.1	0.1	0.9	0.7	1.3	2.1	4.6	18.6	1.9	2.5	27.1	24.5	3.2	5.3	3.7	3.5	5.3	4.9	0.7	0.1	14.2	10.7
France	100.0	100.0	16.2	23.9	4.7	7.0	2.3	4.0	3.0	3.6	3.4	6.5	2.8	2.7	40.8	40.5	4.1	4.7	14.2	14.4	12.0	11.4	0.4	0.5	10.0	9.5
Germany	100.0	100.0	13.8	18.5	2.4	3.5	1.8	3.2	2.6	2.8	3.3	4.9	3.7	4.1	51.1	51.2	4.7	5.5	16.5	19.2	11.3	10.1	0.3	0.3	18.2	16.1
Greece	100.0	100.0	2.1	6.9	0.3	1.5	1.0	2.0	0.1	0.8	0.4	1.8	0.3	0.8	8.6	14.3	1.8	2.4	0.9	1.3	4.3	6.3	0.0	0.1	1.6	4.2
Hungary	..	100.0	..	26.3	..	0.0	..	1.5	..	13.8	..	9.9	..	1.0	..	40.8	..	9.3	..	20.5	..	4.6	..	0.4	..	6.0
Iceland	100.0	100.0	1.0	2.6	0.8	1.4	0.0	0.4	0.1	0.0	0.0	0.0	0.1	0.8	0.8	2.7	0.1	0.1	0.0	0.2	0.0	0.1	0.0	0.0	0.7	2.3
Ireland	100.0	100.0	35.5	49.2	1.0	0.8	6.1	10.4	21.1	24.1	3.1	10.3	4.3	3.5	20.8	30.0	2.7	3.2	0.7	0.7	11.9	23.7	0.0	0.1	5.5	2.4
Italy	100.0	100.0	10.2	10.6	2.0	1.5	1.2	2.7	2.7	1.5	2.1	2.8	2.1	2.2	37.8	40.1	3.2	3.6	8.4	8.4	5.3	6.0	0.7	1.0	20.1	21.1
Netherlands	100.0	100.0	16.1	30.3	2.1	0.7	1.4	2.8	6.7	14.5	3.3	7.4	2.7	4.8	31.5	28.5	2.5	2.9	4.8	6.3	16.2	12.2	0.3	0.5	7.8	6.6
Norway	100.0	100.0	8.8	11.3	1.5	0.9	1.7	2.3	2.1	2.4	1.8	3.1	1.7	2.5	15.9	20.3	2.4	3.3	2.5	2.9	2.8	4.2	0.2	0.2	8.1	9.7
Poland	..	100.0	..	6.4	..	0.5	..	0.7	..	0.3	..	4.2	..	0.7	..	29.4	..	6.2	..	9.6	..	5.8	..	0.8	..	7.0
Portugal	100.0	100.0	6.1	9.0	0.4	0.5	0.6	1.0	0.6	0.4	3.8	6.2	0.6	0.9	20.7	32.0	4.0	7.0	7.1	15.3	5.4	3.8	0.2	0.4	4.0	5.4
Slovak Republic	..	100.0	..	5.9	..	0.3	..	1.2	..	1.5	..	2.2	..	0.7	..	44.2	..	6.0	..	19.5	..	7.3	..	1.5	..	9.8
Spain	100.0	100.0	8.4	10.1	2.2	1.4	1.5	2.2	2.0	1.8	1.7	3.5	1.0	1.3	43.3	47.3	3.3	4.1	23.2	27.0	7.8	7.7	0.2	0.8	8.7	7.8
Sweden	100.0	100.0	16.0	27.9	1.6	1.6	2.6	5.2	2.8	1.0	5.5	17.1	3.4	3.1	36.9	35.5	3.4	4.3	13.3	13.7	4.6	4.3	0.3	0.3	15.3	12.8
Switzerland	100.0	100.0	26.3	34.5	0.6	1.3	8.8	15.9	1.0	1.8	1.6	1.9	14.3	13.7	44.1	39.4	4.9	5.4	1.2	1.2	14.4	13.2	0.3	0.4	23.3	19.1
Turkey	100.0	100.0	3.5	6.8	0.0	2.5	0.8	0.6	0.2	0.3	2.3	3.3	0.2	0.3	13.6	19.6	1.7	2.9	1.7	6.8	8.4	4.7	0.0	0.1	1.8	5.1
United Kingdom	100.0	100.0	26.3	33.8	8.1	6.8	3.0	4.5	6.7	8.9	4.4	9.5	4.2	4.2	38.2	37.0	3.8	4.4	9.1	11.1	11.7	10.5	0.2	0.2	13.4	10.7
European Union	100.0	100.0	14.8	21.5	3.0	3.2	2.0	3.8	3.6	4.9	3.3	6.4	3.0	3.2	40.8	41.0	3.8	4.4	12.4	13.7	10.4	10.2	0.4	0.5	13.8	12.2
Total OECD[2]	100.0	100.0	19.3	25.4	3.7	3.7	1.8	2.9	4.7	5.6	5.4	9.1	3.7	4.0	41.5	40.8	3.9	4.9	13.9	14.6	9.9	9.2	0.5	0.6	13.4	11.5

1. Share of industries in total manufacturing exports.
2. Total OECD excludes Korea, Czech Republic, Hungary, Poland and Slovak Republic in 1990.

Source: OECD, STAN database, May 2001.

Table D.7.2.1. **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	
	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Canada	18.4	15.0	3.3	1.9	2.0	2.9	0.9	1.1	0.1	0.3	12.1	8.8	27.5	25.8	1.7	3.1	5.9	7.1	13.7	8.7	5.3	5.0	0.9	1.9
Mexico	25.3	9.1	5.9	0.6	1.4	2.0	3.3	1.6	0.5	0.0	14.1	4.9	14.6	16.7	1.2	3.3	1.0	0.4	2.0	1.1	7.4	3.0	3.1	8.8
United States	11.4	10.1	2.3	1.1	2.2	2.7	1.0	0.9	0.4	0.3	5.6	5.1	16.6	14.5	1.8	2.5	1.2	0.8	4.2	3.4	7.0	4.8	2.5	3.0
Australia	42.3	34.7	4.9	4.8	0.9	1.2	0.6	0.8	0.7	2.3	35.1	25.6	34.6	33.7	1.5	1.7	1.8	1.6	1.6	1.9	24.4	23.5	5.4	4.9
Japan	12.7	12.3	0.4	0.3	2.1	2.3	1.2	1.1	2.0	2.5	7.1	6.1	5.5	5.0	1.7	2.1	0.0	0.0	0.9	0.8	0.6	0.5	2.2	1.6
Korea	..	22.1	..	4.0	..	2.5	..	0.6	..	5.3	..	9.7	..	17.2	..	1.7	..	0.1	..	1.4	..	1.6	..	12.5
New Zealand	14.5	12.2	2.6	0.2	1.2	1.9	0.4	0.3	0.1	0.5	10.1	9.3	76.1	70.9	0.9	0.9	4.6	6.3	6.6	4.9	53.6	51.8	10.3	7.1
Austria	22.7	18.3	0.4	0.5	4.7	4.2	3.3	1.9	0.0	0.2	14.2	11.4	27.7	26.7	3.2	3.5	4.6	3.8	7.9	7.8	2.8	4.7	9.2	6.9
Belgium-Luxembourg	24.3	18.2	4.0	3.2	3.4	3.7	2.7	2.0	0.1	0.0	14.2	9.2	27.8	26.2	5.5	5.3	1.0	1.0	3.3	3.1	9.4	9.0	8.5	7.8
Czech Republic	..	24.4	..	1.2	..	4.8	..	5.2	..	0.1	..	13.2	..	21.5	..	4.5	..	2.3	..	3.4	..	3.3	..	7.9
Denmark	15.3	14.0	1.8	1.2	3.8	3.6	1.8	1.7	2.1	1.5	5.9	6.0	43.6	38.9	5.4	5.1	1.7	1.8	3.3	2.6	27.2	21.9	6.0	7.5
Finland	18.4	17.0	1.4	2.4	1.9	1.8	1.1	1.2	3.1	2.6	10.9	9.0	45.7	34.4	1.2	1.0	7.1	6.0	31.7	23.8	2.3	1.9	3.4	1.7
France	18.3	14.2	2.4	1.5	3.1	3.3	2.2	1.8	0.5	0.4	9.9	7.2	24.7	21.0	2.3	2.0	0.7	0.7	3.3	3.0	11.7	10.0	6.8	5.4
Germany	16.3	14.3	1.1	1.0	3.4	3.5	1.8	1.5	0.5	0.5	9.6	7.8	16.6	14.6	2.3	2.0	0.5	0.6	3.4	3.3	4.5	4.4	5.8	4.3
Greece	31.7	31.1	8.1	10.8	1.5	2.6	5.2	4.1	0.2	0.6	16.6	13.0	57.6	47.7	0.8	1.2	0.6	0.4	1.2	1.8	20.1	20.1	35.0	24.1
Hungary	..	11.3	..	1.2	..	2.6	..	1.6	..	0.0	..	5.9	..	21.6	..	2.9	..	1.3	..	1.7	..	6.8	..	8.9
Iceland	16.6	23.2	0.0	0.2	0.2	0.4	0.1	0.1	0.7	3.3	15.6	19.2	81.6	71.5	0.0	0.0	0.0	0.0	0.1	0.3	78.8	70.1	2.7	1.0
Ireland	8.4	3.1	0.5	0.2	2.5	0.9	1.3	0.6	0.1	0.0	4.0	1.4	35.2	17.7	1.7	0.8	0.5	0.3	5.5	5.9	22.9	9.5	4.7	1.2
Italy	18.7	17.7	2.0	1.2	3.3	3.9	4.2	3.9	0.3	0.9	8.8	7.8	33.4	31.4	6.7	6.9	0.5	0.6	2.1	2.3	4.9	5.5	19.1	16.0
Netherlands	21.6	15.5	8.3	5.4	3.2	2.7	1.4	1.0	0.5	0.5	8.3	5.9	30.8	25.8	1.7	1.7	0.5	0.4	4.1	3.9	19.3	15.5	5.0	4.3
Norway	51.1	43.2	11.0	10.6	1.8	1.5	1.2	0.9	10.8	8.9	26.2	21.3	24.3	25.3	1.4	2.2	2.1	1.9	8.9	5.2	10.2	14.6	1.6	1.5
Poland	..	26.5	..	1.7	..	3.6	..	2.9	..	4.0	..	14.2	..	37.6	..	8.6	..	4.1	..	3.3	..	8.4	..	13.2
Portugal	13.0	12.7	3.2	1.6	1.4	2.4	4.3	3.8	0.6	0.1	3.5	4.7	60.2	46.3	2.1	2.2	6.4	4.7	6.1	4.8	6.5	6.3	39.1	28.3
Slovak Republic	..	28.0	..	4.7	..	3.9	..	3.5	..	0.5	..	15.5	..	21.9	..	2.3	..	2.2	..	5.1	..	3.0	..	9.3
Spain	24.4	19.3	5.0	2.2	3.2	3.8	3.7	3.9	1.6	1.4	10.9	8.1	24.0	23.2	2.5	2.6	0.9	0.8	3.2	3.1	9.2	9.3	8.2	7.4
Sweden	19.6	15.3	3.2	2.3	2.5	2.6	1.1	0.9	0.7	0.2	12.2	9.4	27.5	21.3	2.2	2.3	4.5	3.9	16.6	10.9	2.0	2.3	2.2	2.0
Switzerland	11.5	12.5	0.1	0.2	2.5	2.6	0.9	0.9	0.0	0.0	8.0	8.7	18.1	13.6	6.5	4.2	0.4	0.5	2.9	3.1	2.9	2.7	5.5	3.0
Turkey	26.9	20.3	2.8	1.3	1.1	2.8	3.9	4.0	0.6	0.7	18.5	11.4	56.0	53.3	0.4	2.1	0.3	0.3	0.7	0.8	8.6	7.8	46.0	42.3
United Kingdom	16.4	12.8	2.9	2.1	2.8	2.7	1.5	1.2	0.4	0.4	8.9	6.4	18.0	15.8	2.3	2.2	0.2	0.2	3.7	3.3	6.7	5.9	5.2	4.2
European Union	18.5	15.0	2.7	1.9	3.2	3.2	2.2	1.9	0.5	0.5	9.8	7.5	25.1	21.9	3.1	2.9	1.0	1.0	4.5	4.1	8.4	7.5	8.1	6.5
Total OECD[2]	17.1	14.4	2.4	1.7	2.8	2.9	1.8	1.6	0.7	0.9	9.3	7.4	21.7	19.1	2.7	2.8	1.2	1.2	4.4	3.6	7.2	6.0	6.2	5.6

1. Share of industries in total manufacturing exports.
2. Total OECD excludes Korea, Czech Republic, Hungary, Poland and Slovak Republic in 1990.

Source: OECD, STAN database, May 2001.

Table D.7.2.2. **Growth of the value of exports in current dollars by industry group**

Average annual growth rate 1990-99 in percentage

	Total manufacturing	High- and medium-high-technology industries	High-technology industries	Medium-high-technology industries	Medium-low- and low-technology industries	Medium-low-technology industries	Low-technology industries
Canada	8.0	9.1	9.8	8.9	6.6	5.5	7.2
Mexico	26.4	29.4	46.7	24.8	20.4	12.8	28.3
United States	7.9	8.5	9.8	7.2	6.4	6.5	6.3
Australia	5.4	9.1	9.7	8.8	4.0	3.1	5.1
Japan	4.0	4.2	4.4	4.0	3.5	3.7	3.0
New Zealand	3.2	10.1	12.1	9.7	2.3	1.3	2.4
Austria	4.6	5.8	8.2	5.0	3.3	2.1	4.2
Belgium-Luxembourg	4.4	6.2	10.6	5.1	2.6	1.1	3.7
Denmark	3.2	4.8	6.8	3.5	2.0	2.3	1.9
Finland	5.0	8.6	17.5	3.9	2.5	4.1	1.8
France	4.5	5.9	9.1	4.4	2.2	1.6	2.7
Germany	3.1	4.0	6.5	3.2	1.6	1.6	1.7
Greece	2.4	10.6	16.7	8.5	1.0	2.2	0.3
Iceland	3.7	17.2	15.6	19.0	3.2	7.6	2.1
Ireland	13.3	17.6	17.4	18.0	4.3	1.2	4.9
Italy	4.0	4.7	4.6	4.8	3.4	3.4	3.4
Netherlands	3.4	5.9	10.9	2.2	0.7	-0.4	1.4
Norway	2.6	5.4	5.5	5.4	1.5	0.7	3.0
Portugal	4.7	9.8	9.4	9.9	2.3	4.5	1.7
Spain	8.2	9.5	10.5	9.3	6.6	5.4	7.8
Sweden	4.7	6.9	11.4	4.3	1.8	1.9	1.8
Switzerland	3.2	3.8	6.4	2.0	1.8	4.2	0.0
Turkey	9.7	15.1	18.0	14.2	8.2	6.3	9.1
United Kingdom	4.9	6.0	7.9	4.5	2.7	2.0	3.3
European Union	4.4	5.7	8.8	4.4	2.5	2.0	2.8
Total OECD[1]	5.4	6.5	8.7	5.4	3.6	3.1	3.9

1. Total OECD excludes Korea, Czech Republic, Hungary, Poland and Slovak Republic.

Source: OECD, STAN database, May 2001.

Table D.7.2.3. **R&D intensities[1] and export specialisation in high-technology industries,[2] 1999**

	R&D intensity	Export specialisation in high-technology industries
Canada	1.24	13.03
United States	2.95	38.30
Japan[3]	3.18	30.73
Korea	1.29	34.15
Denmark[3]	1.85	18.75
Finland	2.64	24.11
France[3]	2.19	23.10
Germany	2.66	18.52
Ireland[4]	1.12	45.99
Italy	0.79	10.63
Netherlands[4]	1.59	25.14
Norway[4]	1.25	10.66
Spain[3]	0.57	9.29
Sweden[3]	3.85	27.00
United Kingdom[3]	2.06	32.38

1. Manufacturing R&D expenditures/manufacturing production.
2. High-technology exports/manufacturing exports.
3. 1998.
4. 1997.

Source: OECD, STAN and ANBERD databases, May 2001.

Table D.7.3. **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.	
	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Canada	0.0	0.0	-3.7	-4.3	0.5	0.3	-0.4	-0.6	-1.3	-1.4	-1.3	-1.4	-1.3	-1.1	-3.2	-1.4	-1.4	-1.5	2.4	3.8	-0.1	-0.9	0.1	0.1	-4.2	-2.9
Mexico	0.0	0.0	-4.6	2.0	-0.4	0.1	-0.4	-0.2	0.2	2.4	-2.7	-0.2	-1.2	0.0	5.7	2.8	-0.8	2.5	12.8	5.3	0.6	-2.2	-0.3	0.0	-6.6	-2.9
United States	0.0	0.0	5.3	5.0	4.2	3.3	0.3	0.1	0.7	-0.9	-0.9	1.2	1.1	1.2	1.4	0.4	0.0	-0.1	-3.9	-3.3	3.2	2.1	-0.1	-0.1	2.2	1.8
Australia	0.0	0.0	-7.1	-6.6	-1.7	-0.9	-0.5	-0.5	-2.3	-2.1	-1.5	-2.5	-1.1	-0.6	-10.8	-8.7	-1.3	-0.8	-3.1	-3.2	-1.9	-1.2	-0.2	-0.3	-4.3	-3.3
Japan	0.0	0.0	6.6	0.7	-1.1	-1.1	-0.7	-0.8	2.5	-0.2	5.4	2.7	0.6	0.0	14.2	14.4	1.3	1.1	8.7	8.1	-0.3	0.6	0.5	0.5	4.0	4.0
Korea	..	0.0	..	-0.4	..	-0.4	..	-0.3	..	1.3	..	0.2	..	-1.3	..	-1.7	..	-1.4	..	3.6	..	-1.9	..	-0.1	..	-1.9
New Zealand	0.0	0.0	-10.8	-9.5	-3.1	-2.3	-1.3	-1.2	-2.5	-2.5	-2.4	-2.4	-1.5	-1.1	-15.2	-10.9	-1.6	-0.5	-5.7	-5.9	-3.5	-1.7	-0.2	-0.2	-4.2	-2.6
Austria	0.0	0.0	-1.9	-2.5	-0.2	-0.2	-0.2	-0.3	-1.0	-1.1	-0.6	-0.5	0.0	-0.3	-1.4	0.7	0.8	0.4	-1.8	-0.1	-1.4	-1.1	0.0	0.3	0.9	1.2
Belgium-Luxembourg	0.0	0.0	-1.4	-1.2	-0.2	0.0	0.0	0.2	-0.7	-0.6	0.0	-0.3	-0.5	-0.5	-1.0	-0.1	-0.1	-0.3	1.5	0.1	-0.2	1.0	-0.1	-0.1	-2.1	-0.8
Czech Republic	..	0.0	..	-4.7	..	-0.2	..	-1.1	..	-1.2	..	-1.4	..	-0.8	..	2.3	..	0.7	..	3.4	..	-1.6	..	0.4	..	-0.6
Denmark	0.0	0.0	-0.5	0.5	-0.3	-0.1	1.0	2.1	-1.6	-1.9	-0.2	-0.5	0.7	0.9	-3.3	-3.1	-0.5	0.0	-1.5	-2.8	-2.7	-1.5	-0.2	-0.2	1.7	1.3
Finland	0.0	0.0	-4.0	-1.5	-0.8	-1.4	-0.6	-1.0	-1.8	-2.1	-0.2	3.4	-0.7	-0.3	-8.4	-7.2	-0.4	-0.9	-4.0	-3.1	-2.6	-2.3	0.0	-0.2	-1.4	-0.7
France	0.0	0.0	-0.4	0.4	0.8	1.4	0.4	0.3	-0.9	-1.1	-0.5	0.1	-0.2	-0.3	2.0	1.6	0.5	0.3	1.6	1.2	0.6	0.6	0.0	-0.1	-0.8	-0.4
Germany	0.0	0.0	-2.2	-2.6	-0.6	-0.5	0.2	0.4	-1.2	-2.1	-0.9	-0.8	0.3	0.3	9.3	7.4	0.5	0.2	3.4	3.5	0.9	0.4	-0.1	-0.2	4.5	3.6
Greece	0.0	0.0	-3.2	-4.6	-0.5	-0.7	-0.5	-1.0	-0.6	-0.8	-0.8	-1.3	-0.8	-0.8	-10.9	-8.2	-0.2	0.0	-4.0	-4.1	-2.3	-1.0	-0.3	-0.4	-4.1	-2.7
Hungary	..	0.0	..	1.1	..	0.0	..	-0.5	..	3.3	..	-1.2	..	-0.6	..	-1.2	..	1.1	..	3.1	..	-2.1	..	0.1	..	-3.4
Iceland	0.0	0.0	-8.4	-6.4	-3.8	-0.4	-0.9	-1.1	-1.2	-2.0	-1.3	-1.9	-1.2	-0.9	-13.3	-15.6	-2.6	-2.8	-3.4	-5.5	-2.9	-2.4	-0.1	-0.1	-4.2	-4.7
Ireland	0.0	0.0	5.4	2.3	-0.9	-1.4	1.6	3.1	4.8	1.4	-1.0	-1.0	0.8	0.2	-5.3	1.1	-0.4	-0.7	-3.0	-3.3	0.7	7.3	-0.1	-0.1	-2.4	-2.2
Italy	0.0	0.0	-3.5	-4.2	0.1	-0.2	-0.5	-0.4	-0.6	-1.4	-1.6	-1.4	-0.8	-0.7	0.2	-0.1	0.1	0.1	-1.9	-2.9	-3.5	-2.9	0.1	0.1	5.4	5.6
Netherlands	0.0	0.0	-1.5	-1.6	-0.1	-0.2	0.0	-0.2	-0.8	-1.2	-0.4	-0.5	-0.2	0.4	-0.9	-0.9	-0.5	-0.2	-1.7	-1.8	2.2	1.3	-0.2	-0.1	-0.8	-0.1
Norway	0.0	0.0	-2.8	-3.5	-0.9	-0.9	0.1	-0.1	-0.9	-1.5	-0.5	-0.8	-0.5	-0.3	-6.4	-6.8	-0.7	-0.4	-1.7	-2.9	-1.9	-1.2	-0.1	-0.3	-2.0	-1.9
Poland	..	0.0	..	-4.9	..	0.0	..	-1.5	..	-1.7	..	-1.1	..	-0.8	..	-6.3	..	0.7	..	-1.2	..	-2.4	..	0.1	..	-3.5
Portugal	0.0	0.0	-3.1	-3.5	-0.1	-0.5	-0.5	-1.0	-1.2	-1.3	-0.5	0.0	-0.8	-0.8	-12.0	-4.4	0.1	1.6	-4.1	-1.4	-2.4	-2.0	-0.1	-0.2	-5.5	-2.3
Slovak Republic	..	0.0	..	-4.3	..	0.1	..	-1.3	..	-0.9	..	-1.1	..	-1.1	..	-0.3	..	-0.4	..	3.2	..	-0.8	..	0.3	..	-2.7
Spain	0.0	0.0	-5.1	-4.0	-0.5	-0.4	-0.1	-0.4	-1.4	-0.9	-1.6	-1.2	-1.5	-1.0	-0.4	0.6	-0.3	0.1	4.4	2.9	-1.6	-1.0	-0.3	0.1	-2.6	-1.6
Sweden	0.0	0.0	-1.1	1.7	-0.5	-0.3	0.5	1.3	-1.4	-2.3	0.4	3.4	-0.1	-0.3	-0.4	-2.2	-0.7	-0.9	1.6	0.6	-1.8	-2.3	-0.1	-0.1	0.6	0.6
Switzerland	0.0	0.0	5.4	4.2	-0.3	-1.1	3.2	4.0	-1.7	-2.2	-0.8	-1.1	5.1	4.5	3.9	3.2	0.6	0.6	-4.3	-3.8	2.1	1.8	-0.2	-0.1	5.7	4.7
Turkey	0.0	0.0	-5.5	-7.3	-0.9	0.3	-0.6	-1.6	-1.3	-1.6	-1.3	-2.9	-1.5	-1.5	-17.3	-12.9	-1.2	-0.8	-2.9	-1.5	-4.6	-5.6	-0.1	-0.1	-8.4	-4.9
United Kingdom	0.0	0.0	2.2	2.4	1.5	1.0	0.8	0.8	-0.1	-0.2	-0.4	0.4	0.4	0.4	1.9	1.0	0.3	0.2	-1.3	-1.4	1.4	1.4	-0.1	-0.2	1.6	1.0
European Union	0.0	0.0	-1.4	-1.2	0.0	0.0	0.2	0.3	-0.8	-1.2	-0.7	-0.3	-0.1	-0.1	2.3	1.8	0.2	0.1	0.7	0.2	-0.1	0.2	-0.1	-0.1	1.5	1.4
Total OECD[2]	0.0	0.0	0.4	0.1	0.4	0.4	0.1	0.1	-0.3	-0.9	-0.1	0.2	0.2	0.2	2.8	2.0	0.2	0.1	0.7	0.4	0.5	0.4	0.0	0.0	1.5	1.1

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, Czech Republic, Hungary, Poland and Slovak Republic in 1990.

Source: OECD, STAN database, May 2001.

Table D.7.3. **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	
	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Canada	1.9	0.8	0.8	0.5	-0.5	-0.2	-0.4	-0.2	-0.1	0.1	2.7	1.1	-0.6	-0.5	5.0	4.9	-0.5	0.0	2.5	3.2	4.9	2.5	0.4	0.4	-2.3	-1.1
Mexico	3.0	-5.3	0.7	-0.7	-0.7	-2.3	0.9	0.2	0.1	0.0	2.3	-1.0	-0.2	-1.5	-4.1	0.5	-0.5	0.8	0.1	0.0	-1.1	-1.1	-2.0	-0.1	-0.6	0.9
United States	-2.2	-0.9	-1.1	-0.4	0.0	0.3	-0.2	-0.2	0.2	0.1	-0.8	-0.6	-0.2	0.0	-4.6	-4.5	-1.9	-1.8	-0.1	-0.5	0.4	0.5	1.0	0.6	-4.0	-3.3
Australia	12.2	9.1	0.8	1.6	-1.3	-1.0	-0.6	-0.3	0.0	0.5	13.6	8.9	-0.4	-0.5	5.7	6.2	-0.7	-0.7	0.1	0.2	-1.8	-1.1	9.1	8.5	-0.9	-0.7
Japan	-5.7	-0.8	-3.9	-1.9	0.4	0.3	-0.1	0.0	0.8	1.1	-3.1	-0.3	0.2	0.0	-15.1	-14.3	-1.7	-1.0	-1.8	-1.7	-0.8	-0.6	-6.9	-6.5	-3.9	-4.6
Korea	..	0.5	..	-0.2	..	0.6	..	-0.3	..	2.4	..	-2.3	..	0.2	..	1.6	..	0.3	..	-0.4	..	-0.4	..	-1.7	..	3.8
New Zealand	-1.3	-3.1	0.3	-1.1	-1.0	-0.8	-0.7	-0.6	-0.4	-1.7	1.2	1.5	-0.7	-0.4	27.3	23.6	-0.8	-0.9	2.0	2.8	0.7	-0.3	23.9	22.0	1.5	0.0
Austria	2.2	0.4	-0.7	-0.6	0.6	0.1	0.6	-0.1	0.0	0.0	1.3	0.9	0.4	0.1	1.2	1.4	-0.4	-0.2	1.5	1.1	1.5	1.6	-0.5	-0.1	-1.0	-0.9
Belgium-Luxembourg	2.1	1.1	0.2	0.2	0.0	0.0	0.4	0.2	0.0	0.0	1.7	0.9	-0.2	-0.2	0.3	0.2	0.0	-0.2	-0.2	-0.1	-0.6	-0.4	0.9	0.4	0.2	0.4
Czech Republic	..	1.1	..	-0.8	..	-0.6	..	1.5	..	0.0	..	-0.5	..	1.4	..	1.3	..	1.0	..	0.7	..	-0.4	..	-0.6	..	0.6
Denmark	-2.7	-0.9	-0.7	-0.2	0.1	0.0	0.1	-0.1	0.2	0.5	-2.4	-1.1	0.1	0.0	6.4	3.6	1.4	0.9	-0.5	-0.5	-1.5	-1.3	8.1	5.7	-1.2	-1.3
Finland	-0.9	0.8	-1.2	-0.1	-0.9	-0.6	-0.4	-0.1	1.1	1.1	0.9	0.8	-0.4	-0.3	13.3	7.8	-0.7	-0.6	3.1	2.4	14.2	9.8	-0.7	-1.7	-2.5	-2.2
France	-0.5	-0.6	-0.6	-0.3	0.0	0.0	0.1	0.0	0.1	0.0	-0.1	-0.3	0.0	0.0	-1.1	-1.6	-0.6	-0.5	-0.2	-0.1	-0.8	-0.6	1.7	1.1	-1.2	-1.4
Germany	-1.5	-0.5	-1.2	-0.4	0.2	0.2	-0.1	-0.1	0.2	0.1	-0.9	-0.4	0.4	0.1	-6.1	-4.6	-0.3	-0.6	-0.4	-0.3	-0.5	-0.1	-1.5	-1.1	-3.4	-2.5
Greece	4.3	5.5	2.2	3.4	-0.4	0.0	1.2	0.8	-1.1	-0.8	2.8	2.1	-0.4	0.0	9.7	7.3	-0.5	-0.5	-0.5	-0.3	-1.0	-0.9	2.4	3.3	9.3	5.6
Hungary	..	-2.1	..	0.2	..	-1.0	..	-0.1	..	0.0	..	-0.7	..	-0.4	..	2.3	..	0.5	..	0.2	..	-0.9	..	2.1	..	0.4
Iceland	-5.0	-0.1	-4.8	-2.6	-1.8	-1.5	-0.8	-0.7	-0.4	0.3	4.8	6.3	-1.8	-1.9	26.6	22.1	-1.8	-2.0	-1.5	-1.0	-2.4	-1.8	35.2	29.8	-2.9	-2.9
Ireland	-4.1	-3.3	-1.6	-0.8	-0.6	-0.8	-0.3	-0.3	0.0	-0.1	-1.0	-0.7	-0.5	-0.7	3.9	-0.1	-0.2	-0.4	-0.4	-0.3	0.1	1.0	6.8	1.3	-2.3	-1.7
Italy	-0.9	0.5	-0.8	-0.3	0.5	0.6	1.3	1.2	0.0	0.3	-2.9	-2.5	1.1	1.1	4.1	3.8	2.5	2.5	-0.6	-0.5	-0.6	-0.6	-3.0	-1.5	5.8	3.9
Netherlands	0.7	0.8	2.1	1.6	-0.3	-0.2	-0.3	-0.2	0.1	0.1	-0.7	-0.4	-0.2	-0.2	1.6	1.8	-0.6	-0.6	-0.6	-0.5	-0.4	0.0	5.1	3.8	-1.8	-1.0
Norway	8.0	9.2	3.9	4.2	-0.7	-0.8	-0.2	-0.4	-0.7	1.6	6.0	5.2	-0.2	-0.7	1.2	1.1	-0.9	-0.8	0.3	0.0	2.0	0.2	2.9	4.4	-3.2	-2.7
Poland	..	3.5	..	-0.1	..	-0.7	..	0.1	..	1.8	..	1.5	..	0.9	..	7.8	..	3.0	..	1.6	..	-0.6	..	1.6	..	2.1
Portugal	-1.6	-1.3	0.1	-0.2	-0.7	-0.5	1.4	1.0	0.0	0.0	-2.4	-1.7	0.0	0.1	16.7	9.2	0.1	-0.2	2.9	1.7	1.6	0.7	-1.2	-1.7	13.3	8.7
Slovak Republic	..	4.5	..	1.3	..	-0.5	..	0.6	..	0.2	..	3.1	..	-0.2	..	0.1	..	0.1	..	0.7	..	0.7	..	-1.6	..	0.3
Spain	4.3	2.4	1.1	0.3	0.4	0.3	0.9	1.2	0.6	0.4	0.8	-0.1	0.4	0.2	1.2	1.1	0.1	0.2	-0.2	-0.2	-0.3	-0.1	0.5	0.7	1.2	0.5
Sweden	-1.3	-0.7	-0.3	0.0	-0.7	-0.5	-0.6	-0.3	-0.3	0.0	0.7	0.0	0.0	0.0	2.8	1.1	-0.5	-0.3	1.7	1.4	6.5	3.8	-1.4	-1.8	-3.4	-2.1
Switzerland	-3.7	-1.7	-1.8	-0.9	-0.4	-0.2	-0.6	-0.5	-0.1	0.0	-1.0	-0.4	0.2	0.3	-5.7	-5.7	-0.9	-1.0	-0.5	-0.3	-1.0	-1.0	-0.8	-1.0	-2.4	-2.4
Turkey	3.1	1.3	-0.3	-1.2	-0.4	0.1	1.1	1.4	-0.2	0.0	2.9	0.8	0.0	0.3	19.7	18.9	-0.1	0.4	0.0	0.0	-0.7	-1.1	0.4	2.2	20.1	17.5
United Kingdom	0.5	0.6	0.2	0.4	0.0	0.0	0.0	0.1	0.1	0.2	0.1	-0.2	0.0	0.1	-4.9	-4.2	-0.5	-0.6	-1.0	-0.5	-1.0	-0.4	-0.9	-0.8	-1.6	-1.9
European Union	-0.2	0.1	-0.3	0.0	0.0	0.1	0.2	0.2	0.1	0.1	-0.5	-0.4	0.2	0.1	-0.9	-0.9	0.0	-0.1	-0.2	-0.1	0.0	0.1	0.0	0.0	-0.7	-0.7
Total OECD[2]	-0.8	-0.1	-0.7	-0.2	0.0	0.0	0.0	0.0	0.2	0.3	-0.3	-0.2	0.1	0.0	-2.6	-2.1	-0.6	-0.6	-0.2	-0.2	0.1	0.1	-0.3	-0.2	-1.6	-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, Czech Republic, Hungary, Poland and Slovak Republic in 1990.

Source: OECD, STAN database, May 2001.

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