D.1. Differences in income and productivity

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

Comparisons of income and productivity levels

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

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

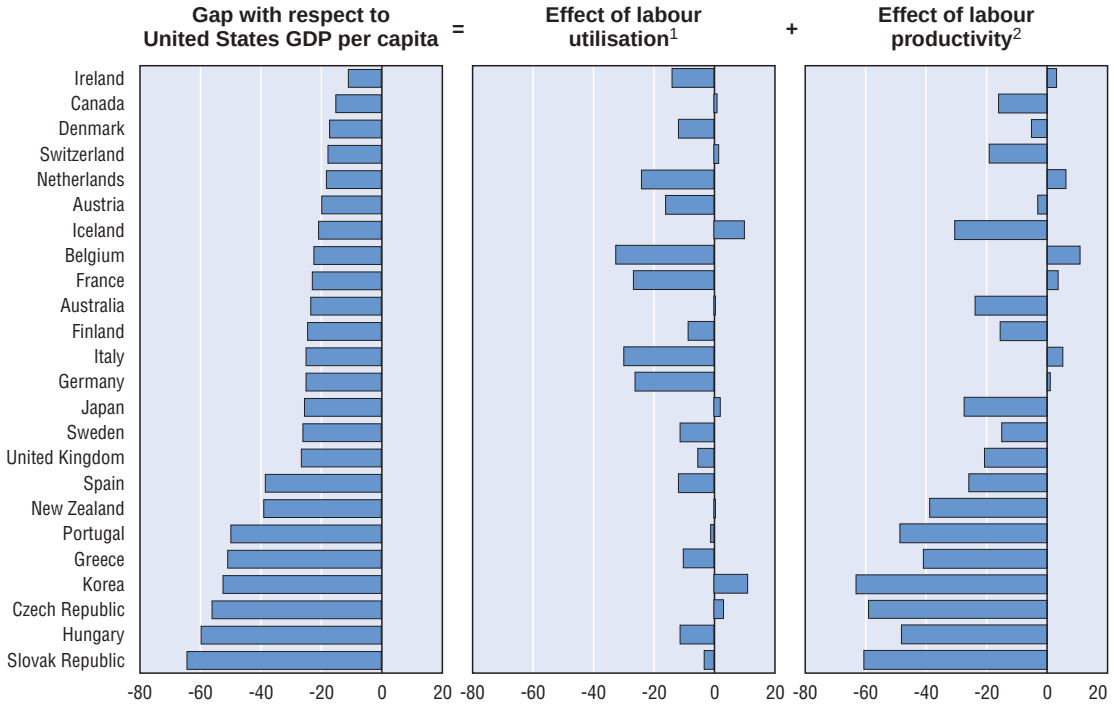
Third, international comparisons require price ratios to convert output expressed in a national currency into a common unit. Exchange rates are of limited use for this purpose because they are volatile and reflect many influences, including capital movements and trade flows. The alternative is to use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

For more details, see Annex Table D.1.

D.1. Differences in income and productivity

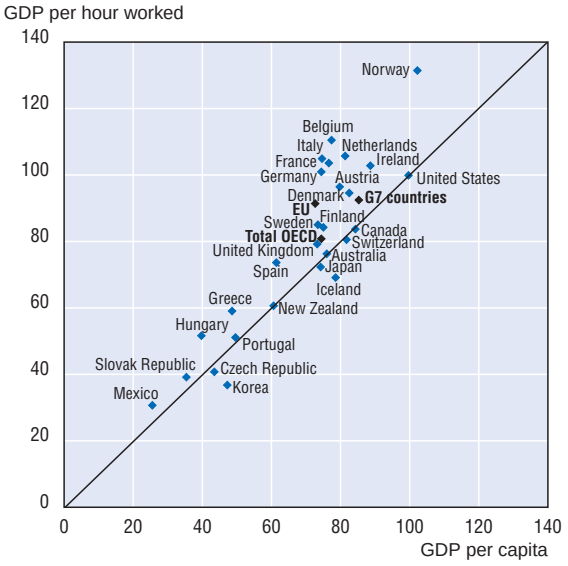
Income and productivity levels, 2002

Percentage point differences with respect to the United States



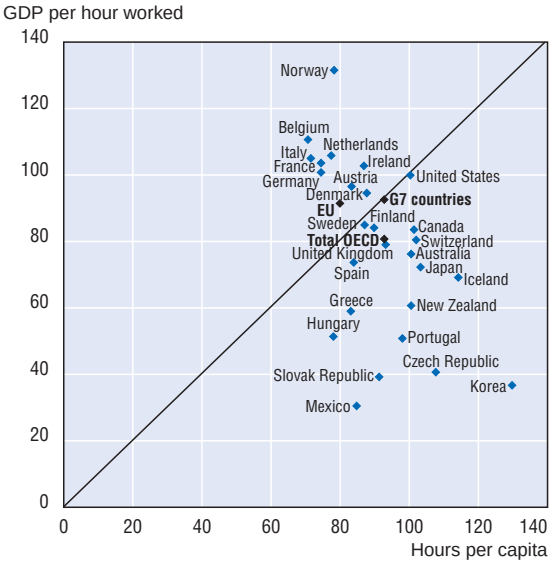
GDP per capita and GDP per hour worked

United States = 100



GDP per hour worked and hours per capita

United States = 100



Note: Total OECD excludes Poland and Turkey.

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

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

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

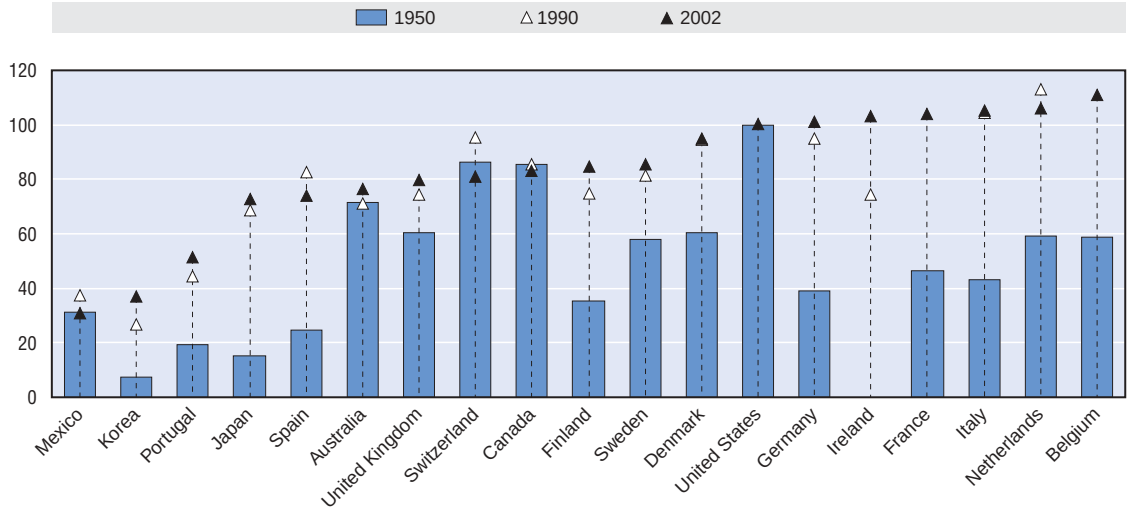
- Cross-country differences in GDP per capita and labour productivity in the OECD area have eroded considerably since the 1950s. Over the 1950s and 1960s, income levels in OECD countries were catching up with those of the United States except in Australia, New Zealand and the United Kingdom. In the 1970s,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

Income and productivity levels over time

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

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

United States = 100

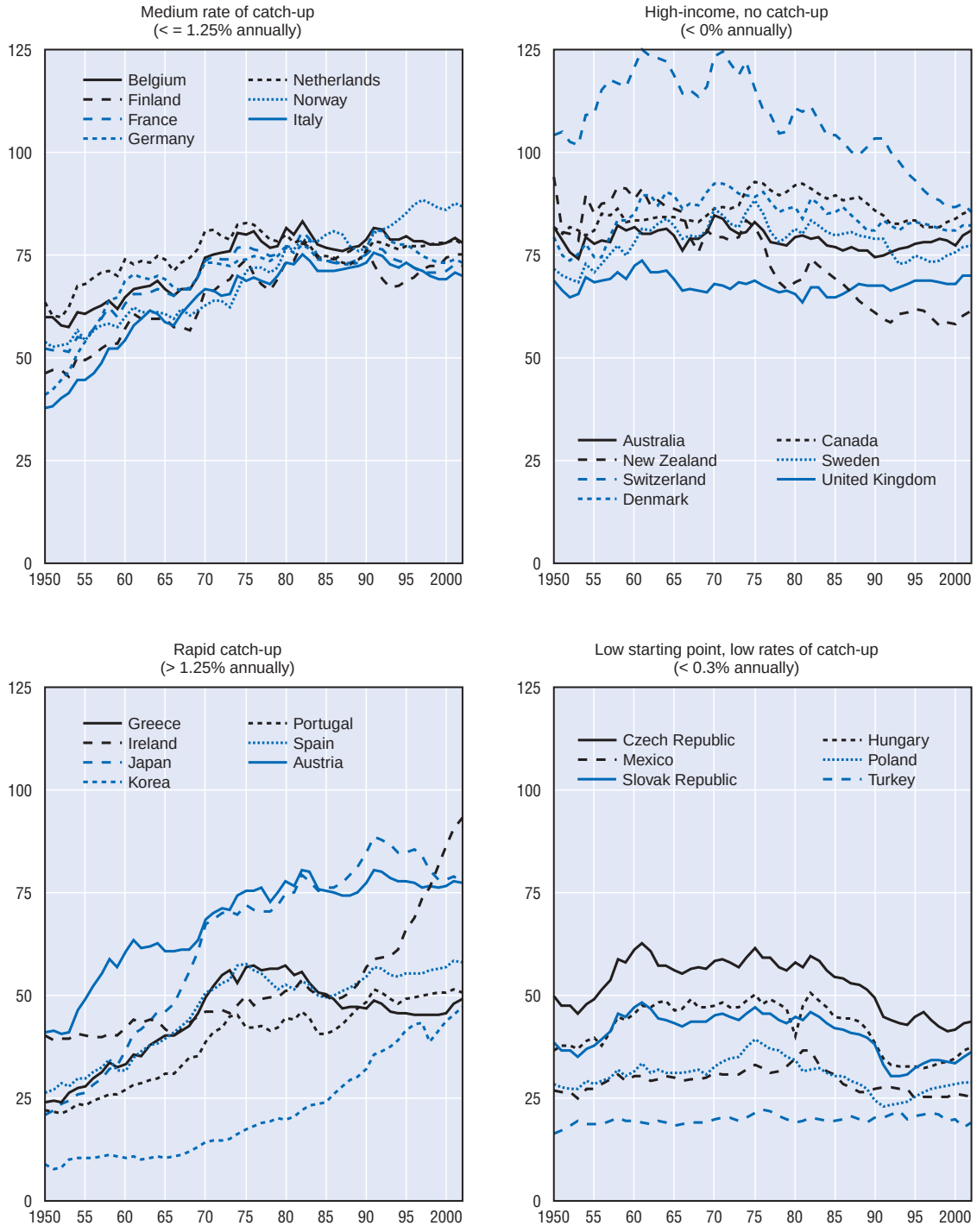


Source: 2002 productivity levels from Annex Table D.1; previous years based on GDP, employment and hours worked from the OECD productivity database and Angus Maddison (2001), *The World Economy: A Millennial Perspective*, Development Centre Studies, OECD, Paris.

For more details, see Annex Table D.2.

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

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



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

D.3. Labour productivity growth

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

OECD measures of productivity

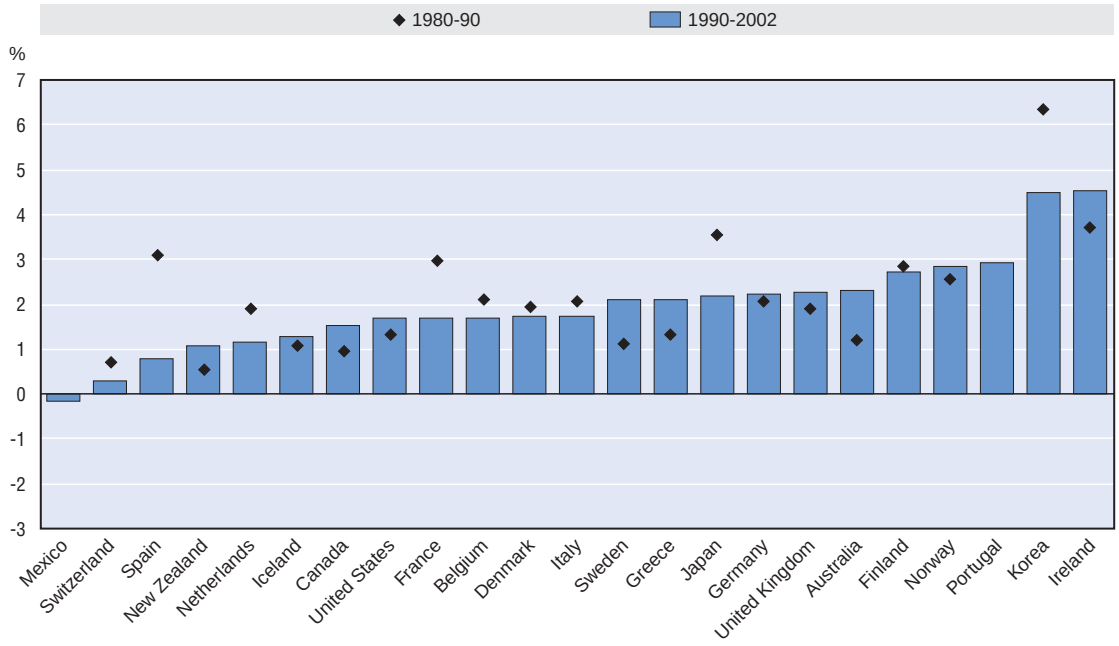
The* OECD *Productivity Manual. There are many different approaches to the measurement of productivity. The calculation and interpretation of the different measures are not straightforward, particularly for international comparisons. To give guidance to statisticians, researchers and analysts who work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

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

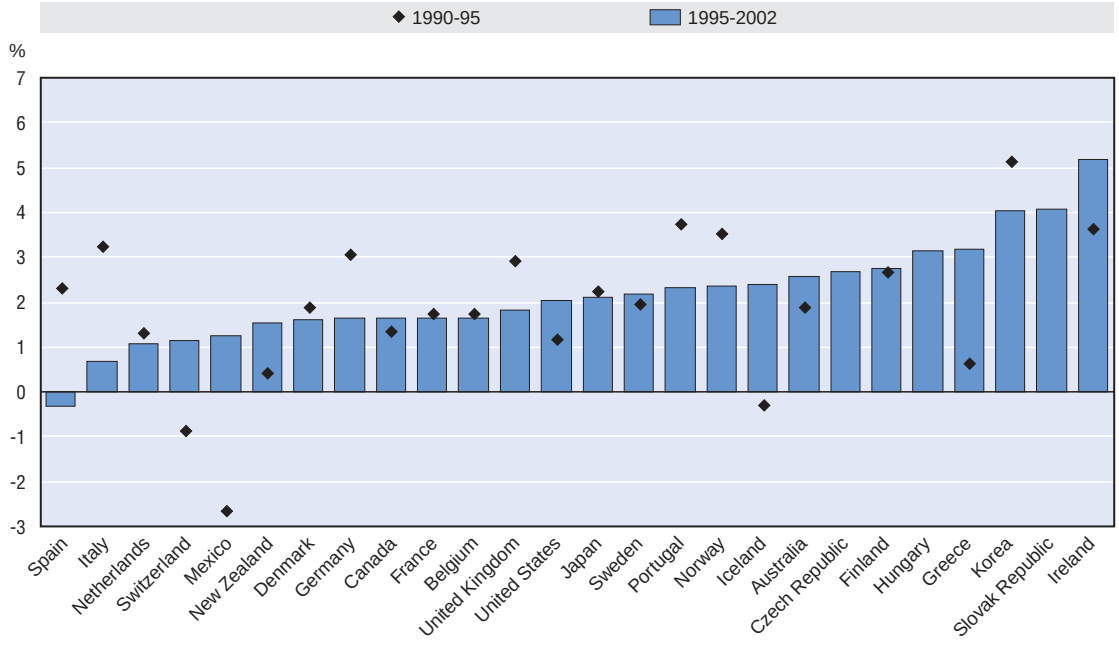
OECD *estimates of productivity adjusted for the business cycle.* For its work on economic growth, the OECD has developed estimates of productivity growth adjusted for the business cycle. Most productivity measures are procyclical; they tend to accelerate during periods of economic expansion and decelerate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

D.3. Labour productivity growth

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



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



Source: OECD, Productivity database, June 2003.

D.4. Growth accounting for OECD countries

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

Growth accounting

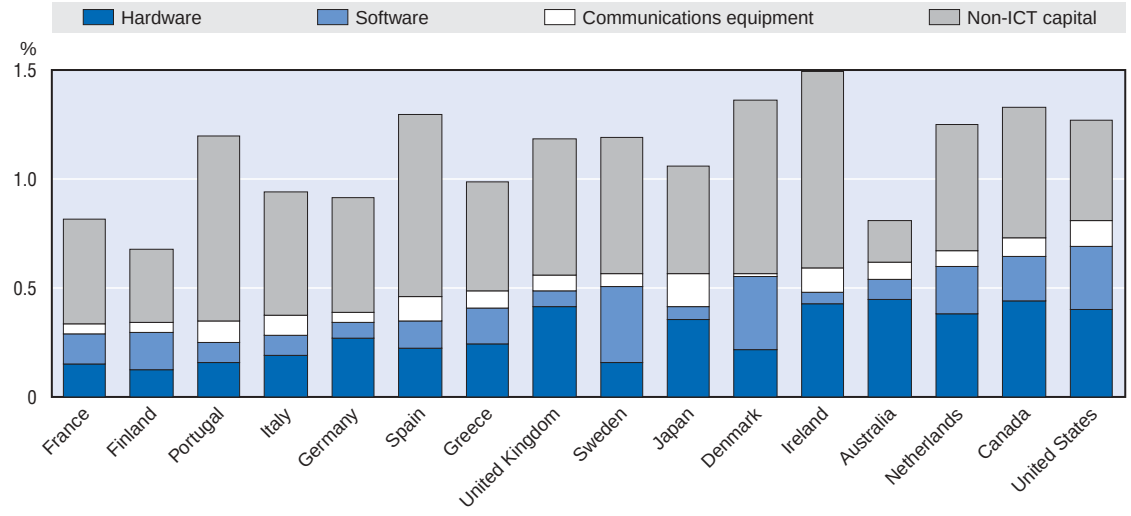
Growth accounting involves breaking down growth of GDP into the contributions of labour input, capital input and multi-factor productivity. The growth accounting model is based on the microeconomic theory of production and rests on a number of assumptions, among which the following are important: *i*)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

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

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

Contributions of capital to GDP growth, 1995-2001

Percentages

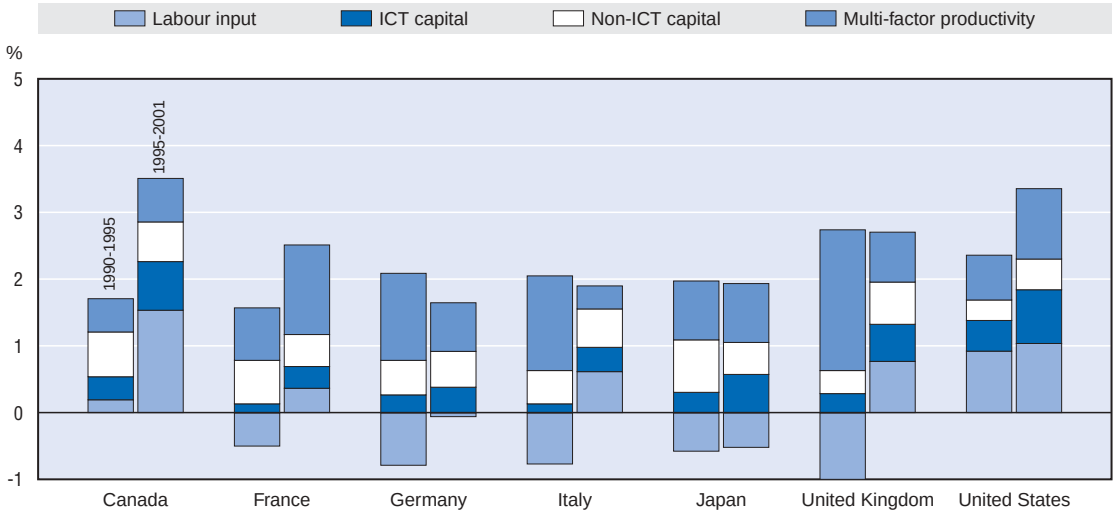


Note: Countries are ranked according to the contribution of ICT capital to GDP growth over the period 1995-2001.
Source: OECD Productivity Database and Database on Capital Services, June 2003.

D.4. Growth accounting for OECD countries

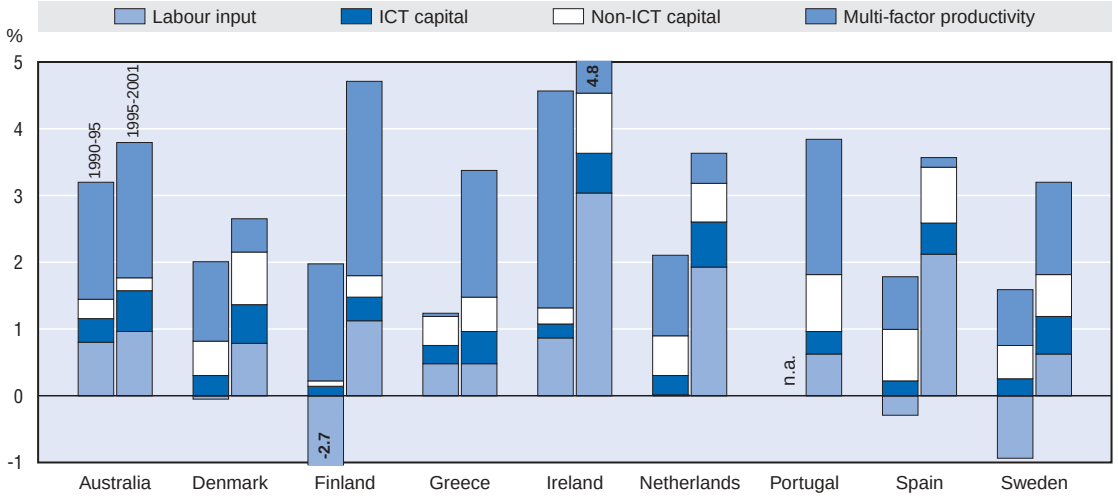
Contributions to growth of GDP, G7 countries, 1990-95 and 1995-2001

In percentage points



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

In percentage points[1]



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

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

D.5. Labour productivity growth by industry

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

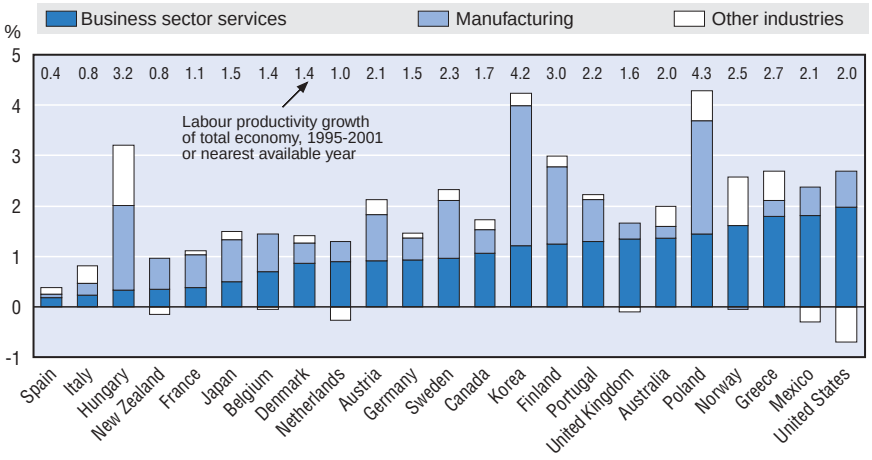
Measuring labour productivity growth by industry

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

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

Breakdown of labour productivity growth by industry

Contributions to average annual growth rate, 1995-2001

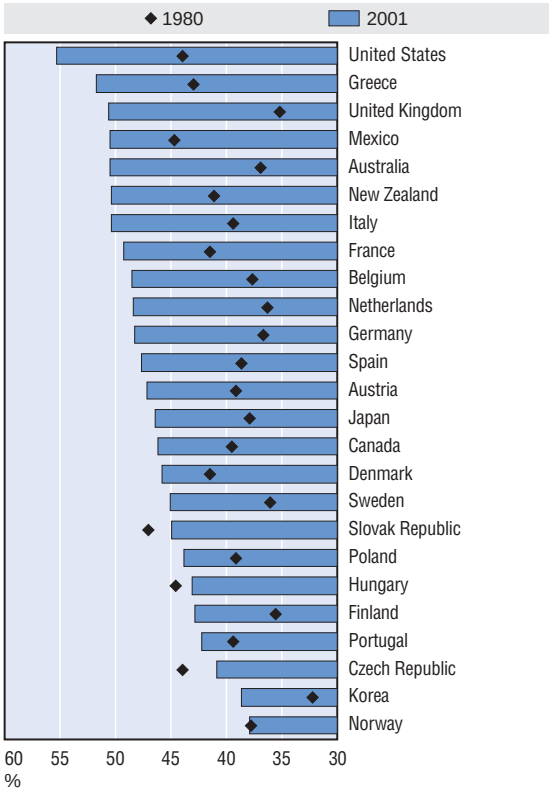


Note: Business sector services cover wholesale and retail trade, restaurants and hotels (ISIC 50-55); transport, storage and communication (ISIC 60-64); and finance, insurance, real estate and business services (ISIC 65-74).

Source: OECD, STAN database, March 2003.

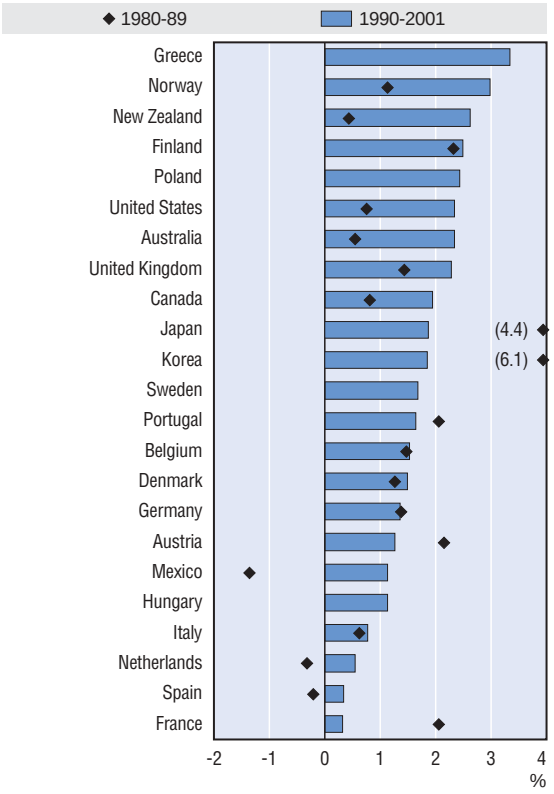
D.5. Labour productivity growth by industry

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



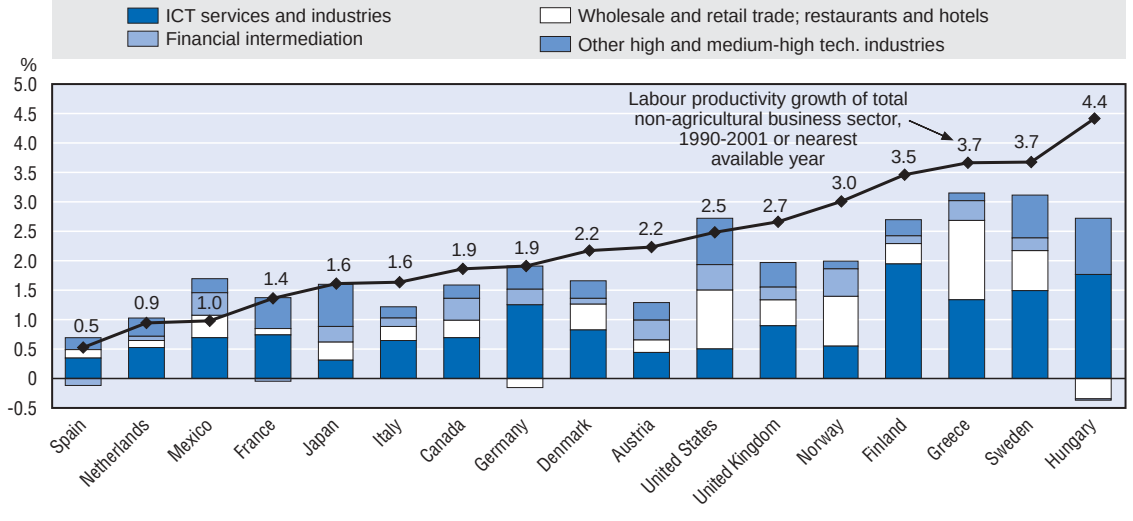
Growth in business sector services labour productivity

Annual average growth rates



Contributions of key sectors to labour productivity growth in the non-agricultural business sector

Contributions to average annual growth rates, 1990-2001



Source: OECD, STAN database, March 2003.

D.6. Technology- and knowledge-intensive industries

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

Measuring technology- and knowledge-intensive industries

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

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

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

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

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

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

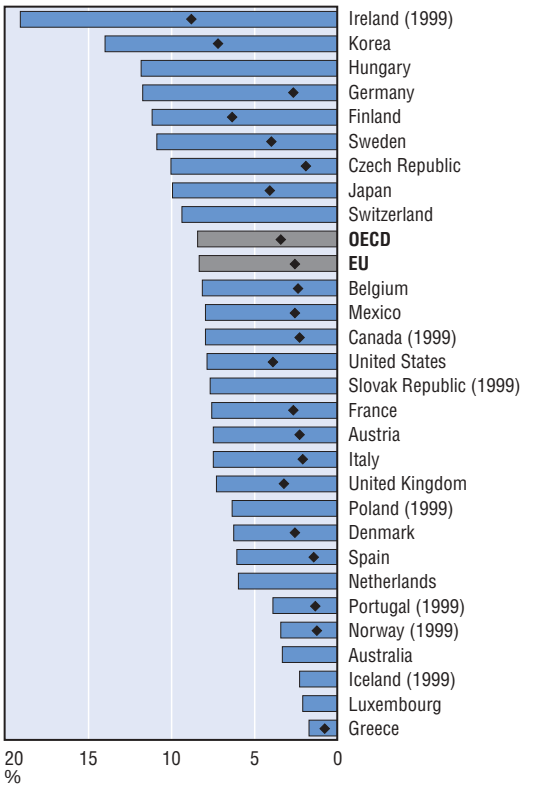
For more details, see Annex Tables D.6.1 *and* D.6.2.

D.6. Technology-and knowledge-intensive industries

Share of total gross value added, 2000

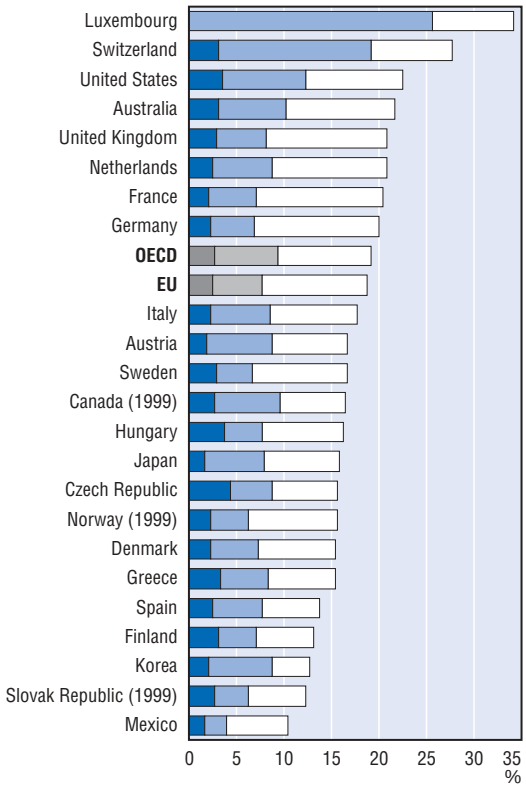
High- and medium-high-technology manufactures

◆ *Of which:* high-technology manufactures



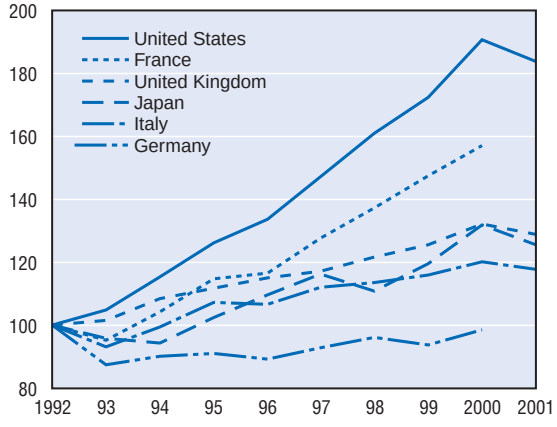
Knowledge-intensive "market" services

Post and telecommunications
Finance and insurance
Business services

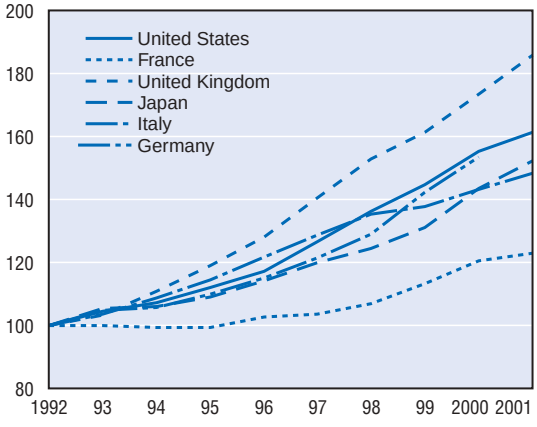


Real value added (1992 = 100)

High- and medium-high-technology manufactures



Knowledge-intensive "market" services



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

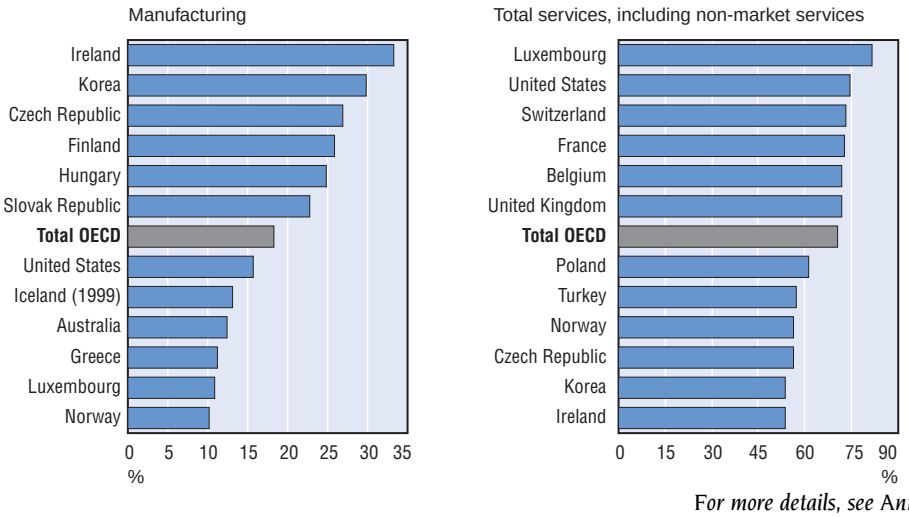
D.7. The structure of OECD economies

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

Structural change in OECD economies

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

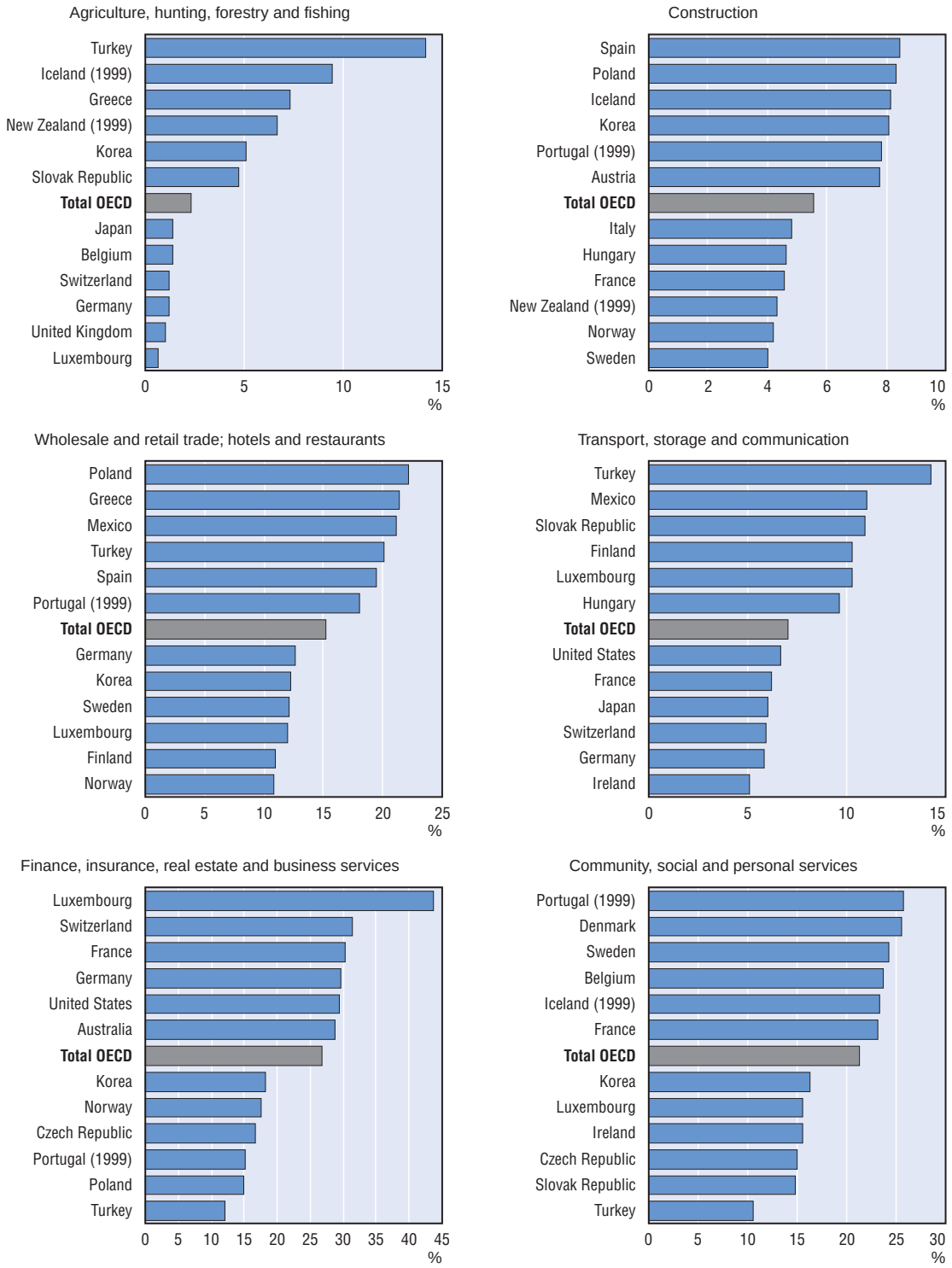
Share of total gross value added in the top six and bottom six OECD countries, 2000



For more details, see Annex Table D.7.

D.7. The structure of OECD economies

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



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

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

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

Measuring services sector value added embodied in manufactured goods

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

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

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

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

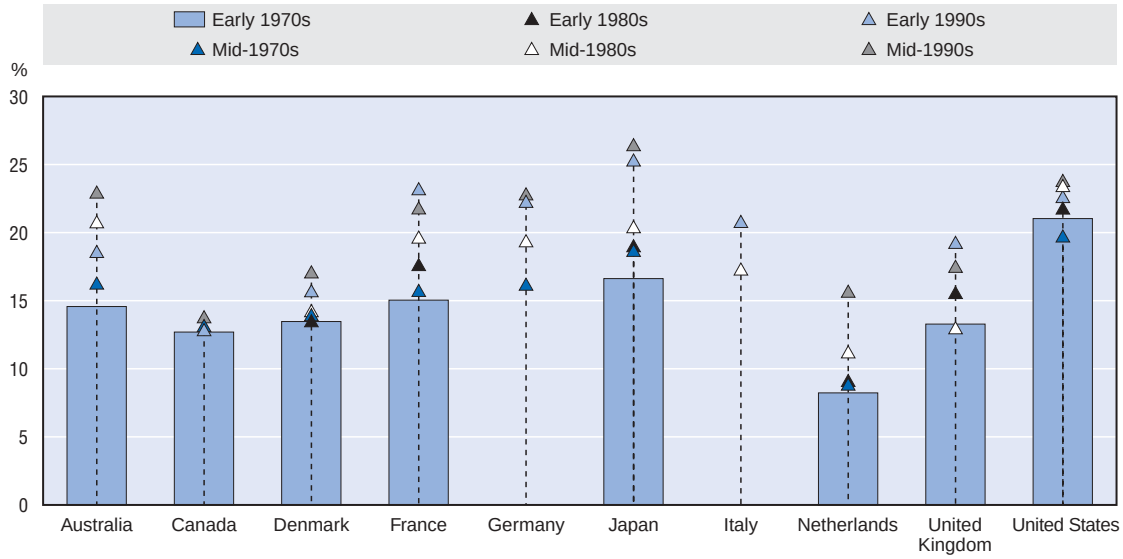
$$v*(I-A)^{-1}*y'/\sum y'$$

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

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

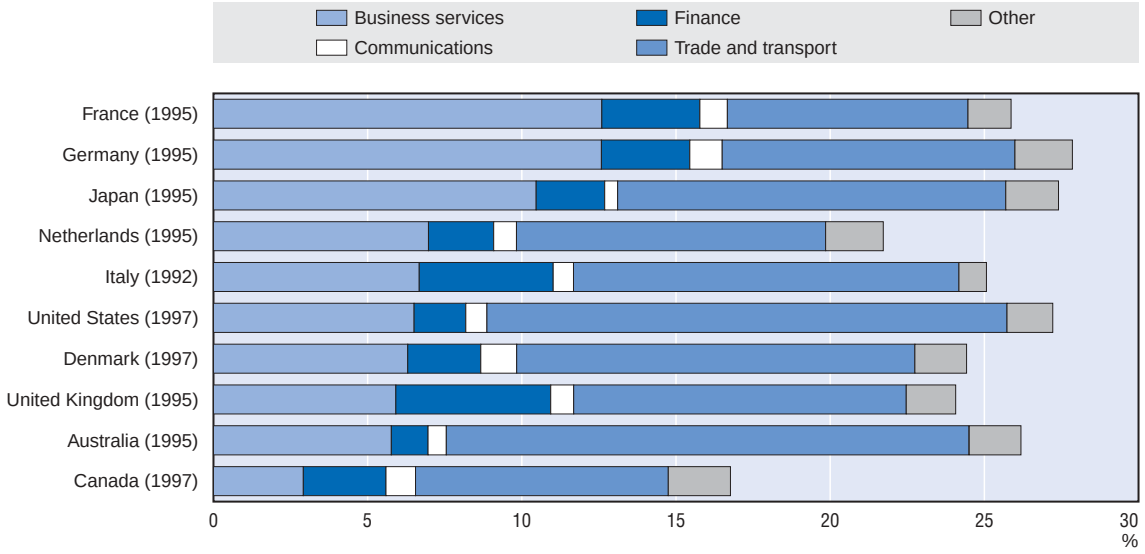
Services sector value added embodied in manufactured goods

Percentage of total value of manufactured goods in final demand



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

Percentage of total intermediate consumption



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

D.9.1. International trade by technological intensity

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

Measuring trade in high-technology industries

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

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

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

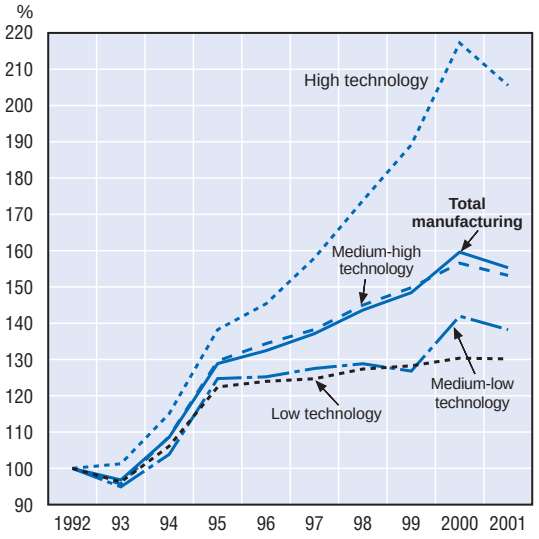
See T. Hatzichronoglou (1997), "Revision of the High-technology Sector and Product Classification", STI *Working Paper* 1997/2 and Annex 1 for further details.

For more details, see Annex Table D.9.1.

D.9.1. International trade by technological intensity

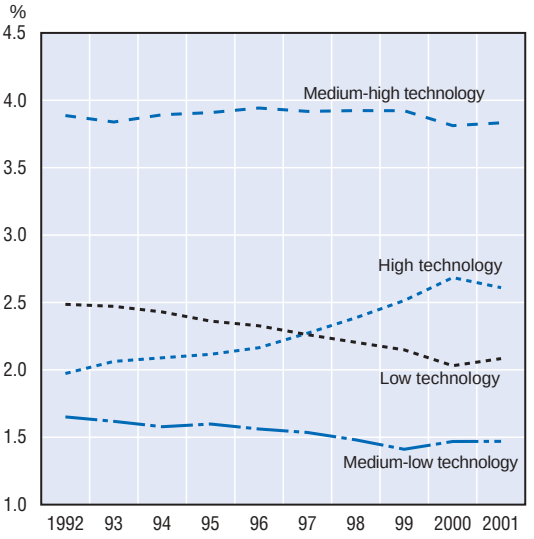
OECD[1] manufacturing trade[2] by technology intensity

1992 = 100



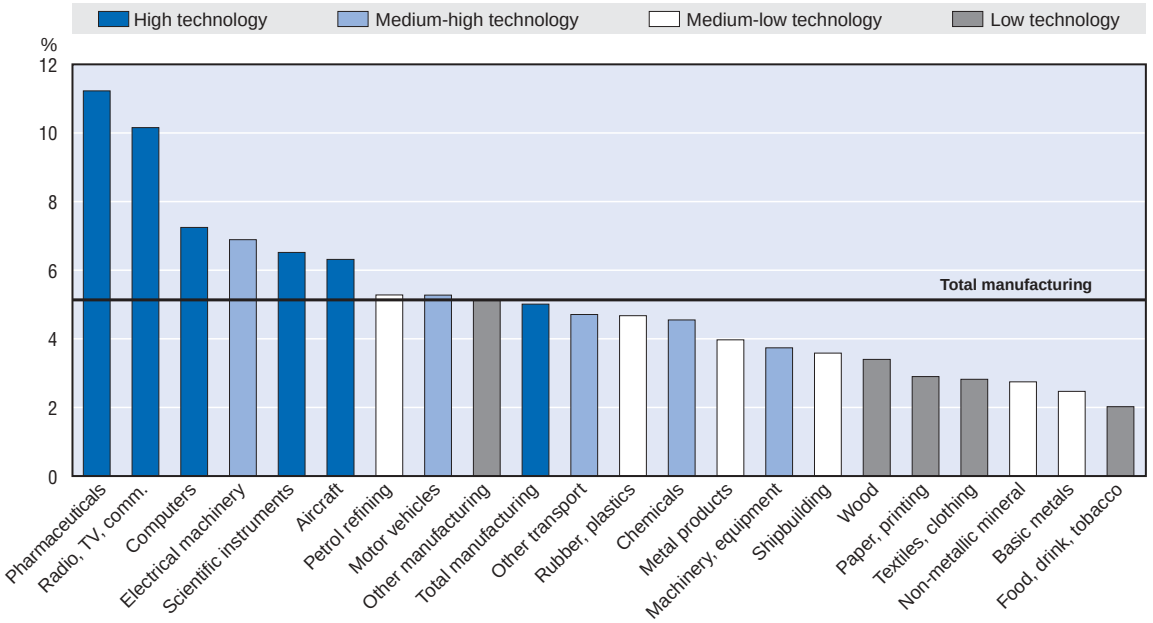
Structure of OECD[1] manufacturing trade[2] by technology intensity

Share in total manufacturing trade



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

Average annual growth rate, 1992-2001



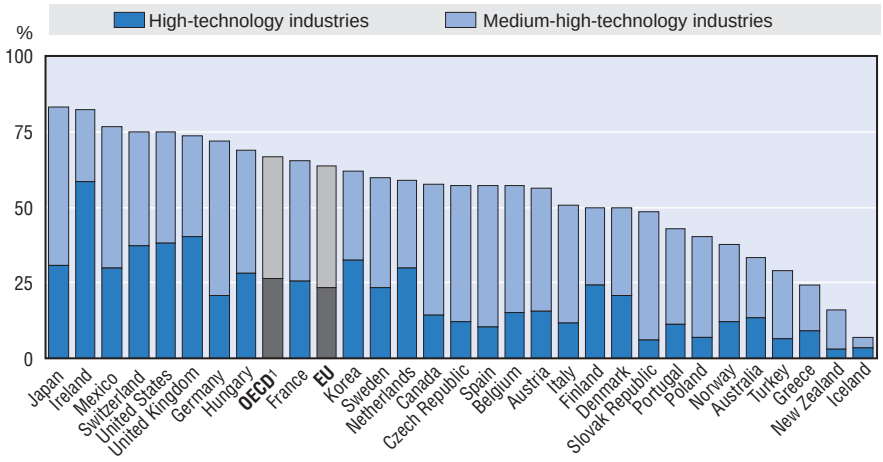
1. OECD excludes the Czech Republic, Korea and the Slovak Republic.
2. Average value of total OECD exports and total OECD imports.

Source: OECD, STAN database, May 2003.

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

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

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

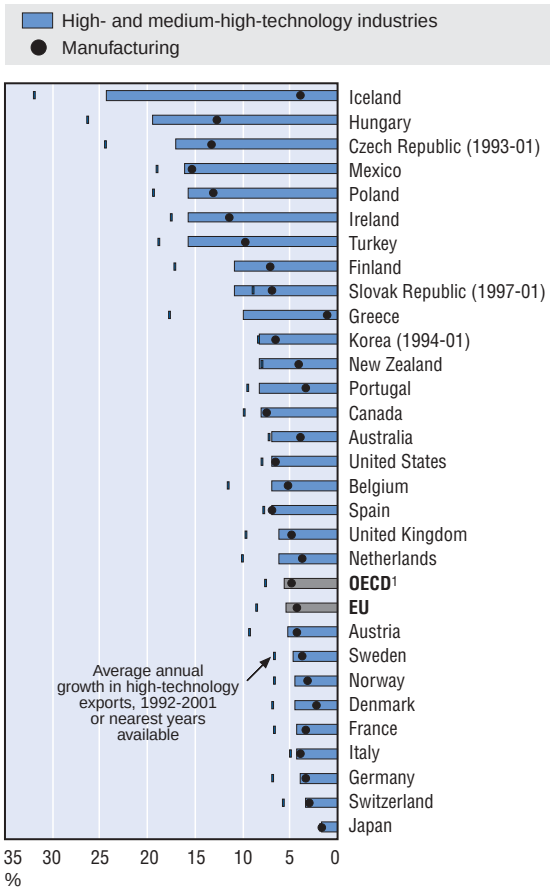


1. Total OECD excludes Luxembourg and the Slovak Republic.
Source: OECD, STAN database, May 2003.

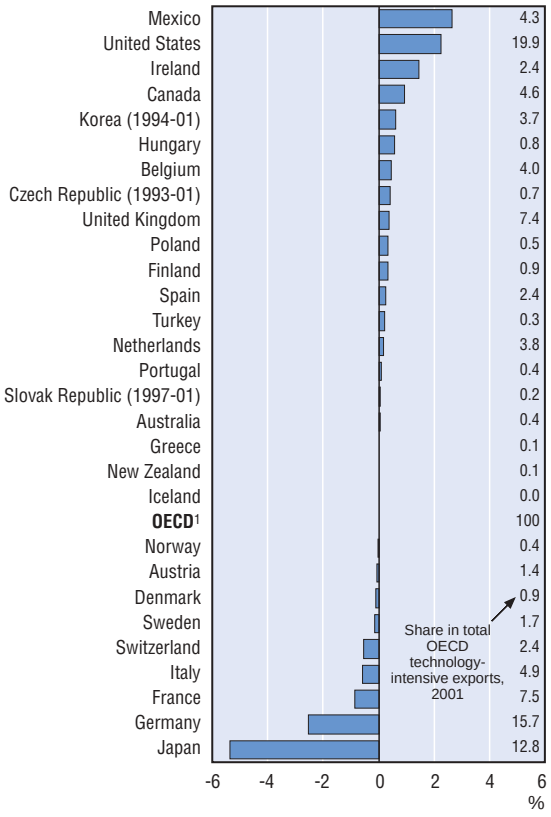
For more details, see Annex Table D.9.2.

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

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



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



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

D.9.3. Revealed comparative advantage by technological intensity

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

Contribution to the trade balance

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

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

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

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

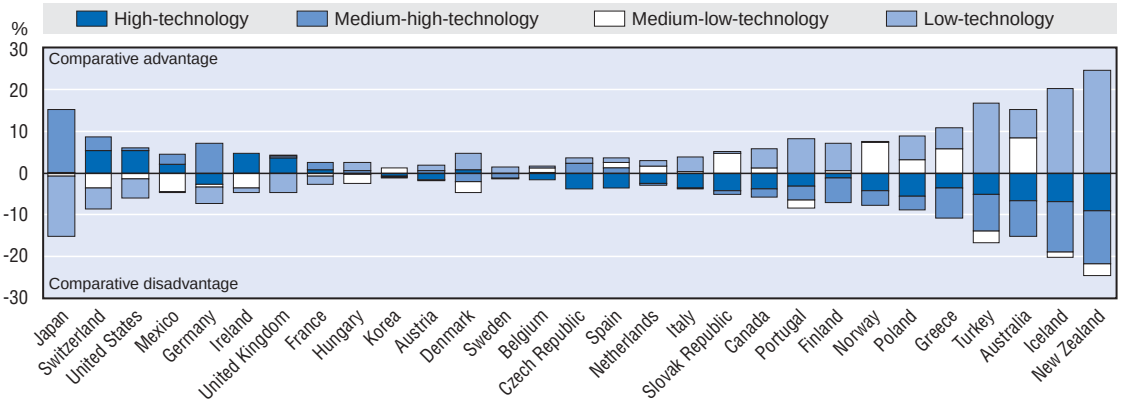
and $(X - M)\frac{(X_i + M_i)}{(X + M)}$ = theoretical trade balance

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

For more details, see Annex Table D.9.3.

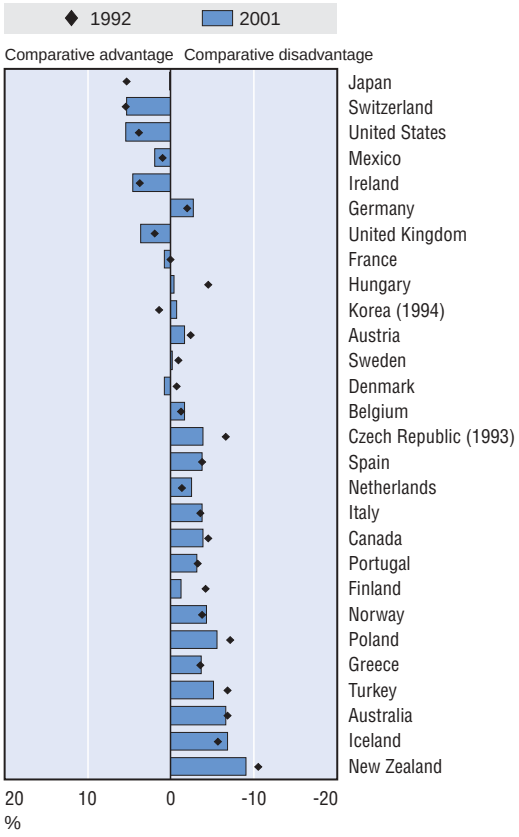
D.9.3. Revealed comparative advantage by technology intensity

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

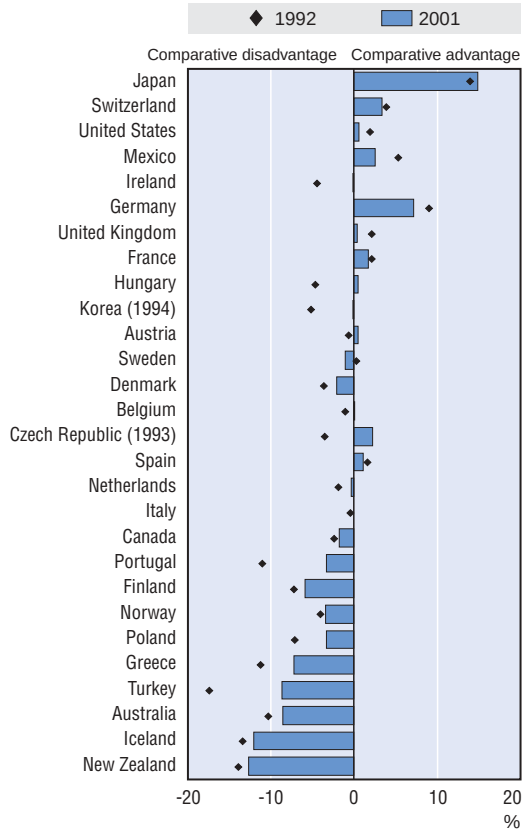


Change in contribution to the manufacturing trade balance between 1992 and 2001
As a percentage of total manufacturing trade

High-technology industries



Medium-high-technology industries



Source: OECD, STAN database, May 2003.

D.10. Entry, exit and survival of firms

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

Measuring business dynamics

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

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

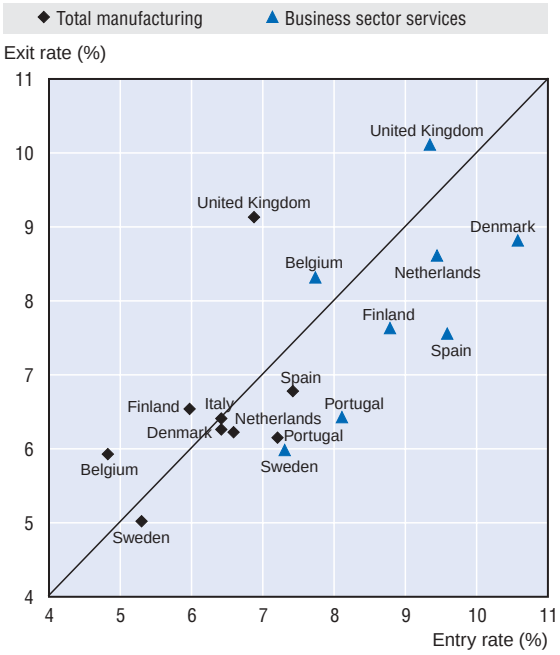
A third problem concerns exits, which are typically more difficult to measure than entries. Most business registers do not reliably register them, and many countries do not require removal from the register. In practice, measuring exits often requires verifying annual changes in a firm's economic activity;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

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

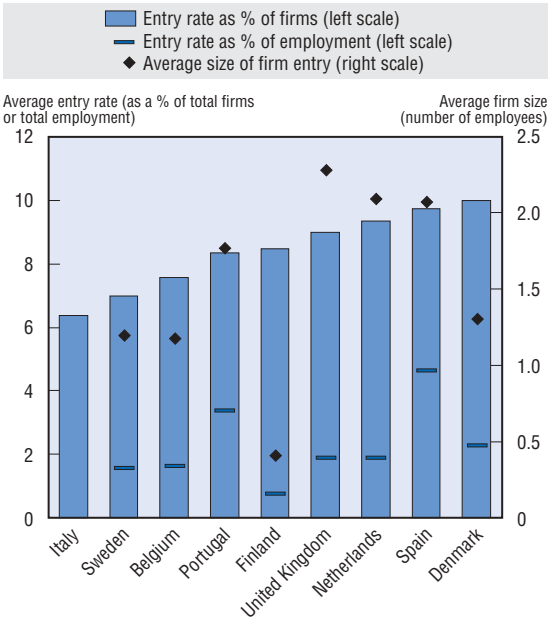
The data presented here draw on a harmonised collection of data carried out by Eurostat, covering 1997-2000. The data collection draws on the growing comparability of business registers in the European Union. The data distinguish genuine firm entry and exit, *i.e.* excluding mergers, acquisitions, takeovers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

D.10. Entry, exit and survival of firms

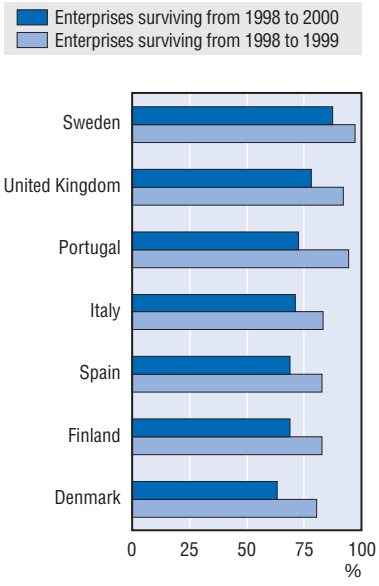
Entry and exit rates in the manufacturing and business services sectors
Average rate over 1997 and 2000



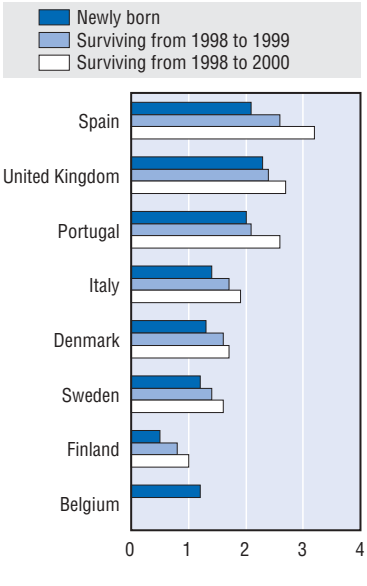
Firm entry rates, job creation and average size of new firms in total non-farm industry[1]
Average rate over 1997 and 2000



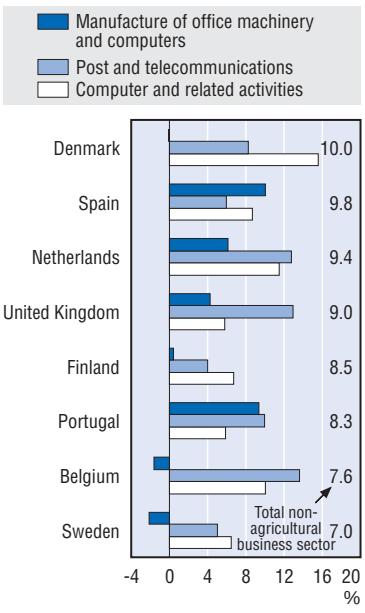
Enterprise survival rates
Percentage of 1998 entries



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



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



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

TABLE OF CONTENTS