Measuring the Information Economy

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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- to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

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).

FOREWORD

The role of information and communication technologies (ICT) in economic growth and social change has received considerable attention in recent years, particularly in the debate on the "new economy". The production, diffusion and use of ICT vary considerably between and within countries, although they continue to spread and their economic importance has grown over the 1990s. To focus the policy debate, especially in light of the recent "exuberance" and subsequent crash in the market value of "dot.com" firms, reliable and comprehensive indicators are needed to track developments in new information technologies and understand their impact on our economies and societies.

As ICT has only been recognised as a major source of economic and social change in recent years, official statistics on ICT are still under development. Over the past years, however, much progress has been made in developing internationally comparable ICT statistics. International organisations, such as the OECD and Eurostat, together with statistical offices in OECD member countries, have worked together to develop common definitions, common methods and common surveys of ICT. Over a very short time span, national statistical offices have made great strides towards responding to the challenge and providing high-quality, timely ICT statistics.

Measuring the Information Economy 2002 (www.oecd.org/sti/measuring-infoeconomy) relies on these official sources and builds mainly on the work of the OECD Working Party on Indicators for the Information Society (WPIIS). Chapter 1 describes the resources devoted to new information technologies, in terms of consumption, investment, innovative efforts or human resources. Chapter 2 looks at the size, growth and contribution of the ICT sector, as defined by the OECD, to economic activity. Chapter 3 presents the latest international comparisons, based on official surveys of ICT diffusion in households, among individuals and in businesses recently developed by national statistical offices. Only a few years ago, internationally comparable official statistics measuring the level, growth and composition of electronic commerce transactions were not available. However, Chapter 4 indicates some interesting patterns relating to the volume and nature of e-commerce transactions, based on OECD definitions and guidelines for measurement in this area. By analysing the data currently available, this report highlights the areas in which much progress has been made in recent years. It also shows, however, that ICT statistics are not yet well developed in areas such as ICT use by governments and in schools (Chapter 5).

Measuring the Information Economy 2002 offers new or improved measures for international comparisons. Methodological boxes discuss issues of measurement and international comparability and the annexes include the OECD definitions and guidelines behind the development of the indicators. Owing to the novelty of some of the databases and indicators, country comparisons should be interpreted with caution when absolute differences are small. In some cases, data provided by member countries have been combined with different data sources to estimate ICT indicators. For this reason, the statistics presented here may differ from figures contained in national reports and in previous OECD publications.

Measuring the Information Economy 2002 is also available on line and provides easy access to individual sections, an elaborate data and metadata 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 (see www.oecd.org/sti/measuring-infoeconomy).

This volume was prepared by Alessandra Colecchia, Elena Anton-Zabalza, Andrew Devlin and Pierre Montagnier of the OECD's Directorate for Science, Technology and Industry (DSTI). Dirk Pilat, Andrew Wyckoff and other OECD colleagues offered guidance and commented on the draft.

Measuring the Information Economy 2002 could not have been prepared, however, without the help of national statistical agencies in all OECD member countries. In particular, the OECD would like to thank the experts who contribute to the OECD Working Party on Indicators for the Information Society (WPIIS) for their valuable assistance and guidance. Nevertheless, none of these individuals or organisations can be held responsible for the findings of the publication.

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

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Chapter I. Resources for the information economy

The contribution of the information economy to overall economic growth and performance is related to the amount of resources devoted to new information technologies, whether in terms of consumption, investment or innovative efforts. This chapter looks first at the share of information and communication technologies (ICTs) in total investment. Investment in ICT establishes the infrastructure for the use of ICT and provides productive equipment and software to businesses, which helps raise labour productivity growth. Statistics on ICT investment are therefore an important indicator of the diffusion of ICT. While ICT investment has accelerated in most OECD countries over the past decade, the pace of that investment differs widely. Data availability and measurement of ICT investment based on national accounts (SNA93) vary considerably across OECD countries, especially as regards measurement of investment in software, deflators applied, breakdown by institutional sector and temporal coverage (see Box 1.1).

Investment is only one component of final demand. A second indicator is the total resources countries devote to ICT, including spending by both households and businesses, as well as the relative weight of ICT consumption and investment in GDP. ICTs are mainly investment goods and this is reflected in the large weight of ICT investment in total final demand. In some countries, however, household expenditure on ICT, mainly expenditure in telecommunication services, can represent a relatively important component, which, if not measured, could lead to underestimating the total contribution of ICT to the economy. Currently, national accounts are not always sufficiently detailed to allow for the identification of both investment in and consumption of ICT goods and services. The second indicator uses the OECD database on purchasing power parities (PPPs), which provides details on the components of final expenditure (see Box 1.2) and has a broader coverage of OECD countries.

ICTs are general-purpose technologies with the highest rate of innovation as measured by patents granted. ICTs are also enabling many of the changes in business processes and innovation processes that help make other sectors more innovative. Among indicators of ICT-related innovation are the numbers of ICT patents produced in OECD countries and their weight in overall innovation. While those indicators have some shortcomings (see Box 1.3), they highlight some important differences in the ICT-related patenting behaviour of Europe, *e.g.* between larger and smaller European economies, as well as *vis-à-vis* the United States and Japan.

Human capital is a key policy area in the information economy, as it is required for innovation and growth. The measurement of stocks and flows of human resources for the information economy and of skills, their distribution among different economic activities and the economic effects of the acquisition or absence of certain skills are of significant concern for policy makers. Human resources and, in particular, skills for the information economy are difficult to measure (see Box 1.4). The last indicators in this chapter seek to gauge the distribution of ICT-related skills in Europe.

Investment in ICT equipment and software

- 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 ICT has been the most dynamic component of such investment in recent years.
- The data available for a number of OECD countries show that investment in ICT rose from less than 10% of total non-residential investment in the business sector in the early 1980s to between 10% and 35% in 2000. The share is particularly high in the United States, Finland and Australia.
- Investment in software was one of the most dynamic areas. In the United States, it rose from only 3.0% of non-residential investment in 1980 to 14.2% in 2000. Australia and Denmark also experienced a rapid increase, but the United Kingdom and Japan showed little change from the level of the early 1990s.
- By 2000, investment in software accounted for over 50% of the major ICT investment categories in Denmark and Sweden. Communications equipment was the most important area for investment in Austria, Finland, Italy, Japan and Portugal, while IT equipment was first in Ireland.
- Real growth in ICT investment was particularly rapid over the second half of the 1990s. Investment in ICT equipment grew fastest, but the growth of investment in software accelerated sharply in the 1990s. 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 indices, constructed using the United States as a benchmark, the rate of decline in the price of computers and office equipment increased from the 1980s to the 1990s, even doubling in some cases (Colecchia and Schreyer, 2001).

Box 1.1. Measuring investment in ICT equipment and software

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 based on national accounts (SNA93) vary considerably across OECD countries, especially as regards measurement of investment in software, deflators applied, breakdown by institutional sector and temporal coverage. 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 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". 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.

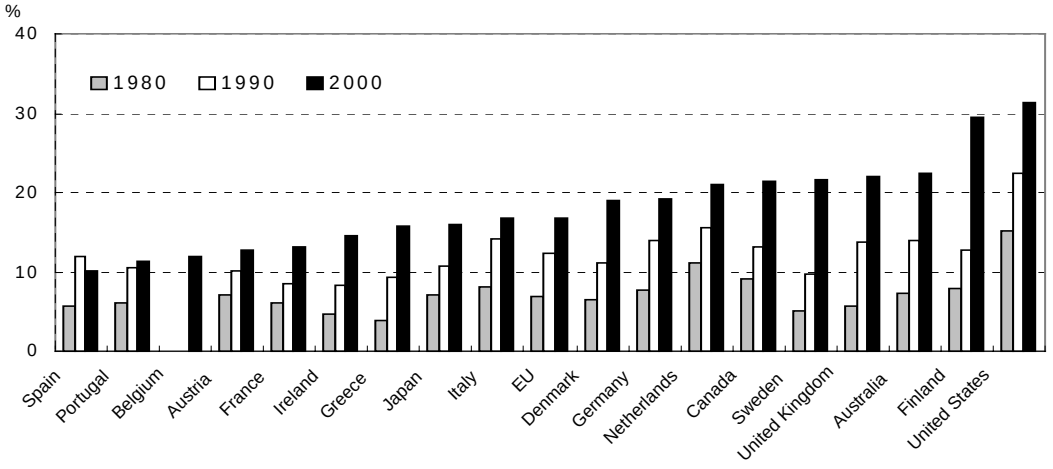
Real investment: deflation methods and adjustment for quality. The measurement of investment in real terms requires price indices that take changes in the quality of products into account. This is particularly important for products subject to rapid technological change such as computers or ICT products 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, and France) are starting to introduce hedonic adjustment to measure real computer investment and sometimes base their deflators on those of the United States. Measures of real investment used in the OECD work are therefore typically based on "harmonised" price indices 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 A. Colecchia and P. Schreyer, "ICT Investment and Economic Growth in the 1990s: Is the United States a Unique Case?", STI Working Paper 2001/7, OECD; P. Schreyer, "Computer Price Indices and International Growth and Productivity Comparisons", STD/DOC(2001)1, OECD; and OECD Taskforce on Software, "Report on the OECD Task Force on Software Measurement in the National Accounts" (forthcoming).

Investment in ICT equipment and software

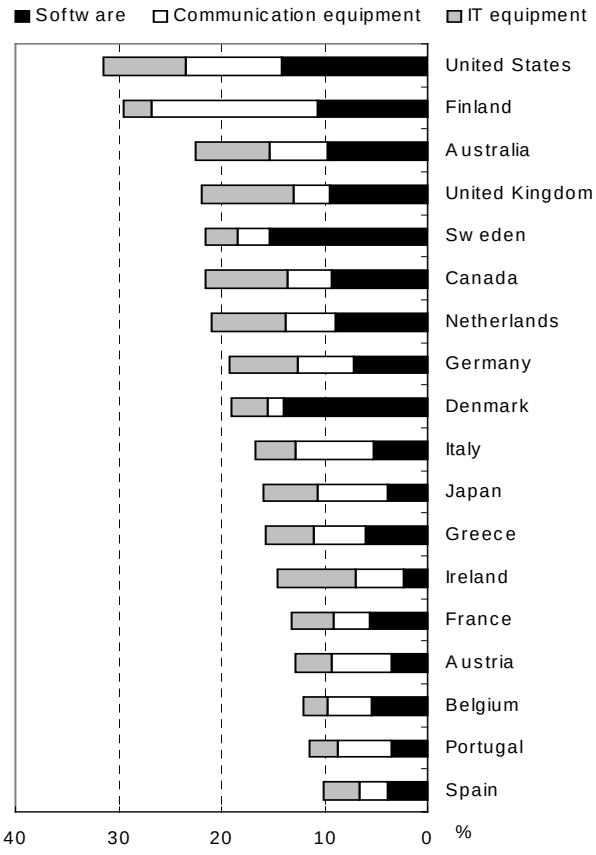
ICT investment[1] in OECD countries, 1980-2000

Percentage of non-residential gross fixed capital formation, total economy



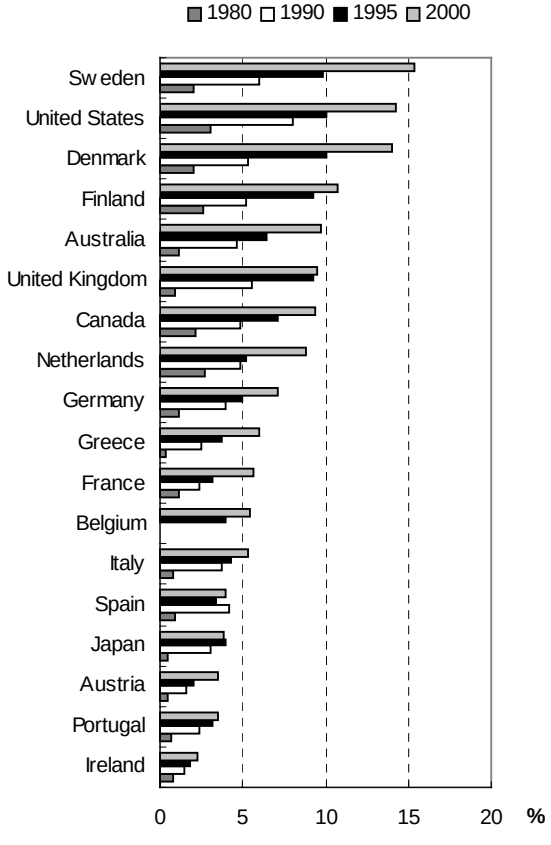
ICT investment by asset[1] in OECD countries, 2000

Percentage of non-residential gross fixed capital formation, total economy



Software investment[1] in OECD countries, 1980-2000

Percentage of non-residential gross fixed capital formation, total economy



1. ICT equipment is defined here as computer and office equipment and communication equipment; software includes both purchased and own account software. Software investment in Japan is likely to be underestimated, owing to methodological differences.
Source: OECD, estimates based on national accounts, data underlying Colecchia and Schreyer (2001) and Van Ark *et al.* (2002).

Consumption of and investment in ICT goods and services

- Estimates of total expenditure on ICT, including consumption and investment, vary considerably across the OECD area. In Austria and New Zealand, household consumption of ICT is higher than business investment in ICT. In most other OECD countries, the situation is the reverse, with investment considerably exceeding consumption in the Czech Republic, Sweden and the United States.
- Estimates of household consumption of ICT show that in 1999 demand for ICT was very strong in Korea and Hungary and relatively weak in Mexico. The bulk of household demand in most countries is for telecommunications equipment and services. In Iceland, IT equipment is also an important component of demand.
- 1999 estimates of ICT investment show that the United States and Sweden had the largest shares of total non-residential investment in ICT hardware and software. Ireland invested a very small share of total investment in ICT. The two largest investors were also the two countries where software represented the largest part of investment.
- Official estimates of software investment were not available for countries such as Iceland, Norway and Korea, so that overall ICT investment is significantly underestimated. In many other OECD countries, software investment is still likely to be underestimated in official national accounts.

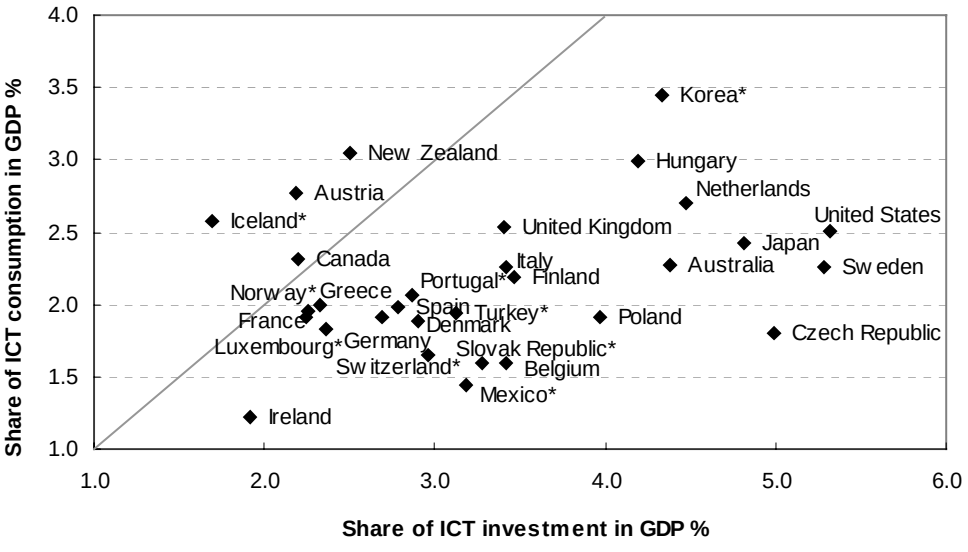
Box 1.2. Measures of ICT consumption and investment – the OECD database on purchasing power parities

Official international data on expenditure on ICT goods and services are scarce. In previous OECD compilations of statistics on the information economy, private data were often used, despite some uncertainty about their quality. In principle, official estimates of household consumption and business investment in ICT should be derived from the national accounts. However, national accounts are not always sufficiently detailed to allow for the identification of investment in and consumption of ICT goods and services. A source that does provide sufficient detail is the OECD database on purchasing power parities (PPPs). The PPP database provides details on the components of final expenditure, including household expenditure on ICT products and services, as well as business investment in ICT hardware and software.

The main categories included in household expenditure are: telephone and telefax equipment; telephone and telefax services; equipment for the reception, recording and reproduction of sound and pictures; photographic and cinematographic equipment and optical instruments; information processing equipment; pre-recorded recording media; unrecorded recording media; and repair of audio-visual, photographic and information processing equipment. Expenditure on videogame software is excluded, since it cannot be separated from the household expenditure category "games, toys and hobbies".

The main categories of ICT investment are office and data processing machines; precision instruments; optical instruments and photographic equipment; telecommunication equipment and measuring equipment; electronic equipment, radio and television, gramophone records; and software. Software investment is not as yet available for all OECD countries; for Canada, it was derived from Colecchia and Schreyer (2001). Further details on the categories used and the underlying products are available in OECD/Eurostat (2000), "Revised Classification of Expenditure on GDP for the 1999 Round", Eurostat-OECD PPP Programme, Paris.

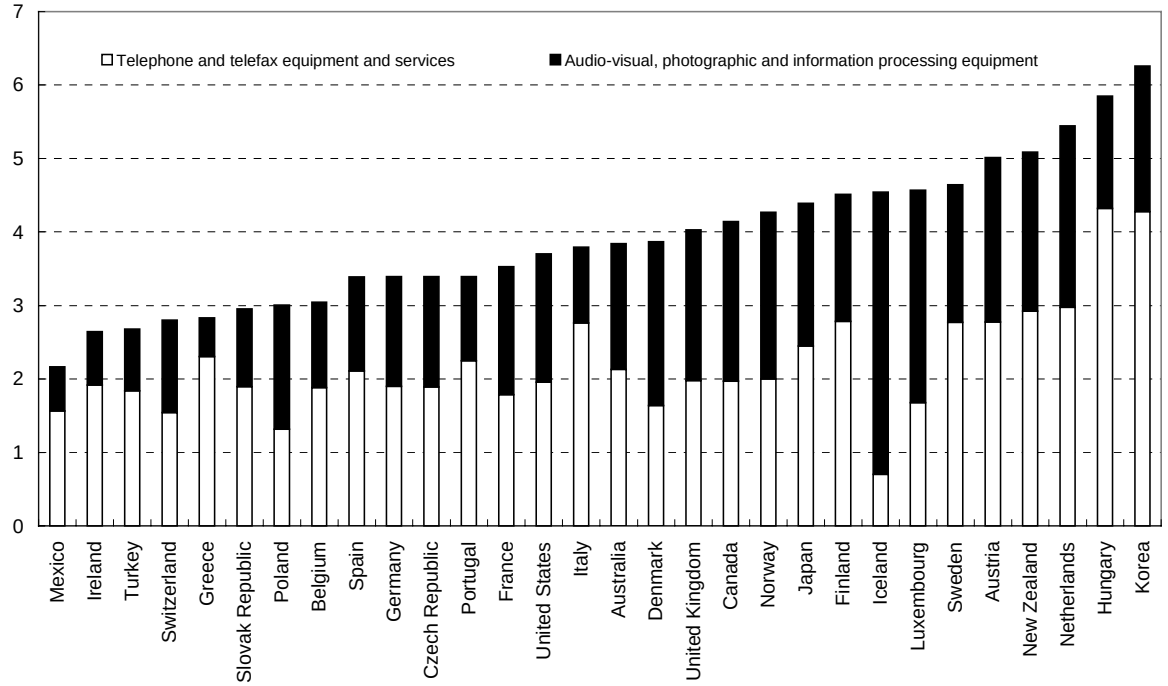
Investment in and consumption of ICT as a share of GDP, 1999



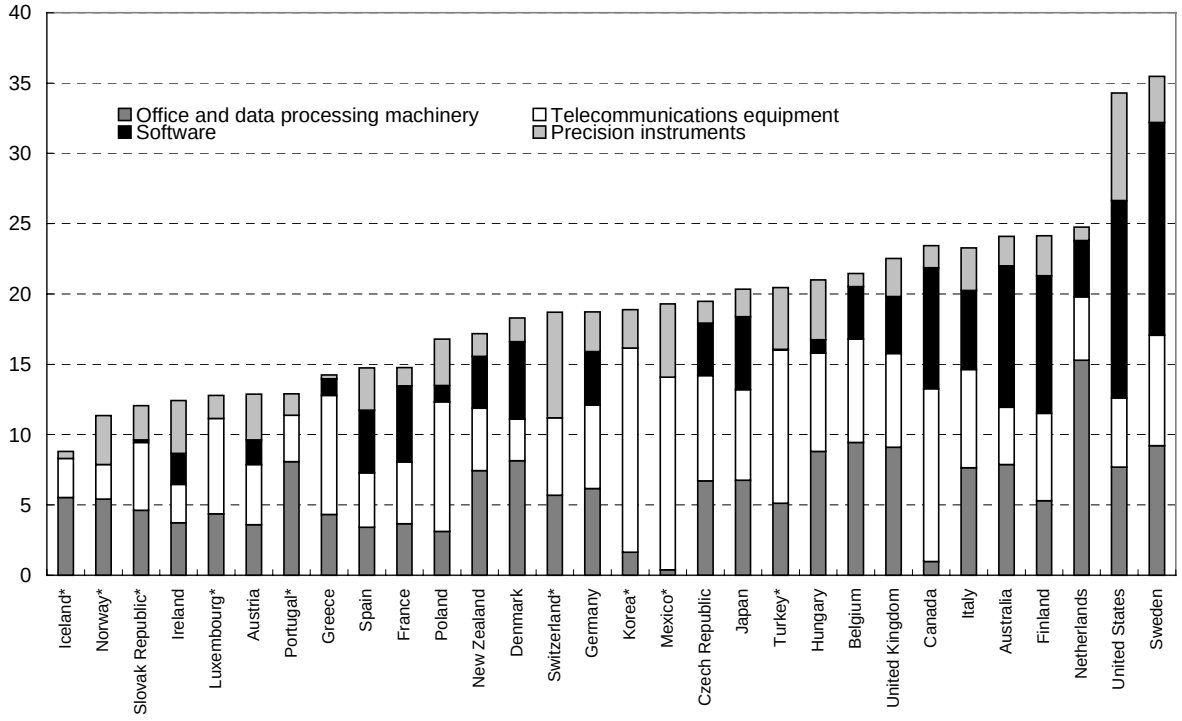
* Software data not available.
Source: OECD, Purchasing Power Parities Database, March 2002.

Consumption of and investment in ICT goods and services

Share of consumption of ICT goods and services in total household consumption, 1999



Share of ICT investment in total non-residential gross fixed capital formation, 1999



* Software data not available.
Source: OECD, Purchasing Power Parities Database, March 2002.

ICT patents

- Patent-based statistics are widely used indicators of the output of inventive activity. During the 1990s, ICT patents grew at 10% in the OECD area, double the rate of total patent applications (5%). In 1998, ICT patents represented about 16% of total OECD patent applications.
- Over the 1990s, ICT patents increased much more rapidly in the European Union and the United States than in Japan, with average annual growth rates of 16%, 10% and 2%, respectively. Shares of ICT patents are higher in Japan and the United States than in the European Union; in 1998, about one in five Japanese patent applications were for ICT, compared to about one in eight for the European Union.
- Shares of ICT patents are high in smaller OECD countries, such as Finland, Iceland and Korea (which also have high ICT R&D expenditure). ICT patents have also increased much more rapidly in Norway, Sweden and Denmark than in larger countries.
- Almost 40% of total patent applications filed at the European Patent Office (EPO) are from EU countries, above the shares of the United States (34%) and Japan (21%). 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 markets of European countries.

Box 1.3. Patent indicators

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 that hamper international comparability. Changes in patent law may also affect patent time series. Finally, the distribution of patents according to their value 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.

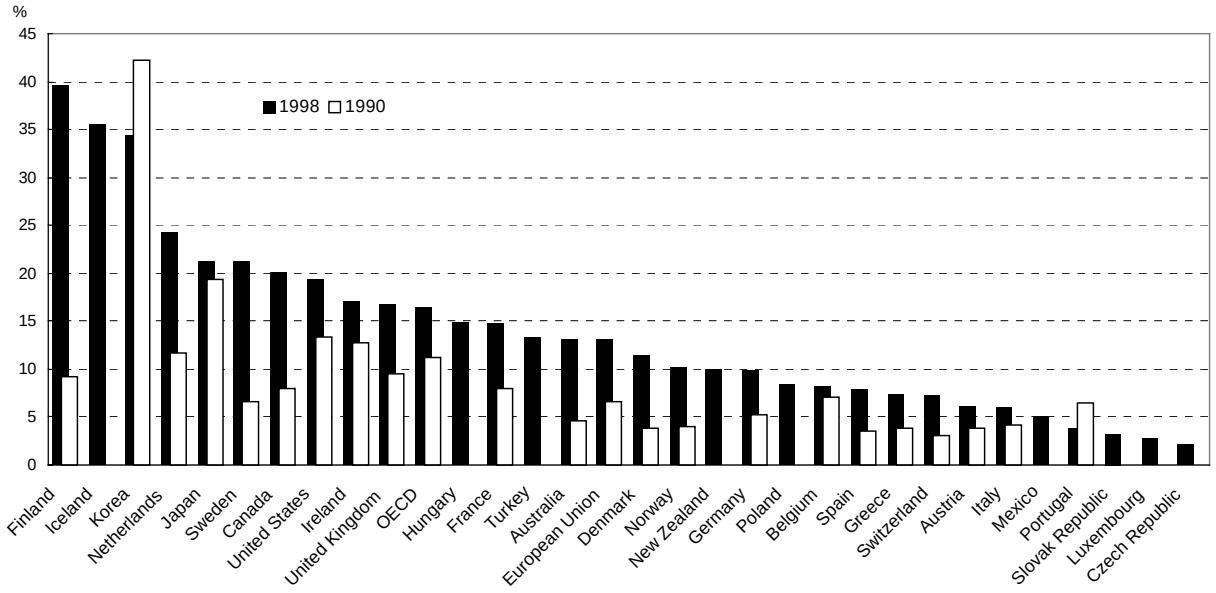
- *Geographical distribution of patents*. Three main criteria can be used: *i)* counts by priority office (country where the first application is filed, before protection is extended to other countries); *ii)* counts by the inventor's country of residence, which indicates the inventiveness of the local 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 counts by the inventor's country of residence.
- *Patents with multiple inventors from different countries*. Such patents can either be partly attributed to each country mentioned (fractional count) or fully attributed to every relevant country, thus generating multiple counting. It is better to use fractional counting procedures.
- *Reference date*. The choice of one date, among the set of dates included in patent documents, is 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 US Patent and Trademark Office) and become actual patent applications. Some 40% of options are not exercised. 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 out of date when published. To have recent patents counts, one must estimate ("nowcast") transfers before they are actually performed.

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 EPO.

For further information, see OECD (1994), "Using Patent Data as Science and Technology Indicators – Patent Manual", Paris.

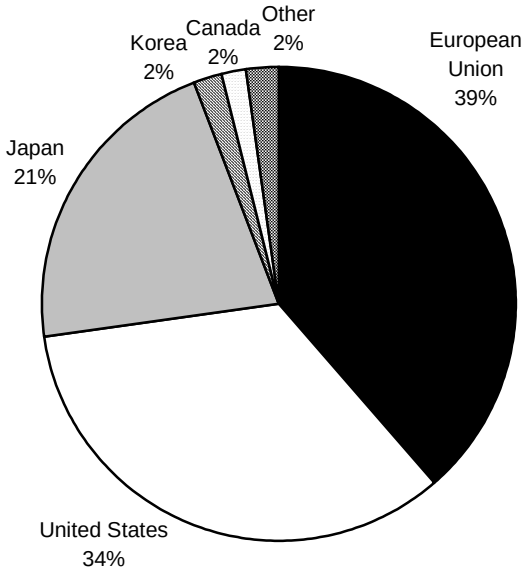
ICT patents

ICT[1] patents as a percentage of total national patents filed at the EPO, for priority years 1990, 1998



1. Classes of International Patent Classification: G06, G11 and H04.
Source: OECD, Patent database, March 2002.

Share of ICT[1] patents filed at the EPO, for priority year 1998



1. Classes of International Patent Classification: G06, G11 and H04.
Source: OECD, Patent database, March 2002.

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%. 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.

Box 1.4. Measuring ICT-related skills

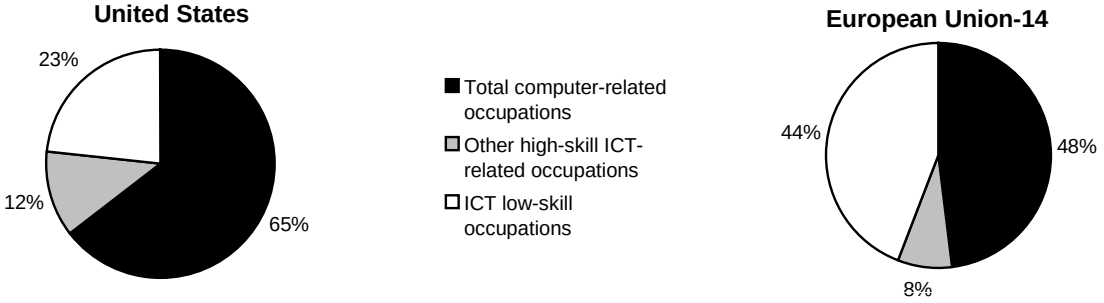
Skills are difficult to measure, and proxies are often used to capture observable characteristics such as educational attainment, on the supply side, and occupations, on the demand side. While an international classification of occupations exists (ISCO-88, International Standard Classification of Occupations, 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 figures for 1999, 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 photographers and image and sound recording equipment operators, broadcasting and telecommunications equipment operators); optical and electronic equipment operators (313, including computer assistants, computer equipment operators, Industrial robot controllers). 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). The US Standard Occupational Classification (SOC) has now been revised (2000, see http://stats.bls.gov/soc/). The revised SOC will be used to classify responses to the 2000 US Decennial Census.

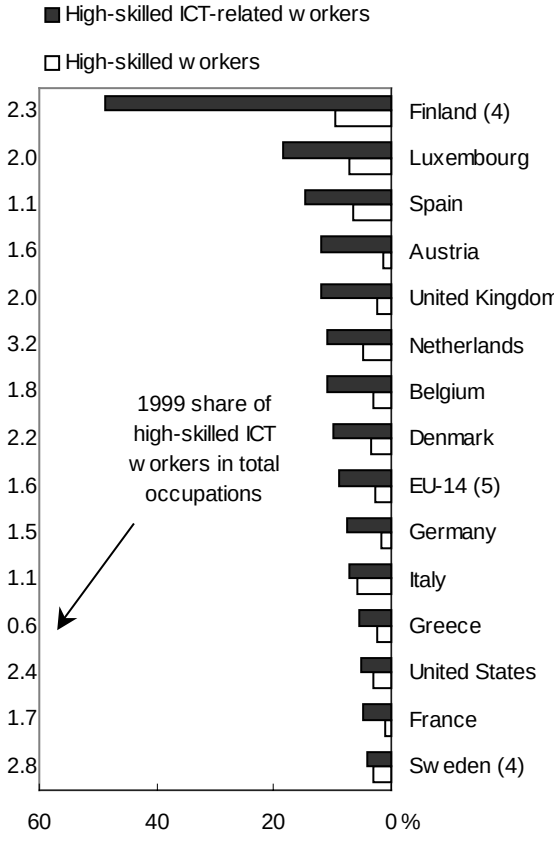
Occupations and skills in the information economy

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



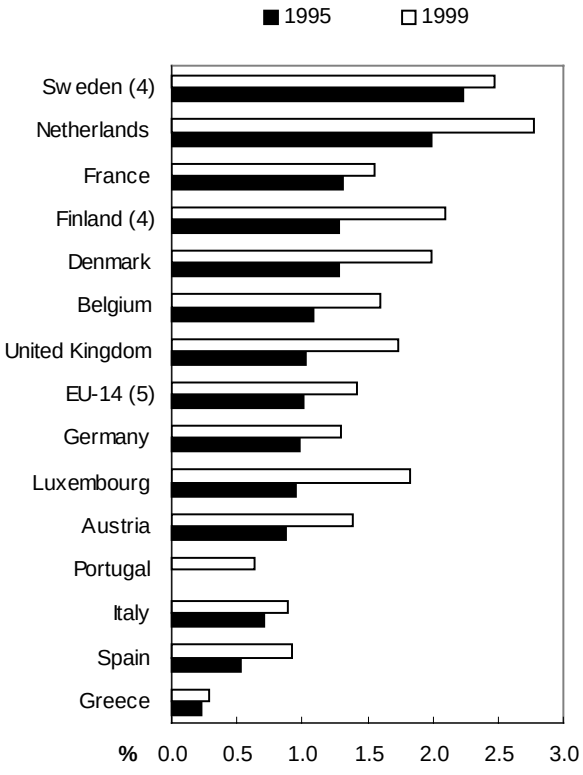
High-skilled ICT workers[2] and high-skilled workers[3] in the European Union and the United States

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 1.4.
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.

Chapter II. The ICT sector

There is no immediate reason why a country with a small or no ICT-producing industry, should not benefit from the positive effects on growth of new information technologies. Yet, the question of the role of the ICT-producing sector has been debated, in particular from the perspective of a comparison of European economies with that of the United States. What is the ICT sector? What is its size, how fast it is growing, what is its contribution to economic activity? How do OECD countries compare in terms of specialisation in ICT production?

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 Annex 1). One important feature of this definition, based on an international standard classification of activities (ISIC Rev. 3), is that it breaks the traditional ISIC dichotomy between manufacturing and services activities. While the production or distribution of ICT products can be found everywhere in the economy, the identification of sectors whose main activity is to produce or distribute ICT products constitutes a first-order approximation of the "ICT sector".

The importance of the ICT sector has grown over time, especially in northern European countries, such as Finland, Sweden, Norway, the Netherlands and the United Kingdom. The composition of the ICT-producing industry varies considerably across OECD countries. Patterns of trade specialisation and comparative advantage seem to suggest the presence of economies of scale in ICT production. Finland and Sweden, for example, have built up their competitive advantage in this sector over the last few years by expanding their communication equipment sector. This might indicate that there is space for new entrants in ICT markets. Moreover, the relative specialisation of some countries in ICT production depends heavily on the presence of foreign affiliates. This is the case for Ireland and Hungary, where a large portion of ICT production is due to foreign affiliates.

On average, Europe lags the United States in terms of specialisation in ICT production, but averages hide wide differences between smaller northern European countries and larger European countries. The latter lag in terms of ICT production, imports of embodied ICT technology and, possibly more importantly, R&D.

While the ICT sector still accounts for a relatively small share of OECD business sector GDP, about 10% in 2000, it can make a relatively large contribution to growth and productivity performance if it grows more rapidly than the rest of the economy. Few OECD countries are specialised in the parts of the ICT sector that are characterised by very rapid technological progress, *e.g.* the production of semiconductors and computers. This is not necessarily a problem for countries that do not produce such goods, since a substantial part of the benefits of ICT production accrue to importing countries and to users, as these can benefit from cheap investment and consumer goods.

The survey data collected from member countries, as well as methodological information about sources and methods used to collect the data on the ICT sector, is being published for the first time in the electronic version of *Measuring the Information Economy 2002* (see www.oecd.org/sti/measuring-infoeconomy). The data provided by member countries have then been combined with different data sources to estimate ICT aggregates compatible with national accounts totals. The estimates compatible with national accounts have been used to construct the figures for ICT-sector production, value added and employment in this chapter. For this reason, the indicators presented here may differ from figures contained in national reports and in previous OECD publications.

ICT-producing sectors

- National accounts estimates of production values, based on the OECD definition of ICT-producing industries, show that ICT production as a share of business sector production (excluding agriculture) ranged between 4% and 15% in OECD countries in 2000. Sweden and Finland became increasingly specialised in the production of communication equipment, and almost doubled their share of ICT production in total production over the 1995-2000 period.
- When ICT manufacturing is compared to total manufacturing, Finland's specialisation in ICT production is over 20%, Korea's is 19%, and Sweden's is 17%, well above the shares for Japan (14%) and the United States (11% in 1999).
- Overall the composition of ICT production differs across OECD countries. Few are specialised in the parts of the ICT sector that are characterised by very rapid technological progress, *e.g.* the production of semiconductors and computers. Some countries are specialised in the manufacturing of communication equipment (e.g. Finland, Korea, Mexico, Japan and Sweden). Other countries have experienced a growing weight of computer services in ICT production. This is especially the case in Denmark, France, Italy, the Netherlands, Norway, and the United Kingdom were computer services now account for over 30% of total ICT production.

Box 2.1. International comparisons of ICT activities

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 Annex 1). The existence of a widely accepted definition of the ICT sector is the first step towards comparisons across time and countries. The quality and comparability of the data collected at the OECD has improved, and some member countries use their national classifications to provide more accurate measures of the ICT sector.

The capacity to provide data according to the OECD definition of the ICT sector is a function of the similarity between national classifications and ISIC Rev. 3. While NACE, the European classification, matches ISIC at the required level of detail and provides an even finer breakdown, specific concordances and estimates have to be provided for NAICS (Canada, the United States), ANZIC (Australia, New Zealand) and SIC (Japan). Table A.1 in Annex 1 shows the concordance between the ISIC Rev. 3 classes included in the OECD definition of the ICT sector and the more detailed national classifications currently used by member countries to provide data to the OECD. While it is generally possible to calculate ICT manufacturing aggregates, a few problems remain for reaching the level of service industry detail required for the ICT sector definition. In particular:

(a) The treatment of ICT wholesale. In 1998 it was recommended that member countries identify and provide the part of the class attributable to the wholesaling of ICT products. National classifications are currently being used by a number of countries – albeit with varying degrees of precision – to isolate ICT wholesale. The United States and Canada differ slightly in their definition of wholesale of ICT products. Australia uses a part-class procedure in which data on ICT specialist businesses are compiled. Australia excluded from wholesale of machinery and equipment (ANZIC 4611) only the wholesale of farm and construction machinery.

(b) ISIC Rev. 3 class 6420 (Telecommunications services). For reasons of confidentiality, some countries are unable to separate data for this class from data related to post and telecommunications. Germany, Greece and Turkey have very limited coverage in terms of variables and time series.

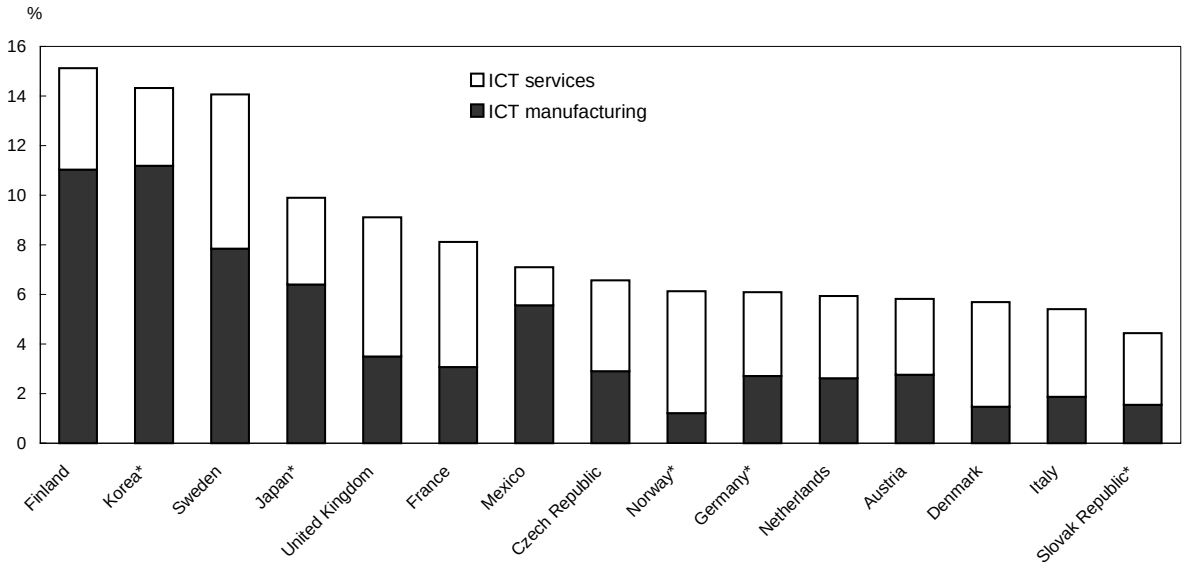
(c) Rental of office machinery and equipment. About one-third of countries are currently unable to provide data for ISIC class 7123.

The survey data collected from member countries, as well as methodological information about sources and methods used to collect the data, are being published for the first time in the electronic version of *Measuring the Information Economy 2002* (www.oecd.org/sti/measuring-infoeconomy). The data provided by member countries have been combined with different data sources to estimate ICT aggregates compatible with national accounts totals. These have been used to construct the figures relating to production for the ICT sector, value added and employment in this publication. For this reason, the statistics presented here may differ from figures contained in national reports and in previous OECD publications.

ICT-producing sectors

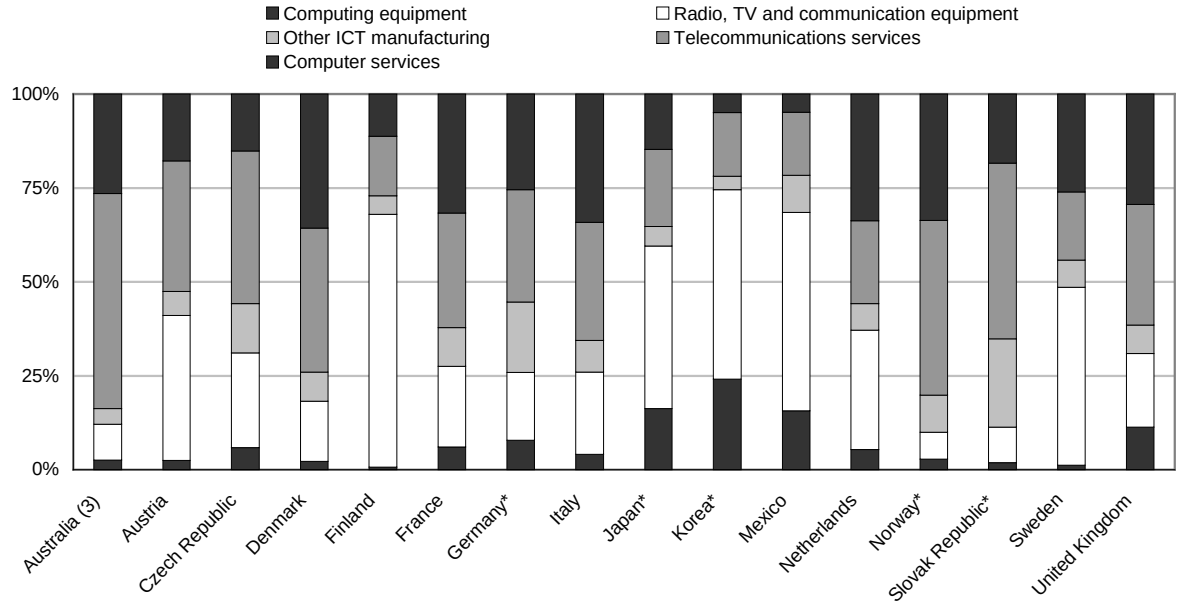
Share of ICT-producing activities in the non-agriculture business sector,[1] 2000

Percentages



Composition of ICT sector production,[2] 2000

Percentage share



* 1999 instead of 2000.
1. Totals for the ICT-producing sector exclude production values in ICT wholesaling and ICT rental services.
2. "Other ICT manufacturing" includes insulated wire and cable and precision instruments.
3. 2000-01.
Source: OECD estimates, based on national sources; STAN and National Accounts databases, August 2002.

Size and growth of the ICT sector

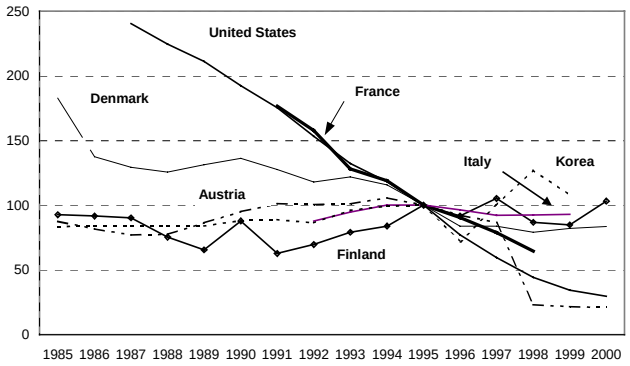
- The importance of the ICT sector within OECD economies has been growing over the 1990s. Rapid growth is especially apparent in northern European countries (Finland, Sweden, Norway, the Netherlands and the United Kingdom). In Finland, the ICT sector's share of value added increased by 7.2 percentage points over the 1995-2000 period and now represents over 15% of total business value added. On average, however, the ICT sector still accounts for a relatively small share of OECD business-sector GDP. In 2000, ICT value added represented between 5% and 16.5% of total business sector value added and the average share in the OECD (25 countries) was about 9.7%, while in the European Union reached 8.5%.
- Ireland, Finland, Korea, Japan and Mexico are specialised in the manufacture of ICT goods. In Finland, for example, ICT accounts for almost 22% of total manufacturing value added. Except for Ireland, where computing and office equipment accounts for over 10% of manufacturing value added, the largest contribution to economic activity typically comes from the manufacture of telecommunication equipment. ICT services, such as telecommunication and computer services, generally constitute between 70% and 90% of total ICT sector value added.
- Most OECD countries already have a well-developed telecommunication services sector, which is reflected in its sizeable contribution to ICT sector value added. Hungary and the Czech Republic, with the highest relative share of telecommunication services, are reaping the benefits of liberalisation reforms in the mid-1990s. At the same time, there is a noticeable increase in the contribution of computer and related services, mainly software services. The share of computer and related services in business services value added was highest in Ireland (7% in 1999), Sweden (5.7% in 2000), and the United Kingdom (4.2% in 2000). Software consultancy accounts for between 60% and 80% of computer services.

Box 2.2. Measuring the contribution of the ICT sector to value added

Examining the real contribution of ICT to value added would require an analysis based on volume measures. This is particularly problematic in the case of the ICT sector. On the one hand, there is the issue of measuring prices in sectors characterised by the significant quality improvements associated with technological advances in goods such as computers and semiconductors. On the other hand, there is the problem of measuring output in the telecommunications industry. Some countries use consumer price indices for phone rates to deflate value added; others use physical quantity indices for calls, telexes and other services to measure volume changes in output; and some countries use a composite index of producer price indices for the relevant components.

Several countries currently use hedonic methods to deflate output in the computer industry (*e.g.* Canada, Denmark, France and the United States). The production price deflator for the computer industry (ISIC Rev. 3, Division 30) is reported below. It shows a very rapid decline in production price indices for France and the United States, and a gradual decline in Denmark since 1984, but relatively little change in some other countries. These differences may partly reflect the use of a hedonic deflator in both France and the United States, the use of an exchange-rate-adjusted US hedonic deflator by Denmark, and the use of conventional deflators in the other countries.

Producer price indexes for the computer industry, 1995=100



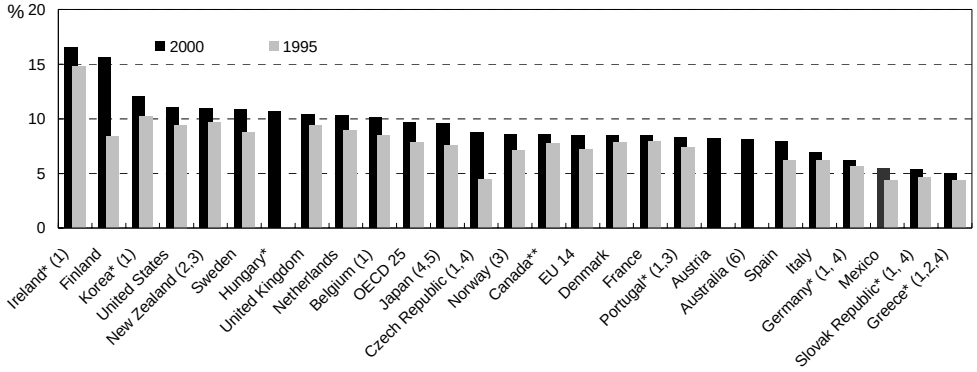
Source: OECD calculations on the basis of the STAN database.

Adjusting for these methodological differences in computer deflators for the purpose of a cross-country comparison is difficult, however, since there are considerable cross-country differences in industrial specialisation. Only a few OECD countries produce computers or semiconductors, where price declines have been very rapid; many only produce peripheral equipment, such as computer terminals. For further information, see Pilat, D., F. Lee and B. Van Ark, "Production and use of ICT: A sectoral perspective on productivity growth in the OECD area", forthcoming in *OECD Economic Studies*, No. 35, Paris (forthcoming).

Size and growth of the ICT sector

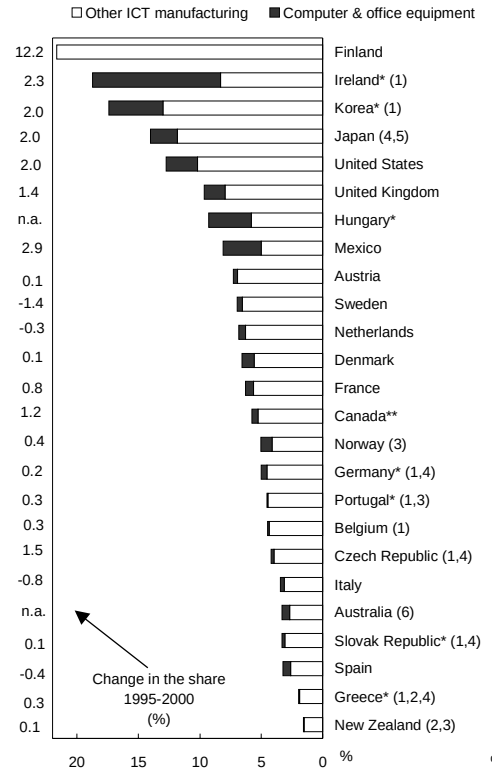
Share of ICT value added in business sector value added, 2000

Percentages



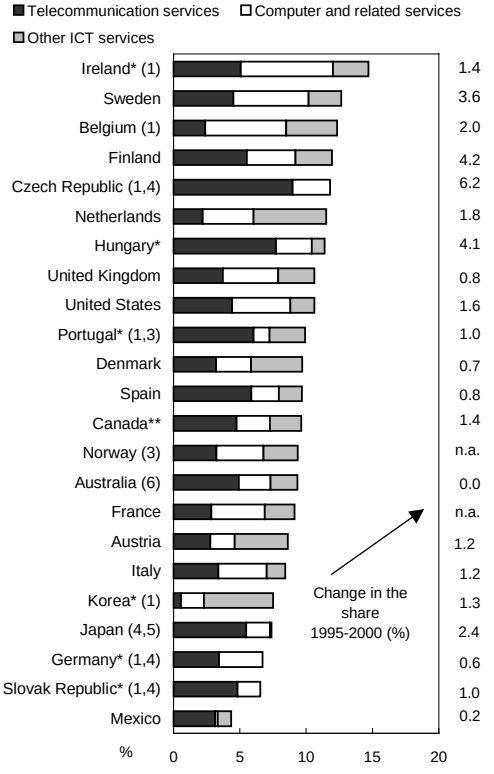
Share of ICT manufacturing in total manufacturing value added, 2000[7]

Percentages



Share of ICT services in total business services value added, 2000[7]

Percentages



* 1999; ** 1998.
1. Rental of ICT goods (7123) is not available.
2. Postal services included with telecommunications services.
3. 1996 instead of 1995.
4. ICT wholesale (5150) is not available.
5. Includes only part of computer related activities (72).
6. 2000-2001.
7. "Other ICT manufacturing" includes communication equipment, insulated wire and cable and precision instruments. "Other ICT service" includes wholesale and rental of ICT goods.

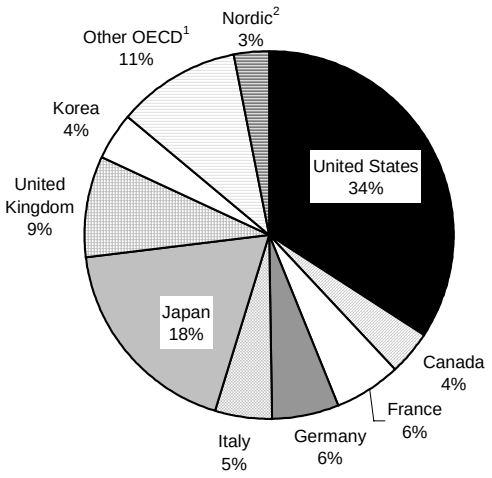
Source: OECD estimates, based on national sources; STAN and National Accounts databases, August 2002.

The contribution of the ICT sector to employment growth

- In 2000, the 20 OECD countries for which estimates are available employed 16 million persons in the ICT sector, about 6.4% of total business employment. The United States and the EU (excluding Greece, Iceland, Ireland and Luxembourg) each represented 34% of this total and Japan 18%.
- The ICT sector has been a major source of employment growth. Over the 1995-2000 period, OECD-area employment in the sector grew by almost 3 million persons, *i.e.* an average annual growth rate of over 4% a year, almost 3 times that of overall business sector employment. ICT services have been driving this growth; employment in the ICT manufacturing sector has generally followed the declining trend of overall manufacturing employment, albeit to a lesser extent. Exceptions are Finland and Mexico, where ICT manufacturing employment grew by over 9% a year, and Canada, the Czech Republic, the Nordic countries, Spain and the United Kingdom where it grew between 3% and 5%.
- Over the 1995-2000 period, ICT services employment grew everywhere except in Austria. The United Kingdom (10.5%), the Netherlands (10.2%), Finland (9.8%) and the United States (9.5%), the Czech Republic and Spain (7.3%) registered annual growth rates above the OECD average (6.3%). Employment in computer-related services, mainly software services, was the most dynamic component, growing by an average of 11% a year in the OECD-20 area and by over 19% in the United Kingdom.
- In 2000, the share of ICT employment in total business sector employment was higher than the OECD average in Finland (10.9%), Sweden (9.0%), Canada (8.4%), the Netherlands (8%), the United Kingdom and Japan (about 8.2%), Belgium and France (about 7.3%).
- Over the 1995-2000 period, the contribution of ICT manufacturing to total manufacturing employment was stable in most OECD countries. It varies widely across the OECD area, ranging from 13.8% in Korea to 1.3% in Italy. The average share of ICT services employment in market services, instead, has grown over time to about 5.9% in the OECD-20 area in 2000.

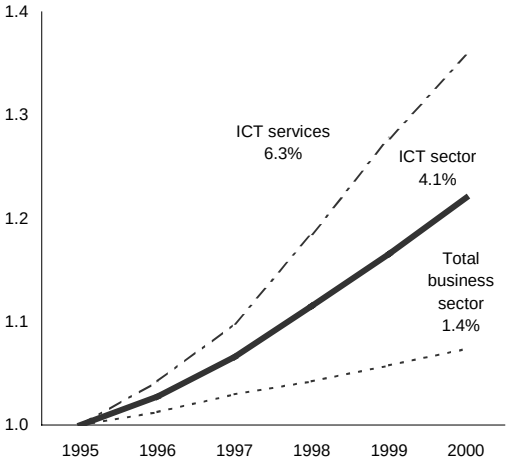
Employment in the ICT sector, selected OECD countries, 2000

Percentage share



The contribution of ICT services to business sector employment growth, selected OECD countries

Average annual growth rate 1995-2000, index 1995=100

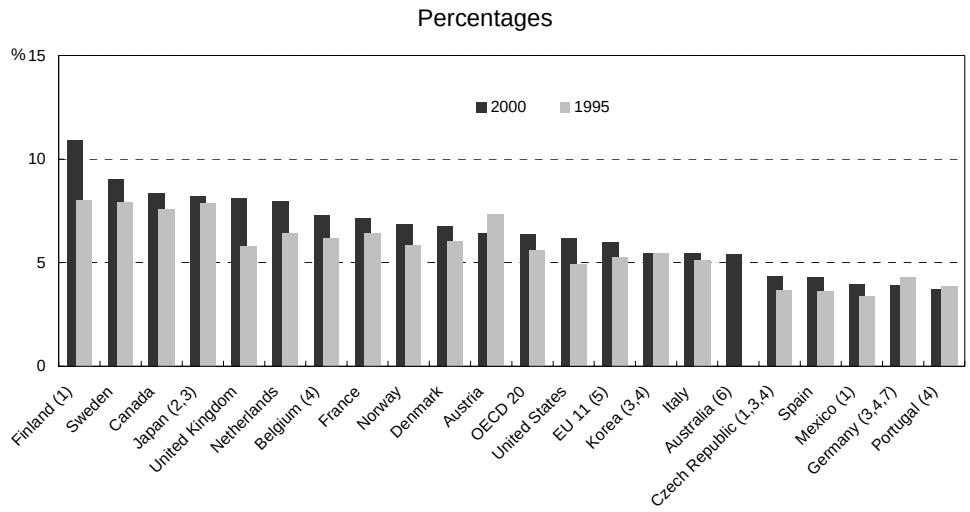


1. "Other OECD": Australia, Austria, Belgium, Czech Republic, Mexico, the Netherlands, Spain and Portugal.
2. Denmark, Finland, Norway and Sweden.

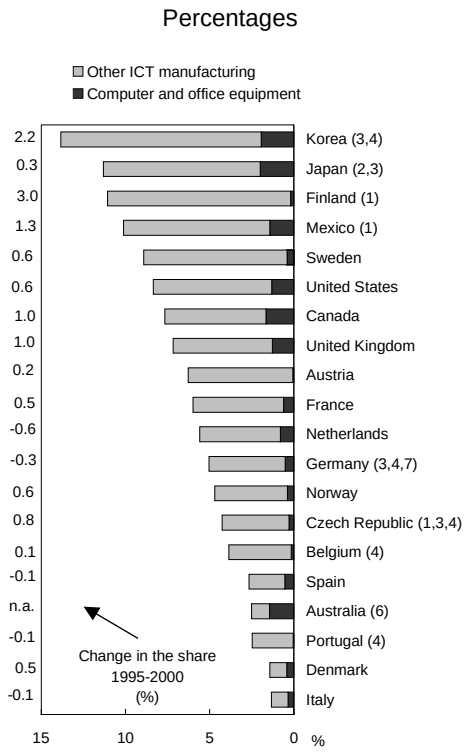
Source: OECD estimates, based on national sources; STAN and National Accounts databases, August 2002.

The contribution of the ICT sector to employment growth

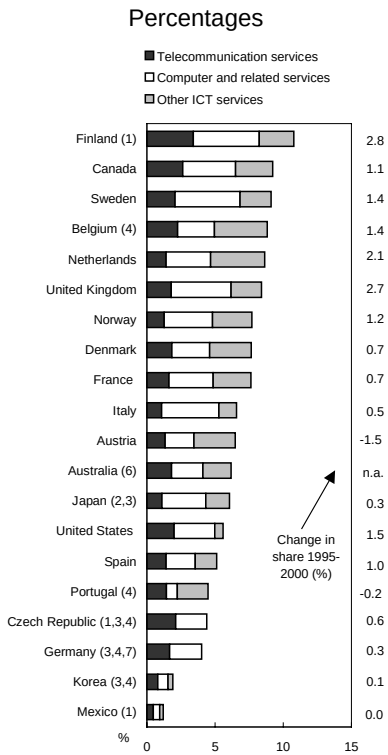
Share of ICT employment in business sector employment, 2000



Share of ICT manufacturing in manufacturing employment, 2000



Share of ICT services in market services employment, 2000[8]



1. Based on employee figures only.
2. ICT services include market research and public opinion polling.
3. ICT wholesale (5150) is not available.
4. Rental of ICT goods (7123) is not available.
5. Greece, Iceland, Ireland, Luxembourg missing.
6. 2000-2001.
7. Telecommunication services (642) are not available.
8. "Other ICT manufacturing" includes communication equipment, insulated wire and cable and precision instruments. "Other ICT service" includes wholesale and rental of ICT goods.

Source: OECD estimates, based on national sources; STAN and National Accounts databases, August 2002.

R&D in selected ICT industries

- The ICT sector invests heavily in R&D and is highly innovative. In 2000, ICT manufacturing industries accounted for more than a quarter of total manufacturing business R&D expenditure in most OECD countries, and more than half in Finland, Korea and Ireland.
- Data for 19 OECD countries show that, in 2000, business R&D expenditure in the ICT manufacturing sector was approximately USD 111 billion (current PPP dollars), while for the ICT services industries, data for 14 OECD countries show expenditure of at least USD 21 billion. The US ICT sector performs some 50% of OECD-wide R&D spending by the ICT manufacturing sector, followed by Japan with about 21%.
- In the 1990s, in countries with data for both manufacturing and services industries, ICT-related expenditure on R&D generally expanded much more rapidly in the services industries. Average annual growth rates for ICT-related manufacturing R&D expenditure were about 6% but for ICT-related services they were about 14%.
- For ICT industries, the ratio of R&D expenditure to GDP or to total business enterprise R&D can indicate the R&D specialisation of ICT industries. Finland, Korea and Sweden are relatively more specialised than large countries in both ICT manufacturing and services. Only Finland allocated more than 1% of GDP to ICT-related manufacturing R&D in 2000.
- ICT-related R&D intensities of the large European economies are well below those of the United States and Japan. The share of ICT-related manufacturing R&D expenditure in GDP in Germany and France is about 0.3%, compared to 0.6% and 0.7% in the United States and Japan, respectively.

Box 2.3 - Measuring R&D expenditure in selected ICT industries

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

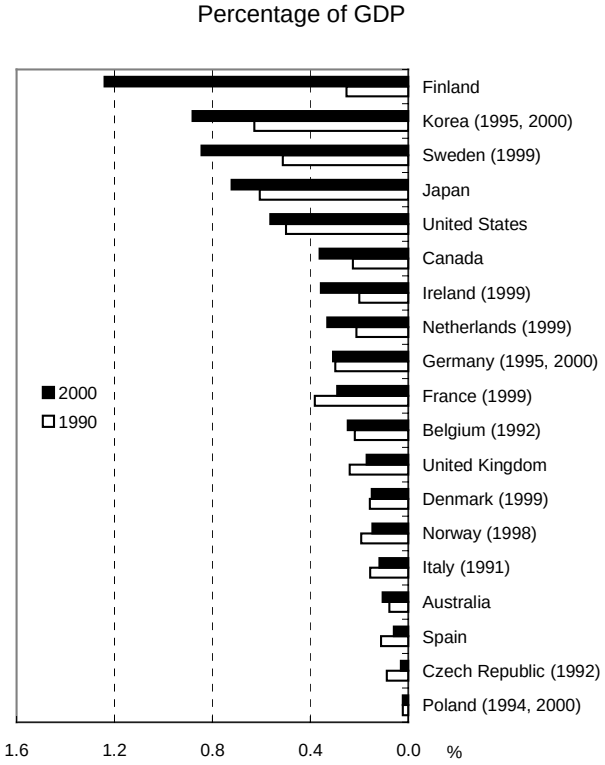
- Manufacturing industries: 30 (Office, accounting and computing machinery); 32 (Manufacture of radio, television and communication equipment apparatus); and 33 (Manufacture of medical, precision and optical instruments, watches and clocks).
- Services industries: 64 (Post and communications); and 72 (Computer and related activities). Two major weaknesses exist with data on R&D in services. In certain countries, the R&D surveys only give partial coverage of the service industries. Additionally, the definition of R&D is better suited to manufacturing industries than to services industries.

Data for R&D expenditure for selected ICT industries are from OECD's Analytical Business Enterprise R&D expenditure (ANBERD) database, 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 may differ significantly from official data.

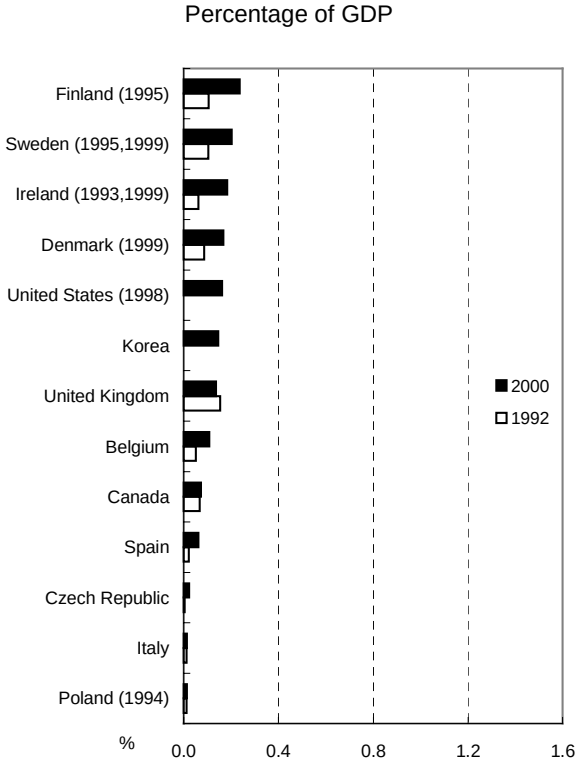
For further information, see *Research and Development Expenditure in Industry*, OECD, Paris, 2002.

R&D in selected ICT industries

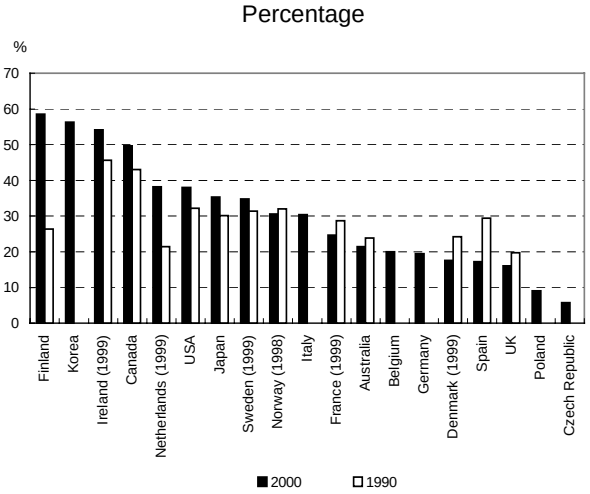
Business R&D expenditure by selected ICT manufacturing industries, 1990-2000[1]



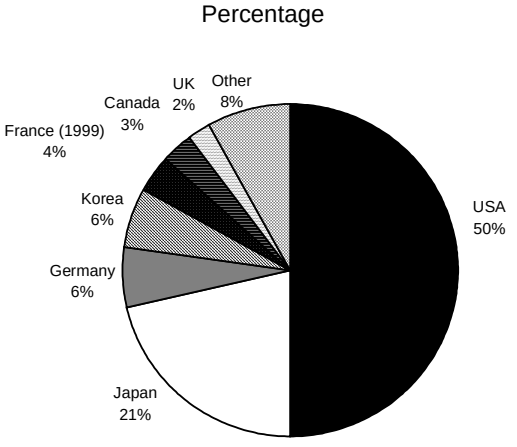
Business R&D expenditure by selected ICT services industries, 1992-2000[1, 2]



Share of ICT manufacturing in total R&D expenditure of the manufacturing sector, 1990-2000



Share of OECD[3] countries in OECD-wide R&D expenditure in ICT manufacturing, 2000



1. 2000 or latest available year. Data are for 1990 or closest year for manufacturing industries, and 1992 or closest year for services industries.
2. Owing to unavailability of R&D data for class 642 (Telecommunications), division 64 (Post and telecommunications) is used as a proxy. Available information shows that in the United States, class 642 accounts for 97-98% of division 64 total.
3. Figures based on only 19 OECD countries.

Source: OECD, ANBERD database, August 2002.

The contribution of the ICT sector to international trade

- The 1990s witnessed a shift in the composition of OECD international trade in manufactured goods towards ICT products. Converting trade in ICT products into trade by ICT activities (see box), shows the growing importance of the ICT sector in total manufacturing trade. In 1990, trade in ICT goods, defined as the average of imports and exports, accounted for over 12% of OECD-wide trade in goods; by 2000, the share had reached almost 20%. ICT imports and exports contributed to total imports and exports by roughly the same amount (18% of imports and 17% of exports).
- The 2001 data mark a reversal of the 1990s trend. The share of ICT manufacturing in total manufacturing trade dropped significantly for the majority of OECD countries. For the 16 countries for which data are available, the share of ICT manufacturing trade dropped on average by 2.4 percentage points since 2000, with Korea and Sweden experiencing decreases of over 4 percentage points. In Ireland, the share of ICT trade increased by 3.5 percentage points.
- Data on ICT trade in services are limited to telecommunications services (for 11 countries) and computer-related services (for 24 countries). They generally only cover the period 1996-99. In 1999, ICT services accounted for little over 3% of the total services balance of payments.
- The ICT manufacturing sector plays a particularly important role in Ireland (41% of manufacturing trade) and Korea (30%). In Hungary the Netherlands, Mexico and Japan, it represented about a quarter of total manufacturing trade in 2000/2001.
- The overall trade balance shows countries' relative comparative advantage in ICT manufacturing. Only seven countries showed a positive ICT trade balance in 2000/2001. The ICT trade surplus was highest in Ireland, Korea and Japan. The main source of comparative advantage in Finland and Sweden is trade in telecommunications equipment; in Ireland, it is trade in computers.

Box 2.4. Measuring ICT sector trade

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

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

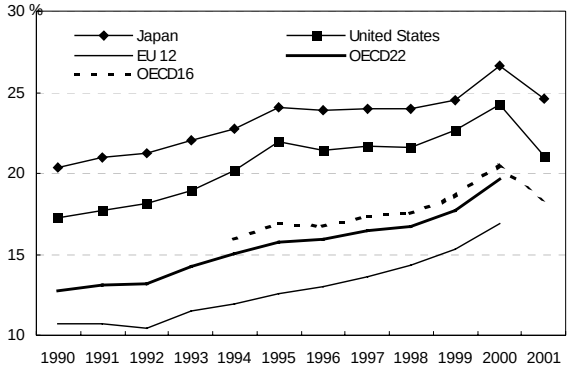
Finally, data for both imports and exports of individual countries include imported goods that are subsequently re-exported. Imports and subsequent re-exports may be in the same or in different reference periods. In the latter case, this may influence not only indicators of countries' relative trade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

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

The contribution of the ICT sector to international trade

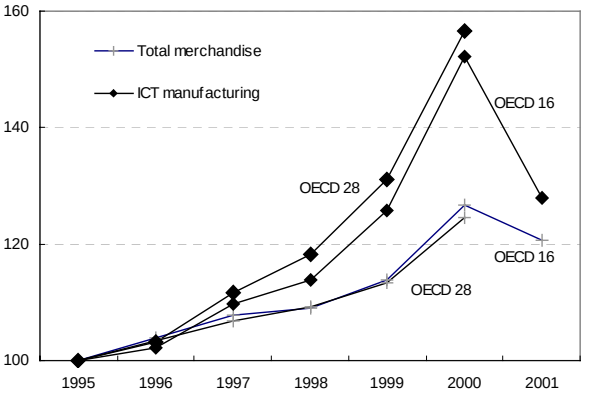
ICT trade by area, 1990-2001[1,2]

Share of total manufacturing trade



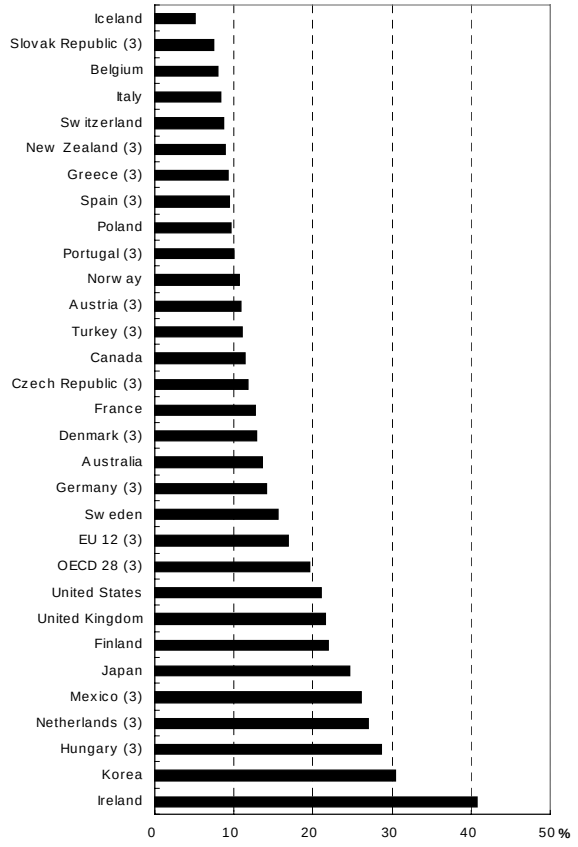
OECD 16[2] and ICT-related trade, 1990-2001

Index: 1995=160

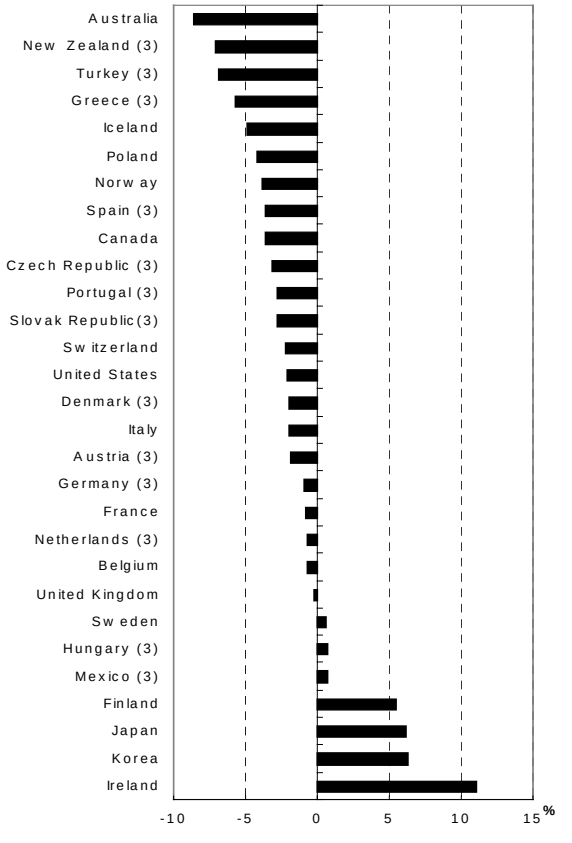


ICT manufacturing trade,[1] 2001 or latest year available

Share of total goods trade



ICT sector trade balance, 2001 or latest year available



1. Average of imports and exports.
2. EU 12 includes all European Union member states except Austria, Belgium and Luxembourg. OECD 28 includes all OECD member countries except for the Slovak Republic and Luxembourg. OECD 22 includes member countries with complete data from 1990 to 2000 and includes EU 12, Australia, Canada, Iceland, Japan, Mexico, New Zealand, Norway, Switzerland, Turkey and the United States. OECD 16 includes member countries with data from 1994 to 2001 and covers Australia, Belgium, Canada, Finland, France, Iceland, Ireland, Italy, Japan, Korea, Norway, Poland, Sweden, Switzerland, United Kingdom and the United States.
3. 2000 data.

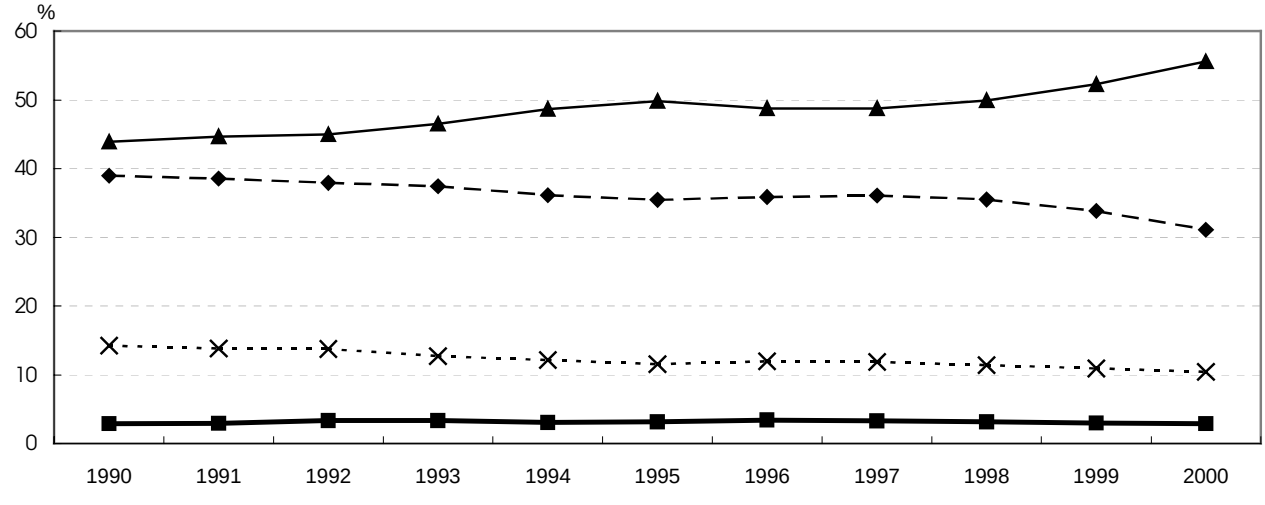
Source: OECD, ITCS and STAN databases, August 2002.

ICT sector exports: share in total exports and composition

- Relative to other sectors, the ICT sector is highly globalised. In 2001, Ireland reported the highest share of ICT sector exports in total merchandise exports (40%). In contrast, Iceland was the country with the smallest share of ICTs in total merchandise exports (0.2%).
- Generally, OECD countries with large ICT sector exports' share at the end of the decade also had large exports at the beginning. However, Mexico, Finland and the Netherlands rapidly increased their ICT sector exports during the 1990s. Japan and Italy were the only countries where the share of ICT sector exports was lower in 2001 than in 1990.
- In the OECD area, the composition of ICT sector exports changed somewhat over the past decade. The share of office and computing machinery fell from 39% in 1990 to 31% in 2000, while the share of radio, TV and communication equipment increased from about 44% in 1990 to just under 56% in 2000.
- The composition of ICT sector exports also differs considerably. In Hungary and Ireland, computer equipment (contained within the office and computing machinery class) represents the bulk of ICT sector exports. In contrast, Finland and Sweden's ICT sector exports are almost completely composed of communication equipment.

Composition of ICT sector exports, 1990-2000

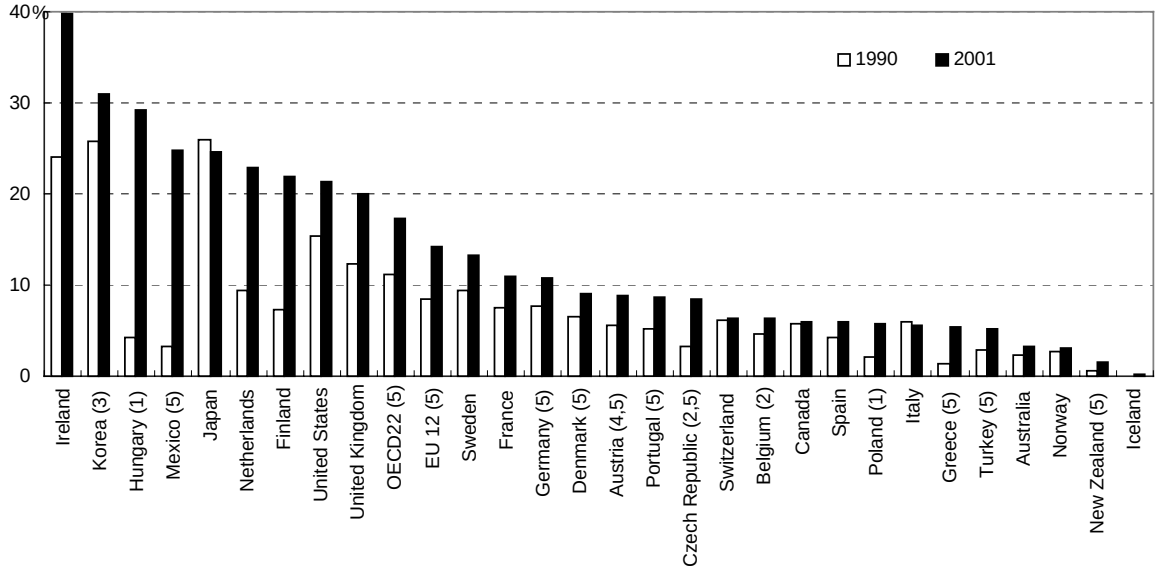
Share of total OECD merchandise exports



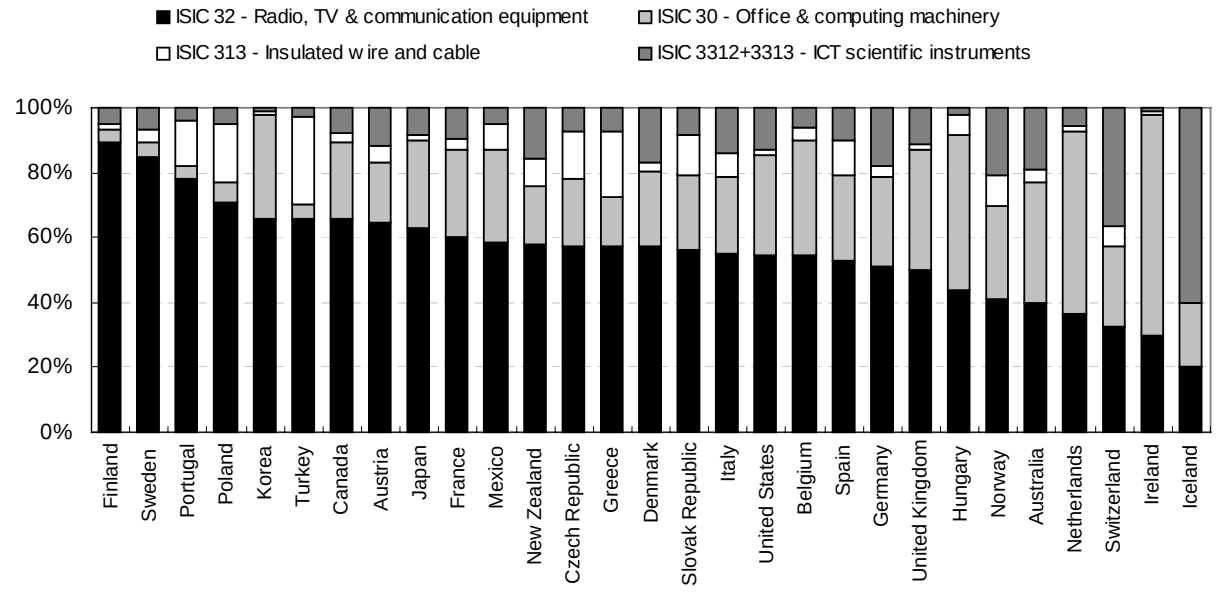
Source: OECD, ITCS and STAN databases, August 2002.

ICT sector exports: share in total exports and composition

Share of ICT sector exports in total merchandise exports, 1990-2001



The composition of ICT sector exports, 2000



1. 1992.
2. 1993.
3. 1994.
4. 1995.
5. 2000.

Source: OECD, ITCS and STAN databases, August 2002.

ICT trade specialisation and comparative advantage

- Three variables of trade specialisation in ICT goods – export specialisation, import specialisation and intra-industry specialisation – offer a view of countries' performance in terms of the relative "openness" of the ICT sector compared to the industry average (see box).
- Several ICT manufacturing producers – Ireland, Korea, Hungary, Japan – have a high export specialisation in ICT sector exports. This index of revealed comparative advantage is quite skewed, as only ten countries are above the OECD average. Among the countries who had a comparative advantage in 1995 and 2000, only Korea and the Netherlands have managed to consolidate their comparative advantage; Japan has lost the most export market share and Hungary, Finland and Sweden have emerged as new actors.
- On the one hand, this unequal distribution may reflect the presence of economies of scale in ICT production. On the other, the fact that countries like Finland and Sweden have built up their competitive advantage in this sector over recent years may indicate that there is space for new entrants in ICT markets.
- Even if a country is not an ICT producer, the benefits of ICT technology may be apparent in its imports of ICT goods. Australia is the prime example of a non-producer that has a relatively high import propensity in ICT goods. Some activity in both imports and exports may be a sign of re-export. The intra-industry trade index (IIT) indicates whether the ICT sector imports and exports roughly the same quantity of ICT goods. Hungary, Mexico and the Netherlands have a relatively high IIT and are also relatively specialised in both exports and imports.
- Based on indicators of manufacturing trade specialisation and comparative advantage in ICT, the European Union lags behind the United States and Japan. However, the European average hides wide differences between smaller and northern European countries and the larger economies. Ireland, Finland, the Netherlands and Sweden have a comparative advantage in ICT sector trade. Relatively high levels of ICT intra-industry trade can instead be found in Germany, France and the United Kingdom.

Box 2.5. ICT specialisation indices

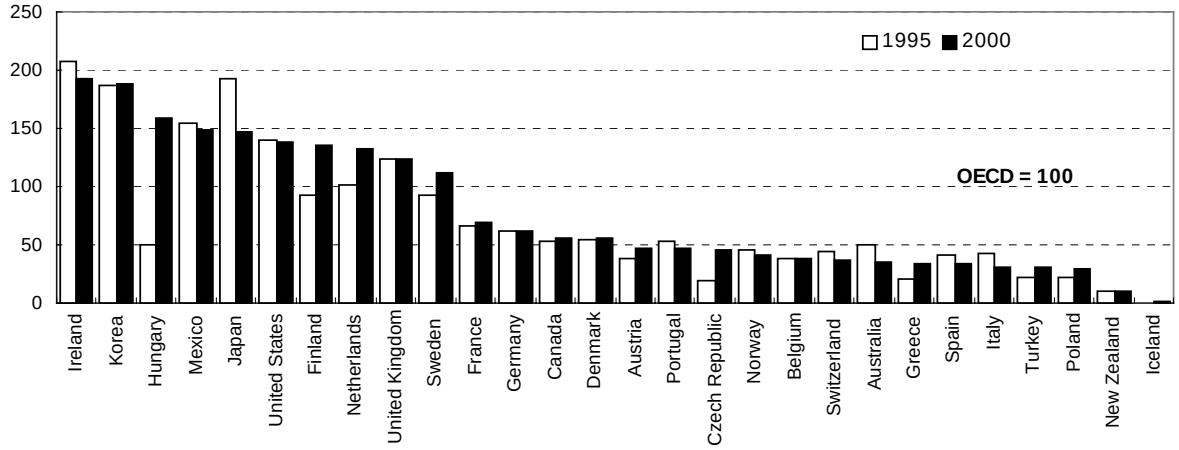
Indicators of import and export specialisation show a country's imports/exports for a given industry relative to total manufacturing imports/exports, divided by OECD imports/exports of the same industry relative to OECD total manufacturing imports/exports. For a given country, a value above 100 in a certain industry implies that, relative to the OECD average, the country specialises in imports or in exports in that industry. The indicator of export specialisation is also commonly known as revealed comparative advantage.

Intra-industry trade is the value of total trade remaining after subtracting the absolute value of an industry's net exports and imports. For comparisons of countries and industries, this measure is expressed as a percentage of each industry's combined exports and imports (intra-industry trade index or IIT). This index varies between 0 and 100. If a country exports and imports roughly equal quantities of a certain product, the IIT index is high. If trade is mainly one-way (whether exporting or importing), the IIT index is low.

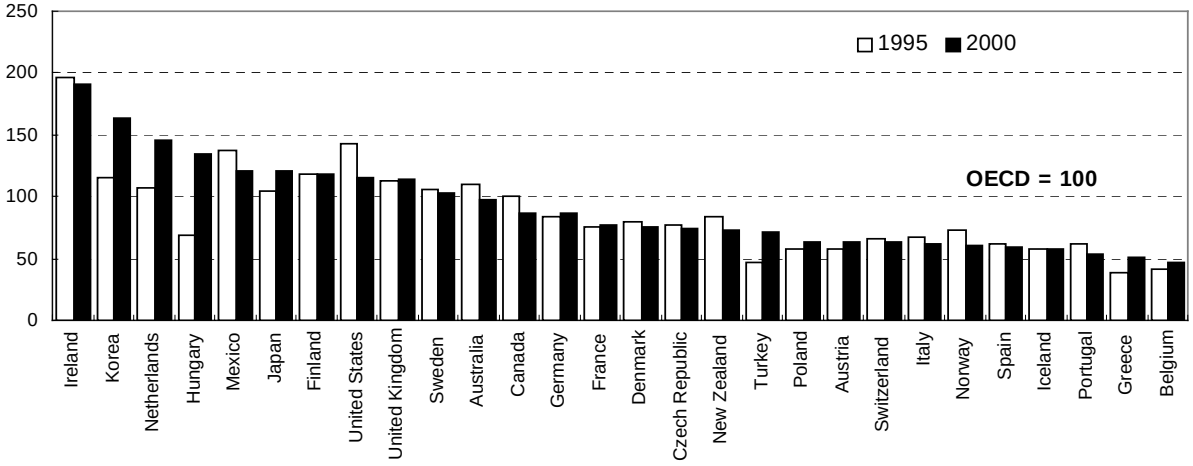
Part of intra-industry trade may be intra-firm trade, *i.e.* cross-border transactions between affiliates of multinational companies. In 2000, US intra-firm trade accounted for 47% of the total value of merchandise imports and 32% of merchandise exports (*Information Technology Outlook*, OECD, Paris, 2002).

ICT trade specialisation and comparative advantage

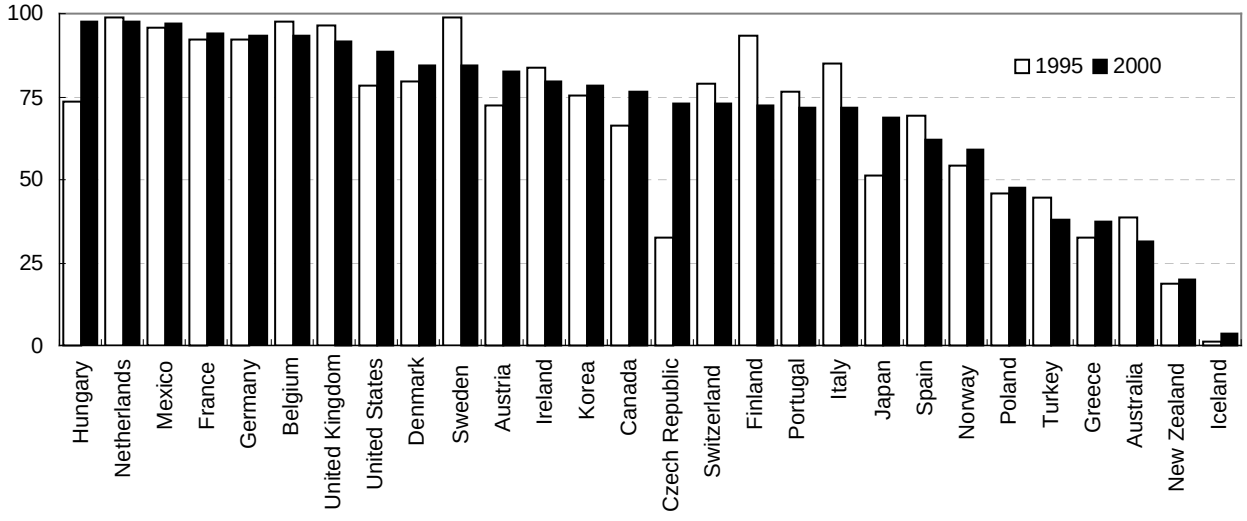
ICT export specialisation index, 1995-2000



ICT import propensity index, 1995-2000



ICT intra-industry specialisation index, 1995-2000



Source: OECD, based on STAN indicators, August 2002.

Foreign affiliates in the ICT sector

- Since the mid-1980s and the increase in globalisation, foreign direct investment has been central to industrial restructuring. Most firms have found the establishment of an affiliate to be a particularly effective way of penetrating markets. As data on foreign direct investment data do not capture this phenomenon directly, indicators on the activities of foreign affiliates provide important complementary information.
- In the ICT sector, the role of foreign affiliates varies considerably, depending on the part of the sector concerned. In computer manufacturing (ISIC 30), almost all production in Ireland and Hungary is due to foreign affiliates, while in the United States and Germany, only a small share of production is attributable to foreign affiliates.
- Foreign affiliates also make a strong contribution to the manufacturing of electronic equipment (ISIC 32). Hungary and Ireland are again the countries with the largest share (almost 90%), but the United Kingdom also has a very high share of foreign multinationals. In the Netherlands, Finland and Sweden, foreign affiliates account for only a small share of the production of electronic equipment, possibly owing to the strong position of domestic firms in these markets.
- In the telecommunications sector (ISIC 642), foreign affiliates play a minor role in almost all OECD countries, Hungary and Portugal being exceptions. This partly reflects the degree of liberalisation of telecommunications markets – for instance the limits that were, until recently, imposed by many countries on foreign investment. In 1998, foreign affiliates in Ireland and Italy accounted for 0% of production in this sector.
- In the other major ICT service sector, computer services (ISIC 72), foreign affiliates play a more substantial role. The share of foreign affiliates is relatively high in Belgium, Norway and the United Kingdom, but very low in Turkey and the United States.
- For manufacturing segments of the ICT sector, there is a close link between the shares of foreign affiliates in employment and in production. In most cases, the share of production is slightly higher, an indication that, on average, the labour productivity of foreign affiliates is somewhat higher than that of domestic firms.
- Foreign affiliates also account for a considerable share of R&D in the ICT sector, particularly in Ireland. In large OECD countries, such as France and the United Kingdom, a considerable share of R&D in ICT manufacturing is due to foreign affiliates, a sign that many firms are establishing R&D laboratories outside their home countries.

Box 2.6 - Activity of foreign affiliates

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

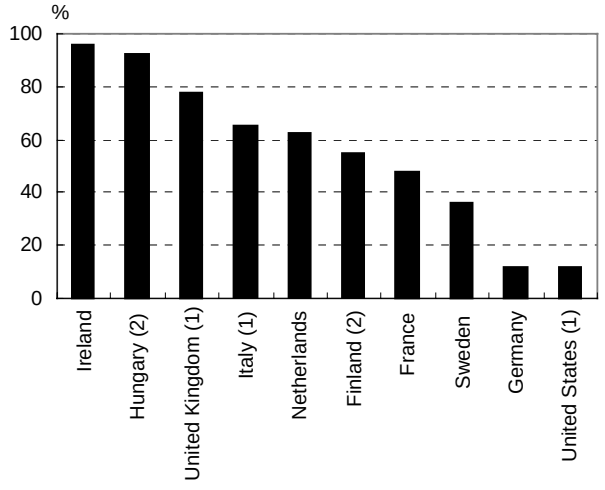
The ownership of a majority of ordinary shares (more than 50%) or voting power on the board of directors implies control and the ability to shape a company's activities. Variables such as turnover, number of employees or exports are attributed in full to the controlling investor.

The term "foreign affiliate" is restricted to majority-owned foreign affiliates. 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.

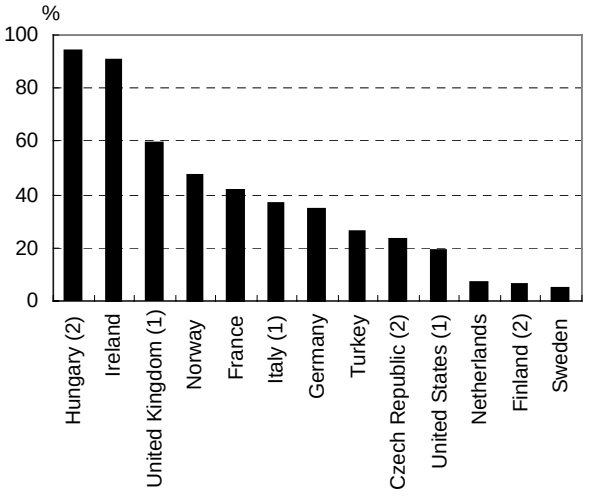
However, the majority-holding criterion is not used for the United States and Hungary, as these countries include minority foreign-owned firms in their statistics.

Foreign affiliates in the ICT sector

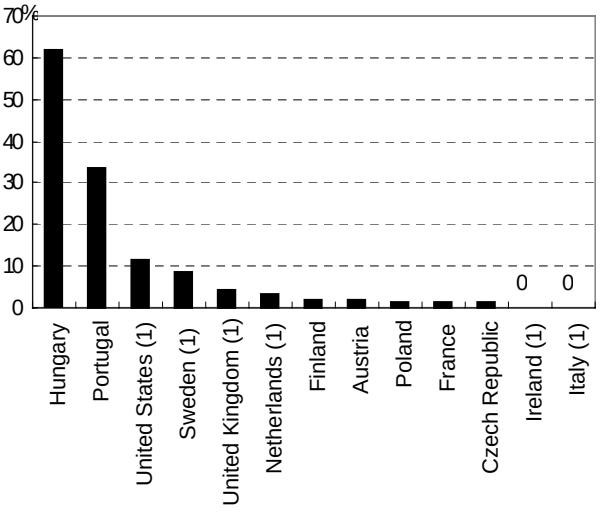
Share of production (turnover) of foreign affiliates in computer manufacturing (ISIC 30), 1998



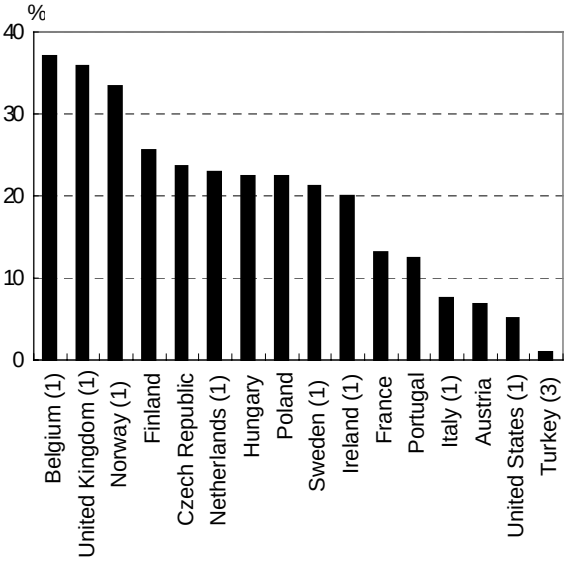
Share of production (turnover) of foreign affiliates in electronic equipment manufacturing (ISIC 32), 1998



Share of production (turnover) of foreign affiliates in the telecommunications sector (ISIC 642), 1998



Share of production (turnover) of foreign affiliates in computer-related services (ISIC 72), 1998

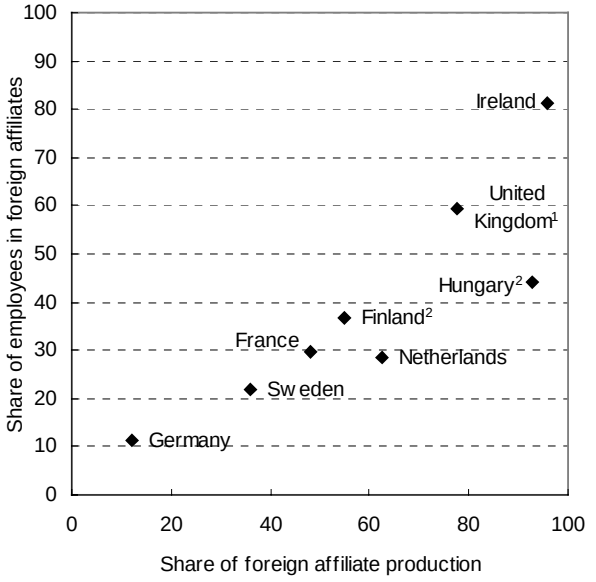


1. 1997.
2. 1999.
3. 1994.

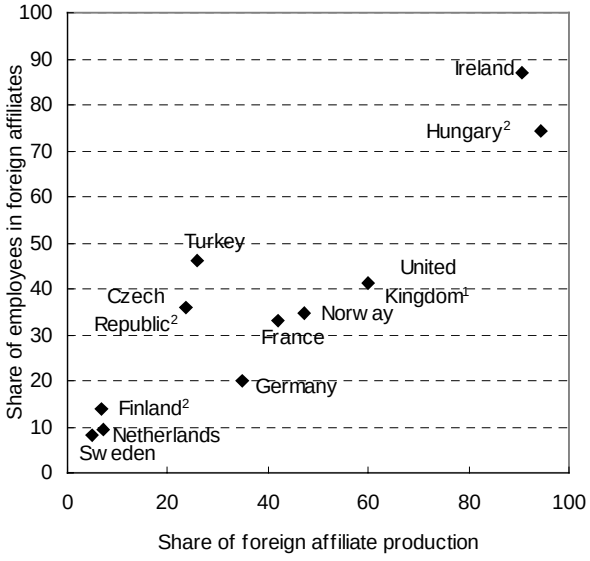
Source: OECD, Activities of Foreign Affiliates (AFA) and Foreign Affiliates Trading Services (FATS) databases.

Foreign affiliates in the ICT sector

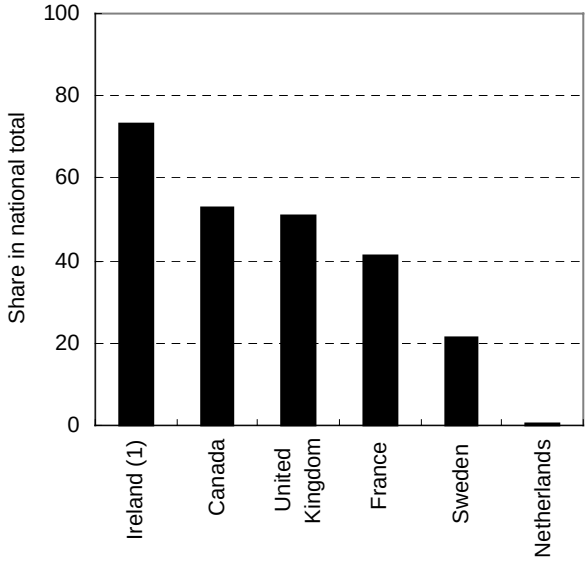
Relationship between share of production and employees of foreign affiliates in computer manufacturing (ISIC 30), 1998



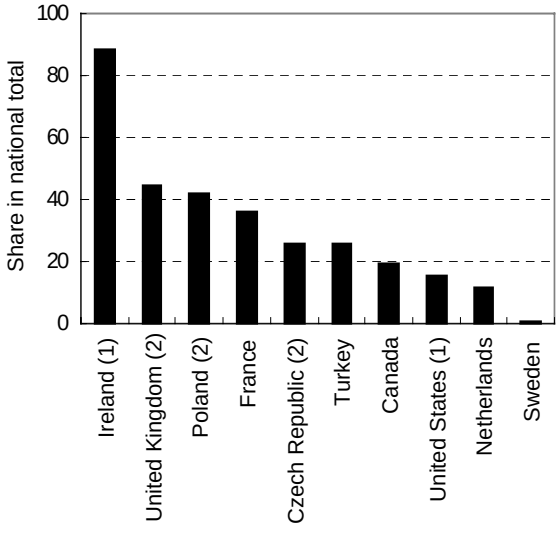
Relationship between share of production and employees of foreign affiliates in radio, TV and communications equipment (ISIC 32), 1998



Share of R&D by foreign affiliates in office, accounting and computing machinery (ISIC 30), 1998



Share of R&D by foreign affiliates in radio, TV and communications equipment (ISIC 32), 1998



1. 1997 data.
2. 1999 data.

Source: OECD, Activities of Foreign Affiliates (AFA) and Foreign Affiliates Trading Services (FATS) databases.

Chapter III. Access to and use of information technologies

The contribution of the information economy to economic growth and performance also depends on the way new information technologies are used by individuals and businesses. Greater use of ICT in the production process may, for example, help raise the overall efficiency of the use of capital and labour, *e.g.* by reducing inventories and transaction costs. For technologies based on networks, such as the Internet, the more people who are connected, the greater the potential benefits of the network owing to spillover effects. Statistics on the diffusion of new information technologies are therefore important for helping to evaluate the extent to which their use has an impact on overall economic performance. Also, the growing interest of policy makers in issues such as universal access, the digital divide, consumer trust and privacy protection has raised demand for indicators on access to and use of ICT.

Access is a prerequisite to the use of the technology. The first indicators in this chapter compare developments in telecommunication networks. Others focus more specifically on the size and growth of Internet infrastructure. The 1990s have witnessed extremely dynamic expansion in telecommunication networks, although differences among OECD countries remain and depend partly on the relative pricing structure and the level of competition for a particular access technology.

For international comparisons of ICT usage statistics, important issues are still to be addressed (see Boxes 3.4 and 3.5), but national statistical offices have made tremendous progress in providing high-quality and timely indicators of ICT use. This chapter presents the latest international comparisons based on official surveys of ICT diffusion in households, among individuals and in businesses that were recently developed by national statistical offices under the aegis of the OECD (see Box 3.4 and Annex 2).

To help to explain differences in the intensity of use of new technologies across countries, this chapter also relies on indicators of barriers to the use of information technology. Answers on perceived barriers and on their evaluation are inevitably qualitative in nature and need to be used with caution in international comparisons (see Box 3.6). Nevertheless, they can be of great interest to policy makers. For example, indicators of barriers can help for monitoring issues of digital divide, point to potential bottlenecks related to the technology or lack of appropriate skills and help address concerns about security and logistics.

Telecommunication networks

- 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 or high-speed networks, also need to be taken into consideration in terms of access to communications.
- 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 has generally been used to keep a line free for telephony, but this is changing as broadband connections increase.
- 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 being 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 13.8 in June 2001. Three other countries - Canada (6.2), Sweden (4.1) and the United States (3.2) – had more than three broadband subscribers per 100 inhabitants by June 2001. The Netherlands, Austria, Belgium and Denmark had all exceeded two subscribers per 100 inhabitants. The trend towards greater infrastructure competition in local markets will encourage the shift towards higher speed access technologies.

Box 3.1. Measuring the telecommunication network

In the past, the penetration rate for standard access lines provided a reasonable indication of the extent to which basic connections were 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.

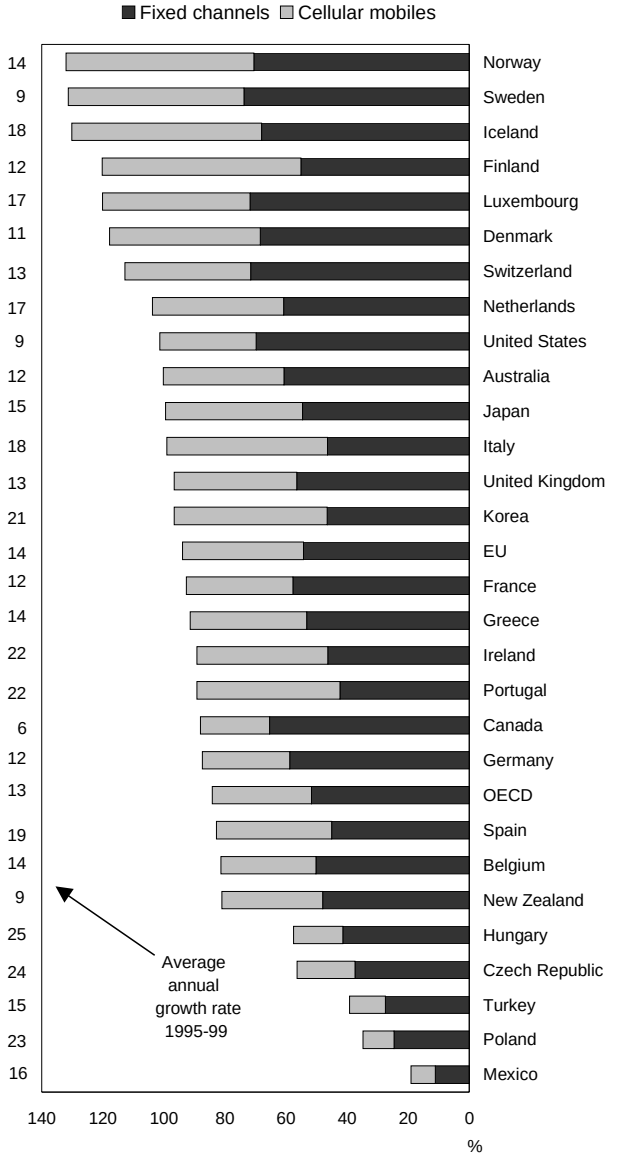
A different methodology than the one traditionally used for the penetration rate of standard access lines is used to measure the penetration of telecommunication channels. Particularly problematic is the measurement of ISDN connections. Telecommunication carriers generally report data for ISDN connections 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.

Telecommunication networks

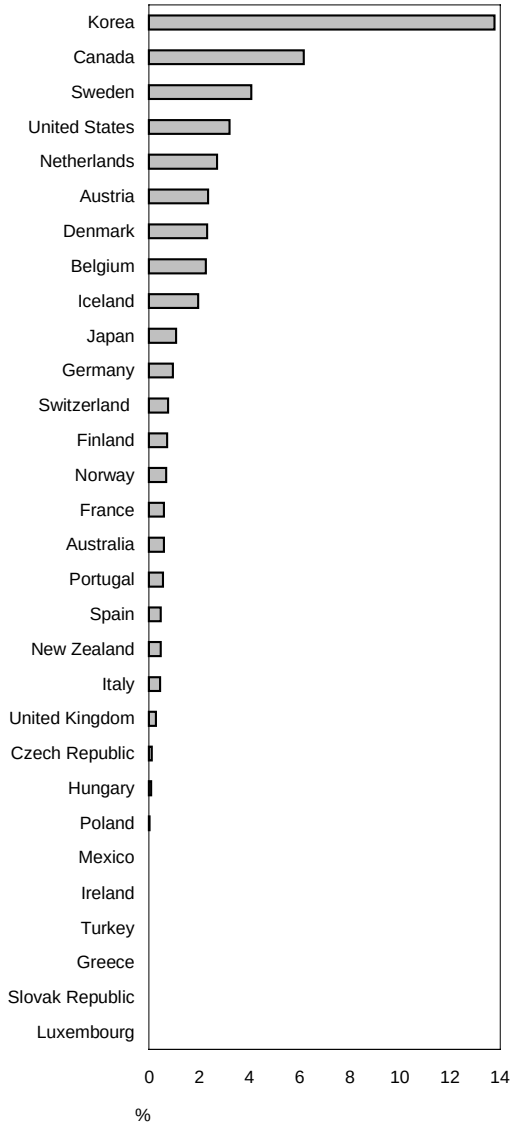
Access paths[1] per 100 inhabitants, 1999[2]



1. Telecommunication access paths include the total of fixed access channels (standard telecommunication lines and ISDN connections) and cellular mobile subscribers.
2. The latest data available for publication (1999) do not reflect major developments in network infrastructure, especially in the wireless segment. More recent data (2001) will be published in the biennial *Communications Outlook* (*forthcoming* 2003).
Source: OECD, *Communications Outlook 2001*, May 2001.

Broadband penetration rates in OECD countries, June 2001

Number of DSL[1], cable modem lines and other broadband[2] per 100 inhabitants



1. Digital Subscriber Lines.
2. The other technologies that were deployed in 2001 to provide broadband services are fixed wireless broadband, direct satellite broadband and various forms of "fibre to the residence".
Source: S. Paltridge, *The Development of Broadband Access in OECD Countries*, OECD, Paris, October 2001.

Internet infrastructure

- The Internet continues to grow at an extremely fast pace. By July 2001, the number of Internet hosts in the OECD area reached 112 million, up from 82 million in July 2000.
- The number of hosts per 1 000 population gives an indication of the relative development of Internet infrastructure in various countries. In July 2001, the OECD average was 101 hosts per 1 000 inhabitants; the EU average was 53 hosts per 1 000 inhabitants. The United States is far ahead of the other OECD countries, with more than 272 hosts per 1 000 inhabitants in July 2001. Other countries with over 150 hosts per 1 000 inhabitants are Finland (183), Canada (183), Iceland (180) and Sweden (177). By way of contrast, Mexico and Turkey had 5 and 4 hosts per 1 000 inhabitants, respectively.
- While the Nordic countries have among the highest penetration rates, between July 2000 and July 2001 Poland was the only country to double its penetration rate. Austria, Germany, Japan, Spain and Sweden all experienced a growth rate exceeding 70%. The unweighted average growth rate in 2001 for OECD countries was 60%. 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.

Box 3.2. 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.

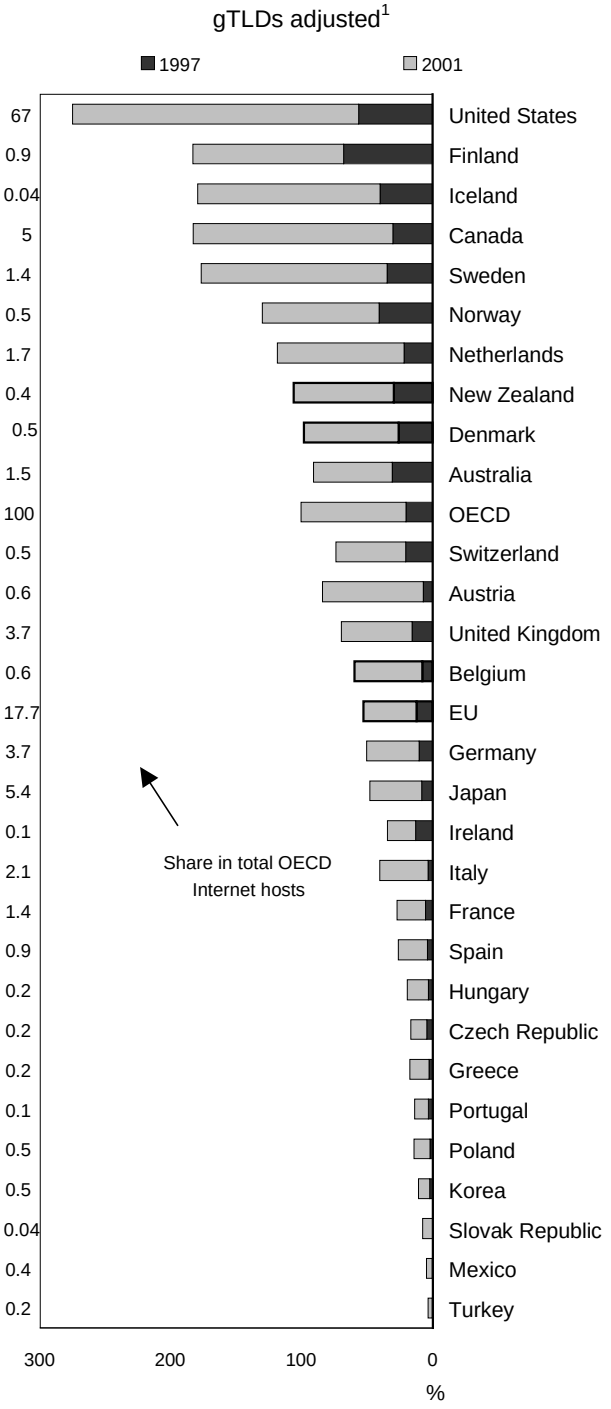
Netcraft surveys Web servers in order to provide information about the software used on computers connected to the Internet. The data can be used to estimate the number of active Web sites under each domain, as well as the number of Web sites in each country by distributing gTLD and ccTLD registrations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

Internet infrastructure

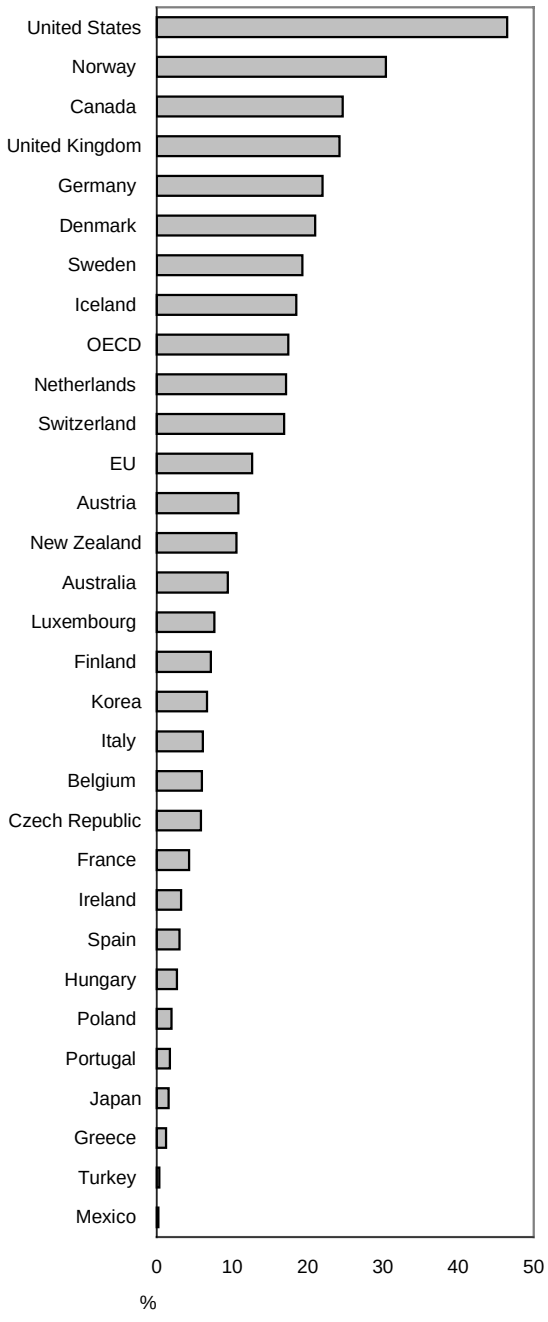
Number of Internet hosts per 1 000 inhabitants, July 1997-July 2001



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

Source: OECD, *Information Technology Outlook 2002*; OECD calculations based on Netsizer (www.netsizer.com), July 2002.

Web sites per 1 000 inhabitants, July 2000



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

Internet subscribers

- For technologies based on networks, such as the Internet, the more people that are connected, the greater the potential benefits of the network.
- 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.

Box 3.3. Measuring Internet access using information on subscribers

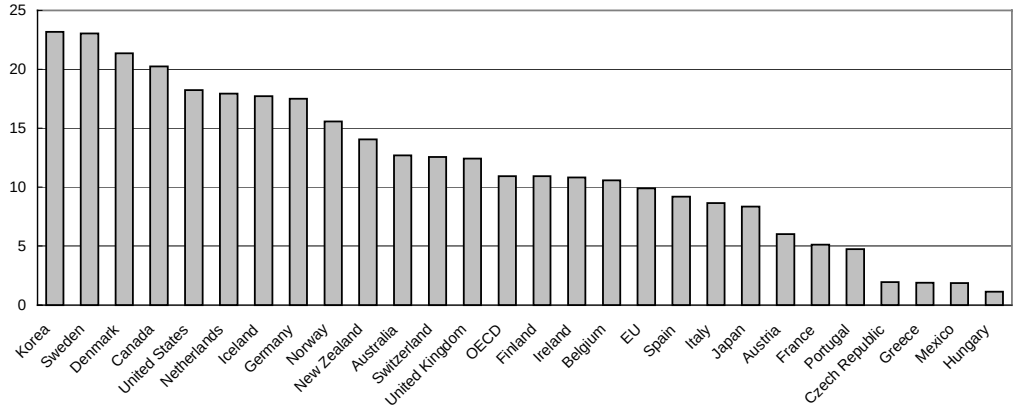
Many public-sector and private-sector organisations report on the number of "users", "people" or "households" on line. National statistical agencies typically measure Internet access on the basis of surveys of businesses, households or individuals (see boxes 3.4 and 3.5). Statistical offices also collect 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*.

Internet subscribers per 100 inhabitants

January 2000



Source: OECD, *Telecommunications Database*, June 2001.

ICT access by households

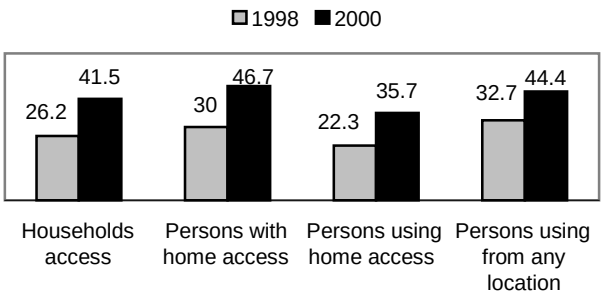
- Recent progress in methodological and statistical work has led to a range of new indicators on access to and use of ICT technologies by households and individuals. This work has also contributed to greater international comparability of the statistics (see Box 3.4).
- Personal computers are still the main device used by households to access the Internet. In most countries for which data are available, more than 40% of all households now have computers.
- While keeping in mind differences in survey methodologies and household structure, there is still a noticeable gap among countries. In Denmark, Switzerland and Sweden over 60% of households have a computer, while in Turkey and Mexico only 11-12% of households have a one. 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. In France, Italy, Spain and Italy, the average penetration rate of computers is 30%.
- The availability of home computers is increasing both in countries with already high penetration rates (an average percent increase of 10% from 2000 to 2001) and those lagging. This is notably in the United Kingdom and Portugal, where computer penetration rates increased by 11 and 12 percentage points, respectively, in 2001.

Box 3.4. The comparability of household- and person-based indicators of Internet access and use and the OECD model questionnaire on ICT use in households/by individuals

Over a very short period of time, national statistical offices 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 still based on different standards and measure rapidly changing behaviour at different points in time. Most countries use existing surveys, such as labour force, time use, household expenditure or general social surveys. Others rely on special surveys. A first issue for international comparability is to address differences in the timeliness, scope and coverage of indicators.

Another important issue for international comparability is the choice between households or individuals as the survey unit. Household surveys generally provide information on both the household and the individuals in the household. Person-based data typically provide information on the number of individuals with access to a technology, those using the technology, the location 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). Such differences complicate international comparisons and make 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



The OECD Working Party on Indicators for the Information Society (WPIIS) is currently addressing these issues of international comparability and working on a model survey on ICT use in households/by individuals. The proposal, led by Australia, consists in measuring a core set of indicators which incorporates core country requirements. As in the case of the model questionnaire on the use of ICT and e-commerce in businesses (see Annex 3), additional components of the questionnaire can be added over time as technologies, usage practices and policy interests change.

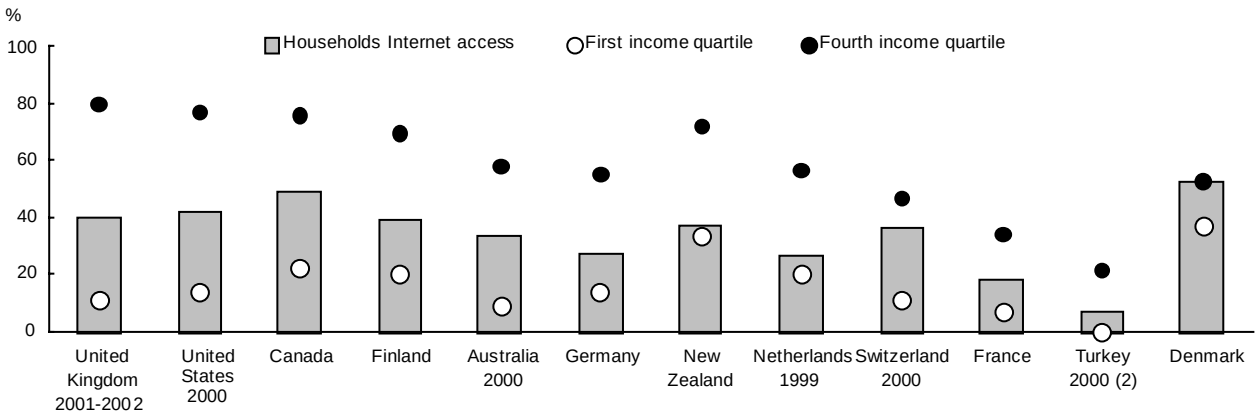
At the moment, five core modules are proposed for inclusion in the model questionnaire: Household access to computers and the Internet; Household barriers to adoption of the Internet; Use of computers and the Internet: location and frequency of use; Purpose and nature of activities on the Internet; Internet-commerce details, with questions on Internet purchases by location, frequency of purchase, type of goods purchased, Internet payments and barriers to purchase online.

Internet access by households

- Internet access in households is soaring everywhere, especially in Portugal where the access rate grew by 125% between 2000 and 2001. Notable also is the increase registered in the United Kingdom, where household Internet penetration increased by 110% in the same period, and in Mexico, albeit from a very small base, from 2.8% in 1999 to 6.2% in 2001. In Japan, following a strong increase in 1999-2000 (74%), the latest data on households Internet access register only a modest increase of 3% between 2000 and 2001.
- Overall households Internet access is highest in Northern Europe and North America, where penetration rates in 2001 ranged between 40% and 60%, and lower in continental and Southern Europe (below 30%).
- The propensity of households to access the Internet once they possess a home computer differs across countries. It is highest in Sweden, the United Kingdom and the United States, where 80-90% of households with a computer have Internet access. Countries with a larger share of home computers have also a greater propensity to have Internet access, but there are some exceptions. In Belgium 45% of households had a computer in 1999, but only about 13% had access to the Internet. In Italy and Ireland in 2000, the share of households with computers was lower (about 30%) and household Internet access rates higher (about 20%).
- Households can access the Internet via different types of services. Indicators of the quality of access, in terms of the speed and capacity of the infrastructure, are of great interest since they point to differences in the potential use of new technologies across countries. So far, data for a very few countries show that most households still use dial-up rather than high-speed access the Internet. Canada is a notable exception, with over 60% of households using cable modem services to access the Internet.
- Internet penetration in households is strongly affected by household income. Relatively high overall rates of Internet access might hide a relatively uneven distribution of access in households with different income levels. Available data show that the difference between Internet access in households belonging to the lowest and highest income quartiles is highest in the United Kingdom and North America and lowest in Denmark.

Households Internet access by income level,[1] 2001 or latest available year

Households with Internet access as a percentage of all households



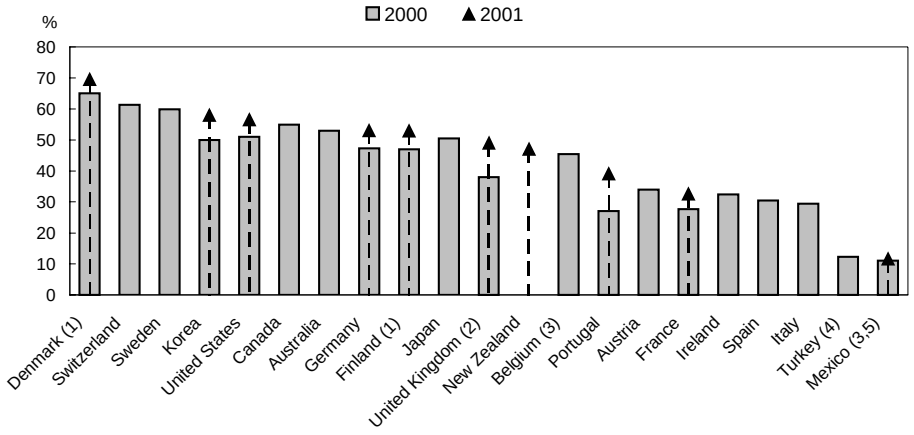
1. For the United Kingdom, first and last deciles instead of quartiles, for Germany and New Zealand, first and last income brackets.
2. Households in urban areas only.

Source: OECD, ICT database, August 2002.

Internet access by households

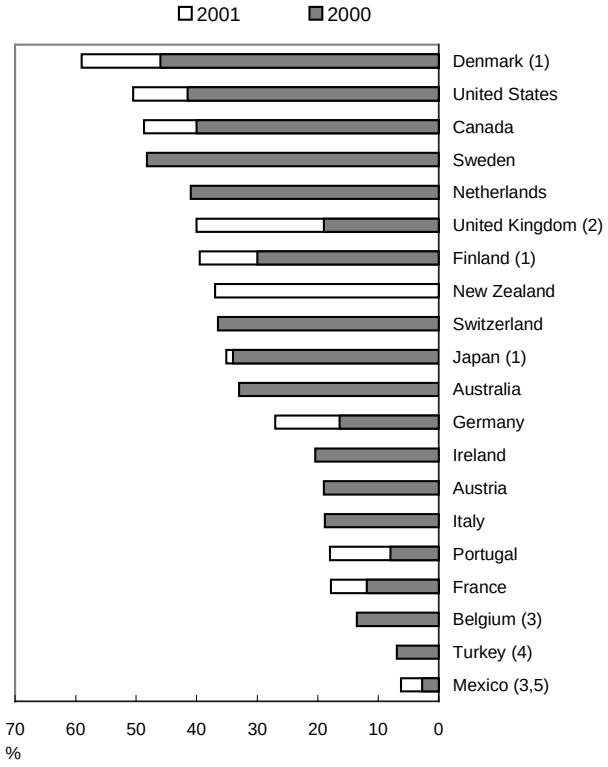
Households with access to a home computer, 2000 and 2001

Percentage of all households



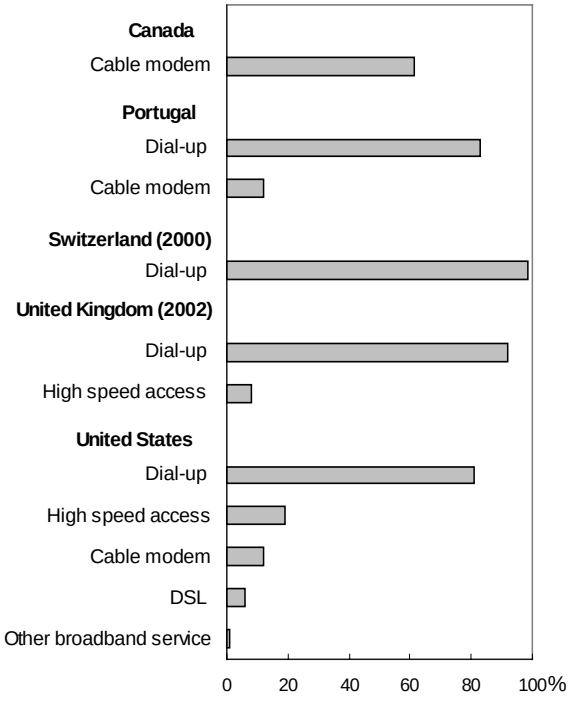
Households with access to the Internet, [6] 2000 and 2001

Percentage of all households



Household access by type of service, 2001

Percentage of households with Internet access



1. Beginning of 2002.
2. March 2001-April 2002 (financial year) instead of 2001.
3. 1999 instead of 2000.
4. Households in urban areas only.
5. For 1999, households in urban areas with more than 15 000 inhabitants only.
6. Internet access via any device except for Denmark, the Netherlands, Ireland, Austria, France and Turkey where Internet access is via a home computer.

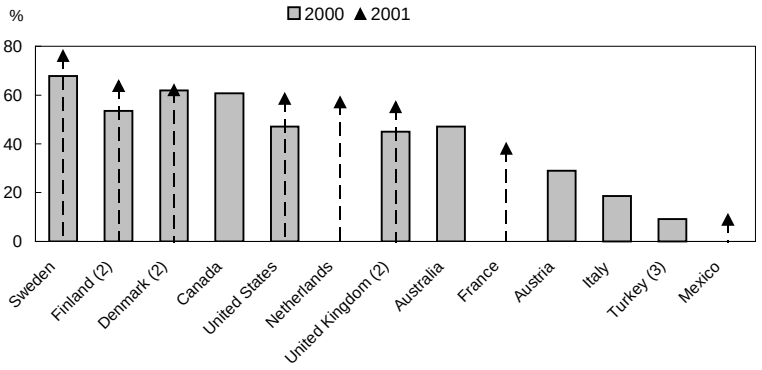
Source: OECD, ICT database, August 2002.

Use of the Internet by individuals

- The share of adults using the Internet from any location is also increasing rapidly, and more than sixty percent of the adult population now use the Internet in Sweden (76%), Finland (64%), Denmark (62%), and Canada (61%). Denmark aside, the share of Internet users is highest in those countries with a relatively lower average Internet price basket over the 1995-2000 period.
- The frequency with which individuals use the Internet varies considerably across countries, with almost 90% of users being frequent users (at least once a week) in the Nordic countries, the Netherlands and Austria. The share of frequent users drops to one fourth to one third in the case of Mexico, France and Canada. Overall, less than fifty percent of users are daily users.
- Individuals using the Internet do so mainly for communication purposes (receiving and sending e-mails) or to find information about goods and prices. But even in countries where over 70% of individuals search for prices online, only 20 to 40 percent purchase over the Internet.
- In most cases downloading digitised goods, such as news, games, music and free software is the most common activity. In Portugal, for example, over 50% of individuals download digitised goods while only 9% purchases over the Internet.
- The Internet is also used to access online services, especially banking services, notably in Finland, where 64% of individuals reported having used the Internet to carry out banking transactions in 2001. Use of the Internet to interact with public authorities is especially common in Denmark and Finland; over 50% of individuals reported using the Internet for that purpose, compared to only 8% in France. Finally, 30% of people in Canada and Portugal report that they carry out on-line job searches.

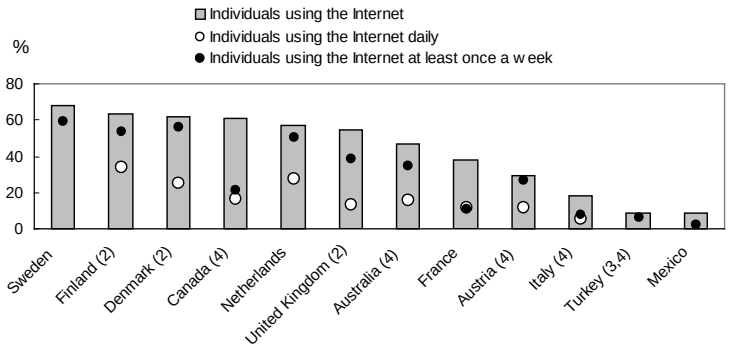
Individuals[1] using the Internet from any location, 2000 and 2001

Percentage of all individuals



Individuals[1] frequently using the Internet, 2001

Percentage of all individuals



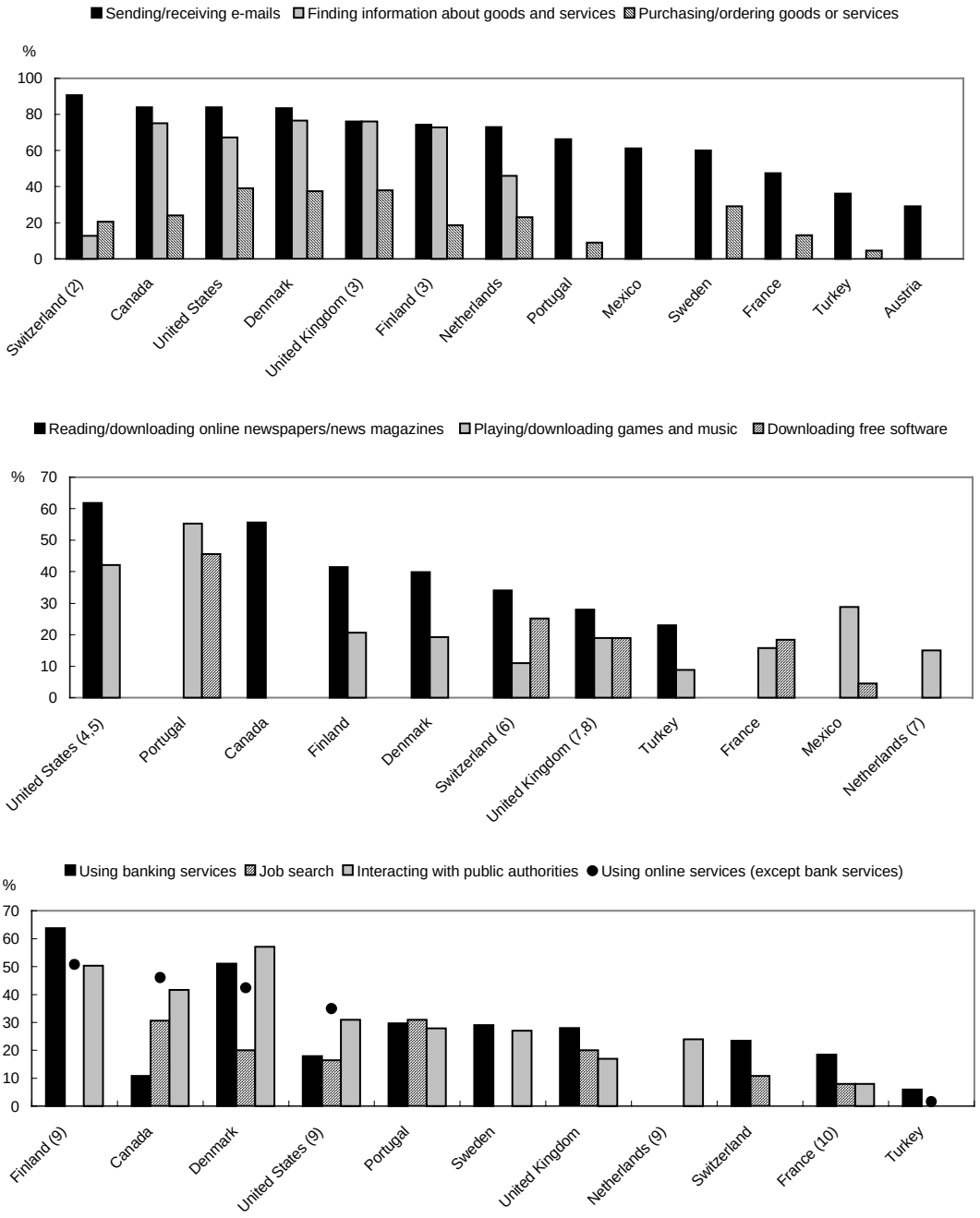
1. Age cut-off: 16 years and older except for Canada and Finland (15+), Italy (11+), Austria (6+), Mexico and the Netherlands (12+) and Australia and Turkey (18+).
2. Beginning of 2002 instead of 2001.
3. Individuals belonging to households in urban areas.
4. 2000 instead of 2001.

Source: OECD, ICT database, August 2002.

Use of the Internet by individuals

Internet use by type of activity, 2001 or latest available year[1]

Percentage of individuals using the Internet



1. 2000 for Canada, Sweden and Turkey. 2001 for France, Mexico, Netherlands, Portugal, Switzerland and the United States. Beginning of 2002 for Denmark, Finland and the United Kingdom.
2. Only sending e-mails instead of sending and receiving e-mails.
3. Purchasing/ordering goods or services excludes shares/ financial services.
4. Reading/downloading newspapers also includes movies.
5. Playing games only instead of downloading games and music.
6. All downloaded software instead of free software only.
7. Downloading music only instead of games and music.
8. Downloading other software instead of free software.
9. Obtaining information from public authorities' Web sites only instead of interacting with public authorities.
10. Downloading official forms only instead of interacting with public authorities.

Source: OECD, ICT database, August 2002.

Internet access and use by businesses

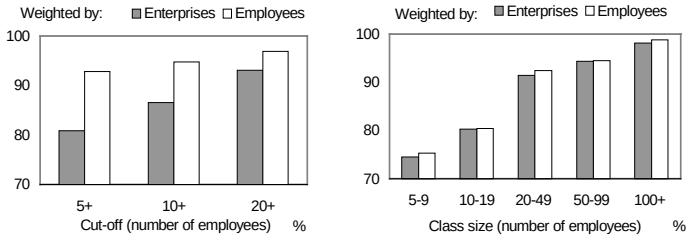
- International comparisons of ICT access and use by businesses suggest interesting patterns but should be interpreted with caution (see Box 3.5).
- Internet penetration in businesses with ten or more employees continues to increase and has reached well above 80% in several OECD countries. In 2001, penetration rates were particularly high in the Nordic countries, with 93% in Denmark. In Asian-Pacific countries, they stood at 91% in Japan, 86% in Australia and 84% in New Zealand.
- Businesses can develop their own Web sites or rely on sites managed by third parties. A Web site, if it is not simply used as a "window", can reflect the firm's level of sophistication in the use of the technology. The propensity to develop Web sites is quite high in Northern Europe (between 65% and 80%), and about 50% in Australia, New Zealand and Canada, but it is only about 7-8 percent in Italy and Spain.
- Available survey data on Internet access by type of service show that high-speed Internet access is spreading in the business sector, with about 30% of businesses in Denmark and Canada using broadband connections. Countries' averages may hide differences between larger and smaller firms, with smaller firms lagging behind in broadband access. In Italy, for example, while over 60% of large enterprises have broadband Internet access, the percentage falls respectively to 30% and 10% in the case of medium-sized and smaller firms.

Box 3.5. Measuring ICT access and use by businesses: OECD efforts to improve international comparability

Technology diffusion varies with business size and industry, so that indicators based on the overall "number" (proportion) of businesses using a technology can give rise to misleading international comparisons. "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 "number of enterprises" and by "employment in enterprises"

Sensitivity to survey cut-off and enterprise size groups, an example based on 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. In Canada, for example, 63.4% of private sector businesses (weighted by revenue) had access to the Internet in 2000, but only 39% of employees. In Denmark and Finland, 80% and 84%, respectively, of businesses with five or more employees had access to the Internet in 2000, but only 40% and 44%, respectively, of employees used personal computers and had access to the Internet.

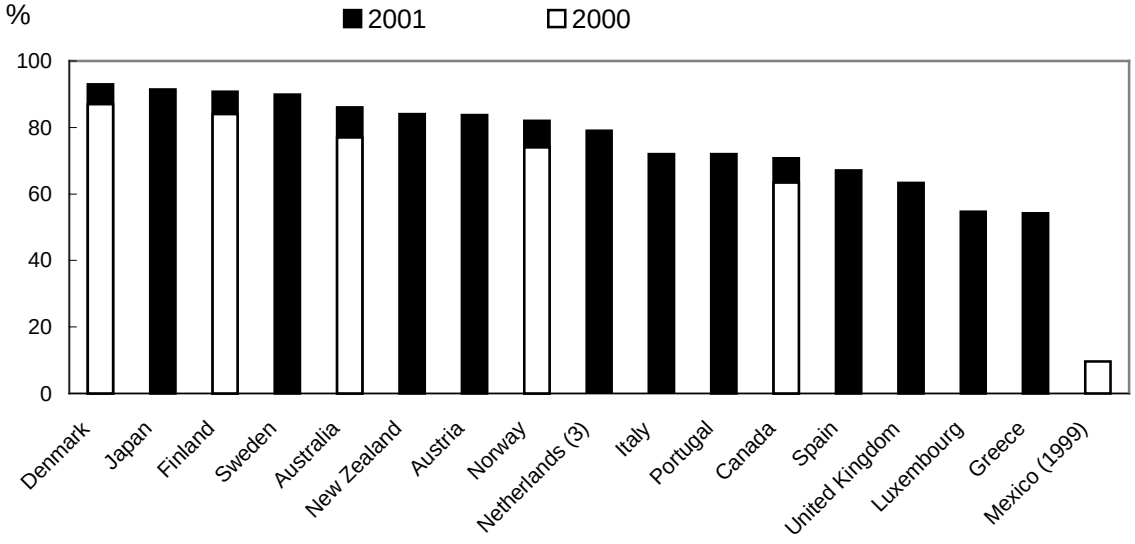
It should also be borne in mind that international comparisons of ICT usage indicators are affected by differences in the sectoral coverage of surveys. While figures for Canada and Australia cover the whole private sector, Danish and Finnish surveys cover selected sectors; for example they exclude finance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

International comparisons are made more difficult by the lack of harmonisation in the definitions of 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 model survey, approved by the OECD in 2001, is intended to provide guidance for 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. See Annex 3.

Internet access and use by businesses

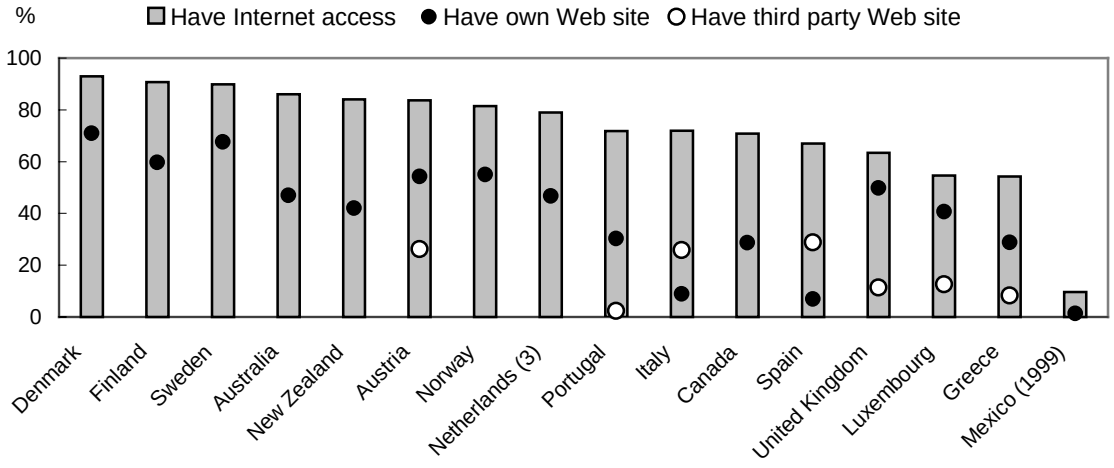
Businesses with Internet access, 2000-01[1]

Percentage of businesses with ten or more employees[2]



Businesses with home and third-party Web sites, 2001[1] or latest available year

Percentage of businesses with ten or more employees[2]



1. Beginning 2001.
2. All business for Canada and Mexico. For Mexico it excludes the public and financial sectors.
3. Use of the Internet and other computer-mediated networks.

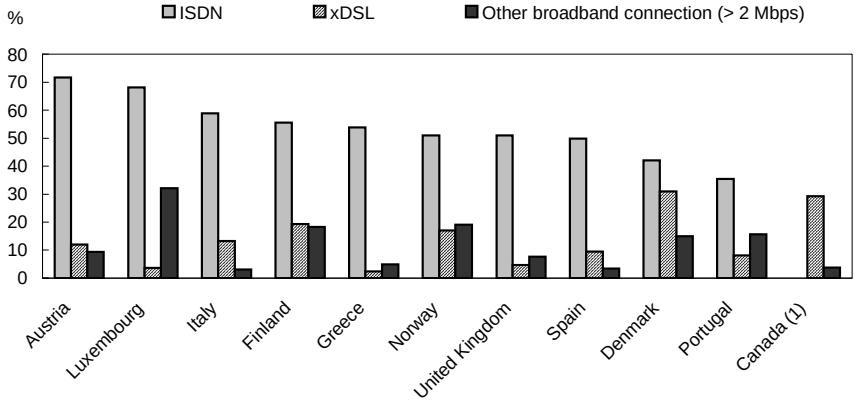
Source: OECD, ICT database and Eurostat, E-Commerce Pilot Survey 2001, August 2002.

Internet access and use by enterprise size and industry

- In general, Internet access is highest in larger enterprises. While country rankings may change according to class size, Denmark generally has the highest penetration rates for any given size class; in that country, 85% of micro enterprises (5-9 employees) have access to the Internet.
- Differences in Internet access in the 17 countries for which data are available are greater for smaller enterprises. The Nordic countries have a more homogeneous distribution across firms of different sizes, while in Spain, for example, 97% and 89% of large and medium-sized enterprises have Internet access, compared to about 60% of small and micro 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 17 OECD countries. Canada and Japan, where Internet access is slightly higher in manufacturing than in market services, are exceptions.

Business Internet access by type of service, 2001

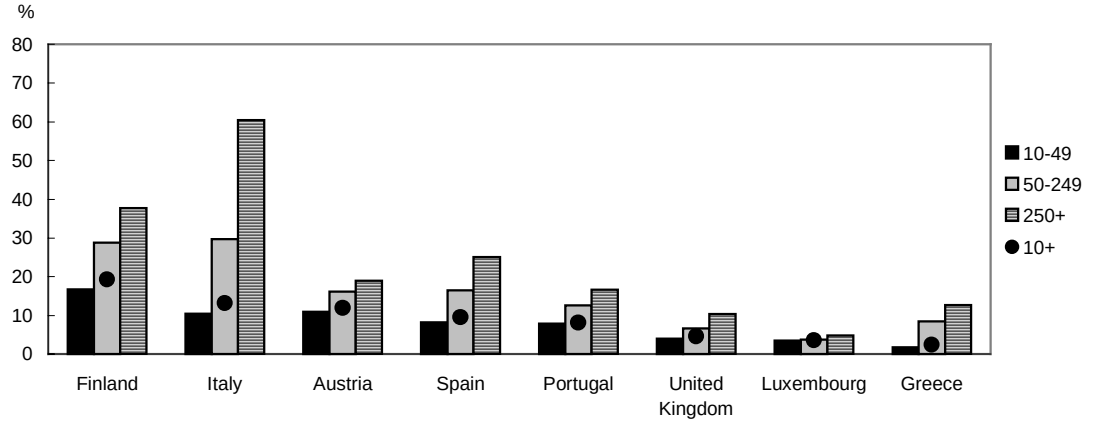
Percentage of businesses with ten or more employees using the Internet



1. All businesses. The first bar refers to high-speed ISDN/xDSL lines and the second to T1 lines or greater (1.544 Mbps or more).
Source: OECD, ICT database and Eurostat E-commerce Pilot Survey 2000, August 2002.

Business use of the Internet via broadband connection (xDSL) by firm size, 2001

Percentage of businesses with ten or more employees using the Internet

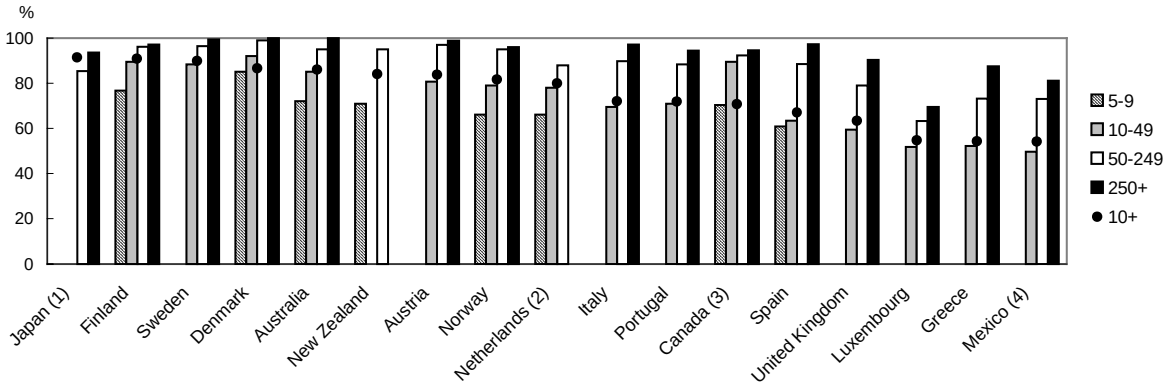


Source: OECD, ICT database and Eurostat, E-Commerce Pilot Survey 2001, August 2002.

Internet access and use by enterprise size and industry

Internet penetration by size class, 2001 or latest available year

Percentage of businesses using the Internet

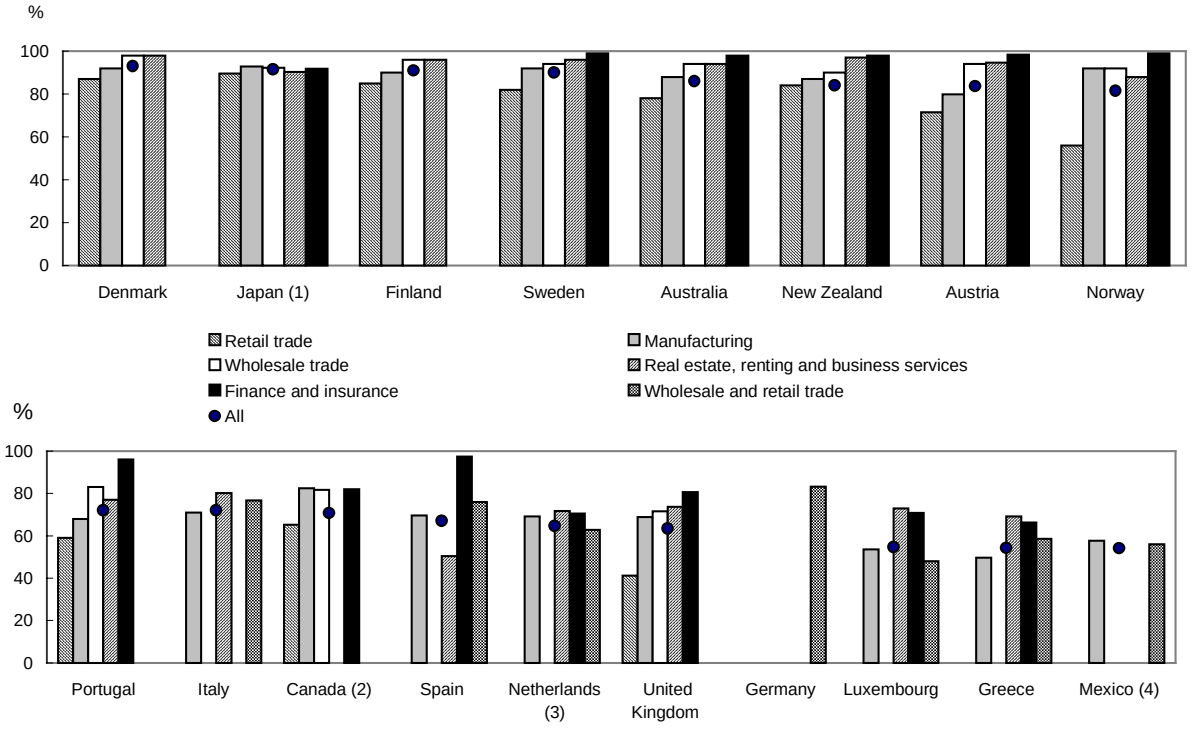


1. Businesses with 50 or more employees; 50-99 employees instead of 50-249 and 100 or more employees instead of 250 or more.
2. Internet and other computer-mediated networks; 50-199 employees instead of 50-249.
3. All businesses; 1-9 employees instead of 5-9, 20-49 instead of 10-49, 50-99 instead of 50-249, 100-249 instead of 250 or more.
4. Businesses with 21 or more employees; 21-100 employees instead of 10-49, 101-250 instead of 50-249, 151-1000 instead of 250 or more.

Source: OECD, ICT database and Eurostat E-commerce Pilot Survey 2001, August 2002.

Internet penetration by activity, 2001 or latest available year

Percentage of businesses using the Internet



1. Businesses with 50 or more employees.
2. All businesses.
3. Internet and other computer-mediated networks.
4. Businesses with 21or more employees, 1999.

Source: OECD, ICT database and Eurostat E-commerce Pilot Survey 2001, August 2002.

Perceived barriers to Internet access and use in the business sector

- Analysis of barriers to the use of information technology is of interest to policy makers, but international comparisons based on qualitative data need to be interpreted with caution (see Box 3.6).
- Indicators of perceived barriers to the use of the Internet show that lack of network security to be is the main obstacle for all European businesses. Analysis by firm size reveals that larger firms tend to rate security issues as very important more than smaller ones. This may be partly due to the fact that "security" is often perceived as a barrier when the technology is actually used (see Box 3.6).
- Perhaps surprisingly, costs of access to and use of the Internet generally receive the lowest ranking in all countries. On average, smaller firms attribute greater importance to costs than larger ones. There are exceptions, however. In Portugal, Luxembourg and Greece, larger firms finds costs to be relatively more important. This may be due to the weight of non-user firms, which are likely to be smaller firms in those countries (see Box 3.6).
- Lack of perceived benefits may partly explain differences in Internet diffusion across sectors. Overall, wholesale and retail trade appears to be the sector with least scope for using the Internet, while "lack of perceived benefits" does not seem to be a very important barrier in the financial sector.

Box 3.6. Measuring "perceived" barriers to ICT access and use in business surveys

While information about perceived barriers may not traditionally be collected as part of official statistical surveys, it is important for policy makers. For example, indicators on barriers can help monitoring issues of digital divide, potential bottlenecks related to the technology, lack of appropriate skills, or concerns about security and logistics. Answers on perceived barriers and on their evaluation (*e.g.* no importance - some importance - much importance) are inevitably qualitative in nature and limit the use of these indicators for purposes of international comparisons. Nevertheless they can be useful for detecting common obstacles to the diffusion of new information technologies and may be used with other types of quantitative indicators to explain differences in the intensity of use of new technologies across countries.

International comparisons based on such qualitative information need to be interpreted with caution. The perception of barriers seems to vary with the type of respondent. Baldwin and Lin ("Impediments to Advanced Technology Adoption for Canadian Manufacturers", Statistics Canada Working Paper No. 173, 2001) show that in the Canadian manufacturing sector impediments are reported more frequently among technology users than non-users and more frequently among innovating firms than non-innovators. A similar pattern also appears for survey tabulations of barriers by type of respondent (*e.g.* by Internet and non-Internet users). A given barrier to Internet use may be interpreted as a "perceived" barrier by a non-Internet user and as an "experienced" barrier by an Internet user. One might expect some types of barriers, such as lack of perceived benefits and loss of working time, as being greater barriers among non-users than users. Interestingly, in Norway, the barrier "lack of security" has increased importance over time and it is much higher for Internet users than non-Internet users (see table below), *i.e.* those who have experienced "lack of security" give it greater importance. If this is the case in all countries, international comparisons of barriers may show that "lack of security" is a greater barrier in countries that are intensive users of the Internet (although those are probably the countries that are more equipped with secure systems). However, this may simply be due to the weight of non-users in different countries, rather than to differences in the degree of "security" of the environment.

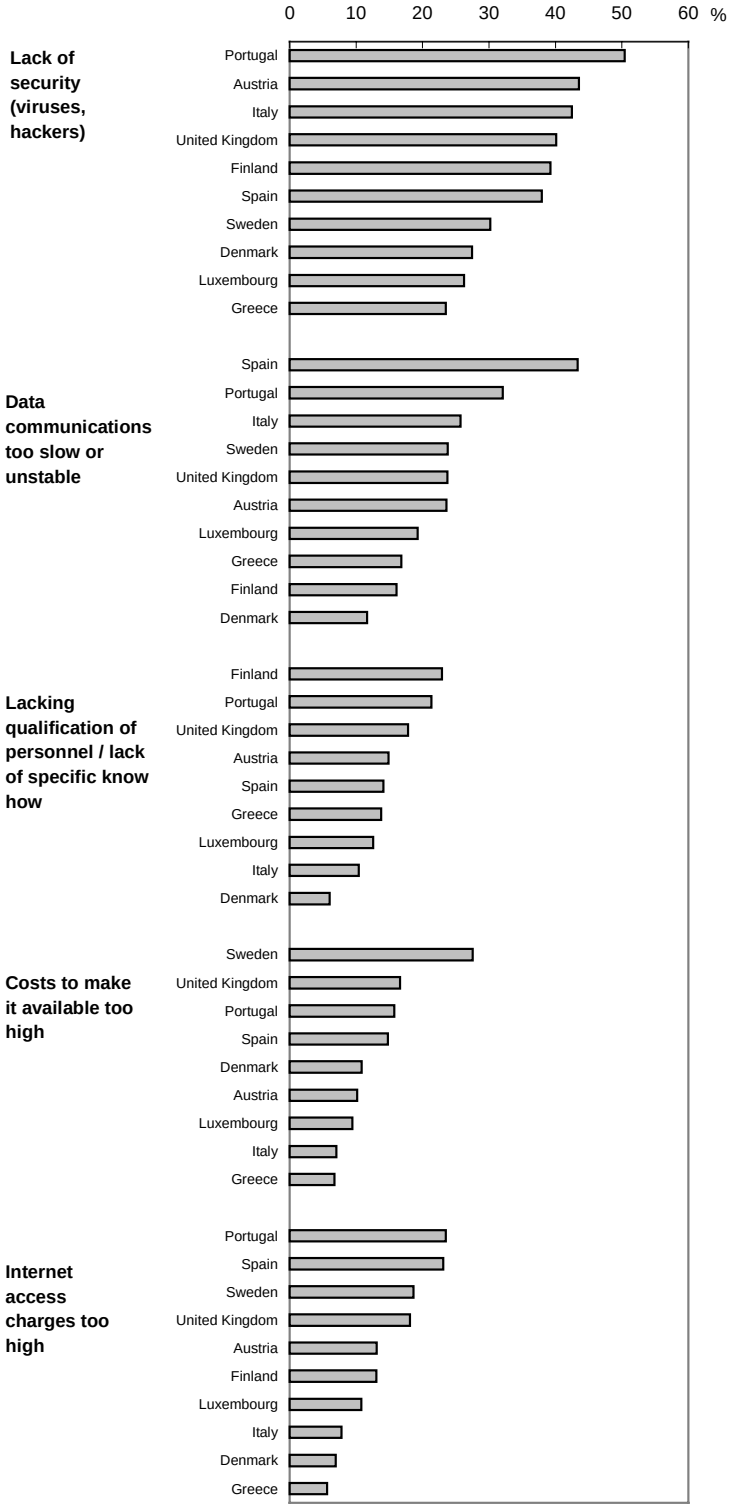
Perceived barriers by respondent: an example based on Norwegian survey data

Barriers judged to be very important	% of non Internet users that judge this barrier very important			% of Internet users that judge this barrier very important		
	1999	2000	2001	1999	2000	2001
Expense on hardware and programmes	6	6	10	11	11	10
Expense on home pages development and maintenance	12	9	13	13	13	13
Internet access charges too high	5	10	8	6	7	7
Lacking qualification of personnel/lack of specific know-how	3	4	3	2	3	3
Lack of perceived benefits for the company	…	19	7	…	8	6
Lost working time because of irrelevant surfing	15	22	11	9	8	8
Data communication too slow or unstable	4	8	10	8	10	9
Lack of security (viruses, hackers)	14	16	26	28	29	35

Perceived barriers to Internet access and use in the business sector

Perceived barriers by businesses, 2000

Percentage of computer users with ten or more employees

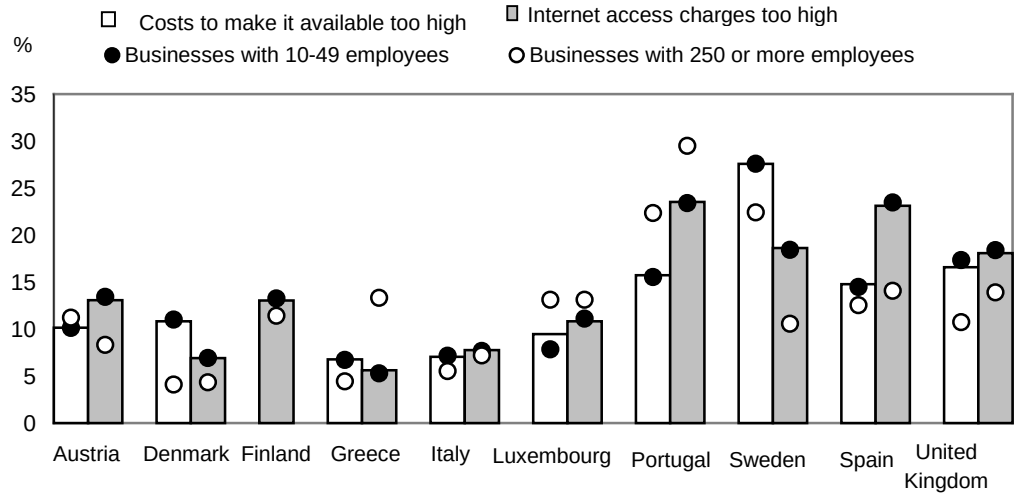


Source: Eurostat E-commerce Pilot Survey, 2001.

Perceived barriers to Internet access and use in the business sector

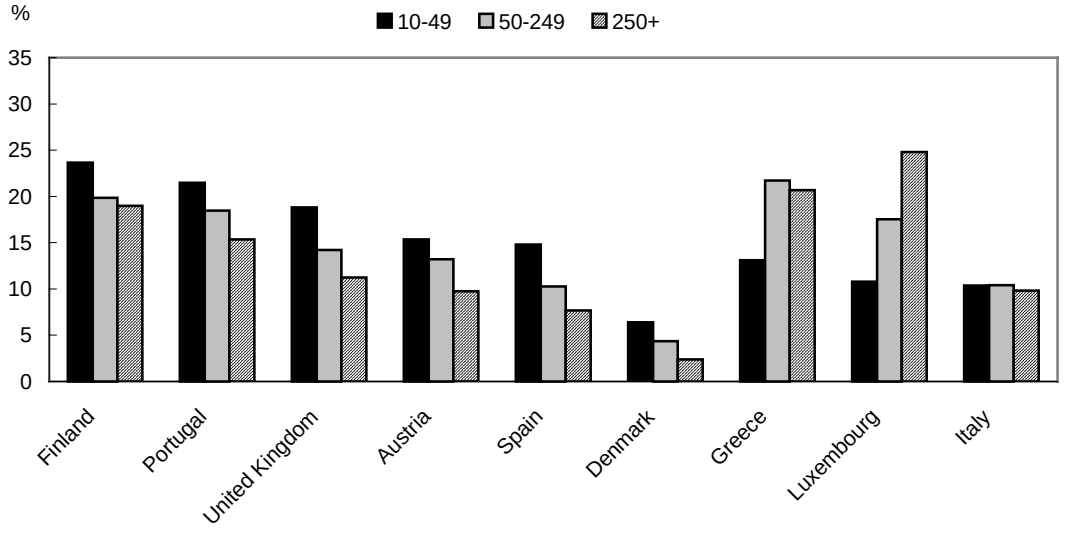
Perceived cost barriers by businesses by firm size, 2000

Percentage of computer users



Businesses lacking qualified personnel or know-how to use the Internet by firm size, 2000

Percentage of computer users

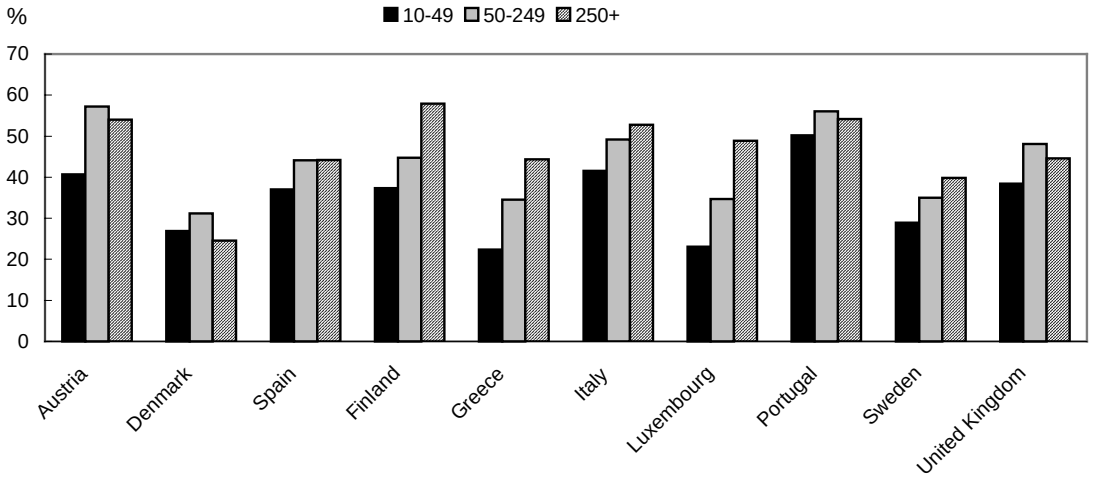


Source: Eurostat E-commerce Pilot Survey, 2001.

Perceived barriers to Internet access and use in the business sector

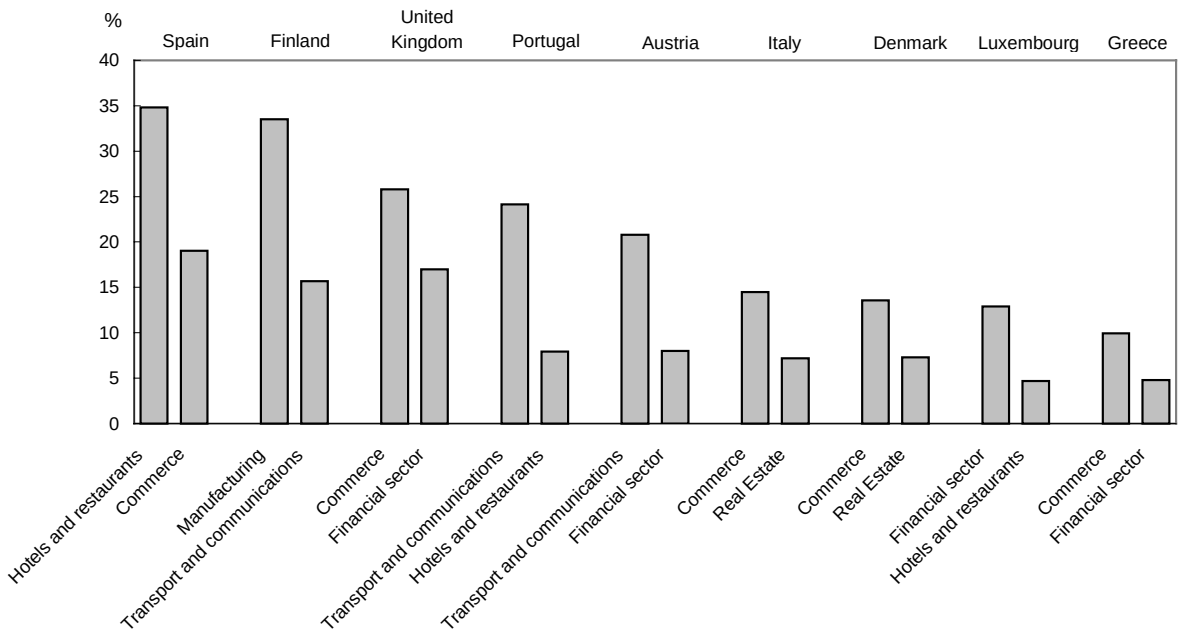
Businesses facing security issues by firm size, 2000

Percentage of computer users



Lack of perceived benefits from Internet use by sector[1]

Percentage of computer users with ten or more employees



1. The sector in which the largest share of firms considers "lack of perceived benefits" to be a very important barrier (left bar) and the sector in which the smallest share of firms ranks it as important (right bar).
Source: Eurostat E-commerce Pilot Survey, 2001.

The price of Internet access and use

- For consumers as for businesses, a significant barrier appears to be cost of access.
- 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-quarter of the OECD average. Elsewhere, the least expensive countries are Switzerland, Luxembourg, Ireland, Germany, and the United States. At the other end of the spectrum, the Czech and Slovak Republics have charges of at least twice the OECD average.
- Another barrier to ICT diffusion is the cost of Internet access for consumers. Prices continue to differ widely and 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, with prices in the previous year affecting the Internet take-up for the current year. Countries with lower average access prices over the period 1995-2000, such as Canada, Finland and the United States, typically have more Internet hosts than those with high average prices. 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.

Box 3.7. 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.

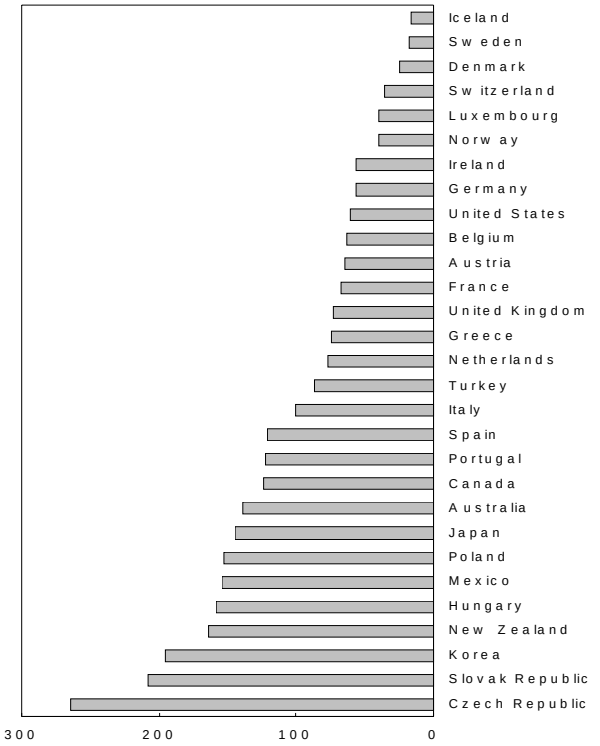
- Fixed charge: the monthly line rental for residential users.
- Usage charge: the price of local telephone calls (or special rates for Internet access) to an ISP for residential users.
- ISP charge: the price of Internet access from the largest telecommunication operator.
- Peak and off-peak times: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

The price of Internet access and use

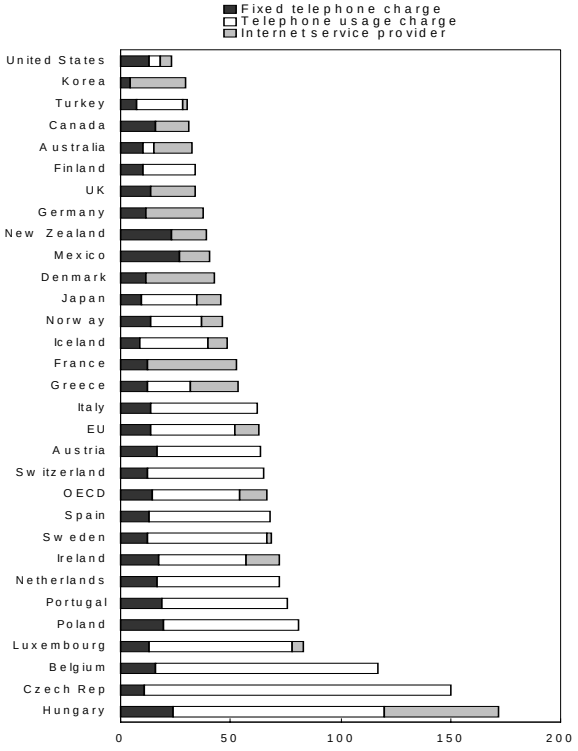
Price of leased lines in the OECD area, May 2002

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



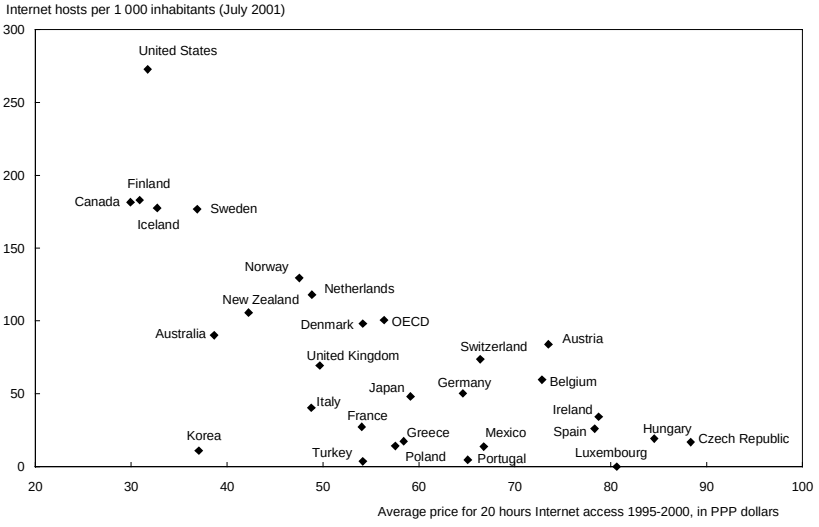
Price of 40 hours of Internet use at peak times, August 2001, in PPP dollars

OECD Internet access basket for 40 hours at peak times using discounted PSTN rates[1]



1. In some countries ISP and PSTN usage charges are bundled and included under the ISP charge.
Source: OECD, *Telecommunications Database*, June 2002.

Internet access prices and Internet hosts[1]



1. Internet access costs include VAT and cover both peak and off-peak.
Source: OECD; Telcordia Technologies: www.netsizer.com, May 2001.

Chapter IV. Electronic commerce

Only a few years ago, internationally comparable official statistics measuring the level, growth and composition of electronic commerce transactions were not available. Today national statistical offices are gradually implementing OECD definitions and guidelines for measurement in this area. While comparisons still need to take into account differences in the type of definition used in surveys and in their coverage (see Box 4.1 and Annex 4), available data show some interesting patterns.

To date, the Internet is still mainly used for marketing purposes. Its use for other purposes varies according to the business's position in the value chain, with, on average, twice as many businesses using Internet for purchases as for sales.

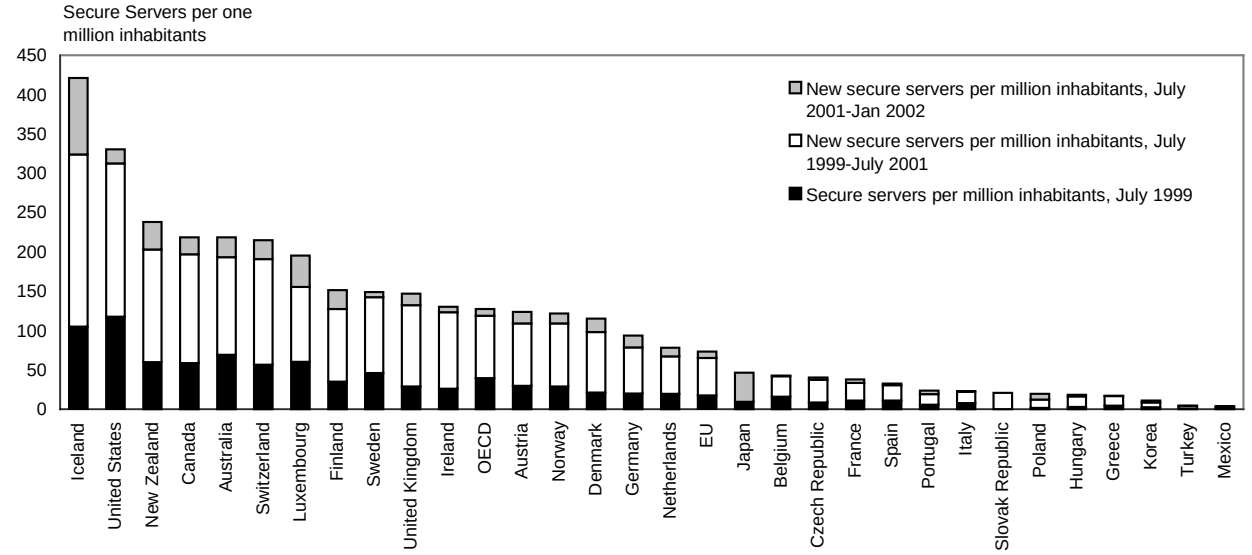
Aggregate patterns hide sector-specific and size-specific differences in the propensity to carry out transactions. Overall, however, Internet transactions still account for a very small share of total sales, mainly take place among businesses and are largely domestic.

To help explain differences in the rate of e-commerce uptake across countries, this chapter also relies on indicators of barriers to Internet commerce. As noted in Chapter 3, data on barriers are qualitative in nature and need to be used with caution when making international comparisons.

Infrastructure for Internet commerce

- The number of secure servers provides one indicator 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 July 1999-January 2002, the number of secure servers in OECD countries increased by 223%. In January 2002, the United States had 65% of the total OECD-area secure servers; the United Kingdom was second with over 6%. Also at that time, Iceland recorded the most intensive use, with 421 secure servers per million inhabitants, followed by the United States with 330. Other countries above the OECD average of 127 per million inhabitants were New Zealand (238), Canada and Australia (218), Switzerland (215), Luxembourg (195), Finland (151), Sweden (149) and Ireland (130).

Internet commerce developments measured by the number of secure Web servers



Source: OECD and Netcraft (www.netcraft.com), August 2002.

Measuring electronic commerce transactions

- Few countries currently measure the value of Internet or electronic sales (see Box 4.1). Total Internet sales in 2000 ranged between 0.3% and 2% of total sales, while electronic sales (including those over all computer-mediated networks) reached 13% in Sweden. The share of Internet sales has been increasing in Canada (from 0.2% in 1999 to 0.5% in 2001), but has remained stable in Denmark (0.9% in both 2000 and 2001).
- The distribution of Internet sales in European countries shows some interesting patterns. In the case of Sweden, the country with the highest share of e-commerce sales, only about 11% of larger businesses had more than 5% of sales originating from Internet sales in 2000. For smaller businesses the distribution of Internet sales is flatter; in Sweden only over 11% of smaller businesses have a share of Internet sales above 1%, compared to over 19% in the case of larger businesses.

Box 4.1. Measuring electronic commerce: OECD definitions of Internet and electronic transactions

Only a few years ago, internationally comparable official statistics measuring the level, growth and composition of electronic commerce transactions were not available. In April 2000, OECD member countries endorsed two definitions of electronic transactions (electronic orders), based on narrower and broader definitions of the communications infrastructure (see Annex 4). According to the OECD definitions, it is the method used to place or receive the order, not the payment or the channel of delivery, that determines whether the transaction is an Internet transaction (conducted over the Internet) or an electronic transaction (conducted over computer-mediated networks). In 2001, the OECD developed guidelines for interpreting the definitions of electronic commerce and encouraged member countries to take such guidelines into account when developing their questionnaires (see Annex 4).

To date, comparisons still need to take into account differences in the type of definition used in surveys and in their coverage. The United States, for example, does not produce economy-wide estimates and uses a broad definition that includes sales over "Internet, extranet, electronic data interchange (EDI) or other on-line systems". Australia and Canada have similar definitions and coverage of Internet transactions, while figures for some countries do not include the financial sector (see below).

Official estimates of Web, Internet and electronic commerce transactions,[1] 2000 or latest available year

Percentage of total sales or revenues

	Web commerce	Internet commerce	Electronic commerce
Business sector[2]	**2.0%** Sweden	**1.8%** United Kingdom **1.4%** Spain **1.0%** Austria **0.5%** Luxembourg **0.4%** Portugal **0.5%** Canada (2001) **0.7%** Australia (2000-2001) **0.3%** New Zealand (2000-2001)	**13.3%** Sweden **7.9%** Finland **5.2%** UK **4.0%** Spain **2.5%** Austria **1.8%** Portugal **0.5%** Luxembourg
Business sector[2] (excluding financial sector)	**0.9%** Denmark (2001) **0.7%** Finland	**2.0%** Norway (2001) **0.9%** United Kingdom **0.4**% Italy	**10.0%** Norway (2001) **9.1%** Finland **6.0%** United Kingdom **6.0%** Denmark (2001) **1.1%** Italy
Retail sector	**0.1%** (France, 1999)	**1.0%** United Kingdom **0.6%** Canada (2001) **0.4%** Australia (2000-2001) **0.2%** Austria	**1.4%** United Kingdom **1.2%** (United States, 2nd Q 2002) **1.3%** (United States, 4th Q 2001 **1.0%** (United States, 2nd Q 2001 **0.2%** Austria

BROADER (Business sector / Business sector (excluding financial sector) / Retail sector) — BROADER (Web commerce / Internet commerce / Electronic commerce)

1. See Annex 4 for a discussion of these definitions.
2. Data for Austria, Italy, Luxembourg, Portugal, Spain and Sweden exclude NACE activity F (construction).

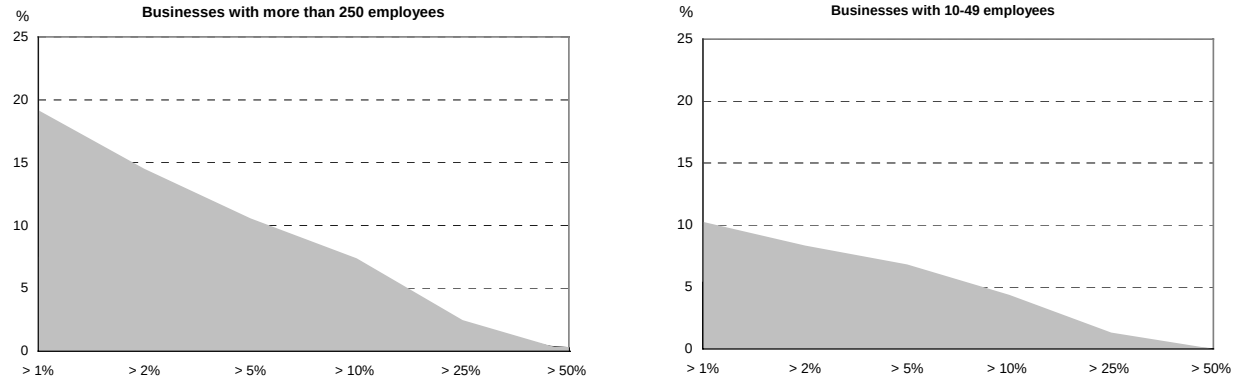
Source: OECD, ICT database, August 2002; Eurostat, *E-commerce Pilot Survey 2001*.

Internet and electronic commerce transactions

- The Internet is still mainly used for marketing purposes and its use for other purposes varies according to the business's position in the value chain (customer or supplier). For 16 countries for which both Internet purchasing and Internet sales data are available, purchasing is more common than selling. Except in Greece and Luxembourg, 63-93% of businesses with more than ten employees reported using the Internet. However, only one in eight on average reported making Internet sales. On average, twice as many businesses use Internet for purchases as for sales.
- Among firms that use the Internet, only a few distribute goods and services on line or offer interactive electronic payment capability. An analysis of the use of computer networks in US manufacturing plants in mid-2000 revealed very limited use of Internet applications to integrate transaction-related business processes. Some plants that do not accept on-line orders accept on-line payments, while some plants that reported no on-line orders provided on-line customer support. About 34% of manufacturing plants reported having purchased on line, while only 9% paid on line. Although firms may not pay on line for security reasons, 29% of those that did, did not purchase on line (US Department of Commerce, 2001). In European countries, up to 8% of businesses delivered digitised products and/or received payments over the Internet in 2000.
- The relation between Internet use and size is a complex one. Not only is business size industry-specific, *i.e.* what may be a small enterprise in one industry may be a large one in another, but Internet use for transactions is industry-specific as well. Data broken down by class size show that smaller businesses that use the Internet appear to have roughly the same propensity to sell over the Internet as larger ones in Australia, Denmark and Sweden. Use of the Internet for purchases seems to be more sensitive to firm size across all countries.
- The propensity to carry out Internet purchases and sales is higher in services than in manufacturing, and financial services, business services and wholesale trade are generally the most intensive users. Internet orders are most frequent in the finance and insurance industry in Australia, Norway, Spain, Sweden and the United Kingdom, and the business services industry also has high rates of Internet commerce. In Denmark and Finland, the business services industry reported approximately every second order to be an Internet order. In Australia, Canada, the Netherlands and New Zealand, the propensity to buy or sell over the Internet seems to be more equally distributed across sectors.

Distribution of e-commerce sales in European countries, 2000

Percentage of businesses for any given country whose sales over the Internet as a share of total sales are higher than 1%, 2%, 5%, 10%, 25% or 50% in larger and smaller businesses

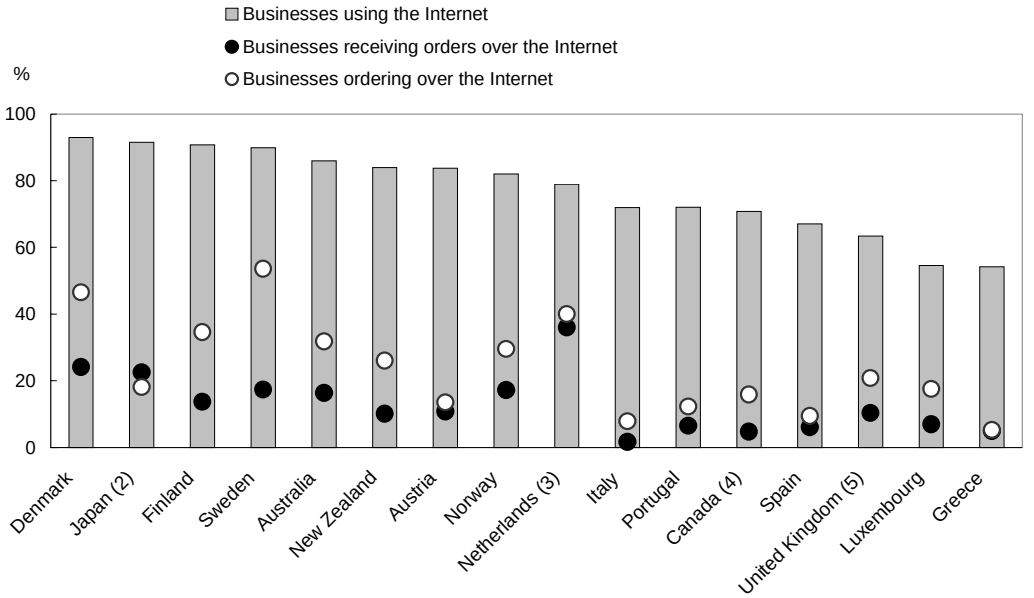


The shaded area represents Internet sales distributions in European countries for every Internet sales interval. In the case of larger businesses a maximum of 10.6% of businesses (in Sweden) had more than 5% of sales originating from Internet sales in 2000, while a maximum of 1.2% of businesses (in Denmark) had Internet sales whose value was more than 50% of overall sales. In the case of smaller businesses the distribution of Internet sales is flatter with over 11% of businesses only having a share of Internet sales greater than 1%, compared to over 19% in the case of larger businesses (in Sweden).
Source: OECD, based on Eurostat, *E-commerce Pilot Survey 2001.*

Internet and electronic commerce transactions

Businesses using the Internet for purchasing and selling, 2001[1]

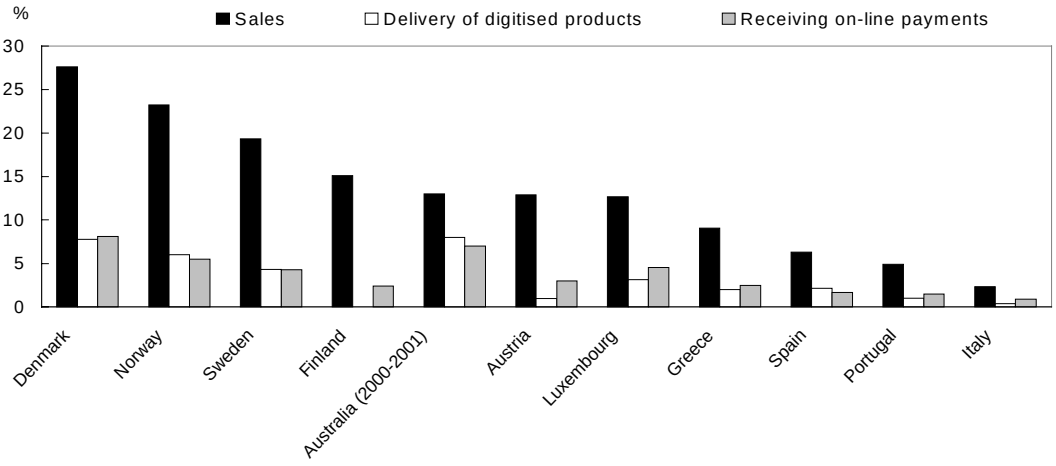
Percentage of businesses with ten or more employees



Note: The results of the Eurostat survey are based on a selection of industries which changes slightly across countries. The main sectors covered are manufacturing, wholesale and retail trade, hotels and restaurants, transport, storage and communications, financial intermediation, real estate, renting and business activities. The surveys of Denmark, Italy, Finland and Norway do not cover financial intermediation; those of Denmark, the Netherlands, Finland, the United Kingdom and Norway also cover construction; Denmark and Norway also survey personal services.
1. Beginning of 2001 for Internet use, purchases and sales refer to 2000, except for Canada where purchases and sales refer to 2001 and for Denmark and Norway where Internet use refers to 2002 and purchases and sales refer to 2001.
2. All businesses with 50 and more employees.
3. Use, orders received and placed refer to Internet and other computer-mediated networks.
4. All businesses.
5. Orders received and placed over the Internet and other computer-mediated networks.
Source: OECD, ICT database, August 2002; Eurostat, *E-commerce Pilot Survey 2001*.

Selling, delivering and paying over the Internet, 2000

Percentage of Internet users

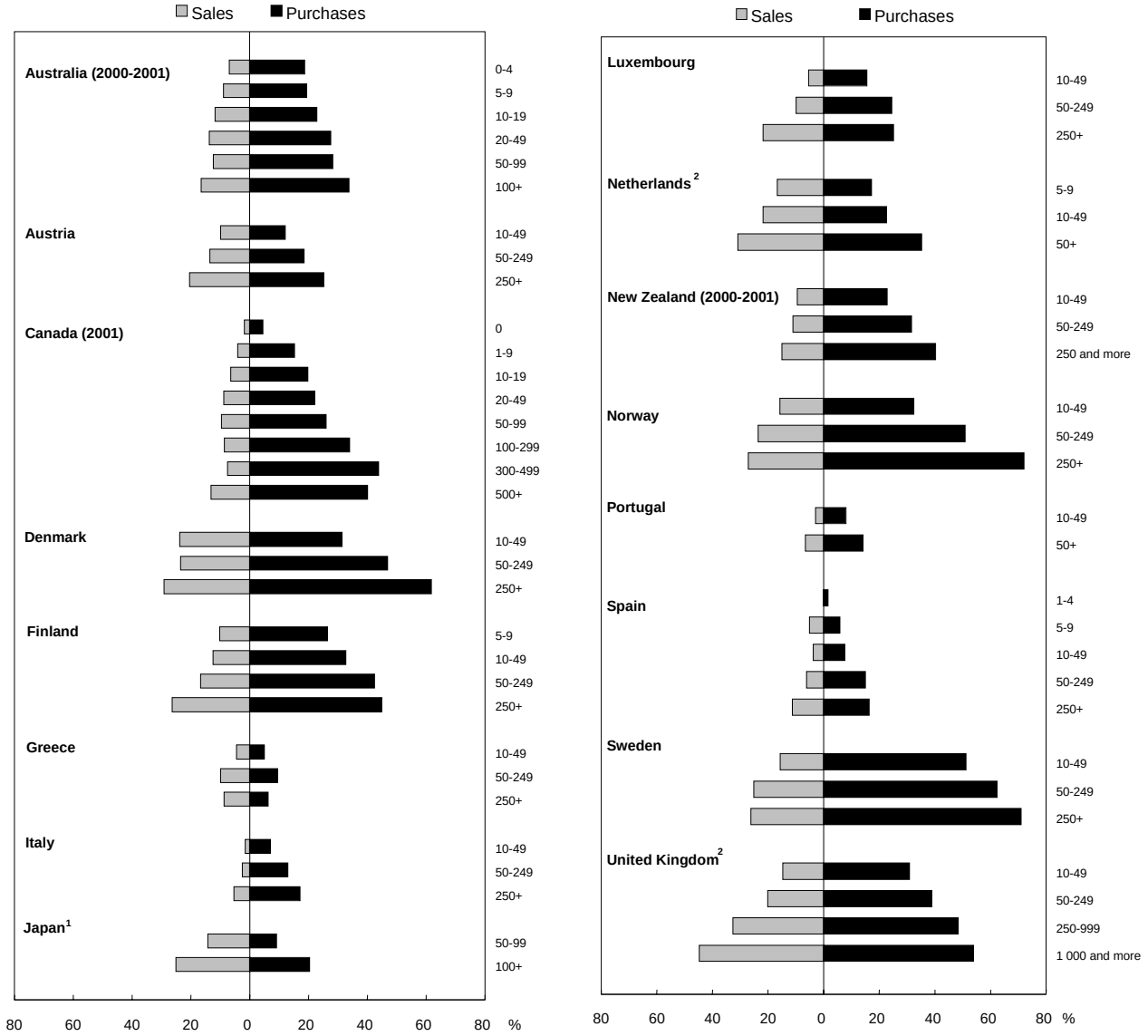


Source: OECD, ICT database, August 2002; Eurostat, *E-Commerce Pilot Survey 2001*.

Internet and electronic commerce transactions

Internet purchases and sales by size class, 2000

Percentage of businesses in each size class



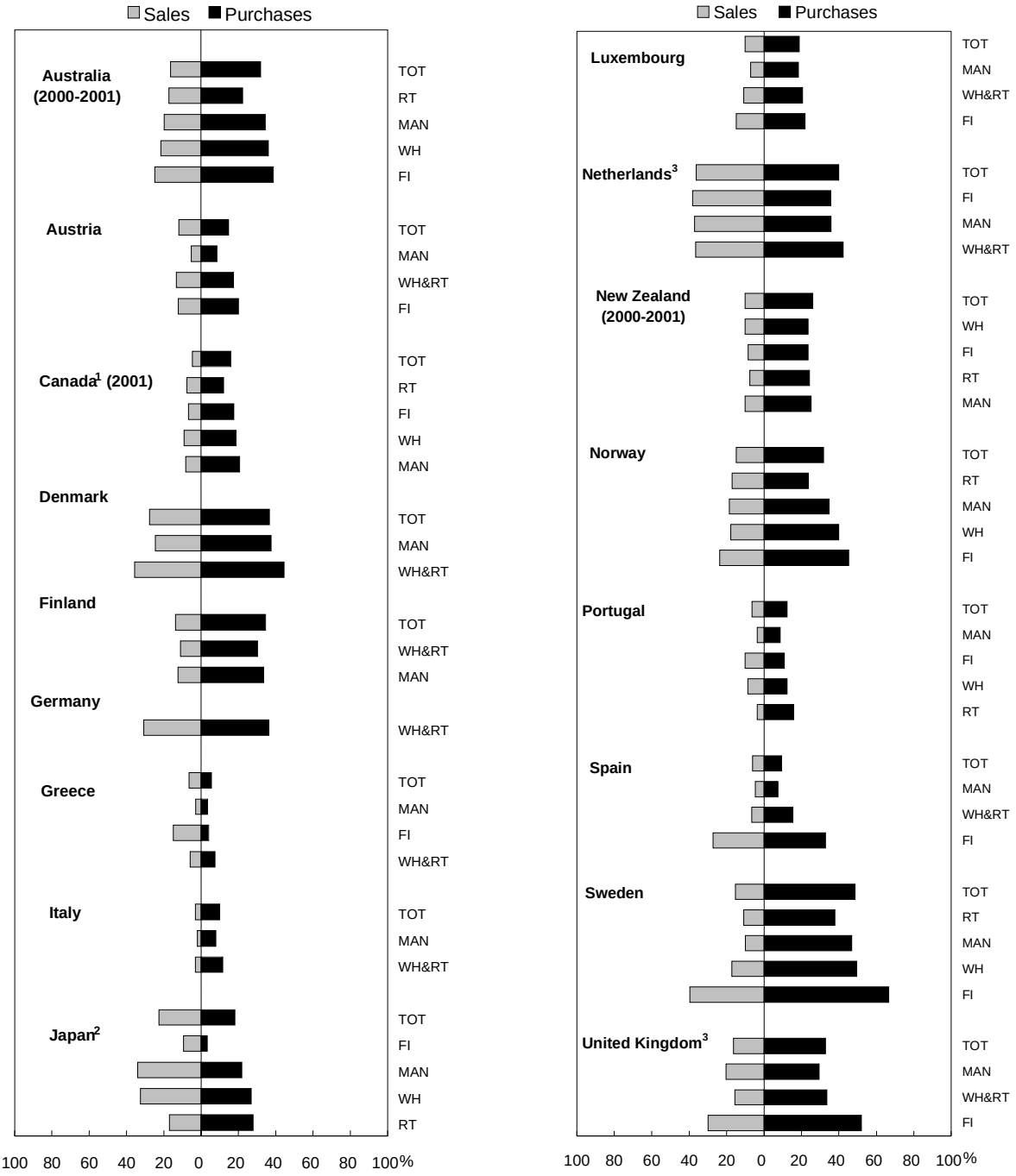
1. All businesses with 50 or more employees.
2. Orders received or placed over the Internet and other computer-mediated networks.

Source: OECD, ICT database, August 2002; Eurostat, *E-Commerce Pilot Survey 2001*.

Internet and electronic commerce transactions

Internet purchases and sales by activity, 2000

Percentage of businesses in each activity class



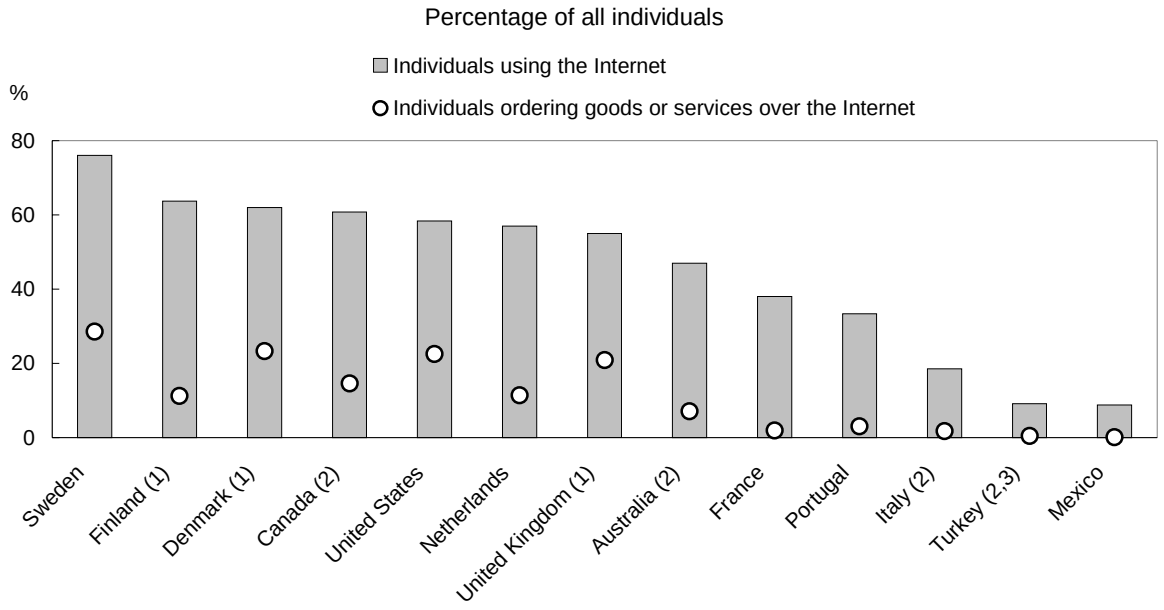
Note: TOT (total economy); FI (finance and insurance); RT (retail trade); WH (wholesale trade), MAN (manufacturing).
1. All businesses.
2. Businesses with 50 or more employees.
3. Orders received or placed over the Internet and other computer-mediated networks.
Source: OECD, ICT database, August 2002; Eurostat, *E-commerce Pilot Survey 2001*.

Internet and electronic commerce transactions by consumers

- Although transactions among businesses represent the bulk of electronic commerce, most attention has focused on business-to-consumer Internet sales. Since household expenditure in OECD countries typically accounts for over half of total domestic demand, this is not surprising. Moreover, the growing interest of policy makers in issues such as consumer trust and privacy protection in the on-line environment has raised demand for indicators of consumers' on-line transactions.
- The share of Internet users buying over the Internet is generally quite low and varies widely. It is highest in Denmark, Sweden, United Kingdom and United States, where about 38% of individuals using the Internet ordered products in 2001, followed by Canada (24%) and the Netherlands (20%). It is lowest in Mexico, where only 0.6% of Internet users purchase over the Internet. With about one in six Internet users purchasing goods over the Internet in Finland and Australia, there is still a potential for a marked increase in Internet sales, especially since over 50% of households in those countries has access to a computer.
- Some countries have started to collect statistics on the proportion or volume of business-to-consumer Internet transactions. Generally, less than 30% of Internet sales are to households, although the share varies considerably, ranging from about 30% in Finland and Luxembourg to only a little over 1% in Singapore in 2000 (Infocomm Development Authority, 2000*)*. In the United Kingdom, the financial sector accounts for most Internet sales to households; if these sales are excluded, household Internet sales drop from 0.36% to 0.1%. In Canada, the finance and insurance sector accounted for 8% of total business-to-consumer transactions in 2001. Retail enterprises had the largest volume of transactions to consumers (30%), followed by wholesale trade (19%) and transportation and warehousing (13%). Manufacturing enterprises had the largest share of business-to-business Internet transactions (22%).
- As it is difficult to estimate business-to-consumer electronic transactions, retail transactions over the Internet are often used as proxies. The Canadian e-commerce survey, which produces estimates of Internet business-to-consumer transactions across all sectors of the economy, shows that only about half of Internet sales in the retail sector go to consumers. Internet retail sales are still a very small share of total retail trade sales, ranging from 0.1% in France to just over 1% in the United Kingdom. Retail sales in Canada doubled from 1999 to 2000, with the average value of an Internet sale remaining relatively unchanged at CAD 121 (USD 75) (Statistics Canada, 2001).
- The US Department of Commerce has published quarterly data on on-line retail sales since the last quarter of 1999. Internet retail trade grew rapidly both in volume and as a share of total retail trade in 1999-2001; its share increased from 0.70% in the fourth quarter of 1999 to 1.2% in the fourth quarter of 2000 and to 1.3% in the fourth quarter 2001. E-commerce retail sales in the second quarter of 2002 accounted for 1.2% of total sales, a decrease from the 1.3% of the previous quarter but an increase over the 1.0% of the second quarter 2001. The total value of on-line retail sales (USD 35.9 billion in 2001) should be considered as a lower bound, as certain categories that are included in other surveys, such as on-line travel services, financial brokers and dealers and ticket sales agencies, are excluded.

Internet and electronic commerce transactions by consumers

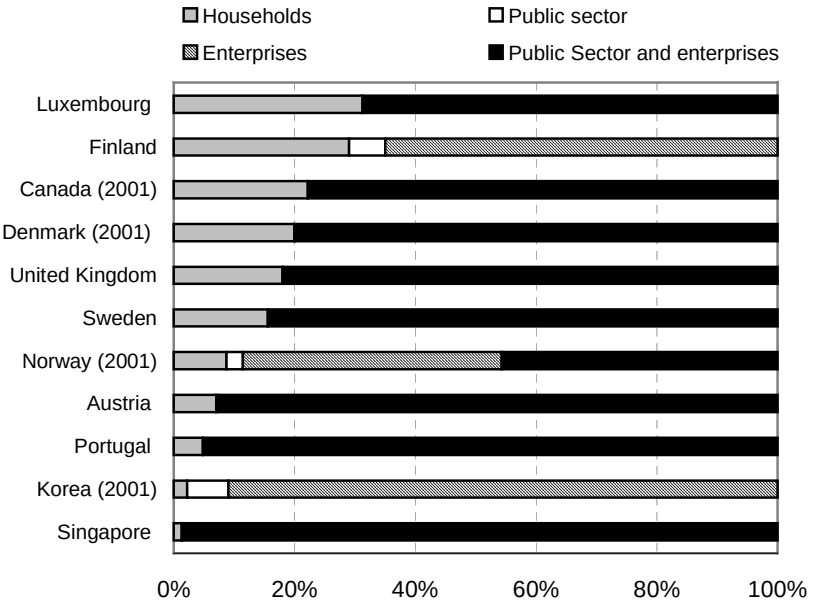
Individuals purchasing over the Internet, 2001 or latest available year



1. 2002 instead of 2001.
2. 2000 instead of 2001.
3. Individuals belonging to households in urban areas.

Source: OECD, ICT database, August 2002.

Share of Internet sales by type of customer, 2000 or latest available year



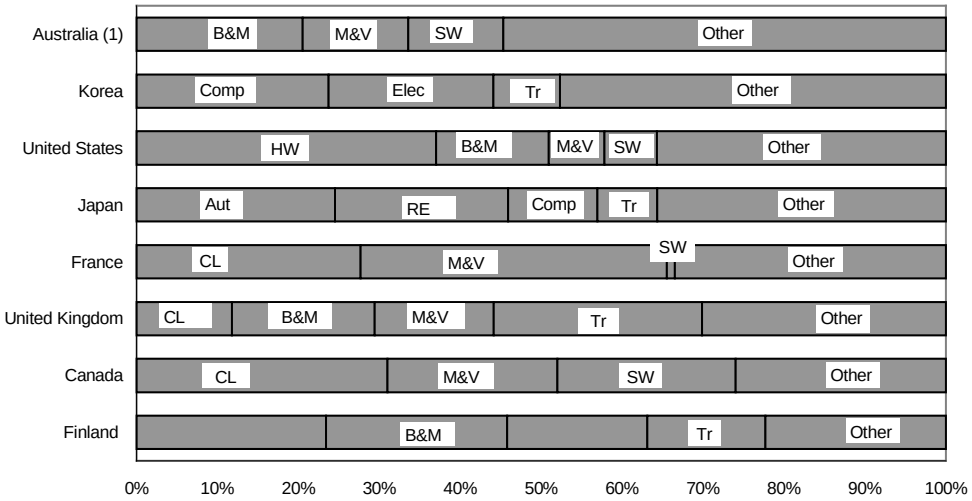
Source: OECD, ICT database, August 2002; Eurostat, *E-commerce Pilot Survey 2001*.

Internet transactions by product and cross-border

- The products that sell the best over the Internet are not necessarily the same across countries, since they reflect not only the nature of the product – digitised products such as music, books and software are easier to sell and distribute over the Internet – but also consumer tastes and habits.
- Computer products represent the biggest shares in the United States, Japan and Korea. In France, clothing accounts for about 30% of consumer purchases over the Internet. Digitised products such as music, computer software and magazines also represent a relatively important source of revenue. In 1999 in France, CDs and DVDs were the top-selling items over the Internet and represented almost 40% of the total value of Internet sales. In the Netherlands in 2000, CDs made up 23% and DVDs a further 4% of Internet sales (*De digitale economie 2001*). In Australia, three products (books, music and computer software) accounted for 45% of household spending over the Internet.
- Statistical offices have started to collect statistics on the share of firms' turnover originating from sales abroad. Such statistics are hard to collect at present, mainly because the volume of sales abroad may not yet be statistically significant. It is also difficult to identify where buyers and sellers are physically located. In Australia, 90% of businesses with a Web site have a site hosted only in Australia; 5% have a site hosted only overseas and the remaining 5% have a site hosted both in Australia and overseas (Australian Bureau of Statistics, 2000).
- Available statistics show that Internet sales are mainly domestic. To understand why, it is necessary to break down sales by industry, destination and type of customer (business or household). In Canada, for example, professional, scientific and technical services are most likely to have Internet sales to customers outside Canada, with 56% of the total value of their Internet sales abroad. In the accommodation and food services industry and the arts, entertainment and recreation industry more than 50% of the value of Internet sales were also to customers abroad. Overall in Canada, manufacturing, transport, wholesale trade and retail trade accounted for 60% of total Internet sales in 2001. In sum, while 16.6% of total Internet sales are to customers outside Canada, their industry composition is highly skewed. Wholesale trade and retail trade account for over a quarter of Internet sales, but their propensity to export is low, at 13.6% and 3.2% of all sales, respectively.
- In Eurostat's *E-commerce Pilot Survey*, sales abroad are broken down by destination within and outside Europe. Initial results for nine European countries indicate that European companies mainly sell over the Internet to locations within Europe. This may partly reflect the overall (intra-Europe) tendency of European trade. In Austria, Denmark and Finland, exports to Europe represent between 55% and 63% of total exports of goods. This roughly coincides with the ratio of intra-European Internet exports to total exports in Finland (56%) and Denmark (63%), while it is a bit higher for Austria (73%). The share of international Internet sales is particularly small in the United Kingdom, at only 0.05% of total sales in the sectors surveyed; the air transport industry has the highest propensity to export abroad, with 0.7% of total sales (ONS, 2001).
- The available data do not allow for breaking Internet exports down by type of customer to know whether business-to-consumer Internet transactions are more "international" in nature than business-to-business transactions. It is also difficult for consumers to know where a firm or a Web site is physically located, or whether a firm's location and that of its Web site coincide. Moreover, even if business-to-consumer transactions have a higher propensity to be "international", Internet sales in volume terms are more likely to be domestic, owing to the weight of business-to-business transactions.
- Statistics on international Internet purchases drawn from household surveys or surveys of individuals might help but rarely exist as yet. In Australia, 50% of adults purchasing over the Internet buy only from Australian Web sites, 32% only from overseas Web sites and 18% from both. Singapore reports that business-to-consumer sales are dominated by overseas customers, with particularly large shares of customers in Malaysia, Thailand, Japan and the United States (Infocomm Development Authority, 2000).

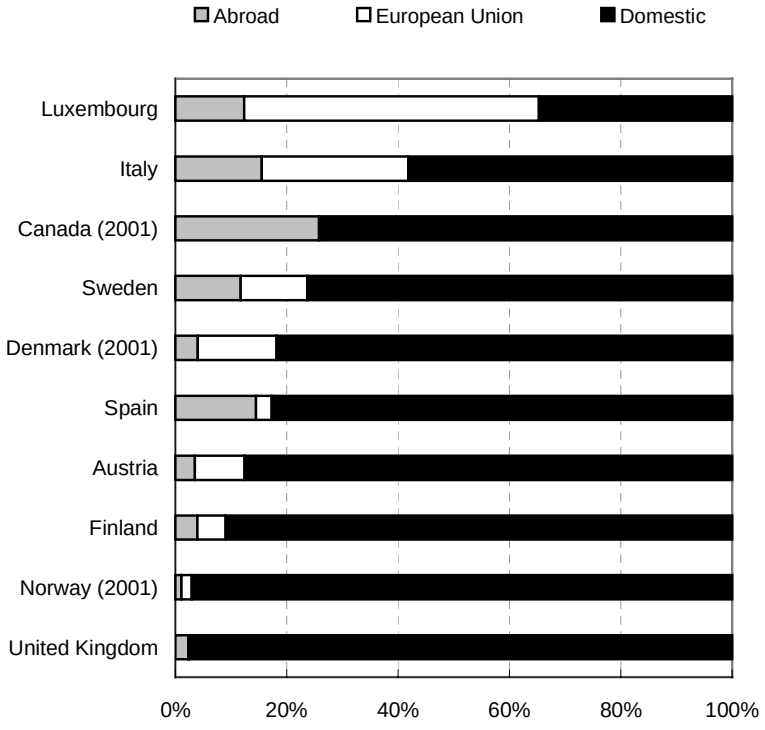
Internet transactions by product and cross-border

Consumers' Internet purchases by product, 2000



Note: Aut (Automotive); Comp (Computer and related products); CL (Clothing/ jewellery/ accessories); M&V (Music and videos); Elect (Electronic telecommunication equipment); RE (Real estate); HW (Computer hardware); B&M (Books/magazines); SW (Computer software); Tr (Travel).
1. Proportions of all adults purchasing or ordering over the Internet for private use.
Sources: ABS, 2001; Statistics Canada, 2000; INSEE, 2001; Statistics Finland, 2001; ECOM in collaboration with the METI, Japan, 2001; Korea National Statistical Office, 2001, US Bureau of the Census, 1999.

Share of Internet sales in domestic and international markets, 2000 or latest available year



Source: OECD, ICT database, August 2002; Eurostat, *E-commerce Pilot Survey 2001*.

Drivers and inhibitors of Internet commerce

- One source of differences in countries' implementation of electronic commerce and in the impact of electronic transactions on business performance and productivity is the extent to which firms incorporate the technology strategically into their business processes. Firms carrying out transactions on line may seek greater efficiency, or speed, in their business processes or production-related efficiency, *i.e.* reduction of transaction costs or of the costs of intermediate inputs by reaching out to more efficient suppliers. Other firms may adopt e-commerce technologies to develop new business practices and change their way of interacting in the marketplace. Still others implement e-commerce technologies as a result of pressures from customers and suppliers or simply to remain competitive.

- In terms of motivation, recent data for European countries show that reaching new/more customers and geographical market expansion represent about 30% and improving efficiency about 50%. Fear of losing market share accounts for 20% at most. For all, reaching new/more customers is generally regarded as the leading motivation for engaging in e-commerce.

- Statistical surveys can also be used to measure barriers to electronic commerce transactions. The barriers and policy issues differ, depending on whether the transactions involved are business-to-business or business-to-consumer. For the former, existing transaction models or tight links with customers and suppliers along the value chain may discourage businesses from introducing new models. Questions about the security or reliability of complex systems that can link all customers and suppliers may also enter as a factor. Business-to-consumer transactions, instead, are typically hampered by concerns about security of payment, the possibility of redress in the on-line environment and privacy of personal data. Other factors with considerable impact on the development of on-line consumer transactions are ease and cost of access, convenience of shopping on line and the appeal of customisation.

- For countries for which data are available, the leading reason cited by businesses for not conducting transactions electronically was a view that electronic commerce was not suited to the nature of their business. In Canada, among businesses that did not buy or sell over the Internet, 56% believed that their goods or services did not lend themselves to Internet transactions; 36% preferred to maintain their current business model. In Sweden, Finland, Italy and Spain, 40% to 50% of businesses with computers consider their goods and services not to be well suited to e-commerce. This perceived barrier to Internet sales seems to be more relevant for real estate services and less relevant for financial services. An insufficient customer base can also be a reason for businesses not to embrace e-commerce, especially in Italy where 35% of businesses perceived this to be an important barrier.

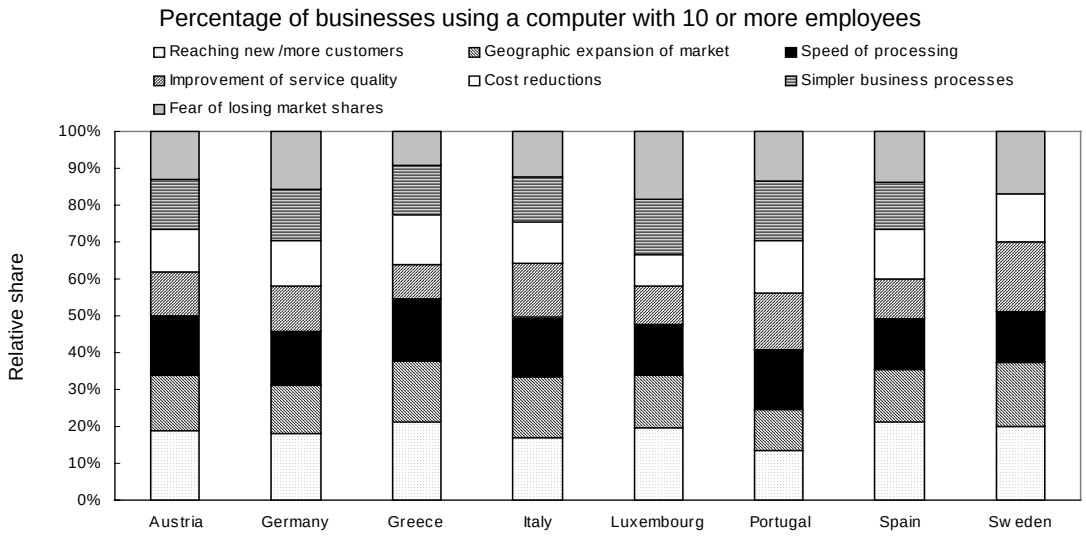
- In Canada a small share of enterprises that did not carry out Internet commerce felt that security was a concern (14%) or that the cost of development and maintenance was too high (12%) (Statistics Canada, 2001). In Europe, instead, major perceived issues are security of payments, uncertainty in contracts and cost of development and maintenance of an e-commerce system.

- Security issues regarding handling of payments are not surprising given the very small percentage of sites that ensure secure transactions. These issues are perceived to be most critical by smaller and medium-sized enterprises in Italy, Spain, Austria, the United Kingdom, Finland and Greece. Larger businesses in Europe seem instead to be more concerned than smaller ones about logistics or cost issues related to Internet commerce.

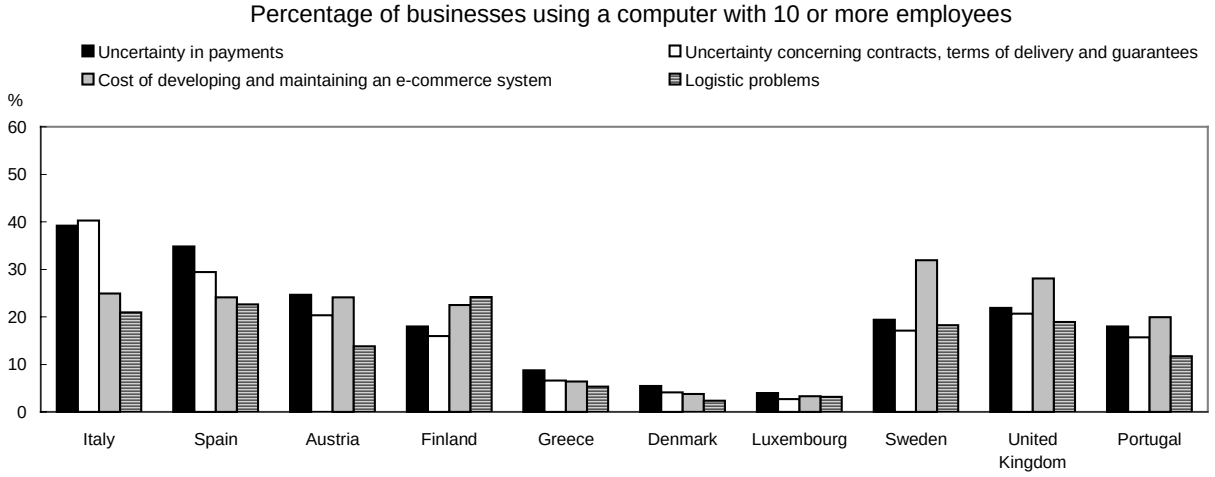
- Many individuals in Australia, Turkey and the United States cited "lack of interest or no use for the Internet" as a reason for not having Internet access at home. Security concerns are also a significant barrier. In Australia, 29% of individuals cited security as the primary reason for not making a purchase over the Internet. Singapore users cited fear of fraud as the leading reason (Infocomm Development Authority of Singapore, 2000).

Drivers and inhibitors of Internet commerce

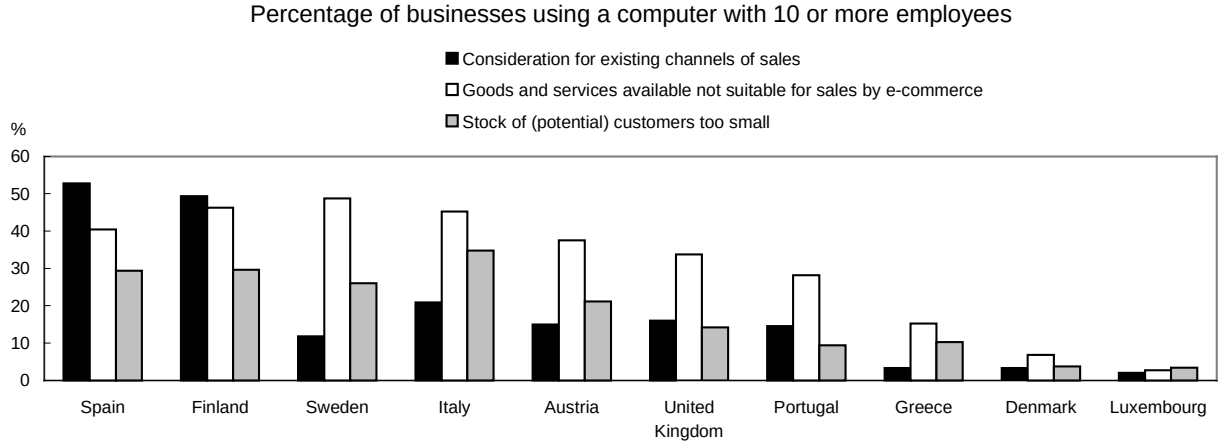
Business motivations for Internet commerce, 2000



Barriers to Internet commerce faced by businesses, 2000



Barriers to Internet commerce faced by businesses, 2000

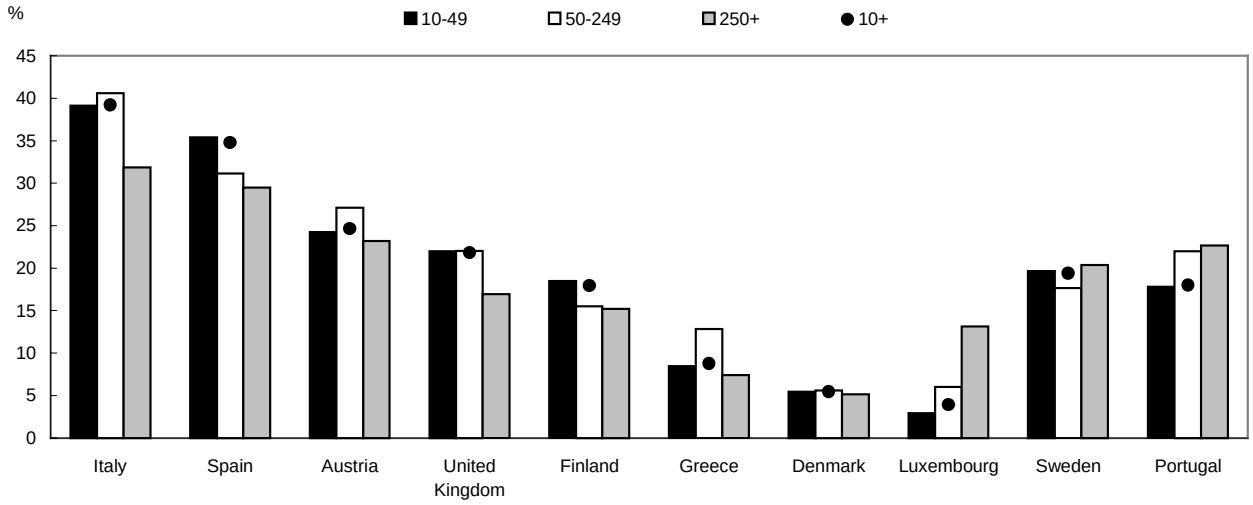


Source: Eurostat, *E-commerce Pilot Survey 2001*.

Barriers to Internet commerce

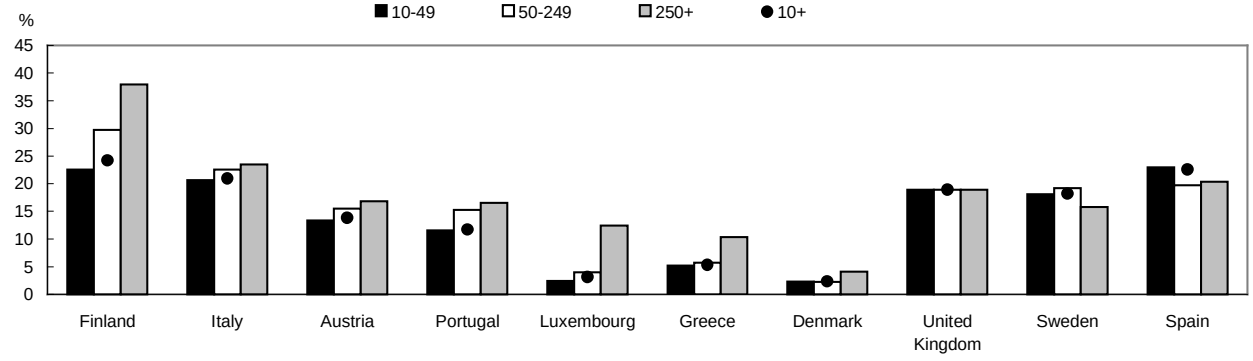
Small and large businesses facing barriers to Internet payments, 2000

Percentage of businesses using a computer with 10 or more employees



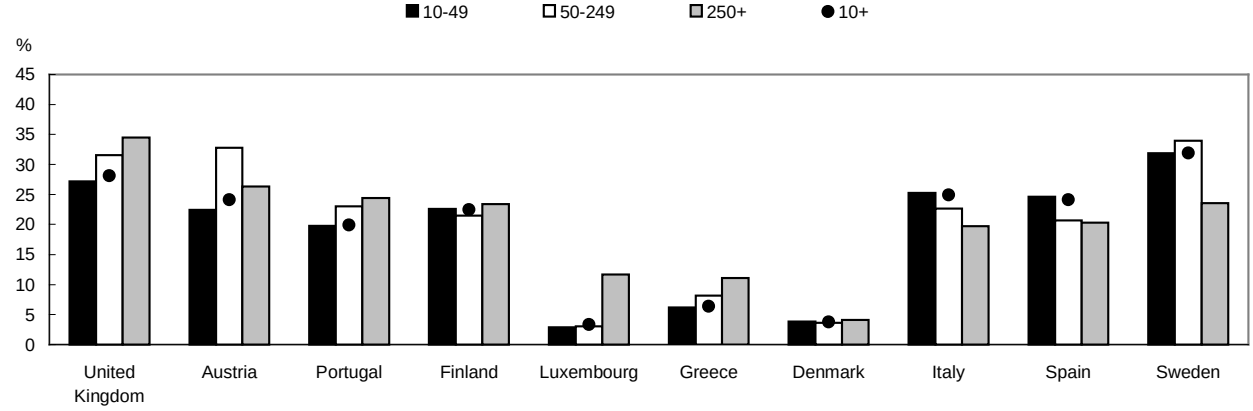
Small and large businesses facing logistics barriers, 2000

Percentage of businesses using a computer with 10 or more employees



Small and large businesses that find it too costly to develop and maintain an e-commerce system, 2000

Percentage of businesses using a computer with 10 or more employees

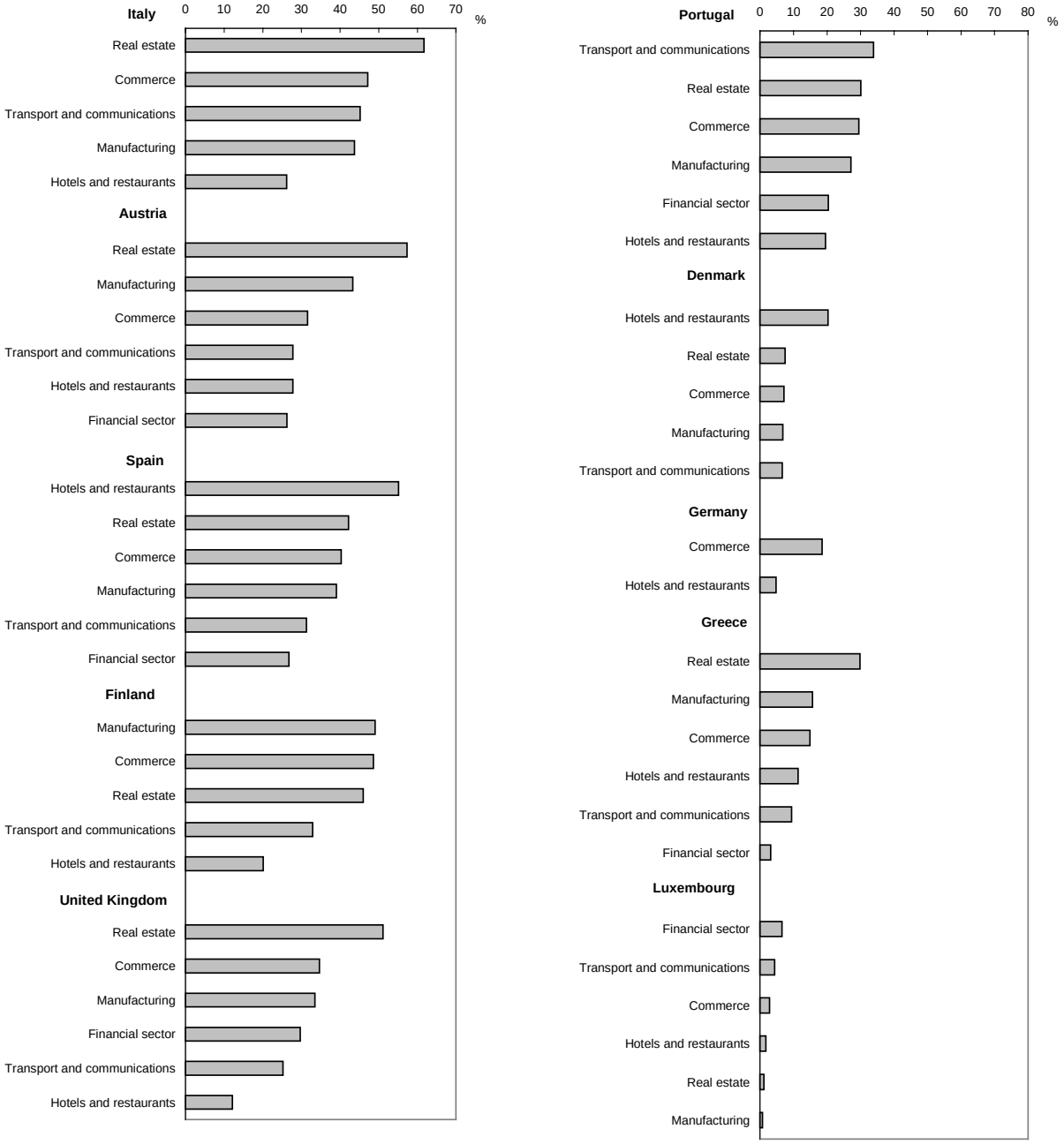


Source: Eurostat, *E-commerce Pilot Survey 2001*.

Barriers to Internet commerce

The nature of products is not suited for Internet sales, 2000

Percentage of businesses using a computer with 10 or more employees



Source: Eurostat, *E-commerce Pilot Survey 2001*.

Chapter V. ICT in education and government

Previous chapters have explored the diffusion of ICT among individuals and businesses. This chapter uses available indicators based on official statistics to describe the uptake of new technologies in schools and public administrations.

The contribution of the information economy to overall economic growth assumes that the population has the skills needed to use the technology. Access to ICT in schools and use of ICT in education are extremely important for raising ICT awareness and for developing an ICT skills base in the economy. For this reason, it is useful to monitor ICT developments in education systems. The first indicators in this chapter make use of international studies undertaken at the OECD to compare some basic indicators of student access to and use of computers.

ICT also affects governments by improving responsiveness, increasing efficiency and enhancing governance practices. Governments can encourage the diffusion of ICT through their supply of on-line services and their own use of new technologies. For these reasons, Member countries have expressed much interest in measuring and comparing government use of ICT. Unfortunately, there are as yet no harmonised official statistics on e-government in OECD countries., Therefore, this chapter only presents indicators for a limited number of countries. One of the problems with collecting internationally comparable statistics in this area is the heterogeneity of government units both within and across countries. Government organisations are quite varied in size and function, ranging from very small entities to huge government departments, hence it is difficult to harmonise the unit to be surveyed. With the increase in interest in the measurement of e-government, more official data will be collected over the coming years and hopefully a certain degree of comparability will be achieved.

ICT in education

- Economies increasingly depend on technological knowledge and skills, and ICT skills are particularly important. The use of computers at an early age helps students to learn ICT skills which can then be used as a tool in the education process. For example, 77% of Swiss students reported using a computer several times a week to prepare their courses. Only 3% reported never using a computer for course preparation (Office fédéral de la statistique, Neufchatel, 2002).
- The average number of students per computer is an indicator of students' access to new technologies. Data in OECD's *Education at a Glance* show that the percentage of students with access to a computer varies from 25% in Italy to 90% or more in Canada, Finland and New Zealand. Computer use also varies by level, with students in secondary schools generally having greater access to computers than pupils in primary schools. In recent years, the number of students per computer has been decreasing.
- Among the 13 countries for which data are available, Canada, New Zealand and Denmark have the smallest number of students per computer, with fewer than 12 lower secondary students per computer, whereas there are over 35 students per computer in the Czech Republic and Hungary.
- *Education at a Glance* also provides statistics on the link between availability and use of computers. In secondary schools where the available computers were not in use, the reason most often given was that the computers were outdated. In addition, many respondents mentioned broken and incompatible computers. Lack of knowledge on how to use a computer was not generally considered a significant problem.
- The second source of international statistics on education, the OECD's Programme for International Student Assessment (PISA), shows that most students generally feel comfortable or very comfortable with using a computer. Most claimed to use a computer more at home than at school, except in Mexico, Ireland and Hungary. On average, less than 40% of students used a computer at school a few times or more a week. Hungarian students appear to have the highest use, with at least six in ten claiming to have used a computer at school at least a few times a week. On average, approximately one student out of two in OECD countries uses the Internet. Internet usage rates are the highest in Sweden and Canada, where over 70% of students claimed to have used the Internet at least a few times a week.

Box 5.1. OECD statistics on education

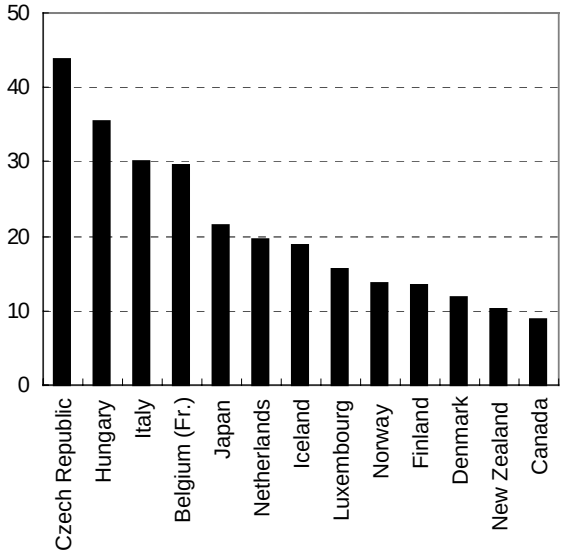
The OECD collects a large range of internationally comparable statistics on education. A main outcome of this work is the publication *Education at a Glance*, which provides statistics on OECD member countries and also 18 non-member countries. To ensure comparability, data for all countries are reported on the basis of common OECD definitions and methods. However, Belgium, Canada, Finland, Italy and New Zealand do not meet all the sampling criteria.

A second source of data on education is the OECD's Programme for International Student Assessment (PISA). It is based on a large-scale survey of 15-year old students in OECD member countries. The first survey, an Adult Literacy Survey, was carried out in 2000, and is reported on in the publication *Knowledge and Skills for Life.*

The PISA survey will be repeated every three years. In 2000, 265 000 students in 32 countries took part. Students sat pencil and paper assessments in their schools. Students and principals also answered questions about themselves and their schools. This allowed PISA to identify factors associated with performance.

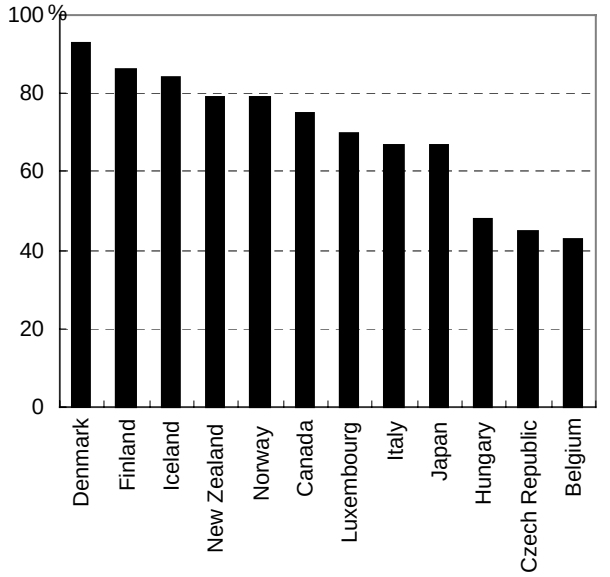
ICT in education

Ratio of students to available computers in lower secondary education, 1998/99



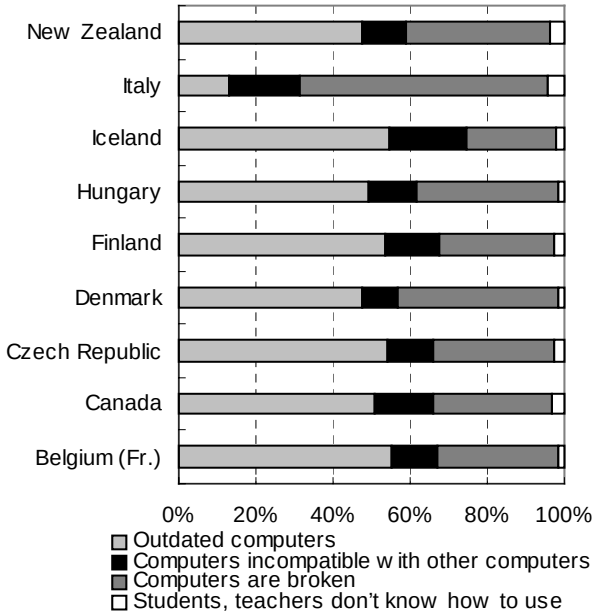
Source: *Education at a Glance*, OECD 2001.

Percentage of lower secondary students using the available computers, 1998/99



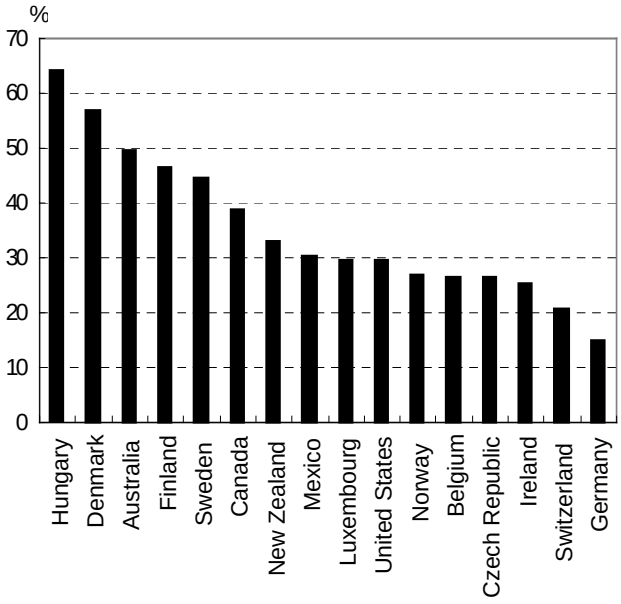
Source: *Education at a Glance*, OECD 2001.

Reasons for not using available computers in lower secondary schools



Note: Belgium (Fr.) refers to the part of Belgium where French is spoken.
Source: *Education at a Glance*, OECD 2001.

Percentage of 15-year old students using a computer at school at least a few times a week



Source: *Knowledge and Skills for Life*, OECD 2002.

ICT in government

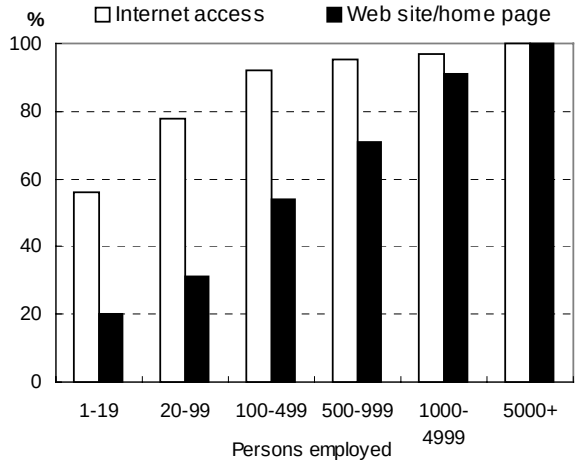
- The Internet gives governments the opportunity to offer public services and to provide information and policies more efficiently. The more public services can be delivered through electronic media, such as the Internet, the larger the potential savings. Processing documents, such as licences, or collecting taxes electronically are examples of such possibilities.
- Few countries currently provide official data on ICT in government, however. The Australian Bureau of Statistics conducted a survey of government use of IT in 1997/98 and again in 1999/2000. The earlier results showed that the larger the government department or agency, the more likely it was to have Internet access and a Web site or home page.
- Statistics Canada surveyed Internet and e-mail access in the public and private sectors in 2000 and found that public sector enterprises were more likely to have a Web page. Use of e-mail and the Internet was also more prevalent among employees in the public sector.
- Statistics published by the Japanese Statistics Bureau show that the number of employees per PC in the Japanese central government fell from 1.5 in 1996 to 0.8 in 2000. There is considerable variation across government functions, however. In 2000, local branch offices of the central government still had, on average, 1.5 employees per PC, whereas facilities and institutes (such as national universities) had 0.5 employee per PC.
- Data from Statistics Finland suggest that the use of ICT increased significantly from 1995 to 2000. Access for civil servants increased from 36% to 85%, the share of government PCs with multimedia capability increased from 5% in 1995 to 42% in 2000, and in 2000 10% of all government PCs were laptops.

Box 5.2. ICT in government

Governments in member countries recognise the benefits of ICT, in particular for enhancing good governance practices, being more responsive and governing more effectively. However statistics on ICT use in government are scarce. Countries such as Australia, Canada, Denmark, Finland, Japan, and the United Kingdom are collecting data on government use of ICT but, because of differences in the focus and timing of the surveys and the phrasing of the questions, the data currently available are not always internationally comparable. It will only become possible to draw valid international comparisons when agreement is reached on core indicators in this area.

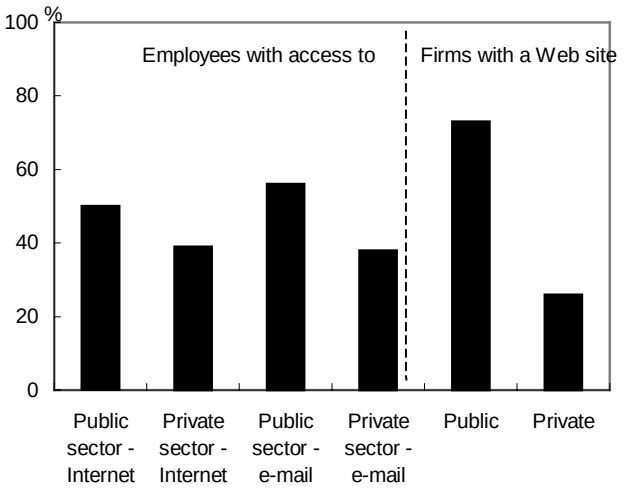
ICT in government

Government Internet access and Web sites in Australia, 1997/98



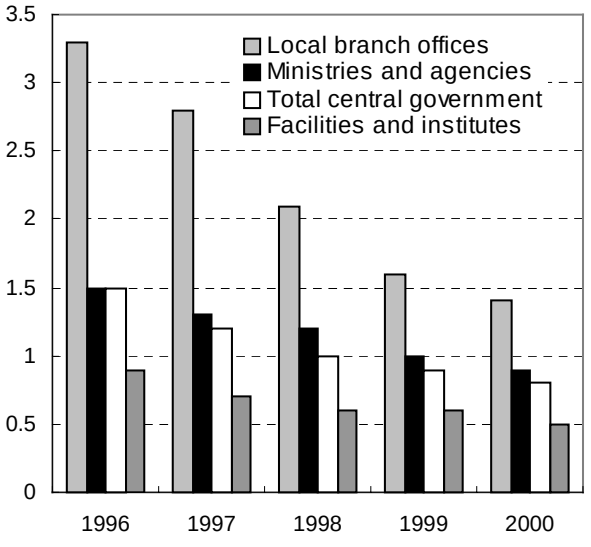
Source: Australian Bureau of Statistics (1999), "Government Use of Information Technology", 8119.0, Canberra.

Internet and e-mail access in Canada's public and private sectors, 2000



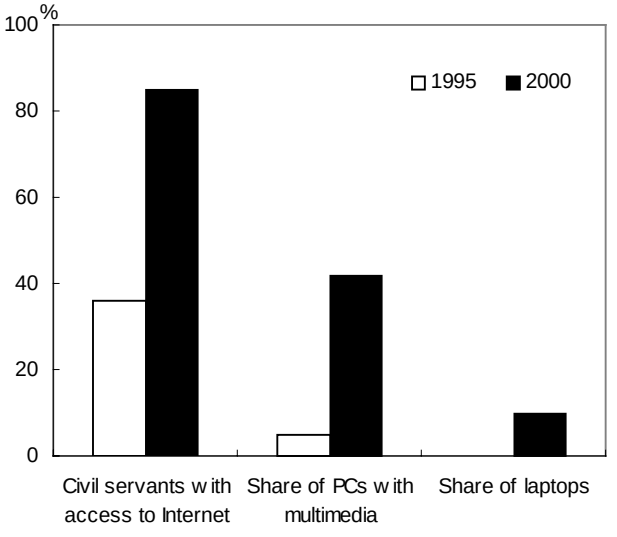
Source: Statistics Canada (2001), "Electronic Commerce and Technology Use", Connectedness Series, Ottawa, September.

Employees per PC in Japan's central government, FY 1996-2000



Source: Administrative Management Bureau (2001), *Basic Survey on the Progress of Government ICT Use*, Tokyo.

ICT use in the Finnish government, 1995 and 2000



Source: Statistics Finland (2001), *On the Road to the Finnish Information Society III*, Helsinki.

ANNEX 1. THE OECD DEFINITION OF THE ICT SECTOR

In 1998, OECD member countries agreed to define the ICT sector as a combination of manufacturing and services industries that capture, transmit and display data and information electronically. This definition, based on an international standard classification of activities (ISIC Rev. 3), was considered to be a first step towards obtaining some initial measurements of ICT sector core indicators.

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 ISIC Rev. 3 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 OECD's 1998 activity-based definition of ICT was reviewed in April 2002. It was decided that, although this definition gives only a first approximation of the ICT sector, it should not be changed at this stage; rather its implementation should be improved with the help of more detailed national classifications. This decision is subject to reconsideration at a later date and in the context of the major revision of ISIC to be undertaken in 2007. The only minor modification to the OECD ICT sector definition is to take into account the split of ISIC 5150 (Wholesaling of machinery, equipment and supplies) that was introduced in the ISIC Rev. 3.1 of 2002, *i.e.* class 5151, "Wholesale of computers, computer peripheral equipment and software", and class 5152, "Wholesale of electronic and telecommunication parts and equipment".

One important feature of the OECD ICT sector definition is that it breaks the traditional ISIC dichotomy between manufacturing and services activities. Activities producing or distributing ICT products can be found everywhere in the economy. Moreover, by identifying the key sectors whose main activity is producing or distributing ICT products, this definition constitutes a first order approximation of the "ICT producing sector". In 1998, it was recognised that an activity-based definition should be complemented by an ICT products classification. Mapping products to activities would allow a more precise quantification of ICT-related production, value added and employment, both within the core ICT sectors and in other sectors of the economy. The OECD is currently working on an ICT products classification.

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. Table A.1 shows the concordance between ISIC Rev. 3 ICT sector classes and national classifications used by member countries to report business survey data on the ICT sector (gross fixed capital formation, employment, production, value added, wages and salaries). Tables with core business survey statistics on the ICT sector, as well as detailed metadata on every country and variable, will be published in the electronic version of *Measuring the Information Economy 2002* (www.oecd.org/sti/measuring-infoeconomy).

The ICT sector business survey 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 charts presented in *Measuring the Information Economy 2002* are based on data that may differ from figures contained in national reports and in previous OECD publications.

Table A.1. The OECD sector definition. Concordance table between ISIC Rev.3 and national classifications[1]

Activity classes used in the reporting of ICT sector data for the *Measuring the Information Economy 2002* publication

Classifications / ISIC rev. 3	European Union NACE Rev.1	Canada NAICS	United States US SIC	United States NAICS	Australia ANZSIC	New Zealand ANZSIC	Japan JSIC Rev.10 (1993)	Mexico CMAP 1994
30	30	33331 33411	3571,2,5,7pt,8, 9pt	333313 334111, 334112, 334113, 334119	2841	2841	2981 3051	382301 382302 385007
3130	31.3	33592	3357	33592 = (335921+ 335929)	2852	2852	2741 2742	383109
3210	32.1	33441	3671 3672 3674 3675, 6, 7, 8, 9pt, 3661pt	334411 334412 334413 334414, 334415, 334418, 334419	2849	2849	3081 3082 3083 3088	383202 383206
3220	32.2	33421 33422	3663, 3679pt, 3699 3661pt, 3577pt, 3679pt	334220, 334290 334210, 334418pt	2842	2842	3041 3042	383201
3230	32.3	33431	3651, 3679pt	334310			3043, 3044, 3062, 3084, 3086, 3087, 3085, 3089, 3093	383204
3312	33.20	33451	3825pt 3826	334514pt, 334515 334516	2839	2839	3069,3071, 3211, 3212, 3213, 3214, 3215, 3216, 3217, 3218, 3219, 3221, 3241 2998, 3072	385004 385005 961105 961106
3313	33.30		3823	334513				382203
5150 [2]	51.43 51.64 51.65	41731 41732 41791	5045pt 5045pt	421430	4612 4613 4614 4615	4612 4613 4614 4615	5211, 5212, 5213, 5214, 5219, 5232, 5291	612020
6420	64.20	51322 51331 51332 51333 51334 51339	481,82, 89 4841	513310, 21, 22, 30, 40, 90 513210, 20	7120	7120	4711 , 4712 , 4713 , 4719 , 4721, 4731 , 4749 , 8131 , 8132	720003 720006
7123	71.33	53242	7377	532420	7743(pt)	7743	7931	831113
72	72	51121 51419 51421 54151 81121	7371 7372 7373 7374 7375 7376 7378 7379	541511 334611, 511210 541512 514210 514191, 514199 541513 811212 541519	7831, 7832, 7833, 7834	7831, 7832, 7833, 7834	8211 8211, 8212 8221 8222 7811, 7812	951004

1. ANZIC (Australian and New Zealand Standard Industrial Classification); CMAP (Codificador de Actividades del Sistema de Cuentas Nacionales de México); JSIC (Standard Industrial Classification for Japan); NACE Rev. 1 (Statistical Classification of Economic Activities in the European Community, Rev. 1); NAICS (North American Industry Classification System); US SIC (US Standard Industrial Classification).
2. Activity classes reported by countries in order to approximate “ICT Wholesale”.

ANNEX 2. THE PRODUCT CLASSIFICATION USED TO ESTIMATE ICT SECTOR TRADE

In the absence of tables of international trade in goods and services by detailed industrial activity which are compatible with the national accounts, ICT sector exports and imports have been estimated using the OECD's International Trade in Commodity Statistics (ITCS) database by applying a Harmonised System Rev. 1 (HS1) to ISIC Rev. 3 conversion key. The conversion method was developed within the OECD for the new STAN database – ahead of implementation of a full HS Rev. 1 to detailed ISIC Rev. 3 conversion regime.

The OECD definition of the ICT manufacturing sector (see Annex 1), based on ISIC Rev. 3 has been used as the basis for the ICT trade indicators. Thus, the trade indicators constructed here reflect trade in goods for which the ICT manufacturing sector can be considered the origin (exports) or the destination (imports) according to the UN standard conversion table. This type of aggregation, as well as the use of a single conversion key for all OECD countries, means that the figures reported here are not strictly comparable with those published in national accounts.

The following table shows the conversion of ICT manufacturing codes using the HS REV 1 classification to the ISIC Rev. 3 classification as used in the STAN database.

Table A.2.1. HS Rev. 1 to ISIC Rev. 3 conversion regime used to estimate ICT sector trade

ISIC Rev. 3	HS Rev. 1	*less*	DESCRIPTION
3000			**Office, accounting and computing machinery**
	844312		Offset printing machinery : Sheet fed, office type (sheet size not exceeding 22 x 36 cm)
	8469		Typewriters and word-processing machines.
	8470		Calculating machines; accounting machines, cash registers, postage-franking machines, ticket-issuing machines and similar machines, incorporating a calculating device.
	8471		Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included.
	8472		Other office machines (for example, hectograph or stencil duplicating machines, addressing machines, automatic banknote dispensers, coin-sorting machines, coin-counting or wrapping machines, pencil-sharpening machines, perforating or stapling machines).
	8473		Parts and accessories (other than covers, carrying cases and the like) suitable for use solely or principally with machines of headings Nos. 84.69 to 84.72.
	9009		Photo-copying apparatus incorporating an optical system or of the contact type and thermo-copying apparatus.
3130			**Insulated wire and cable**
	8544		Insulated (including enamelled or anodised) wire, cable (including co-axial cable) and other insulated electric conductors, whether or not fitted with connectors; optical fibre cables, made up of individually sheathed fibres, whether or not assembled with
		- 854430	*Ignition wiring sets and other wiring sets of a kind used in vehicles, aircraft or ships*
3210			**Electronic valves and tubes and other electronic components**
	8532		Electrical capacitors, fixed, variable or adjustable (pre-set).
	8533		Electrical resistors (including rheostats and potentiometers), other than heating resistors.
	8534		Printed circuits.
	8540		Thermionic, cold cathode or photo-cathode valves and tubes (for example, vacuum or vapour or gas filled valves and tubes, mercury arc rectifying valves and tubes, cathode-ray tubes, television camera tubes).
	8541		Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes; mounted piezo-electric crystals.

Table A.2.1. HS Rev. 1 to ISIC Rev. 3 conversion regime used to estimate ICT sector trade (continued)

3210		**Electronic valves and tubes and other electronic components (continued)**
8542		Electronic integrated circuits and microassemblies.
3220		**TV and radio transmitters and apparatus for line telephony and telegraphy**
8517		Electrical apparatus for line telephony or line telegraphy, including such apparatus for carrier-current line systems.
8525		Transmission apparatus for radio-telephony, radio-telegraphy, radio-broadcasting or television, whether or not incorporating reception apparatus or sound recording or reproducing apparatus; television cameras.
3230		**TV and radio receivers, sound or video recording or reproducing apparatus etc.**
8518		Microphones and stands therefor; loud-speakers, whether or not mounted in their enclosures; headphones, earphones and combined microphone/speaker sets; audio-frequency electric amplifiers; electric sound amplifier sets.
8519		Turntables (record-decks) record-players, cassette-players and other sound reproducing apparatus, not incorporating a sound recording device.
8520		Magnetic tape recorders and other sound recording apparatus, whether or not incorporating a sound reproducing device.
8521		Video recording or reproducing apparatus.
8522		Parts and accessories of apparatus of headings Nos. 85.19 to 85.21.
8527		Reception apparatus for radio-telephony, radio-telegraphy or radio-broadcasting, whether or not combined, in the same housing, with sound recording or reproducing apparatus or a clock.
8528		Television receivers (including video monitors and video projectors), whether or not combined, in the same housing, with radio-broadcast receivers or sound or video recording or reproducing apparatus.
8529		Parts suitable for use solely or principally with the apparatus of headings Nos. 85.25 to 85.28.
3312 + 3313		**Instruments and appliances for measuring, checking, testing, navigating etc. Industrial process control equipment**
8526		Radar apparatus, radio navigational aid apparatus and radio remote control apparatus.
9012		Microscopes other than optical microscopes; diffraction apparatus.
9014		Direction finding compasses; other navigational instruments and appliances.
9015		Surveying (including photogrammetrical surveying), hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses; rangefinders.
9016		Balances of a sensitivity of 5 cg or better, with or without weights.
9017		Drawing, marking-out or mathematical calculating instruments (for example, drafting machines, pantographs, protractors, drawing sets, slide rules, disc calculators); instruments for measuring length, for use in the hand (for example, measuring rods and ta
9024		Machines and appliances for testing the hardness, strength, compressibility, elasticity or other mechanical properties of materials (for example, metals, wood, textiles, paper, plastics).
9025		Hydrometers and similar floating instruments, thermometers, pyrometers, barometers, hygrometers and psychrometers, recording or not, and any combination of these instruments.
9026		Instruments and apparatus for measuring or checking the flow, level, pressure or other variables of liquids or gases (for example, flow meters, level gauges, manometers, heat meters), excluding instruments and apparatus of heading No. 90.14, 90.15, 90.28
9027		Instruments and apparatus for physical or chemical analysis (for example, polarimeters, refractometers, spectrometers, gas or smoke analysis apparatus); instruments and apparatus for measuring or checking viscosity, porosity, expansion, surface tension or
9028		Gas, liquid or electricity supply or production meters, including calibrating meters therefor.
9029		Revolution counters, production counters, taximeters, mileometers, pedometers and the like; speed indicators and tachometers, other than those of heading No. 90.15; stroboscopes.
9030		Oscilloscopes, spectrum analysers and other instruments and apparatus for measuring or checking electrical quantities, excluding meters of heading No. 90.28; instruments and apparatus for measuring or detecting alpha, beta, gamma, X-ray, cosmic or other i
9031		Measuring or checking instruments, appliances and machines, not specified or included elsewhere in this Chapter; profile projectors.
9032		Automatic regulating or controlling instruments and apparatus.
9033		Parts and accessories (not specified or included elsewhere in this Chapter) for machines, appliances, instruments or apparatus of Chapter 90.

ANNEX 3. THE OECD MODEL SURVEY OF ICT USAGE IN THE BUSINESS SECTOR

Since 1999, the WPIIS has worked with the Voorburg Group (the United Nations City Group on Service Statistics) and Eurostat to develop a model questionnaire on the use of ICT goods and services in the business enterprise sector. The activity was led by the statistical offices of the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden), which were the first to establish a project for a common set of guidelines to measure ICT usage in enterprises.

After two years of sharing and testing, a model questionnaire on ICT usage in the business sector was approved by the OECD in 2001 [DSTI/ICCP/IIS(2001)1/REV1]. The questionnaire is intended to provide guidance for the measurement of indicators of ICT, Internet use and electronic commerce, and is composed of separate, self-contained modules to ensure flexibility and adaptability to a rapidly changing environment. While the use of "core" modules makes measurement on an internationally comparable basis possible, additional modules can be added to respond to evolving or country-specific policy needs. The five core modules in the current version of the OECD model questionnaire are:

A. *General information about ICT systems.* These questions relate to the type of computer-mediated devices, applications or networks used in the enterprise. They also measure the extent to which employees use personal computers (PCs) and the Internet in their daily work.

B. *Use of the Internet.* The module first focuses on the type of connection used and its speed. It then turns to the business processes for which the Internet is used. At this stage, the indicators mainly relate to information- and communication-intensive activities (*e.g.* information search, banking and financial activities, etc.) and to business processes that involve transactions over the Internet. A distinction is made, and separate questions are asked about, processes relating to purchases (the enterprise as a customer) and sales (the enterprise as a provider) of goods and services. In the case of selling-related activities, the indicators are restricted to the functionality of the enterprise's Web site in order to focus on innovative ways of marketing, managing information, selling and providing payment facilities and other interactive services to customers.

C and D. *Electronic commerce: Internet transactions and electronic transactions via EDI and other computer-mediated networks.* Drawing on OECD work to define and measure electronic commerce (see the box on the definitions of electronic transactions), the questionnaire contains two modules on electronic commerce transactions. **Module C** measures indicators for Internet sales and purchases. Questions relating to the monetary amount of the transactions or their breakdown by customer and geographical destination, are expressed in terms of percentage of total sales or purchases in order to maximise the response rate. In general, statistical offices will be able to use that information to provide estimates of the monetary amount of the electronic transactions. EDI (electronic data interchange) and other computer-mediated networks are traditionally used to conduct electronic transactions. **Module D** aims at better monitoring the development of new forms of sales by separating the turnover of Internet sales from that of other types of computer-mediated networks. The scope of EDI should be restricted to proprietary EDI and EDIFACT. Ideally, EDI transactions transported over the Internet and in the HTML-based format, XML, should be included in module C (electronic commerce via the Internet). This would allow countries to monitor the migration towards Internet technologies and the substitution between computer-mediated transactions and Internet transactions.

E. *Barriers to the use of the Internet to sell goods and services, and barriers to the use of the Internet and ICT in general.* While information about perceived barriers may not traditionally be collected as part of official statistical surveys, it is important for policy makers. For example, indicators on barriers can help in monitoring issues of digital divide, potential bottlenecks related to the technology, lack of appropriate skills, or concerns about security and logistics. Answers about perceived barriers and their evaluation (*e.g.* no importance – some importance – much importance) are inevitably qualitative in nature and limit the use of these indicators for purposes of international

comparisons. Nevertheless, they can aid in detecting common obstacles to the diffusion of new information technologies and may be used with other types of quantitative indicators to explain differences in the intensity of use of new technologies across countries.

The questions presented in the OECD model questionnaire mainly take a qualitative approach to the need for internationally comparable ICT usage statistics. The questions primarily focus on the use of ICT, especially the Internet, as a tool and on the barriers to its use. At the moment, the model does not contain questions on the impact of ICT use on enterprises' organisation, production processes and skills, or quantitative questions such as investment in ICT goods and services. This is because the model has been designed to cover a core set of initial indicators related to the "readiness" and "intensity" of use of ICT and to limit the response burden. As the diffusion and impact of ICT increase, and as experience is gained in the measurement of internationally comparable indicators, new modules covering "impact" and quantitative indicators will be tested and added to the questionnaire. The modules related to "readiness" and "intensity" of use of ICT will need to be revised and updated to take into account the emergence of new technologies and ICT-related services.

ANNEX 4. THE OECD DEFINITIONS OF INTERNET AND E-COMMERCE TRANSACTIONS

In April 2000, OECD member countries endorsed two definitions of electronic transactions (electronic orders), based on narrower and broader definitions of the communications infrastructure. According to the OECD definitions, the method by which the order is placed or received, not the payment or the channel of delivery, determines whether the transaction is an Internet transaction (conducted over the Internet) or an electronic transaction (conducted over computer-mediated networks). In 2001, the OECD developed guidelines for interpreting the definitions of electronic commerce and encouraged member countries to take such guidelines into account when developing their questionnaires.

Table A.4.1. The OECD definition of electronic commerce transactions and guidelines for their application

E-commerce transactions	OECD definitions	Guidelines for the interpretation f the definitions (WPIIS proposal April 2001)
BROAD definition	An **electronic transaction** is the sale or purchase of goods or services, w hether betw een businesses, households, individuals, governments, and other public or private organisations, conducted over **computer-mediated networks**. The goods and services are ordered over those netw orks, but the payment and the ultimate delivery of the good or setrvice may be conducted on or off-line.	**Include**: orders received or placed on any online application used in automated transactions such as Internet applications, EDI, Minitel or interactive telephone systems.
NARROW definition	An **Internet transaction** is the sale or purchase of goods or services, w hether betw een businesses, households, individuals, governments, and other public or private organisations, conducted over the **Internet**.The goods and services are ordered over those netw orks, but the payment and the ultimate delivery of the good or setrvice may be conducted on or off-line.	**Include**: orders received or placed on any Internet application used in automated transactions such as Web pages, Extranets and other applications that run over the Internet, such as EDI over the Internet, Minitel over the Internet, or over any other Web enable application regardless of how the Web is accessed (e.g. through a mobile or a TV set, etc.). **Exclude**: orders received or placed by telephone, facsimile or conventional e-mail.

Although OECD member countries have agreed on two definitions of electronic commerce transactions and on some general guidelines for their interpretation, several issues remain open and continue to be discussed. The definitions and guidelines will be reviewed in light of their statistical feasibility. Some of the issues still to be debated relate to definitional issues and some to the structure of member countries' data collection programmes. They include:

- How to measure electronic commerce transactions in the financial sector. Ideally, one would collect only the value of fees on those transactions. Some countries avoid the problem by not surveying the sector (*e.g.* the Nordic countries), but this poses a problem of differences in survey coverage.

- Assuming that organisations will not necessarily know the value of electronic commerce transactions undertaken on their behalf, how to capture this information. For example, the Canadian 2000 survey excludes sales of an organisation's goods and services by agents as well as those for which the respondent is an agent.

- What income concept to use to produce an indicator on electronic commerce sales as a ratio of total sales, *e.g.* operating revenue, turnover, sales. Should it vary according to the sector for which transactions are measured?

Examples of issues relating to the structure of countries' data collection programmes are:

- Relatively few businesses or households may currently engage in electronic commerce, so the absolute numbers appearing in samples of businesses or households are likely to be small.

- Some key industries may consist of a small number of businesses, making it difficult to publish statistics that do not disclose confidential information.

- Recently, many businesses have entered and exited electronic commerce activities and changed the nature of those activities relatively quickly when looked at in the light of the rate at which governments update the business registers from which they draw their samples.

- Many electronic commerce transactions of interest occur within businesses, but data collection programmes typically focus on transactions between and not within businesses.

Survey vehicles differ in coverage (sector and firm sampling) as well as in timing. Some business surveys are based on enterprises, some on establishments (this adds the problem of double counting the value of transactions when calculating a total). Values of purchases measured from household surveys raise the problem that the person interviewed responds on behalf of other individuals in the household. Even purchases measured by surveys of individuals require the choice of a common reference period for the transaction.

ANNEX 5. 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 relatively detailed level of activity across countries. It includes annual measures of output, labour input, investment and international trade which allow users to construct a wide range of indicators focused on areas such as productivity growth, competitiveness and general structural change. The industry list provides sufficient details to enable users to highlight high-technology sectors and is compatible with those used in related OECD databases.

STAN is primarily based on member countries' annual National Accounts by activity tables and uses data from other sources, such as national industrial surveys/censuses, to estimate any missing detail. Since many of the data points in STAN are estimated, they do not represent the official member country submissions.

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

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

Science and technology

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

Publication: OECD (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 member countries and seven non-member economies (China, Israel, Romania, the Russian Federation, Singapore, Slovenia, Chinese Taipei). The indicators, expressed in the form of ratios, percentages, growth rates, cover resources devoted to R&D, patent families, technology balance of payments and international trade in highly R&D-intensive industries.

Publication: OECD (2002), *Main Science and Technology Indicators 2002/1*. Biannual. Also available on CD-ROM.

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

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

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

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

Globalisation and international trade

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

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

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

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

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

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

Information and communication technology (ICT)

Telecommunications: This database is produced in association with the biennial *Communications Outlook*. It provides time-series data covering all OECD countries, where available, for the period 1980-2000. 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.

Publication: OECD (2002), *Measuring the Information Economy, 2002*. Selected indicators of ICT usage and supply are contained in the *Science, Technology and Industry Scoreboard, 2001*. Freely available as a Web book with "clickable" access to the data used in charts and figures at: www.oecd.org/sti/statistical-analysis.

Further details on these databases are available on the Internet at:
http://www.oecd.org/EN/statistics/0,,EN-statistics-54-1-no-no-no-0,00.html.

Table A.5.1. Current country coverage of main DSTI databases used in this publication

	Industry	Science & 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	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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