Chapter 4

ELECTRONIC COMMERCE, JOBS AND SKILLS

Introduction

This chapter focuses on the potential impact of electronic commerce on jobs and skills. Given the current relative size of electronic commerce with respect to other factors that may contribute to overall labour market turbulence (*e.g.* technology, trade, policies), it is necessarily speculative in nature. At this stage, the impact of electronic commerce on employment can only be very small, but, in the longer term, its effect may be felt more strongly. It may worsen or improve countries' trade balances or the skill matching between employment and the labour force; and it may allow economies to reap the benefits of increased productivity at the micro and sectoral level.

The overall effect of electronic commerce on employment will be the balance of direct new jobs, indirect jobs created by increased demand and productivity, and job losses (due to workers, *e.g.* retailers or other intermediaries, being replaced by electronic commerce). Gains and losses may differ by industry, by geographic area, by skill group. To assess the impact of electronic commerce, it is essential to understand for which industries it is generating or will generate new demand and growth, which types of jobs will be destroyed and which created, and what the overall needs are in terms of skills.

Even if electronic commerce is still quantitatively "small", it is very pervasive. It implies the seamless application of information and communication technology along the entire value chain of a business process that is conducted electronically. It favours the introduction of new business models and entails organisational changes at firm level. It also facilitates international trade and is a means of supplying goods and services across borders (*e.g.* transmission of digital products over the Internet). Moreover, it affects product markets by increasing the efficiency of transactions, by affecting market structure, and by providing more quality and variety. Information and communication technologies (ICTs), organisational change, international trade, and product market competition all have an impact on the labour market, either directly, by acting on skills, wages, and on work organisation, or indirectly, through the effects of productivity and demand on employment. The impact of electronic commerce on the job market is thus the result of a complex balance and many interactions and cannot easily be quantified. However, some lessons can be learned by looking at the various channels of transmission and the literature that examines their impact on employment.

This chapter starts by looking at the employment effects of electronic commerce at the micro, sectoral and aggregate level. First, US firm-level data are used to give an overall picture of e-commerce-related employment. Then, employment trends in related industries, such as those providing online services, audio-visual services, information services, as well as the Internet and the software industries, are examined. As electronic commerce is also likely to displace jobs, especially in retailing, the postal sector, or travel agencies, national statistics (despite the lack of comparability) and data from professional associations are used to quantify the weight of these industries in overall employment, and their potential for employment creation or displacement. Finally, an attempt is made to see how sectoral employment changes might translate to the aggregate level, by drawing lessons from available evidence on the employment impact of the growth of electronic transactions and e-commerce-related industries.

The spread of the Internet and the growth of electronic commerce, together with the substitution of off-line activities by online activities, will also affect the demand for skills. The final part of this chapter

tackles the issue of skill needs in e-commerce-related industries and tracks the evolution of occupations affected by the growth of electronic commerce. The Annex presents empirical evidence that complements and substantiates the analysis.

The employment effects of electronic commerce

Electronic commerce affects a wide range of heterogeneous industries

A number of industries are affected by electronic commerce. The distribution sector ("commerce") is directly affected, as electronic commerce is a way of supplying and delivering goods and services. Other industries, indirectly affected via upstream and downstream linkages to e-commerce activities, are those related to ICTs (the infrastructure that enables electronic commerce), content-related industries (information-related goods and services, entertainment, software and digital products), transactions-related industries, *i.e.* those affected by the size and type of economic transactions (*e.g.* the financial sector, the postal sector, advertising, travel and transport). Some of these sectors are quite important in terms of employment; Table 4.1 shows the weight and composition of employment in ICT-related industries and in the finance and business and commerce-related sectors. Together, these industries account for almost one-third and one-fourth of total employment in the United States and the European Union, and roughly one-third of job creation in 1993-96 (28 and 35 per cent in the United States and the European Union, respectively).

Table 4.1. **Contribution[1] of selected industries to average annual employment growth rate, United States and EU-10**

	Percentage of total employment		Percentage contribution to total employment growth	
	United States 1996	EU-10[2] 1996	United States 1993-96	EU-10[2] 1993-96
Hardware and communication equipment[3]	1.4	2.0	0.034	0.002
Computer and data processing services[4]	1.0	0.8	0.090	0.078
Communications[5]	1.0	1.8	0.021	0.017
Financial intermediation[6]	5.7	4.3	0.038	–0.013
Trade[7]	22.6	13.4	0.570	0.094
Total	31.7	22.3	0.751	0.178
Others	68.3	77.7	1.521	0.330
Total employment growth rate			**2.272**	**0.508**

1. Contributions are calculated as the growth rates weighted by average shares in employment.
2. Belgium, Denmark, France, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom.
3. For the EU, sectors 30 to 33 of NACE Rev. 1, and 357, 365-367, 369 and 382 of the US SIC.
4. For the EU, sector 72 of NACE Rev. 1, and sector 337 of the US SIC.
5. For the EU, sector 64 of NACE Rev. 1, and sector 48 of the US SIC.
6. For the EU, sectors 65-67 and 70 of NACE Rev. 1, and sectors 60-65 and 67 of the US SIC.
7. For the EU, sectors 50-52 of NACE Rev. 1, and sectors 50-52 of the US SIC.

Source: OECD, based on US Bureau of Labour Statistics and Eurostat Labour Force Survey and OECD data.

The sectors affected by electronic commerce are also not homogeneous in terms of growth trends and skill composition. Table 4.2 shows the contribution of the ICT industries, the financial, and the commerce sectors to growth; it also shows that the share of high-skilled workers (defined as the sum of ISCO-88 occupational categories 1, 2 and 3) is typically higher in the financial sector, and that, while trends are similar, sectoral skill shares, as well as the weight of the three sectors in employment, differ widely across countries. Owing to heterogeneity, the impact of electronic commerce may be expected to differ, in both qualitative and quantitative terms, in these three sector.

Table 4.2. **Heterogeneity in e-commerce-related sectors**

Percentages

	Information and communication technologies[1]				
	Share of total employment		Contribution to total employment growth[2]	High-skill sectoral share[3]	
	1980	1995	1980-95	1980s	1990s
United States	2.6	1.9	–0.01	26.4	28.0
Canada	2.7	3.0	0.07	..	..
Finland	2.6	3.4	0.03	14.0	21.6
France	3.1	2.9	–0.01	36.4	44.3
Japan	3.7	4.0	0.05	14.6	16.8
	Finance, insurance, real estate and business services				
	Share of total employment		Contribution to total employment growth[2]	High-skill sectoral share[3]	
	1980	1995	1980-95	1980s	1990s
United States	10.7	14.7	0.46	31.2	32.8
Canada	9.4	12.4	0.36	47.3	53.5
Finland	5.7	8.4	0.11	30.3	36.9
France	7.8	11.3	0.25	43.2	51.6
Japan	4.0	4.7	0.08	32.4	34.9
	Wholesale and retail trade				
	Share of total employment		Contribution to total employment growth[2]	High-skill sectoral share[3]	
	1980	1995	1980-95	1980s	1990s
United States	19.6	20.5	0.37	12.6	11.8
Canada	22.3	23.5	0.42	11.4	12.3
Finland	15.7	14.0	–0.26	24.4	31.9
France	16.7	17.5	0.07	38.4	40.8
Japan	17.8	16.7	0.07	15.8	18.9
	Total economy				
	Total employment 1980-95 AAGR		High-skill share		
United States	1.53		24.3	26.3	
Canada	1.49		26.2	31.0	
Finland	–1.00		22.9	30.5	
France	0.12		28.1	33.2	
Japan	0.86		19.1	22.9	

1. ICTs are defined as sectors 3825, 3832 and 72 (ISIC Rev. 2). Due to the level of aggregation, software services – part of business services – are not included.
2. Contribution of sectors to total employment growth are calculated as growth rates weighted by average shares in total employment.
3. The high-skill sectoral share is defined as the share of occupational categories (1 + 2 + 3) of the ISCO-88 classification in total employment for the sector.

AAGR = Average annual growth rate.

Source: OECD, based on data from STAN, ISDB and Services and Skills databases, and national sources.

The net direct impact: complementarity, substitution and market size effects

Some activities may increase as a direct consequence of electronic commerce (*e.g.* activities related to the information industries and services). Virtual firms entering the market create new jobs, and, at least initially, online and off-line activities tend to be carried out simultaneously. Nevertheless, this may not translate into increased jobs at a later stage, because of a substitution effect (online activities may replace traditional ones). It is reasonable to expect that the adoption of e-commerce will complement the adoption of ICTs, that it will imply major changes in financial transactions, with electronic financial services replacing traditional financial transactions to some extent, and that, in retailing, there may be employment shedding as electronic transactions and delivery replace physical ones.

Electronic commerce might also create new markets or extend market reach beyond traditional borders. Enlarging the market will have a positive effect on jobs. To understand the direct overall impact, it would be necessary to identify activities that have replaced existing ones, analyse their revenue growth compared with that of the sector as a whole, and identify those whose emergence has led to a readjustment of market share and those whose effect has been to enlarge the market.

Indirect effects on employment

Another important issue relates to interlinkages among activities affected by electronic commerce. Direct and indirect effects must be distinguished and aggregated, and overall, indirect effects may be greater than direct ones. Moreover, indirect effects follow several paths. Expenditure for e-commerce-related intermediate goods and services will create jobs indirectly, on the basis of the volume of electronic transactions and their effect on prices, costs and productivity. Depending on price elasticities, electronic commerce transactions will have a net positive impact on the demand for industries such as software, online services, audio-visual, music, and publishing. Their expansion, in turn, will have a multiplier effect on other industries. Due to intersectoral linkages, growth opportunities in e-commerce-related industries may translate into overall employment growth.

E-commerce players: employment at glance

Where are electronic commerce jobs created, and what are the related industries' employment trends? This section builds a profile from microeconomic market and employment data of individual US firms. The choice of the United States is compelled, first, by the fact that company data are readily available on the EDGAR database,[1] and, second, by the observation that, because of the maturity of the US e-commerce market relative to that of other countries, the US data can be taken as a benchmark for forecasting future trends. A rough estimate of e-commerce-related employment in various industry sectors can be obtained from examining micro data. Then, industry trends and employment projections can be studied.

The sample includes public Internet-related companies that are strongly influenced by electronic commerce developments (for the firm-level employment data and methodological details, see Annex 4.1). One group provides infrastructure for electronic commerce over the Internet, the second provides software and services for electronic commerce, and the third conducts electronic commerce (providing online services, content, selling goods and services). The firms providing infrastructure and software services are part of the computer and office equipment industry (manufacturing) and the communications and computer and data processing services (part of business services). The firms that provide online search/aggregation and information services also belong to the computer and data processing services industry. Electronic commerce content providers cover a wide spectrum of industries, ranging from publication and advertising to business services and financial services.

Most of the employment created by the US Internet/electronic commerce firms in the sample is related to computers (41.5 per cent) and to telecommunications equipment and services (20.3 per cent). Table 4.3 presents estimates (for the methodology, see Annex 4.1) which, while not representing the entire sample of Internet-related firms that conduct e-commerce-related activities, do provide a minimum order of magnitude for employment directly created by electronic commerce occurring over the Internet (approximately 123 000 employees).

Table 4.3. **Estimated electronic commerce full-time employees in selected US firms**

	Estimated employment
Data networking/telecommunication equipment	6 238
Internet service providers	22 927
Internet security equipment and software	5 057
Total infrastructure	**34 222**
Applications software	19 190
Enterprise and related software	5 327
Commerce enablers	2 487
Internet/on-line consulting and development	2 151
Total software	**29 154**
Organisation/aggregation	2 256
On-line services/information services	9 340
Publication	12 022
Transaction processing, financial services, and on-line commerce	36 354
Total content/aggregation/commerce	**59 971**

Source: OECD estimates, based on data from the US Securities and Exchange Commission.

The firms' employment numbers are very small. Moreover, the sectors to which they belong (Table 4.4) represent a small share of the overall 1997 US employment figures, ranging from a high of 1.4 per cent of a sector's total employment (business services) to a low of 0.04 per cent (services n.e.c.). Employment in some of these industries is projected by the US Bureau of Labor Statistics to grow at below average rates by the year 2006, with computer and telecommunications equipment actually losing employment. Among the industries expected to create employment are those belonging to the financial services sectors, computer services, motion pictures, and other business sectors.

Table 4.4. **Employment in selected e-commerce-related US industries: estimates and projections**

US SIC	Industry	1997		2006		Employment change, 1997-2006	
		Number	Share in total (%)	Number	Share in total (%)	Number	%
357	Computer and telecom. equipment	379 000	0.30	314 000	0.23	–65 000	1.72
481	Telecommunications	922 238	0.74	925 000	0.66	2 762	0.03
272	Periodicals	132 575	0.11	140 000	0.10	7 425	0.56
596	Non-store retailers	341 892	0.27	350 000	0.25	8 108	0.24
621	Security and commodity brokers	590 971	0.47	740 000	0.53	149 029	2.52
720	Personal services	1 220 707	0.98	1 294 000	0.93	73 293	0.60
731	Advertising	255 732	0.21	270 000	0.19	14 268	0.56
733	Mailing, reproduction and stenographic services	313 324	0.25	361 000	0.26	47 676	1.52
737	Computer and data-processing services	1 341 711	1.08	2 509 000	1.80	1 167 289	8.70
738	Miscellaneous business services	1 690 787	1.36	2 086 000	1.50	395 213	2.34
781	Motion picture production and distribution	256 031	0.21	328 000	0.24	71 969	2.81
820	Education, public and private	2 080 994	1.67	2 478 000	1.78	397 006	1.91
890	Services, n.e.c.	48 603	0.04	62 000	0.04	13 397	2.76
	Total economy	**124 470 593**		**139 192 000**		**14 721 407**	**1.18**

Source: OECD, based on data from the US Bureau of Labor Statistics.

Job gains and losses in e-commerce-related industries

The convergence of media, telecommunication and computing technologies is creating a new integrated supply chain for the production and delivery of multimedia and information content. Most of the

employment related to electronic commerce evolves around the content industries and communication infrastructure such as the Internet. Both in political circles and in the mass media, these industries often raise great hopes for job creation. What is the relative size of these industries and what are their dynamics?

Previous chapters have dealt with the production function of new firms entering the electronic market and of existing firms that are trying to adapt and move towards electronic commerce activities. As pointed out, changes in the production function tend to mean that production will become less labour-intensive. In addition, electronic markets may partly displace traditional ones, although, eventually, new industries will emerge and the output and employment effects of innovation are expected to be expansionary (see Chapter 1). During the transition, some industries or jobs, *e.g.* travel agents, retailing and postal services, will be particularly hard-hit. This section offers some evidence on the role that electronic commerce may play in direct job creation or displacement in these industries; further details can be found in Annex 4.2. Indirect job creation effects are discussed in the next section.

The "copyright" industry

The "copyright" industry broadly includes information services (mainly software services) and the content industries, such as motion picture, audio-visual and publishing industries. Its share in total employment is estimated at 3 per cent in Canada, Japan, the United States and the European Union (see Annex 4.2). The industry is quite diversified, and the software and computer-related services industry is the main driver of employment growth. In the content industry, job gains will have to be balanced against job declines, as new media activities are likely to replace traditional ones, and new electronic information services will partly replace old ones. A study by DIW, the German economic research institute, carried out projections based on 1995 estimates of the demand for media and communication services in Germany (defined as media, consumer electronics, office machines, computer hardware and software, photo-optical equipment, mail and telecom services).[2] Sectors expected to be affected by substitution, such as postal service and photo-optics were included. Taking into account that growth in demand is partly met by increased imports, overall employment in these sectors was expected to grow only 3.5 per cent by the year 2000 (70 000 additional jobs) and 9.5 per cent by 2010 (about 180 000 additional jobs).

While software is the most dynamic industry in terms of employment growth, it is estimated to represent only about 1 per cent of overall employment (see Annex 4.2). It is very difficult to quantify the impact of electronic commerce on job creation in this sector. Among software and service companies involved with the Internet and multimedia applications, most are not very labour-intensive, and estimates of job creation due to the implementation of Internet Web sites or intranet applications are still very modest (see Annex 4.2).

The move towards network-based (particularly Internet) services will reduce employment for physical delivery systems and stand-alone media, such as printed text and CD-ROMs. However, network-based distribution of content is expected to increase demand for technical, creative, managerial/administrative staff and direct marketing positions (OECD, 1998*b*).

New media content industries are creating jobs in the United States as well as in Europe. One report on electronic publishing (European Commission, 1997*d*), estimates than 1 million jobs will be created in electronic publishing in Europe in the next ten years. These job gains will have to be balanced against job declines in the print media industry. Therefore, opportunities in the new media industries may not translate into net sectoral gains. The traditional US publishing industry, which counted 1.5 million employees in 1996, is projected to see its overall employment share drop from 1.26 per cent (1996) to 1.08 per cent (2006). An interesting feature of multimedia jobs is that, at least in the United States, they often emerge at an extremely rapid pace in specific locations. In the New York metro region, the number of new media jobs jumped by 48 per cent to 105 771 in the period early 1996-mid-1997 (*New York Times*, A30, 23 October 1997); the number of new media companies climbed by 16 per cent and revenue rose by 50 per cent. Surveys of this industry in southern California reveal that its workers are predominantly young, white, highly educated, and well-paid (Scott, 1998).

Some online information services are relatively new and are predicted to grow. Others are replacing existing ones (see the example of electronic mail in Chapter 1). Transaction processing services, such as

credit and debit card processing, are expected to migrate to the Internet and may require less labour input; on the other hand, they will require new services, such as security and payment services tailored to Internet transactions.

Evidence of noticeable net job creation in online services is lacking or varies, depending on the sources (see Annex 4.2). The extent to which electronic information services will be a source of job creation will depend on the extent to which there will be substitution between off-line and online services. It will vary across countries on the basis of national development trends and will depend on countries' degree of openness.

The Internet industry

Electronic commerce development is strongly connected with Internet development. Employment related to the Internet industry is fairly difficult to calculate. Amano and Blohm (1996), using some *ad hoc* assumptions, estimated that Internet-related employment amounted to 0.6 per cent of the total US work force in 1996.[3]

Since the Internet is a network of networks, delivery of its services is fairly complex and includes many levels of interconnection among suppliers. Actors involved in Internet delivery and services provision have different sizes and belong to different industries.[4] It can be said that Internet service providers (ISPs) are typically not labour-intensive. A survey of all US ISPs by Commercial Internet eXchange estimates that the 215 providers employed about 5 000 workers in 1997.[5]

Travel agencies

Internet auctions of unsold flight seats by airlines are becoming more frequent, and airlines are effectively eliminating travel agents. In 1996, for example, independent travel agents handled 80 per cent of US airline reservations; in 1998, the share is down to 52 per cent, with airlines dealing directly with customers via the Web or telephone (Kehoe, 1998). On the other hand, virtual travel agencies, which combine price advantages with ready access to a server available 24 hours a day, are emerging. These virtual organisations often take advantage of new niche markets and are able to reach a certain type of customer, *e.g.* a clientele able to travel at very short notice (young people, students or freelance professionals). Initially, therefore, such operators can make it possible to enlarge the market and create demand for new services and therefore have an overall positive impact on employment.

One example is Dégriftour in France. First set up in 1991, it offers discounts, two weeks prior to departure, on tickets that tour operators, airlines and hotels have been unable to sell. Since its creation, its turnover has grown by between 20 and 40 per cent a year. Table 4.5 compares Dégriftour employment and turnover with that of its main competitors in France. In 1998, Dégriftour had 150 employees, 40 involved in updating computer files and 110 in dealing with orders. Nouvelles Frontières, which has focused on both the conventional and virtual markets, has the lowest turnover/staff ratio, while Havas Voyages, which has retained a conventional structure, has the highest turnover/staff ratio. This has not prevented Havas from following its competitors into the virtual market, however, so as to explore new niches and increase market shares. The employment size of Dégriftour seems small compared to that of its major competitors but, in fact, 64 per cent of the French firms providing travel agency services in 1995 employed only up to five people (*effectifs salariés*) (INSEE, 1997).

Post offices

The development of electronic transactions is also threatening revenues and thus employment in post offices (see Chapter 1), and new companies that take advantage of the Internet are emerging. E-Stamp Corp., for example, is a start-up firm that plans to sell postage over the Internet. Potential revenues are very high: in 1996, the US Postal Service had revenues of $56 billion, of which 21.5 per cent from stamps and 37.5 per cent from postage meters (*Financial Times*, 17 April 1998). As mentioned above, e-mail messaging is growing fast and replacing traditional mailing activities.

Table 4.5. **Virtual/conventional forms of organisation: some examples of productivity and profitability**

1997	Type of firm	Year set up	Turnover (FF million)	No. of employees	Turnover/staff ratio (FF 1 000/employee per annum)
Dégriftour	Virtual, all transactions via videotex	1991	350	150	2 333
Nouvelles Frontières	Virtual and conventional 219 agencies	Not known	8 796	4 500	1 954
Havas Voyages	Primarily conventional 220 agencies and two telephone sales platforms (2% of turnover)	Not known	15 000	4 000	3 750
Travel agencies	All travel agencies (1995)	–	44 779	28 405	1 576

Source: Alzon, 1998; Rouland, 1998; Havas, 1998; INSEE, 1997.

On the other hand, electronic commerce will have positive spin-offs for transport activities when it entails a physical delivery. The use of the Internet is resulting in increased competition between the Post Office and actors such as DHL, Federal Express and United Parcel Service. The deregulation of the telecommunications sector may well allow post offices to provide telecommunications services. In France, for example, post offices are equipped with sophisticated IT systems for conducting counter operations and, in one of the latest initiatives, a service, Datapost, was introduced for transforming messages submittd in one form (physical or electronic, Minitel or Internet) into another.

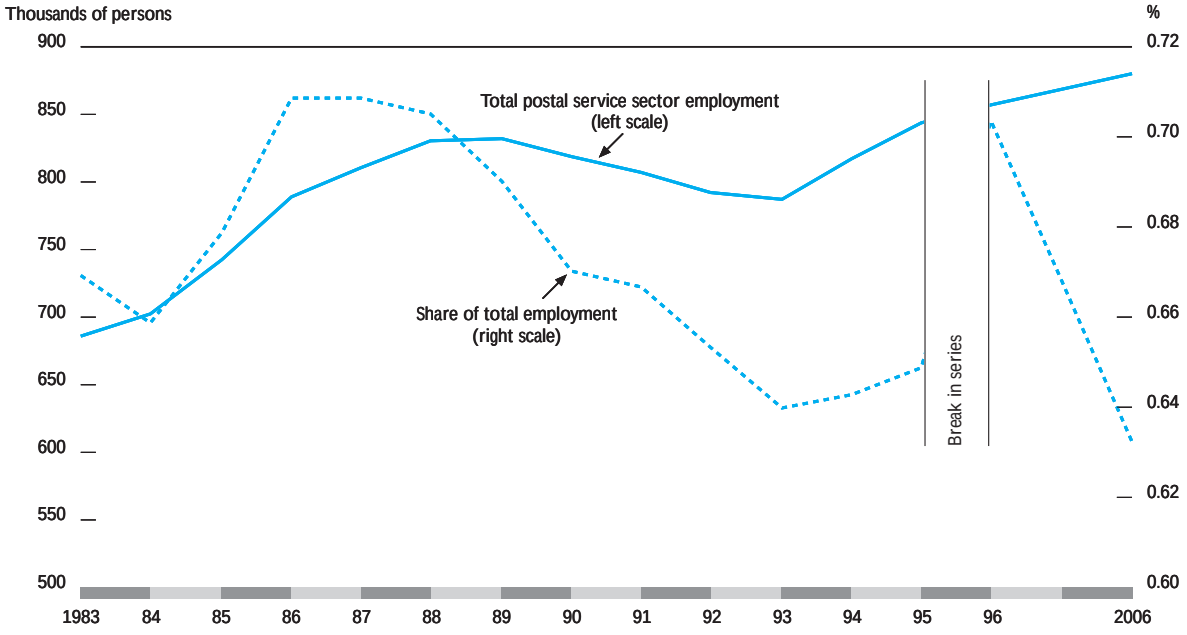
The impact of these developments on employment remains unclear. Productivity gains achieved in postal delivery activities appear to have yielded labour savings that have subsequently been invested in new services as they are developed. These new activities, however, are characterised by much higher labour productivity than mail delivery. Labour adjustments in the post office sector, whose share in employment varies across countries (*e.g.* 0.68 per cent in the United States, 0.81 per cent in Canada and 1.41 per cent in France in 1996) are apparently being made gradually as employees retire or are hired and in accordance with internal training programmes. Figure 4.1 shows that, in the United States, the post office sector's employment share has been declining since 1986; nevertheless, the increase in electronic delivery is likely to exacerbate these trends and require more radical and less gradual adjustments.

Retail

According to a 1997 survey, 52 per cent of European retailers think that electronic customers will cease using traditional outlets, while 35 per cent think that electronic customers will correspond to new demand created by the availability of new shopping channels (Cap Gemini, 1997). The first industry expected to be affected by electronic commerce is traditional retailing. While electronic commerce may lead to expanded employment in the near term, as retailers maintain a presence in both physical and cyber channels, disintermediation and the changes in the value-added chain, discussed in previous chapters, are expected to have a negative impact on employment in this sector.

At 21.6 million and almost 18 per cent of the total work force in 1996, the US retail sector is fairly big in terms of employment and has been increasing over time (Figure 4.2). However, in terms of share in total employment, and taking into account the break in the series, it is forecast by the US Bureau of Labor Statistics to follow a downward trend. Chapter 2 formulates some scenarios on the disintermediation of the US wholesale and retail sectors. Under those assumptions, which were characterised as being optimistic, US retail activities may decline by 25 per cent. The extent to which these "guesstimates" may translate into retail sector job losses should be investigated. In particular, the restructuring and reorganisation of retail activities, as well as differences in labour requirements implicit in the production function of online and off-line retailers, should be researched. Direct job losses should then be weighed against potential indirect job gains due to efficiency gains and increased demand at the economy level (discussed below).

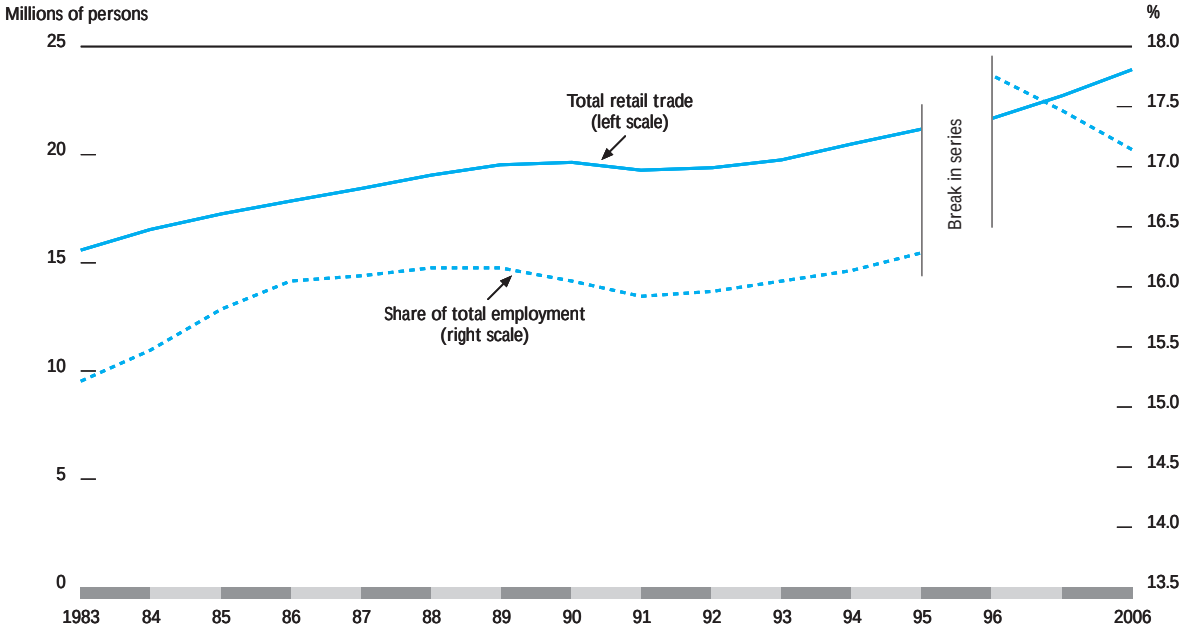
Figure 4.1. ***Employment trends in the US Post Office***[1]



1. 1983-95: national industry-occupation employment matrix 1983-95 time series. 1996-2006: national industry-occupation employment matrix for 1996-2006.

Source: OECD, based on data from the US Bureau of Labor Statistics.

Figure 4.2. ***US retail trade employment, 1983-2006***[1]



1. 1983-95: national industry-occupation employment matrix 1983-95 time series. 1996-2006: national industry-occupation employment matrix for 1996-2006.

Source: OECD, based on data from the US Bureau of Labor Statistics.

Finance and banking

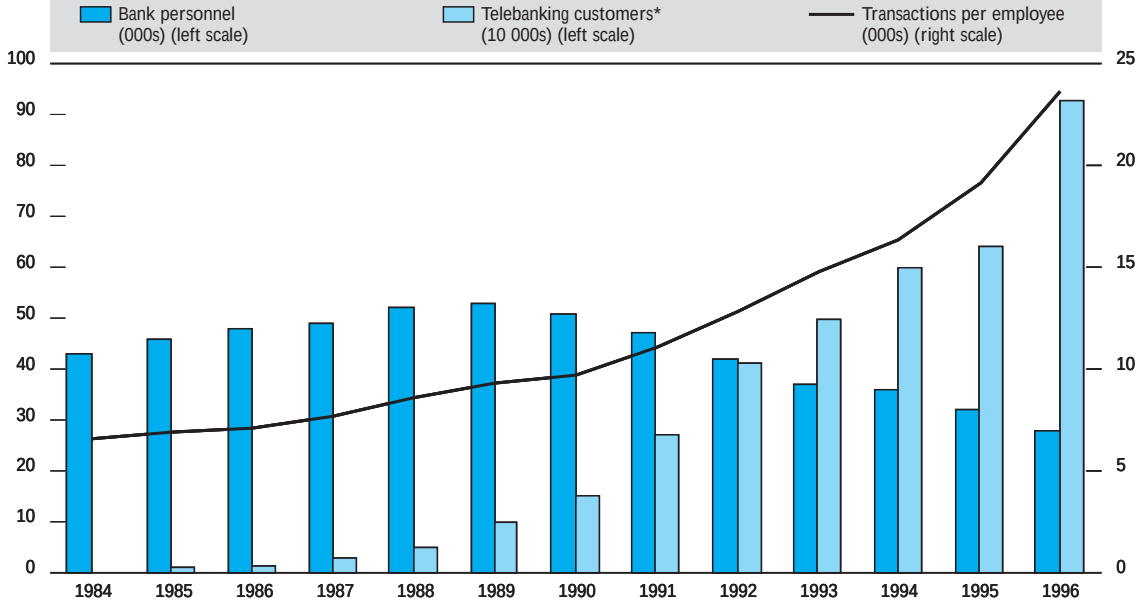
Finance is also likely to be significantly affected by electronic commerce. Preliminary results from the Canadian Survey of Innovation (1996) reveal that 82 per cent (representing 99 per cent of the total sample revenues) of the banks (chartered banks, other banking intermediaries, and trust companies) are using the Internet, and that 19 per cent (representing 86 per cent of the total sample revenues) use it to sell goods and services. Shifting from retail to Internet banking has entailed job losses. In moving banking out of branches and onto networks, Finland, a leader in the use of electronic payments (see Table 4.6), has seen a 3.5 per cent annual decline in employment, resulting in a cut of more than a third of the jobs between 1984 and 1996 (Figure 4.3).

Table 4.6. **Indicators of network banking: Finland and EU, 1994**

Indicator	Finland	European Union average
Cash in circulation as % of GDP	2.0	5.5
ATM withdrawals as a % of GDP	6.0	1.5
ATMs per million inhabitants	560	370
Point-of-sale terminals per capita	38	9
% bills paid by ATM	33	n.a.

Source: Kontinen, J. (1998), "Network Banking in Finland", presentation at the OECD, 18-19 February.

Figure 4.3. ***Finnish bank employment and transactions, 1984-96***

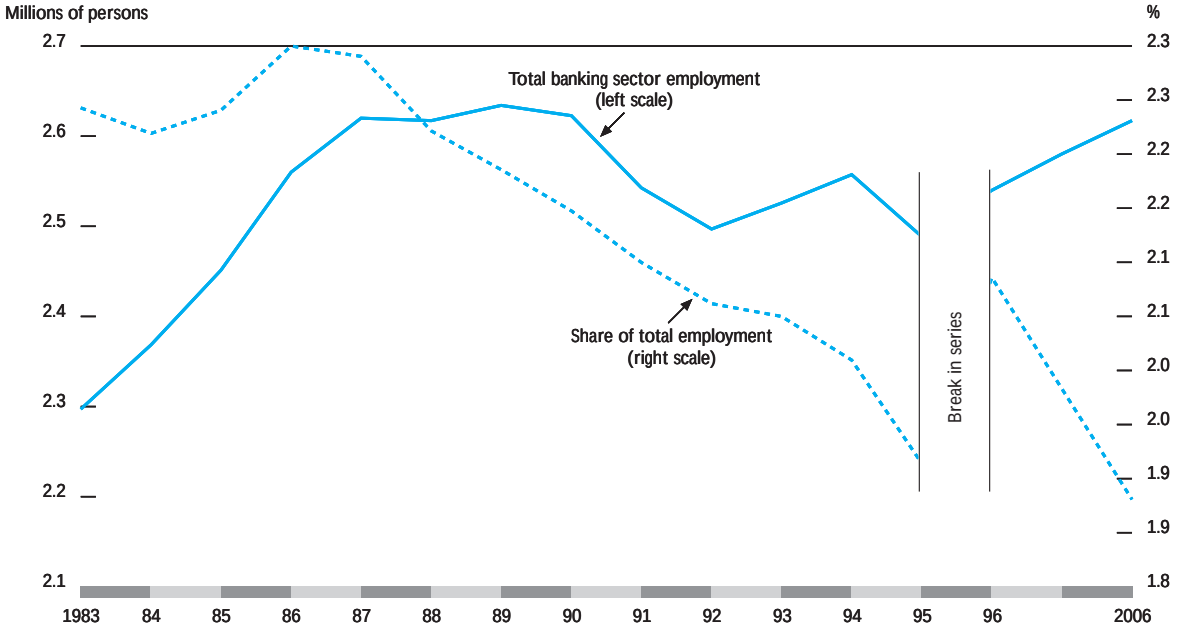


* Includes phone, PC and Internet.
Source: Finnish Bankers' Association, May 1997. Presented at the OECD by J. Kontinen, Merita Bank, 18-19 February 1998.

On the other hand, reorienting activities towards electronic commerce does not always come at the expense of jobs. Charles Schwab & Co. (see Chapter 1) seems to have managed the substantial shift to online transactions not by dismissing brokers (it currently has 5 000 registered brokers) but by redefining brokers' functions (Girishankar, 1998*b*).

It is especially difficult to single out the impact of electronic commerce on banking, a very IT-intensive sector which has undergone a great deal of deregulation and rationalisation. For the banking sector, US data show that employment has been declining since the beginning of the 1990s and its share in total employment since 1986 (Figure 4.4).

Figure 4.4. ***US banking sector employment, 1983-2006***[1]



1. 1983-95: national industry-occupation employment matrix 1983-95 time series. 1996-2006: national industry-occupation employment matrix for 1996-2006.

Source: OECD, based on data from the US Bureau of Labor Statistics.

Substitution effects and employment impact: examples from past experience

In order to understand what substitution mechanisms come into play when shifting from off-line to online provision of products and services, and to see whether any employment impacts can be detected and measured, it may be useful to look at past experience in adopting new technologies and delivery channels. For banking, different stories can be told. The example of the Canadian Imperial Bank of Commerce (Box 4.1) shows that while the introduction of automated banking machines (ABM) destroyed CIBC jobs over the years, the shift to new delivery channels, such as telephone banking, has in fact created jobs.

France's Minitel is an interesting case. It was the first large-scale application of electronic commerce and reached a 20 per cent penetration rate (Box 4.2). In order to learn some lessons from this experience, a study was conducted to examine the employment impacts, if any. The study concludes that there were no major impacts on employment as a result of the introduction of the Minitel. Nevertheless, as the report underlines, the same conclusion cannot simply be applied to electronic commerce over the Internet. Unlike the Minitel, the Internet has developed on international markets and has benefited from market deregulation in a favourable economic context.

Box 4.1. Job losses and gains at CIBC (Canada)

The Canadian Imperial Bank of Commerce, Canada's second largest bank, invested heavily in information technologies between 1988 and 1995 (86 per cent increase in IT investment, corresponding to 80 per cent of total investment over the period). Between 1987 and 1996, the number of ABMs grew nearly 310 per cent, with most of the increase (225 per cent) occurring between 1987 and 1991. The number of branches started falling in 1991 and fell by 9 per cent between 1991 and 1996. Both the increasing number of ABMs and the decreasing number of branches played a role in the changes in employment at CIBC (–8 per cent between 1992 and 1995, as opposed to –4 per cent for the banking industry as a whole over the same period). A turnaround was achieved at CIBC in 1996. It was primarily attributable to the creation of nearly 1 000 jobs because of the opening of two new telephone banking centres. The shift to the new delivery channel has meant, however, that occupations such as bank teller are in decline, while customer service representatives are increasing in number and importance.

Source: Conference Board of Canada, 1997.

Box 4.2. Learning from the Minitel experience?

The French videotex industry can be considered an instructive case study of the development and organisation of electronic commerce. The videotex system, which was developed for the mass market as early as the beginning of the 1980s, was for many years the main vehicle for electronic commerce in consumer goods. By 1987, some 3 million terminals had been distributed and 7 000 services were available. By 1994, the number of terminals distributed had passed the 6 million mark (available in 20 per cent of households), and traffic volume amounted to 110 million hours a year, generating FF6 billion of revenue for data traffic alone. In 1994, 1.2 million households used the Minitel to buy a product, whereas in the same year, only 800 000 US households used the Internet to carry out at least one commercial transaction.

None of the existing studies on the Minitel really addresses the issue of net job creation or loss due to its introduction. On the basis of personal opinions collected through interviews, there seems to be agreement that the number of jobs created and lost is more or less evenly balanced. In creating new value added and services, and in developing new strategies, the impact of the electronic commerce generated by Minitel on industry and competition is comparable to that of the Internet. However, unlike the Internet, the Minitel system has not expanded to international level and therefore has not generated one of the most potentially important wealth-creating aspects of the Internet, namely the creation of new markets at international level through the aggregation of dispersed demand. Its growth dynamic therefore cannot be compared with that of the Internet. Moreover, conditions when the Minitel system was launched were not what they are today: the telecommunications market was a monopoly, system convergence and competition between systems were not yet perceived as important, and the economic context was not particularly favourable.

Summary of estimates made or used in reports on videotex services and employment in France

Thousands

Sources	1987	1989	1993	1997
Vidéotex Magazine No. 44 (1990)		+12-13		
Breton (1996)			+15-20	
Ladoux (1998)			+15	
France Télécom (1997)	+40		+15	
Tregouët (1997)				+15

Economy-wide employment impacts of e-commerce-related industries: a review of selected studies

The previous section looked at direct job creation and displacement in sectors related to electronic commerce. This section reviews the literature on the economy-wide impact of the growth of e-commerce-related industries on employment. Most of these studies are based on macroeconomic modelling simulations of different scenarios or on static input-output modelling. They rely on different and often strong assumptions, but, by taking a representative sample in terms of sectors analysed and methodology used, some conclusions can be drawn on the potential aggregate effects of electronic commerce on employment.

Economy-wide impacts of e-commerce

Databank Consulting (1998) has attempted to estimate directly the employment impact of electronic commerce in four European countries. The approach and methodology are interesting (see Annex 4.3), although they are based on a great number of *ad hoc* assumptions, ranging from estimates of electronic transactions and different sectoral business models for electronic transactions *vis-à-vis* traditional transactions, to hypotheses underlying the use of input-output modelling. Overall, the employment effects, calculated on the basis of 1997 electronic revenue estimates, are very small. The four European countries (in which $ 4.53 billion or 60 per cent of European electronic transactions are assumed to take place) see a total gain of 173 000 jobs, of which almost 60 per cent are due to indirect effects. When compared to current employment levels, this very small number is not surprising, given the current size of electronic revenues.

This type of exercise is certainly useful for trying to understand the channels through which electronic transactions affect the economy. More work should be done, however, to understand the source of the different relative impacts across countries. To reduce the size of the cumulative error due to different assumptions and approximations made in the exercise, it would be best to use the wider range of estimates of US electronic transactions. Another convenient feature of US data is that input-output matrices are linked to employment and occupational matrices (hence, the employment impact could be translated into changes in the demand for skills). Finally, as electronic markets are more mature in the United States, the US example could provide a benchmark.

Forecasts of telecommunication, media and Internet-driven employment growth

Cohen (1997) develops three growth scenarios for the US communications and media industry to the years 2000 and 2005. One is a baseline telephony-oriented scenario while the other two are Internet/intranet based scenarios (see Annex 4.4 for the methodology and results). In the Internet/intranet scenarios, the multipliers (hence the impact on employment) are higher than those applied for wired services, owing to the investment in servers, server software, and content needed for the Internet and intranets. Basically, in 2005, the Internet is expected to contribute 50 per cent of jobs created in the US telecommunication sector. Additional jobs created in the Internet/intranet scenarios do not arise from Web usage *per se* but come almost exclusively from the production of Web-related hardware-software content.

This evidence suggests that services diffused via the Internet and intranets generate higher direct and indirect employment growth than traditional telecommunications services. If so, studies on the employment impacts of liberalisation in the telecommunication markets can be used to establish the minimum level of employment gains attributable to Internet and intranet growth. The results of the BIPE-IFO-Lentic study on the employment impact of telecommunication liberalisation in Europe (see Annex 4.4) indicate that, in the best-case scenario of rapid liberalisation and technology diffusion, more than 1.3 million jobs would be created in Europe by the year 2005 (Cohen's baseline scenario for the United States, and for the same year, gives 3 million). Like other macro-modelling exercises such as those that examine the impact of regulatory reform, this study suggests that net job creation usually comes from indirect and secondary effects.

An interesting question is whether the conditions for exploiting the potential of this Internet multiplier are the same across countries, especially given differences in the production of Web-related hardware and software content, which seems to be driving employment gains due to the Internet multi-

plier. The diffusion of the Internet and intranets in Europe is certainly slower than in the United States. US firms also dominate the development of Web-related hardware and software products. According to the European Commission's Telecommunication Infrastructures Study (1997*a*), between July 1995 and June 1996, $890 million of US venture capital was invested in Web-related start-ups, whereas European venture capital for such investment was between $10 million and $20 million.

Studies of the impact of Internet revenue streams might give a different result depending on whether telecommunication and backbone operators or simple ISPs are being considered. In Europe, Internet revenues still account for a very small part of the income of the largest telecommunication operators at national and global level (ranging from 5 to 7 per cent of the overall revenues per operator), but they are growing fast with respect to other more traditional sources, such as PSTN (packet switched telephone network) telephony. However, for European operations, the Internet is not yet a profitable activity (European Commission, 1997*a*).

ICT diffusion and its impact on jobs

Electronic commerce contributes to the spread of information and communication technologies (ICTs) which are playing a key role in the transformation of OECD economies. This structural transformation has a number of dimensions linked to employment. One is the shift of economic activities from manufacturing to services and the associated reallocation of jobs. A second is the increased investment in ICTs, with an important impact on productivity and growth (and thus indirectly on employment). A third is the falling cost of telecommunications and the increased availability of ICTs, which has contributed significantly to increased international competition and trade, which in turn constitute another channel affecting the labour market.

The overall impact of ICTs on employment is the result of complex interactions which have been reviewed in detail in a number of OECD studies (OECD, 1996*a*; 1996*b*). Much recent research has used firm-level data to investigate the relationship between technology and employment in a number of OECD countries. These studies broadly find a positive relationship between technology adoption and employment at firm level. The impact of technology on employment at industry level, instead, is dependent on the nature of the jobs created, the extent to which they replace other jobs, and the effect on rival firms in that industry as well as in other industries or countries. In turn, sectoral impacts say little about aggregate employment or unemployment. The net outcome for employment depends on the nature of technological advance, the degree of substitution between inputs, the degree of labour market flexibility and mechanisms for upgrading labour skills, and the role of institutions. The evidence on the economy-wide impacts of ICTs on employment is mixed.

Electronic commerce and the skills mix

Jobs are both created and destroyed by technology, trade, and organisational change. These processes also underlie changes in the skill composition of employment and in the importance of different occupational categories to job growth, (OECD 1996*a*). Beyond the net employment gains or losses brought about by these factors, which occur independently of electronic commerce but are certainly stimulated by its rapid development, it is apparent that workers with different skill levels will be affected differently.

Is electronic commerce generating demand for skills which cannot be met at the rate necessary for its development? Electronic commerce is certainly driving demand for IT professionals but it also requires IT expertise to be coupled with strong business application skills, thereby generating demand for a flexible, multi-skilled work force. Some examples of occupations and underlying skills in the companies performing electronic commerce are provided. Apart from contingent needs for staff implementing Internet/intranet maintenance and development to support electronic commerce transactions and applications, there is a more structural and long-term shift in the skills required to perform economic activities on line. This section also examines those occupations that are most likely to be affected by electronic commerce, such as computer engineers, information-related occupations and commerce-related occupations.

Internet and e-commerce growth are driving demand for IT professionals

As Internet adoption moves to a "transaction" model, there is a growing need for increased integration of Internet front-end applications with enterprise operations, applications and back-end databases. The lack of staff to support ongoing Internet/intranet maintenance and development, coupled with integration problems and cost and time overruns, drives demand for outside services providers to help plan and implement solutions. Activities in demand include security design and firewall implementation, Web page design and creation, and Internet/intranet application development (EITO, 1998).

With the spread of electronic commerce, and the consequent re-engineering of business processes and changes in competitive paradigms (see Chapter 3), software will increasingly be used to create business value. Electronic commerce will thus sustain a high demand for IT personnel. This is expected to exacerbate what has been called a "critical shortage" of IT workers. Such a shortage, which has received great attention in the United States, is not a trend peculiar to that country. Annex 4.5 discusses the issue and presents some estimates of IT skills needs across countries.

Matching network programming activities with business application skills

Many of the IT skill requirements needed for Internet support can be met by low-paid IT workers who can deal with the organisational services needed for basic Web page programming. However, wide area networks (WANs), competitive Web sites, and complex network applications require much more skill than a platform-specific IT job. Box 4.3 provides some examples of employment and skill needs in European innovative firms that provide network applications and consultancy for electronic commerce.

To be effective, electronic commerce requires new generic services as well as competitive operational services. The skills required for electronic commerce are rare and in high demand, as network programming abilities need to be coupled with strong business applications skills (http://www.techworkforce.org/skill.htm). In practice, e-commerce requires people with eclectic skills. Box 4.4 provides a description of some new e-commerce jobs.

In companies that organise and aggregate Internet content, such as those that offer search engines (Excite, Lycos, Yahoo!, Infoseek), the work force seems either to perform research and development activities related to technical networking issues or to be in the marketing and sales area (from 43 to 52 per cent, see Table 4.7). Online and information services providers like America Online and Individual, with the same core business activity (computer and data processing), have a rather different work force composition. America Online employs the bulk of its workers in operations and support activities (73 per cent) while Individual has a more balanced distribution of activities: marketing and sales (36 per cent), research and development (22 per cent), and editorial activities (33 per cent). In the business-to-consumer segment of e-commerce, companies search for managerial, marketing and selling and technical skills, while software and hardware development and maintenance is often contracted out. An example is Auto-By-Tel which provides Internet-based marketing services for new and used vehicle purchase and related consumer services. The company's employment base increased rapidly from 17 employees in December 1995 to 73 in December 1996, plus an additional 19 contractors for software and hardware development. In terms of its employee distribution, 56 per cent are in marketing and sales, while the rest are equally divided among technical, managerial and administrative occupations.

Structural shifts and the need for skills in the e-economy

Electronic commerce might accelerate the existing upskilling trend in the OECD economies by requiring high-skilled computer scientists to replace low-skilled information clerks, cashiers or market salespersons. It would be worth exploring whether such low-skilled workers can be effectively retrained or would be able to find occupations in other growth sectors, such as personal services. This section examines skill trends for sectors and occupations affected by electronic commerce. It relies mainly on US and European data.

Box 4.3. Skill needs in Internet-/intranet-related European companies

Ex-Novo is a small Italian graphic advertising and communication company (eight employees) which started a new Internet-related activity (multimedia and Internet services) and a more consultancy-oriented activity (intranets and virtual marketing) in 1996. The new Internet activity required three additional full-time external consultants; the consultancy activity is carried out by a virtual company that works on a project basis with temporary staff. In shifting to these activities, Ex-Novo has had to adapt to an environment where the rate of technical change and the related learning requirements for all personnel are much higher. Sales staff and creative designers must be constantly updated on the potential constraints of multimedia tools. The main challenge for the company seems to be the qualifications/skills of staff for the higher-level jobs, rather than finding people for operational jobs.

Informa is an Italian start-up company (established at the end of 1995) which develops Intranet solutions. This is both a consultancy activity and an activity of developing *ad hoc* software tools for SMEs. It also provides networking and "Internetworking" solutions (pure technological consultancy). It also builds Web sites on the Internet. This requires developing solutions for complex databases, research engines, means of carrying out transactions, and advertising. Apart from the managing director who has a commercial and administrative role, 4.5 persons work on Intranet issues, 1.5 on networking, 1.5-2 on WebFrame package development, and 2.5 (including the general manager) perform pure consultancy activity. Almost all Informa employees are engineers, with a background in telecommunications and networking. As this professional profile is not very common in Italy, the company relies on internal training.

Informconsult is a German consulting company that provides intranet solutions. Implementation of an intranet may require anything from a minimum of two to three man-months (software installed by the customer, 200 people connected, building an internal e-mail system, technological know-how transfer) to two man-years (many thousands of people connected in many locations, integration of the customer's network with its subsidiaries or providers, design of work flow and workgroup software). Lack of qualified employees is cited as the major problem for the company's development, as demand for information technology graduates appears to exceed supply in the Cologne area.

Loud-n-clear is a virtual company (no physical office) started as a joint venture by a group of three companies (British and Swedish). It provides Internet services, as well as consultancy and support for the software products developed by one of the group companies. The company started in 1995 with three members and reached eleven in 1997. A number of external consultants work on specific tasks (mostly graphics and research). Employees have professional profiles in: programming/system architecture/communications (three people with an average of ten years' experience); database/data analysis/high-level systems (two people specialised in databases and data description); marketing and market exploitation (one person with more than 20 years' experience); sales (two people with some technical skills); translation (from Swedish to English), copyrighting and proof-reading (one person, with some limited technical experience); two trainees familiar with Web site development. Once it has a core of technical skills, the company expects to recruit in the field of marketing. It will employ more people on a part-time/specific project basis and will only recruit teleworkers.

Source: Databank Consulting, 1997.

Table 4.7. **The work force in e-commerce-related companies: content aggregation**

Company	Full-time employees	Sales and marketing	Research and development	Administration and finance	Other
Excite	434	43%	35%	15%	7% (operations and support)
Infoseek Corp.	171	44%	26%	29%	
Lycos	137	46%	39%	15%	Contractors (operations and support)
Yahoo!	386	52%	19%	8%	21% ("surfers")

1. 1997 or latest available year.
Source: OECD, based on data from the US Securities and Exchange Commission.

Box 4.4. **Ten new e-commerce jobs**

Entrepreneurial consultant: *Pay*: Up to $250 000 a year. *Background*: Master of Business Administration or similar, extensive business management experience, consulting firm experience.

Task: To analyse the overall business case for a project and turn around struggling enterprises. Part merchant banker, part visionary, part technocrat – you force your clients to rethink their place in the world and then re-engineer their business.

Application developer: *Pay*: Up to $150 000 a year. *Background*: Rocket scientist, astrophysicist, pure science researcher, software engineer, Andersen consulting experience, project director, postgraduate degree.

Task: Create new software programmes or online business tools. New businesses require people to create (develop) the structures (applications) to help them succeed. This may be a new Web site selling technique or a way to share company information among employees.

Fulfilment specialist: *Pay*: $60 000-$100 000 a year. *Background*: Logistics and transportation/trucking, military procurement, police services, entrepreneurs.

Task: To get the product to the customer.

Consumer behaviour consultant: *Pay*: $100 000-plus a year. *Background*: Psychologist, writer, journalist, layout designer, magazine editor.

Task: Analyse why people buy things. The AC Nielsens of e-commerce. With so many people using the Web in so many different ways, it is necessary to have adaptive, meaningful measures of success. Someone who can evaluate consumer behaviour can help an enterprise better target its audience.

Broker: *Pay*: $200 000-$2 million a year. *Background*: Merchant banker, ex-employment agency professional, negotiator (*e.g.* police or counsellor), sales.

Task: Find new business opportunities and staff – a recruiter. As an employment broker you can expect to get 20 per cent of the talent's first-year salary in commission. In return, you will find the people from the other nine categories listed here, many of whom will not have direct IT training, but complementary skills that can translate to e-commerce.

Network security specialist: *Pay*: $100 000 a year. *Background:* Intelligence operative ("spooks" or spies), ex-signals directorate officer, "white" hacker, traditional IT security network manager.

Task: Make sure computer systems are safe from prying eyes.

E-commerce business analyst: *Pay*: $60 000-$100 000 a year. *Background*: accountant, auditor, stockbroker, business manager;

Task: A bean counter, a number cruncher.

Internet architect: *Pay*: $100 000 a year. *Background*: Webmaster "with muscle", designer, relational database construction.

Task: Put it on the Web. The people who design the site and conceive concepts. A Webmaster controls the team that puts the pages on line, like an editor for a newspaper or magazine.

Product manager: *Pay*: $60 000 a year. *Background*: Events management, SAP project manager, traditional IT project manager, producer for TV, magazine or radio.

Task: Make sure it stays on the Web. The environment is constantly evolving and e-commerce products need to be kept on track. The day-to-day programming of the Web needs a timekeeper.

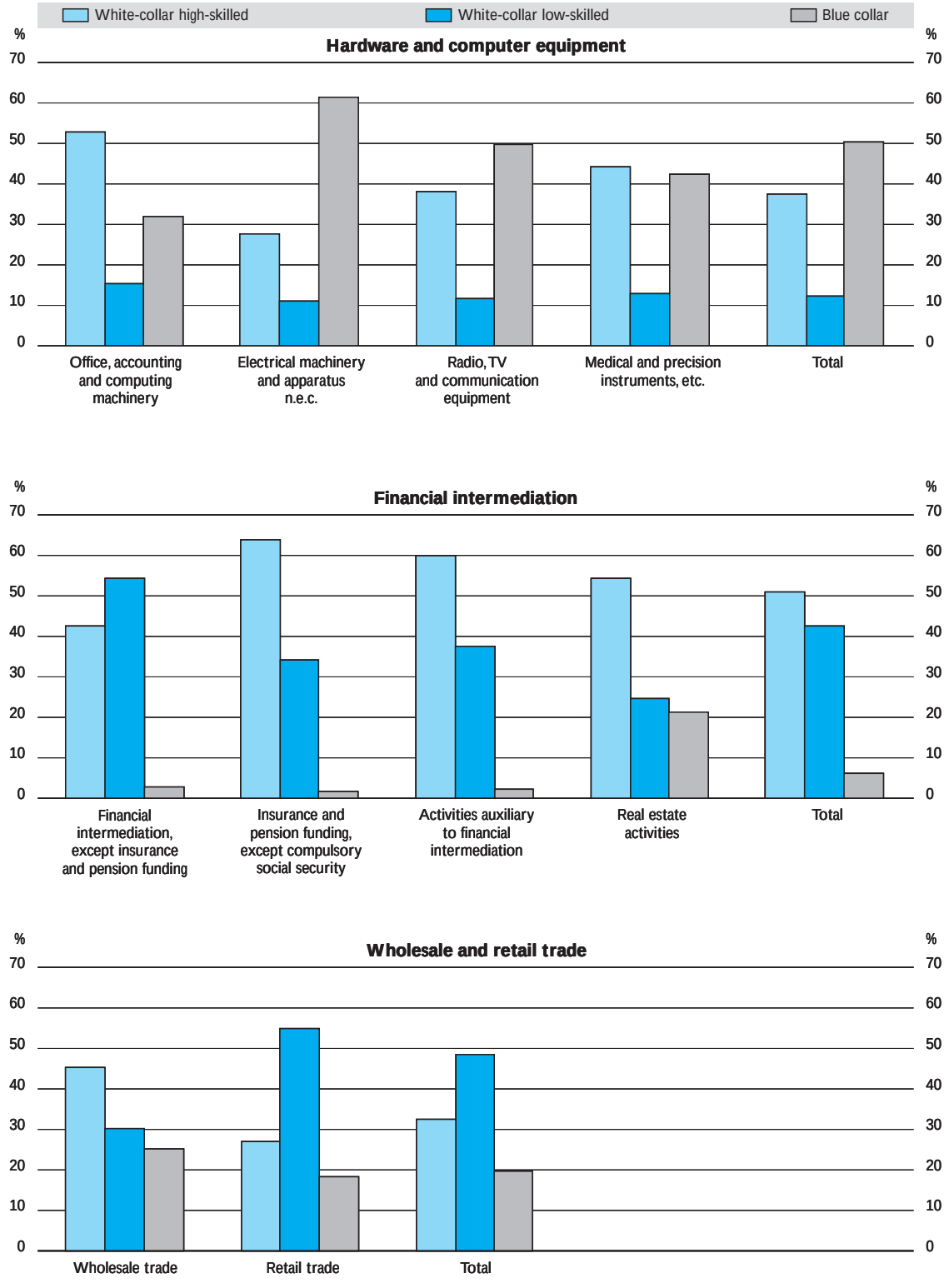
Core programmers: *Pay*: $50 000 a year. *Background*: Programming degree and/or extensive low-level skills in SQL, Java, Corba and network operating systems, especially Windows NT and Unix. Communications experience in TCP/IP an advantage.

Task: Take care of day-to-day computer programming tasks.

Source: Cochrane and McIntosh, 1998.

Figure 4.5 breaks down EU white-collar workers into high-skilled and low-skilled on the basis of the ISCO-88 occupational classification. Hardware and computer equipment, financial, and wholesale and retail are blue-collar, white-collar high-skill, and white-collar low-skill "intensive", respectively. This overall sectoral "skill intensity" hides the heterogeneity within sectors affected by electronic commerce. In the financial and wholesale and retail sectors, industries have different mixes within the white-collar category. In the hardware and computer equipment sector, high- and low-skill-intensive industries coexist. Hence, the impact of electronic commerce will not necessarily fall on any one segment or skill level.

Figure 4.5. ***Skill shares within selected sectors, EU-10, 1996***



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

Box 4.5. **Selected occupations affected by electronic commerce**

ICT-related occupations

Computing professionals (ISCO-88 213): conduct research, plan, develop and improve computer-based information systems, software and related concepts, develop principles and operational methods as well as maintain data dictionary and management systems of databases to ensure integrity and security of data.

Physical and engineering science technicians (ISCO-88 311): perform technical tasks related to the research and the practical application of concepts, principles and operational methods particular to physical sciences including such areas as engineering, technical drawing or economic efficiency of production processes.

Computer associate professionals (ISCO-88 312): provide assistance to users of microcomputers and standard software packages, control and operate computers and peripheral equipment and carry out limited programming tasks connected with the installation and maintenance of computer hardware and software.

Optical and electronic equipment operators (ISCO-88 313): take photographs, control motion picture and video cameras and other equipment to record and edit images and sound, control broadcasting and telecommunication equipment and telecommunications systems, as well as technical equipment used for medical diagnosis or treatment.

Information-related occupations

Office clerks (ISCO-88 411-4 + 419): record, organise, store and retrieve information related to the work in question and compute financial, statistical and other numerical data. The group includes secretaries and keyboard-operating clerks, accounting, bookkeeping, statistical and finance clerks, material-recording and transport clerks, library, mail and related clerks.

Customer services clerks (ISCO-88 421 + 422): deal directly with clients in connection with money handling operations, travel arrangements, requests for information, appointments and by operating telephone switchboards. The group includes cashiers, tellers and related clerks, client information clerks (*e.g.* travel agencies, receptionists, telephone switchboard operators).

Commerce-related occupations (ISCO-88 522)

Shop salespersons and demonstrators: sell goods in wholesale or retail establishments and demonstrate and explain the functions and qualities of these goods.

Stall and market salespersons: sell various goods (*e.g.* newspapers, periodicals) in open spaces or sell foodstuff in markets.

Owing to sectoral heterogeneity, it seems more useful to track those occupational categories that are more likely to be affected by electronic commerce: ICT-related occupations, information-related occupations, and commerce-related occupations. An *ad hoc* non-exhaustive classification for these three groups has been constructed (see Box 4.5), based on the ISCO-88 classification, and Table 4.8 provides a list of the occupational categories chosen for the EU and US comparisons.

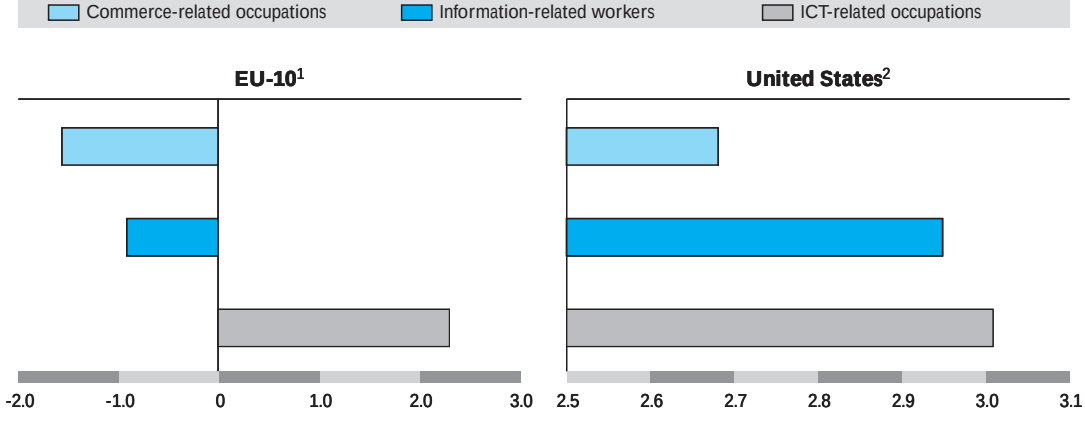
Figure 4.6 provides a snapshot of the three broad trends in e-commerce occupational categories in the United States and the European Union. ICT occupations are the smallest category, with 2.4 per cent in the former and 3.8 per cent in the latter in 1995. In the same year, information workers represented 12.9 per cent in the United States and 16.1 per cent in the European Union. Although the EU and US classifications are not strictly comparable, Figure 4.6 shows that ICT occupations are growing everywhere and that the number of information- and commerce-related workers were declining in the European Union but rising in the United States in that time span. The underlying data also show wide differences in these occupational trends within Europe. Even if the role of electronic commerce cannot be separated from that of other structural or cyclical factors, electronic commerce will exhibit country-specific impacts that should be investigated case by case.

The positive growth rates in US e-commerce occupations (Figure 4.6) are confirmed by a general long-run positive trend (Figure 4.7). The growth in ICT occupations, also stressed in a US Department of Commerce report (Margherio *et al.*, 1998), is less spectacular in relative terms. Figure 4.8, which shows ICT-related occupations as a share of the overall US work force, makes it clear that the increase begins to be

Table 4.8. **Occupational categories used in the EU-US comparisons**

Definitions ICT-related occupations include the following categories:	
For EU countries (ISCO 88):	***For the United States (US Standard Occupational Classification):***
ICT-related occupations	**ICT-related occupations**
213 Computing professionals 311 Physical and engineering science technicians 312 Computer associate professionals 313 Optical and electronic equipment operators	22126 Electrical and electronics engineers 25197 Computer engineers, scientists, and systems analysts 35101 Engineering technicians 34028 Broadcast technicians 25109 Computer programmers 25111 Programmers, numerical, tool, and process control 57100 Communications equipment operators 56100 Computer operators and peripheral equipment operators
Information-related workers	**Information-related workers**
411 Secretaries and keyboard-operating clerks 412 Numerical clerks 413 Material-recording and transport clerks 414 Library, mail and related clerks 419 Other office clerks 421 Cashiers, tellers and related clerks 341 Finance and sales associate professionals 342 Business services agents and trade brokers 343 Administrative associate professionals	55700 Information clerks 59900 Other clerical and administrative support work 57323 Mail clerks and messengers 53200 Records-processing occupations This category includes: Brokerage clerks Correspondence clerks File clerks Financial records processing occupations
Commerce-related occupations	**Commerce-related occupations**
522 Shop, stall and market salespersons and demonstrators	40 000 Marketing and sales occupations

Figure 4.6. ***Average annual growth rates in selected occupations, EU-10 and United States, 1993-97***



1. Belgium, Denmark, France, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain and United Kingdom.
2. 1993-95 only for United States, due to break in series in 1996.

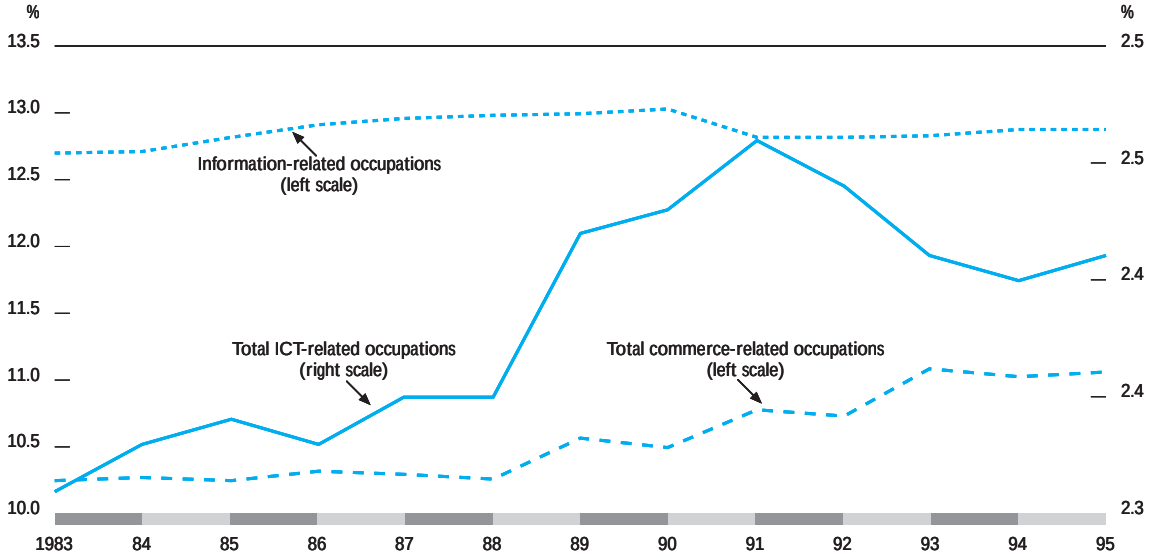
Source: OECD, based on data from Eurostat and the US Bureau of Labor Statistics.

noticeable in 1995. The OECD selection of ICT-related occupations is based on the US occupations listed in Table 4.8, while the US selection is based on the IT-related occupations used by the Department of Commerce (Margherio *et al.*, 1998).

A closer look at US ICT occupations over time reveals that what is really growing within the ICT category is "computer engineers, scientists and system analysts" (Figure 4.9). This category is expected to be in greater demand as electronic commerce develops.

Figure 4.7. ***Share of e-commerce-related occupations within the US economy, 1983-95***[1]

As a percentage of total US employment

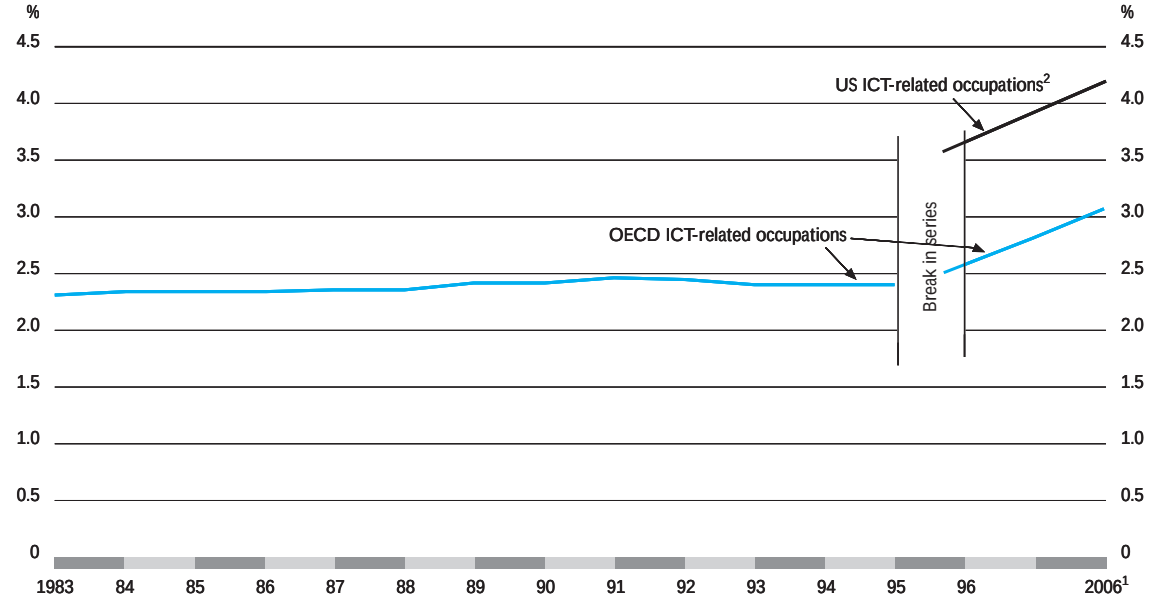


1. See Table 4.8 for the definition of occupational categories.

Source: OECD, based on data from the US Bureau of Labor Statistics.

Figure 4.8. ***Share of ICT-related occupations in the United States and the OECD, 1983-2006***

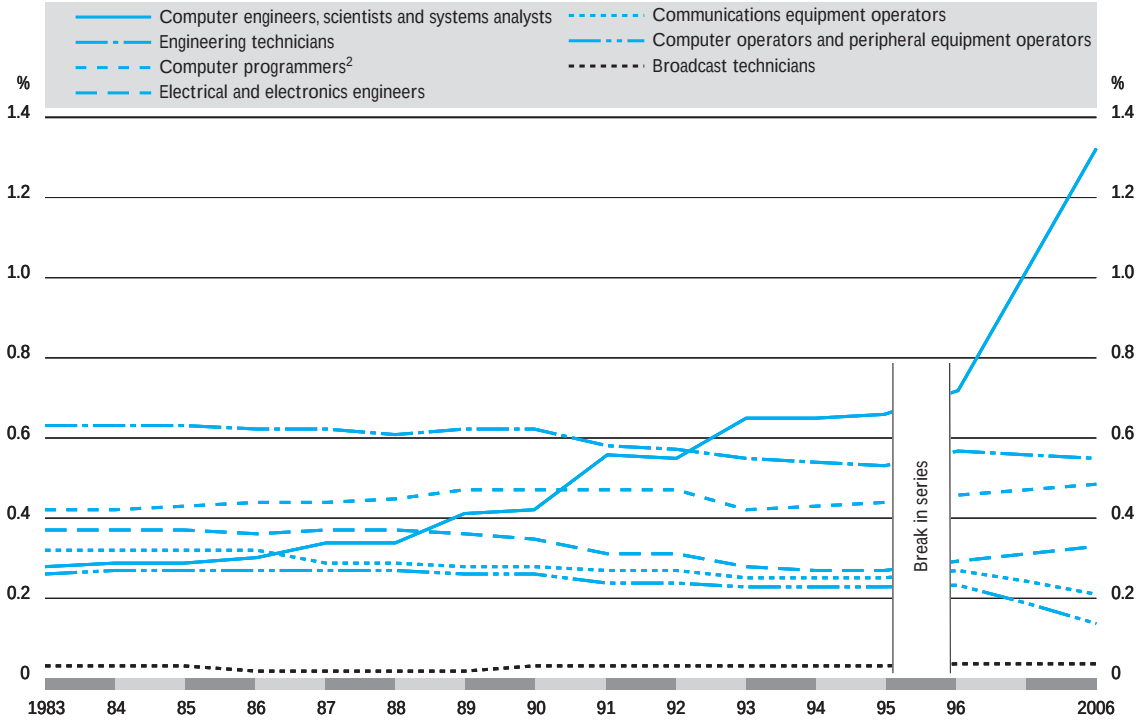
As a percentage of total employment



1. 2006 forecast.
2. Data only available for 1996.

Source: OECD, based on data from the US Bureau of Labor Statistics.

Figure 4.9. ***Share of ICT-related occupations within the US economy, 1983-2006***
As a percentage of total US employment



1. 1983-95: national industry-occupation employment matrix 1983-95 time series. 1996-2006: national industry-occupation employment matrices for 1996-2006.
2. The category "Computer programmers" (25109) includes the category "Programmers, numerical, tool and process control" (25111).

Source: OECD, based on data from the US Bureau of Labor Statistics.

CONCLUDING REMARKS AND FUTURE RESEARCH AGENDA

Given the current relative size of electronic commerce with respect to other factors that may contribute to overall labour market turbulence (*e.g.* technology, trade, policies), the impact of electronic commerce on employment can only be very small, but, in the longer term, its effect may be felt more strongly.

The direct employment impact of electronic commerce will depend on complementarity, substitution and market-size effects. Electronic commerce may also create new markets or extend market reach beyond traditional borders. The final effect on jobs will depend crucially on development of demand for electronic activities.

- *The labour intensity and the work force characteristics of electronic commerce activities should be analysed on the basis of micro-level data. A special focus should be placed on firms that carry out online and off-line activities simultaneously in order to determine in which cases electronic commerce offers "intermodality" and "complementarity" in business processes.*
- *Research is also needed to identify activities that have replaced existing ones, analyse their revenue growth compared with that of the sector as a whole, and identify those whose emergence has led to a readjustment of market shares and those whose effect has been to enlarge the market. Given the crucial role played by demand, demand trends for these new activities should be monitored and policy makers should be made aware of the factors underlying country-specific differences.*

Direct job creation associated with electronic commerce is still fairly small and mainly driven by employment growth in the software sector. Evidence of substantial direct job displacement by e-commerce is lacking at this stage but it is most likely to occur in the retail, post office and financial sectors. In particular, electronic commerce is likely to cause a radical transformation of the distribution

sector, whose share in total employment varies in the OECD countries from a minimum of 10.8 per cent in Denmark to 22 per cent in Korea.

- *Case studies are needed to better understand impacts on sectoral employment. In particular, as the employment potential of electronic commerce is not the same across countries, the differences among countries in the production of Web-related hardware and software content, which seems to be driving employment gains from electronic commerce, should be explored. Also, the impact on employment in the distribution sector, which will depend on differences in the sector regulatory and organisational structure across countries, should be investigated.*

Indirect/long-term employment effects driven by demand and productivity growth are likely to offset shorter-term/job destroying effects, depending on the country and the assumptions made about the size and structure of electronic transactions.

- *Research on country-specific differences in the size and growth potential of electronic transactions, as well as on countries' differences in online organisational models, is essential in order to evaluate the long-term impact on employment.*

Electronic commerce is driving demand for IT professionals but it also requires IT expertise coupled with strong business applications skills. Therefore, it generates demand for a flexible, multi-skilled work force. Apart from contingent skill needs to support electronic commerce transactions and applications, there will be a more structural and long-term shift in the skills required to perform economic activities online. E-commerce is likely to accelerate existing upskilling trends in the OECD work force.

- *Work to identify specific skill needs for e-commerce and opportunities for worker requalification is needed. Policies to cope with skill mismatches will have to be reinforced as the volume of electronic transactions increases.*

Annex 4.1

E-COMMERCE-RELATED EMPLOYMENT IN US FIRMS

Morgan Stanley reports a list of public Internet-related companies that comprises those providing infrastructure (among which are companies providing data networking and telecommunication equipment, Internet service providers, and Internet security equipment and software providers), those providing software and services (application software companies, enterprise and related software companies and commerce enablers), and those companies providing content, aggregation and commerce (Morgan Stanley Dean Witter, 1997). This taxonomy is very useful for looking at Internet-related companies that are strongly influenced by electronic commerce developments. While the third category represents firms that conduct electronic commerce (providing online services, content, selling goods and services), employment opportunities also need to be assessed with respect to industries that enable electronic commerce. The data were collected for a sample of the firms given in the Morgan Stanley list.

Annex Tables 4.1, 4.2, and 4.3 show selected Internet-related firms' market capitalisation and number of full-time employees in 1997 or latest year. Market capitalisation bears the same relation to GDP contribution as an individual firm's return on sales does to its return on equity market value (Amano and Blohm, 1997). This variable is supposed to give a real-time measure of the economic impact of those firms. The share of Internet-related employment is obtained by using Amano and Blohm's estimates of the share of firms' Internet-related activities. Where these estimates were not available, it is assumed that employment is entirely related to Internet/electronic commerce activities.

Annex Table 4.1. **Selected US Internet-related firms' market capitalisation and number of full-time employees**

Infrastructure providers, 1997[1]

Company	Industry	US SIC	Market capitalisation (1997) (US$ million)	Internet-related market capitalisation (%)	Full-time employees	Internet-related employment
Data networking/telecommunication equipment						
Ascend	Computer communications equipment	3 576	6 768	50	1 644	822
Cisco	Computer communications equipment	3 576	50 735	25	3 500	875
3Com	Computer communications equipment	3 576	8 880	20	7 109	1 422
Internet service providers						
PSINet	Computer programming, data processing, etc.	7 370	360	100	775	775
Earthlink	Prepackaged software	7 372	190	*	785	785
IDT	Computer-integrated systems design	7 373	396	*	360	360
WorldCom	Telecommunications	4 813	35 261	30	20 300	6 090
Concentric Network	Telecommunications	4 813	182	100	387	387
Internet security equipment and software						
Cylink	Computer peripheral equipment, n.e.c.	3 577	405	*	432	432
Security Dynamics	Computer peripheral equipment, n.e.c.	3 577	1 332	*	610	610
Total infrastructure						**12 558**

* Estimates are not available. It is assumed that 100% of market capitalisation is related to the Internet.
1. Or latest available year.
Source: OECD estimates, based on data from the US Securities and Exchange Commission.

Annex Table 4.2. **Selected US Internet-related firms' market capitalisation and number of full-time employees**

Software and services providers, 1997[1]

Company	Industry	US SIC	Market capitalisation (1997) (US$ million)	Internet-related market capitalisation %	Full-time employees[2]	Internet-related employment
Application software						
Accent Software	Prepackaged software	7 372	36	35	88	31
FTP Software	Prepackaged software	7 372	136	50	350	175
Microsoft	Prepackaged software	7 372	179 145	25	22 232	5 558
NetManage	Prepackaged software	7 372	172	50	440	220
Netscape	Prepackaged software	7 372	3 813	100	2 310	2 310
Spyglass	Prepackaged software	7 372	120	100	162	162
Enterprise and related software						
Business Objects	Prepackaged software	7 372	153	*	757	757
Versant Object Tech. Corp.	Prepackaged software	7 372	238	*	196	196
Verity	Computer processing and data preparation	7 374	55	50	311	156
Commerce enablers						
Broadvision	Prepackaged software	7 372	140	*	188	188
Cybercash	Computer integrated systems design	7 373	220	100	227	227
Edify	Prepackaged software	7 372	270	*	349	349
Open Market	Prepackaged software	7 372	434	60	527	316
Premenos	Prepackaged software	7 372	180	35	254	89
Internet/on-line consulting and development						
CKS Group	Business services	7 389	630	*	580	580
Eagle River Interactive	Business services	7 389	165	*	463	463
Total software and services						**11 777**

* Estimates are not available. It is assumed that 100% of market capitalisation is related to the Internet.
1. Or latest available year.
Source: OECD estimates, based on data from the US Securities and Exchange Commission.

Annex Table 4.4 shows sample totals by sector. Most employment created by US Internet/electronic commerce firms in the sample is related to computers (41.5 per cent) and telecommunications equipment and services (20.3 per cent).

Given that data were collected from selected firms in the Morgan Stanley list, Internet-related firms' employment was then scaled up to represent the complete sample. Total employment in each segment (infrastructure, software, etc.) was increased proportionally to the weight of the chosen firms in total market capitalisation for the whole sample. Therefore, a one-to-one correspondence between market capitalisation and employment was assumed within each segment.

Moreover, these are public firms and, according to Amano and Blohm (1997), employment in publicly traded firms in the United States represents about 50 per cent of total employment. The estimates obtained were thus doubled to represent overall (private and public) employment. The second column in Table 4.4 presents the estimated number of jobs resulting from both scaling up to the complete sample and scaling up to the total economy.

Annex Table 4.3. **Selected US Internet-related firms' market capitalisation and number of full-time employees**[1]

Content/aggregation/commerce providers, 1997

Company	Industry	US SIC	Market capitalisation (1997) (US$ million)	Internet-related market capitalisation (%)	Full-time employees	Internet-related employment
Organisation/aggregation						
Excite	Prepackaged software	7 372	377	*	434	434
Infoseek Corp.	Prepackaged software	7 372	234	*	171	171
Lycos	Miscellaneous business services	7 380	518	100	137	137
Yahoo!	Computer-integrated systems design	7 373	2 448	100	386	386
On-line services/information services						
America Online	Computer programming, data processing, etc	7 370	7 425	30	7 371	2 211
Compuserve	Computer programming, data processing, etc.	7 370	1 302	30	3 050	915
Individual	Computer processing and data preparation	7 374	112	*	176	176
Infonautics	Computer processing and data preparation	7 374	27	*	177	177
Publication						
CMG Information Services	Direct mail advertising services	7 331	270	25	912	228
CMP Media	Publishing and printing	2 721	638	*	1 720	1 720
Mecklermedia	Publishing and printing	2 721	216	*	182	182
CNET (4)	Motion picture and videotape production	7 812	533	*	581	581
TMP Worldwide	Advertising agencies	7 311	576	*	3 300	3 300
Transaction processing, financial services, and online commerce						
Amazon.com	Publishing and printing	2 721	1 128	*	614	614
CheckFree	Business services	7 389	1 050	*	1 444	1 444
CUC International	Personal services	7 200	13 140	*	15 000	15 000
CyberCash	Computer-integrated systems design	7 373	220	100	227	227
E*Trade	Security brokers, dealers and flotation companies	6 211	1 394	100	245	245
First Virtual	Services	8 900	54	100	77	77
iMall, Inc	Educational services	8 200	57	*	65	65
Onsale	Retail catalogue and mail-order houses	5 961	464	*	129	129
Peapod	Business services	7 389	170	*	285	285
Total content/aggregation/commerce						**28 704**

* Estimates are not available. It is assumed that 100% of market capitalisation is related to the Internet.
1. Or latest available year.
Source: OECD estimates, based on data from the US Securities and Exchange Commission.

Annex Table 4.4. **E-commerce-related jobs by industry in the United States**

US SIC	Industry	Number	%
737	Computer and data processing services	42 303	41.5
481	Telecommunications	20 687	20.3
720	Personal services	15 000	14.7
357	Computer and telecommunication equipment	13 295	13.0
731	Advertising	3 300	3.2
738	Miscellaneous business services	2 909	2.9
272	Periodicals	2 516	2.5
733	Mailing, reproduction and stenographic services	912	0.9
781	Motion picture production and distribution	581	0.6
621	Security and commodity brokers	245	0.2
596	Nonstore retailers	129	0.1
890	Services, n.e.c.	77	0.1
820	Education, public and private	65	0.1
	Total selected industries	102 019	100.0

Source: OECD estimates, based on data from the US Securities and Exchange Commission.

Annex 4.2.

JOB OPPORTUNITIES IN E-COMMERCE-RELATED INDUSTRIES

The "copyright industry"

The computer software, motion picture, audio-visual and publishing industries have been defined as the "copyright industry" (Economist Incorporated, 1996). In the United States, the industry's employment share grew from 1.60 per cent in 1977 to 3.08 per cent in 1996 and is forecast to generate 1.4 million new jobs in the period 1996-2006 (Annex Table 4.5). The industry is quite diversified, with software services a fast-growing component (see below); employment in the advertising and publishing industries is forecast to lose share.

Annex Table 4.5. **Employment in the US copyright industries**

	US SIC	Employment (thousands)				Share of US workforce (%)			
		1977	1987	1996	2006	1977	1987	1996[1]	2006[1]
Publishing-related industries	2711, 2721, 2731, 2741, 277, 2732, 2789, 2791, 2796	697.3	884.5	1 537.7	1 501	0.76	0.79	1.26	1.08
Computer programming and software	737	186.6	630.5	1 208	2 509	0.20	0.56	0.99	1.80
Radio and TV broadcasting	483	162.2	225.4	242.8	245	0.18	0.20	0.20	0.18
Advertising	731	131.5	216.8	242.4	270	0.14	0.19	0.20	0.19
Motion picture	78	214	235.7	522.4	628	0.23	0.21	0.43	0.45
Theatrical production	792	65.5	117	n.a.	n.a.	0.07	0.10	n.a.	n.a.
Records and tapes	3652	26.5	21	n.a.	n.a.	0.03	0.02	n.a.	n.a.
Total		**1 484**	**2 331**	**3 753**	**5 153**	**1.60**	**2.07**	**3.08**	**3.70**

1. Total excludes theatrical production and records and tapes.
Source: Economist Incorporated for the years 1997; US Bureau of Labor Statistics for the years 1996 and 2006.

In Europe, there seem to be no consistent source of data to estimate employment for this industry. Adding estimates of the publishing, audio-visual and software industry, Databank Consulting (1997) obtained an estimate of around 5 million people (*i.e.* 3 per cent of overall employment). The main difficulty is estimating software programming and computing services in Europe. The Community Labour Force Survey reports an estimate of about 1 million employed in software companies in 1995 (excluding software personnel in hardware manufacturers and user companies). Another survey reports 2 million employees for the same year and for a wider definition. A third survey reports an estimate of 1.5 million employees only for Germany, France and Italy (Databank Consulting, 1997). Japan carries out a special survey on information services; for 1996, it gave a total of 417 087 employees. In addition, employment in the publishing industry and the audio-visual sector is estimated at 2 million for the year 1996 (*i.e* 3 per cent of total employment). Annex Table 4.6 summarises estimates of the copyright industry for Canada, Japan, the United States and the European Union. The industry's share in total employment averages 3 per cent.

Employment growth in the content industry is driven by information services, and particularly by professional computer services (which represent 58 per cent of information services in the United States), data processing and network services (28 per cent in the United States), and electronic information services (14 per cent in the United States). Annex Table 4.7 shows the trends in software and computer-related services in a sample of selected countries. While the number of jobs differs greatly among countries, employment in this fast-growing industry represents only about 1 per cent of overall employment across countries.

Annex Table 4.6. **Estimates of the copyright industry (Canada, Japan, United States and European Union)**

	Year	Copyright employment (millions)	Share in total employment (%)
Canada[1]	1994	0.22 million	2
European Union[2]	1995	5 million	3
Japan[3]	1996	2 million	3
United States[4]	1996	3.8 million	3

1. Includes print and publishing, audio-visual, new media content, and software and computer services.
2. Includes computer software, motion picture, audio-visual and publishing.
3. Includes print and publishing, information services and broadcasting, movies and entertainment.
4. Includes print and publishing, information services, computer programming and software, radio and TV programming and motion picture.

Sources: OECD, based on data from Databank Consulting for the European Union, US Bureau of Labor Statistics for the United States, Industry Canada for Canada, and MITI and various sources for Japan.

Quantifying the impact of electronic commerce on job creation in the software sector is very difficult. According to the estimates presented above, US Internet-related companies to the computer services sector employ more than 42 000 full-time employees. According to the European Commission's *Panorama of EU Industry* (1997*e*), western Europe has more than 16 000 software and services companies with over 300 000 employees. In terms of employment evolving from software and services in the context of Internet and multimedia applications, however, most of these companies have less than 20 employees, and several not more than five. Databank Consulting estimates, on the basis of case studies, that Internet activities such as the implementation of Web sites only created about 6 000 man-years of additional work in Europe (Databank Consulting, 1997). As of September 1997, 59 per cent of US companies and 38 per cent of European companies have an intranet. In 1998, these percentages are expected to increase to 77 per cent and 75 per cent, respectively. By the year 2001, it is expected that there will be 133 million intranet users around the globe (Mecklermedia Corp., financial statement, 1997). According to Databank Consulting, the adoption of an intranet for internal communication in large corporations does not seem to have a positive impact on employment.

Electronic or online information services include companies that provide proprietary databases and information either on line, via CD-ROM, or on other media (*e.g.* magnetic tape, floppy disks or audiotext). Online services still represent a small portion of information services, but employment that is strictly related to electronic commerce partly depends on their development. Booz-Allen & Hamilton provides a useful taxonomy of online services and distinguishes among services supplied for *information* (news, information, online databases, search engines), *communication* (e-mail, video conferencing, direct marketing, PC-fax, discussion groups, bulletin boards), *transactions* (EDI, telemedicine, teleworking, training, telediagnosis, e-banking, e-brokerage, e-insurance, e-shopping, travel, cultural, telelearning) and *entertainment* (music, video, games, etc.).

Data on online services are difficult to find and are based on ad hoc surveys which are often out of date. According to European Commission (1996) (Annex Box 4.1), there were only about 60 000 employees in the European electronic information industries in 1994, and given that these services are in part replacing off-line services, there does not seem to be much hope of net job creation. However, a report prepared by Booz-Allen & Hamilton (1997) for the Dutch Economics Ministry, which also takes into account the potential "linkages" in job creation due to the openness of the Dutch economy, estimates the new online services to have created 6 800 full-time equivalent jobs in 1997 (about 1 per cent of 1997 total employment) and forecasts 40 000 more full-time equivalent jobs by the year 2001.

Annex Table 4.7. **Software and computer-related services employment: international comparisons**

	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996
United States[1]	. .	363 549	637 409	779 656	791 031	838 334	894 256	955 094	1 083 977	1 223 263
As % of business services	. .	13.3	15.4	15.3	15.5	16.3	16.1	16.0	16.4	17.5
As % of services	. .	0.6	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.3
As % of total employment	. .	0.4	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0
Canada[2]	. .	. .	. .	71 660	90 015	72 024	79 021	99 056	123 312	. .
As % of business services	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
As % of services	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
As % of total employment	. .	. .	. .	0.5	0.7	0.6	0.6	0.7	0.9	. .
Japan	57 164	93 271	162 010	458 462	493 278	488 469	445 662	424 867	407 396	. .
As % of business services	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
As % of services	. .	. .	. .	6.7	. .	. .	. .	5.4	. .	. .
As % of total employment	. .	. .	. .	0.9	. .	. .	. .	0.8	. .	. .
France[3]	. .	62 509	100 181	144 766	146 220	151 347	147 881	153 329	158 544	. .
As % of business services	. .	6.2	9.0	8.7	8.7	8.8	8.6	8.3	8.4	. .
As % of services	. .	3.1	4.6	5.0	5.0	5.1	4.9	4.8	4.9	. .
As % of total employment	. .	0.3	0.5	0.6	0.6	0.7	0.7	0.7	0.7	. .
Finland	4 800	8 200	14 100	18 000	17 500	16 200	17 000	16 500	17 400	. .
As % of business services	10.9	15.2	18.6	15.9	16.0	16.3	17.6	16.4	15.9	. .
As % of services	0.4	0.7	1.1	1.3	1.3	1.2	1.4	1.3	1.4	. .
As % of total employment	0.2	0.4	0.6	0.8	0.8	0.8	0.9	0.9	0.9	. .

1. 1982 instead of 1980, 1987 instead of 1985.
2. Including self-employment.
3. Wage earners as of 31 December. 1981 instead of 1980.

Industry definition: United States (US SIC 737); Canada (Canadian SIC 7720); Japan (Japan SIC 84); France (NAF 72); Finland (NACE 72).

Source: OECD, 1997.

Annex Box 4.1. **Jobs and online services in Europe**

The MSSTUDY on the markets for electronic information services in the European Economic Area surveyed both suppliers and users of electronic information. It therefore combines a market approach, measuring expenditure for electronic information services, with a supplier approach, measuring the world-wide revenues of suppliers.

According to the study, 60 639 full-time equivalent professionals were employed in the European information industry in 1994. Almost 40 per cent of all jobs on the supplier side were in British companies. Job creation due to the growth of the UK information industry also benefited export countries. Of the 24 000 employees, approximately 25.8 per cent were employed in the United Kingdom. The rest were employed in other countries of the European Economic Area (28 per cent), in the United States (28 per cent) and in the rest of the world (18.2 per cent).

While employment in the information industry is increasing at a rate of 10 per cent a year, qualitative information points to the fact that electronic information services are also an instrument of rationalisation and reduce the number of information professionals, for example in paper-based archives.

Employment in the European information industries, 1994

Region country	Full-time equivalents	Country share (%)
United Kingdom	23 910	39.5
France	7 532	12.4
Germany	7 500	12.4
Italy	6 500	10.7
Netherlands	3 001	4.9
Sweden	880	1.5
Denmark	1 937	3.2
Norway	2 100	3.5
Finland	628	1.0
Belgium	763	1.3
Spain	1 449	2.4
Portugal	2 090	3.4
Austria	629	1.0
Luxembourg	65	0.1
Greece	1 367	2.3
Ireland	185	0.3
Iceland	106	0.2
EEA	60 639	100.0

Source: European Commission, 1996.

Annex 4.3

THE EMPLOYMENT EFFECTS OF ELECTRONIC COMMERCE: ESTIMATES OF THE IMPACT MULTIPLIERS

Databank Consulting (1998) estimates the impact multipliers of electronic commerce on employment in four European countries. The multipliers take into account the direct effects on employment generated by electronic commerce revenues in the industries directly involved in electronic transactions, the indirect effects generated by inter-industry linkages, and the secondary effects originating from the consumption-income link. The methodology used can be summarised as follows:

1. 1997 electronic commerce forecasts (from the European Information Technology Observatory) for France, Germany, Italy and the United Kingdom were broken down by Web-generated revenue segment (see Annex Table 4.8).
2. Different business models for electronic commerce were studied in order to choose a limited set of models to be applied to the revenue segments.
3. It was assumed that electronic transaction revenues replaced about 96 per cent of traditional ones.
4. Input-output multipliers, taking into account direct, indirect and secondary effects, were calculated.

Annex Table 4.8. **Revenue generated by commercial Web sites in Europe, 1998**

Percentages

Segment	France	Germany	Italy	United Kingdom	Average of the four countries
Computers and softwares	25	25	26	25	25
Consumer products	17	20	10	13	15
Finance and insurance	4	4	4	4	4
Manufacturing industry	7	6	8	8	7
Publication and information	10	10	11	10	10
Travel	5	4	6	5	5
Business and professional	18	18	20	20	19
Advertising	12	11	12	12	12
Other	3	3	4	4	4
Total	**100**	**100**	**100**	**100**	**100**

Source: Databank Consulting, 1998.

The exercise required many assumptions, some of which may be questioned. Among these is the assumption of the degree of substitution between off-line and online activities, which is crucial for estimating net job creation. Interestingly, the study adopts the worst-case scenario, in which about 96 per cent of electronic commerce revenues replace traditional ones. As expected, first-order effects are negative; labour-intensive activities, such as retail and wholesale, are assumed to be completely replaced by electronic ones. However, indirect and secondary effects more than compensate the negative first-order effects (except for Germany). 1997 electronic revenues in the four European countries are estimated to have generated about 173 000 jobs in 1998. Annex Table 4.9 presents the net gain in the number of jobs obtained by substituting electronic transactions for traditional ones (the difference between the jobs that would have been created by electronic revenues and those that would have been created by traditional revenues).

Annex Table 4.9. **E-commerce fully replacing traditional commerce: number of jobs created or lost**

Multipliers	France	Germany	Italy	United Kingdom
Primary: direct (industry direct requirements)	–169	–520	–109	–76
Primary: indirect (inter-industry linkages)	44	20	53	680
Secondary (consumption-income linkage)	322	324	851	3 062
Total	**+197**	**–216**	**+795**	**+3 666**

Source: Databank Consulting, 1998.

Annex 4.4.

FORECASTS OF TELECOMMUNICATION, MEDIA AND INTERNET-DRIVEN EMPLOYMENT GROWTH

Three scenarios for the development of the US communications and media industry

Cohen (1997) develops three scenarios for the development of the US communications and media industry to the years 2000 and 2005. One is a baseline telephony-oriented scenario which assumes that current development trends in telecommunications continue and incorporate the further liberalisation of services expected to follow the 1996 Telecommunication Act. This scenario makes use of predictions by Wall Street analysts and the Federal Communications Commission on the growth of the (narrow and broadband) wireline business, cable operators, wireless companies and satellite service providers. The second and third are more Internet-based scenarios and reflect Massachusetts Institute of Technology predictions that the bandwidth required for data, much of which are in intranets and on the Internet, will equal the bandwidth used for telephony by the year 2000 and will substantially overtake it by 2005. The third Internet-intranet scenario is the most dramatic and assumes that 60 per cent of leased lines will be replaced by Internet and intranet infrastructure. Scenario 2 (also intranet/Internet-based) is intermediate and assumes the share to be 20 per cent.

To measure employment impacts, Cohen used estimates of thousands of jobs created for each billion dollars of revenue in some of the main industries affected by the growth of the Internet and intranets, such as communication services, software services, computer equipment and motion picture content. Employment estimates were then corrected using revenues adjusted for substitution effects. Parts of the sales of products and services on the Internet and corporate intranets replace sales through traditional retail channels, such as retail stores, software firms, business service companies, and firms that sell different types of content. Between 25 and 40 per cent of the revenue gains due to sales of content and transactions on the Internet and intranets were subtracted from the original estimates. Annex Table 4.10 shows the estimated impact on jobs. The first (baseline) scenario estimates a contribution of 3 million new jobs in wireline services by the year 2005. The two Internet/intranet-based scenarios have a different impact depending on the assumption of substitution of Internet/intranet jobs for jobs lost in the wireline sector (lower impacts correspond to a higher substitution rate, *i.e.* 40 per cent, higher ones to a 25 per cent substitution rate).

Annex Table 4.10. **The impact of the development of the US telecommunications and audio-visual industry on employment, 2005**

	Scenario		Employment impacts (thousands of jobs)
1. Telephony-oriented	Baseline		2 961
2. Internet/intranet-oriented	Intermediate	40% substitution	3 648
		25% substitution	3 939
3. Internet/intranet-oriented	Radical	40% substitution	4 391
		25% substitution	5 138

Source: Cohen, 1997.

In the Internet and intranet scenarios, the multipliers (hence the impact on employment) are higher than the ones applied for wired services, owing to the investment in servers, server software, and content needed for the Internet and intranets. In the third scenario, the much greater use of content and software for the Internet and intranets results in the creation of an additional 1.4 to 2.2 million jobs in content-related industries in 2005 as compared to the baseline scenario (where content growth is driven by cable and satellite distribution only). The additional increases in GNP and jobs created in the third scenario do not arise from Web usage *per se*, as the direct impact on GNP of Web usage is more or less nullified by the loss of revenues from other existing wired

services (broadband, leased lines, etc.). They come almost exclusively from the production of Web-related hardware-software content (Databank Consulting, 1997).

The BIPE-IFO-Lentic study of EU-15 countries

The BIPE-IFO-Lentic study adopts an integrated methodological approach, which includes country studies and macroeconomic modelling, to forecast the effects on employment of the liberalisation of the telecommunications sector in the EU-15. Four different liberalisation scenarios (against the baseline scenario of no liberalisation) were distinguished, based on the combination of the pace of liberalisation and technology diffusion (see Annex Table 4.11). The study includes all telecommunications sector technologies: radiotelephone communication, mobile telephony, cable telephony, satellite telephony, data transmission and value-added networks and services.

Annex Table 4.11. **Liberalisation of the telecommunications sector: economy-wide gains in employment in the EU-15**

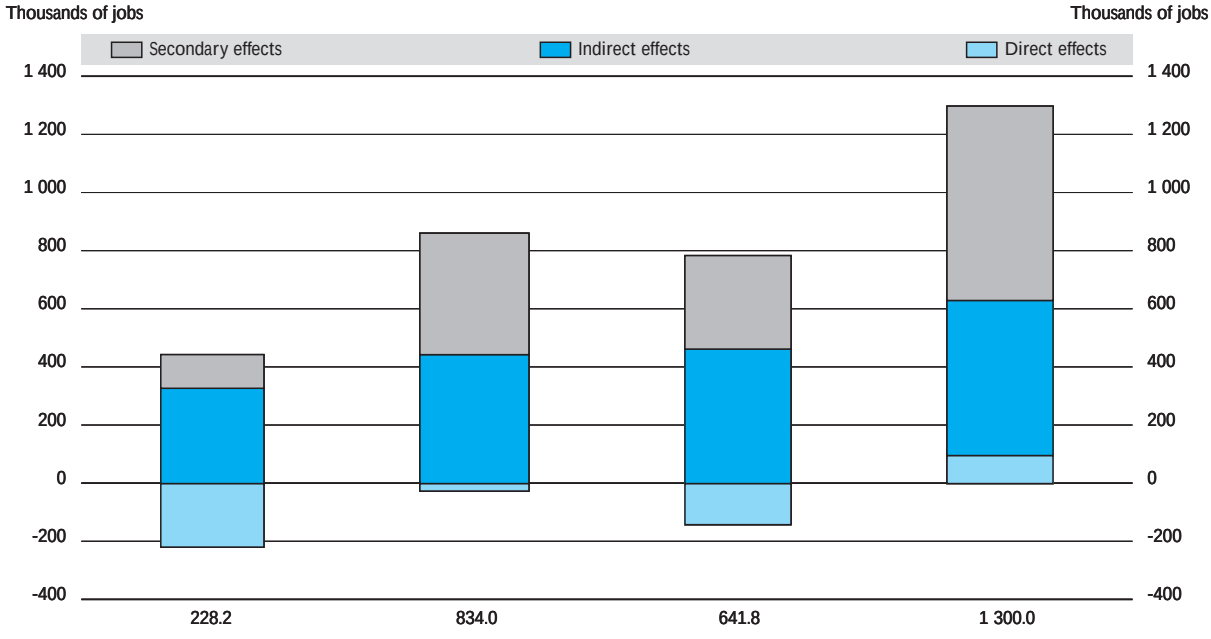
Liberalisation	Technology diffusion			
	Slow		Rapid	
	2000	2005	2000	2005
Gradual	121 000	228 200	374 500	834 000
Rapid	291 700	641 800	49 020	1 300 300

Source: European Commission, 1997*f*.

The overall impact was estimated through four stages:

– job destruction at dominant operators;
– job creation at other providers of telecommunication services (emergence of new operators and services);
– jobs generated by purchases of intermediate goods and equipment by the rest of the economy (rise in the volume of telecommunication activity, price reductions that translate into higher consumer purchasing power, and lower cost/higher productivity for companies, investment and productivity gains and greater competitiveness);
– macroeconomic benefits via the improvement in employment and corporate investment.

Figure A4.1. ***Job creation is due to indirect and secondary effects***



Source: European Commission, 1997*f*.

Annex 4.5.

THE "SKILLS SHORTAGE"

This section first attempts to assess whether electronic commerce is generating demand for skills or for new skills which cannot be met at the rate necessary for its development, thereby generating or exacerbating what is currently seen as a critical shortage of information technology (IT) workers.

In 1996, 4.2 million people worked in IT-related occupations in the United States, and the number is expected to reach 5.6 million by the year 2006.[6] A survey of medium-sized and large US companies by the Information Technology Association of America (ITAA) concluded that there are about 346 000 unfilled IT jobs in the United States today owing to a shortage of qualified workers (ITAA, 1998). In another study, conducted by Coopers and Lybrand, nearly half of the chief executive officers (CEOs) of America's fastest-growing companies reported that they had inadequate numbers of IT workers. According to an *Information Week* survey of 400 top-level managers, the jobs in shortest supply are IT professionals, followed by network administrators, database administrators, and system administrators. Some 80 per cent of managers said that they currently have IT job vacancies, and nearly a quarter said that the vacancy rate reaches 10 per cent of all IT jobs in their organisations. Wages in US ICT industries are 73 per cent higher than in other private industries (American Electronics Association, 1997) and have been growing at higher than average rates over the period 1985-96 (Annex Table 4.12). The US Bureau of Labor Statistics estimates that an additional 1.3 million workers will be needed in the period 1996-2006 (Margherio et *al.*, 1998).

Annex Table 4.12. **US workers' annual wages in ICT industries**

Average annual growth rate, 1985-96 (%)

Average of all private industries	3.8
ICT industries	**5.2**
Hardware	5.1
Software/services	6.6
Communications equipment	4.1
	4.3

Source: Margherio *et al.*, 1998.

This has been called a "critical shortage" of qualified IT personnel and has received great attention in the United States, but it is not a trend peculiar to that country. Annex Table 4.13 presents some estimates of IT skills needs across countries.

Annex Table 4.13. **IT jobs unfilled owing to skill shortages**

	Current estimate of unfilled jobs	Source
World	600 000	European Information Technology Observatory
United States	190 000	Information Technology Association of America[1]
United States	346 000	Information Technology Association of America[2]
United States	450 000	Microsoft
Germany	60 000	European Information Technology Observatory
Canada	20 000/30 000	US Office of Technology Policy
United Kingdom	20 000	European Information Technology Observatory

1. February 1997 survey.
2. January 1998 survey, with a different sample including small business and definition of the "core" IT workers.

Source: OECD, compiled from various sources.

Employment in the European IT industry declined from 940 000 in 1995 to 935 000 (1.1 per cent of total employment) in 1996. The hardware sector was particularly affected (–7 per cent), while the software, services and distribution sectors showed a slight increase (10 000 more employees in 1996 than in 1995). This was due to the Year 2000 problem and to the deployment of Internet-based hardware and software technology which generated both demand for staff skilled in Internet technology, who are rarely available in IT departments, and increased outsourcing of functions (EITO, 1998).

Germany seems to have more than 50 000 ICT jobs for which there is no skill match, and UK industry needs 30 000 IT recruits (while only 10 000 computer science and information systems graduates leave UK universities yearly) (EITO, 1998). In Birmingham, the second largest city in the United Kingdom, one recruitment agency reports that it cannot find computer programmers for less than £80 ($133.80) an hour. Pertemps, a national UK recruitment agency, is spending more than £1 million on IT recruitment this year; however, it still cannot fill 4 500 vacancies for jobs paying up to £1 000 a day. The shortage is driven by demand for programmers using new-generation information systems and for solving the Year 2000 problem (*Financial Times*, 30 March 1998).

Some developing countries may also soon experience a shortage of IT skills. India has a work force of approximately 160 000 high-skilled software professionals (1996-97). Although it supplies graduates at a pace of about 55 000 a year, this may be insufficient to keep pace with a software industry that is growing at over 40 per cent a year (ITAA, 1997).

In other countries, local IT development strategies can create skill shortages. As an essential part of its long-term development strategy, Malaysia is creating a "multimedia supercorridor" (a 9 x 30 mile IT centre) that is expected to boost the country's technological development. At the moment, however, Malaysian universities are producing less than 6 000 IT engineers a year for an estimated annual demand of 10 000.

"If the information technology industry were experiencing shortages, market pressure would be likely to raise salaries for IT workers more rapidly than for other professional workers" (Lerman, 1998). However, Lerman shows that the pattern of US median salary levels for computer scientists, operations researchers, and computer programmers has been essentially flat and not very different from that of US professionals overall through 1996, thereby calling into question the existence of a real shortage and attributing the 1997 median wage rises to the Year 2000 problem. Nonetheless, there is evidence that demand is growing much faster than educational capacity (ITAA, 1997), but increased demand for software professionals may not translate promptly into increased average wages, owing to the specificity of the software industry labour market.

Barr and Tessler (1998) segment the software industry into three tiers characterised by different labour dynamics (Annex Table 4.14). In the top tier, higher wages are matching increased demand for software professionals; however, this segment only employs about 10 per cent of overall software personnel. The third tier does not seem able to deal with the skills shortage. It is in the second that almost all the dynamics are to be found. According to the authors, some firms in this tier are able to offer higher salaries for small, specially recruited teams of software programmers, but most software-related positions are filled by those willing to accept the salaries offered. Some of these firms, because they do not recognise the key role of software personnel, incur massive losses. Data shows that 33 per cent of projects are seriously delayed and/or over budget and that another 40 per cent are abandoned completely (Barr and Tessler, 1998).

Annex Table 4.14. **Different labour dynamics within the software industry**

Segment	Users of software professionals	Market dynamics	Response
1	Venture-capital-funded software start-ups, "boutique" software service firms, software publishing houses	Attract best software talent, shortage felt only recently	Dramatic salary increases, aggressive recruiting practices
2	Computer and other high-tech equipment manufacturers, communication companies, financial services, and other IT-intensive industries	Shortage apparent for many years, outdated management practices give software talent lower status and wages	Hire less experienced software personnel to contain wages, projects are delayed or abandoned
3	Manufacturing, government	No executive-level awareness of the key role of software	No response to labour market changes

Source: Adapted from Barr and Tessler, 1998.

Is the skills shortage a lasting trend or a cyclical peak exacerbated by the Year 2000 problem? According to the Stanford Computer Industry Project (SCIP), the shortage of software talent is universal, is not limited to any specific technology, such as Java, SAP or Year 2000 workers, and extends to all industries (Barr and Tessler, 1998). Certainly the Year 2000 problem increases the need for workers with IT skills, and analysts report that the United States is only prepared for about 10-20 per cent of the workload, while world-wide preparation is minimal. Demand for software professionals nonetheless seems to be driven by the Internet (Joyce Plotkin, Executive Director of the Massachusetts Software Council, http://www.techworkforce.org/skill.htm).

NOTES

1. A database with financial income statements of publicly traded firms (US Securities and Exchange Commission).
2. DIW, German Institute for Economic Research, "Multimedia: Forecasts of Employment Growth in the Media and Communications Sectors Often Exaggerated", as reported in Databank Consulting (1997).
3. Amano and Blohm measure the US market capitalisation of 65 publicly traded leading Internet-related firms at the end of 1996. An "Internet weight" is attributed to each of these firms in order to roughly measure their related Internet value and employment. According to their calculations, US Internet-related jobs in 1996 amounted to approximately 760 000.
4. According to a recent survey of Internet service providers (ISPs) in Europe, carried out by Databank Consulting, IDATE and TNO for the European Commission, about 34 per cent of the sample originates from the telecommunications industry, 33 per cent from the IT industry, about 10 per cent is related to a scientific community, only one explicitly originates from the marketing sector, and only about 8 per cent are start-ups. About 38 per cent of the ISPs interviewed had less than 10 employees, 25 per cent of the sample had between 10 and 20 employees; another group had between 20 and 100, and only a minority had over 100.
5. The survey (March 1997) defined ISPs as any organisation that uses the TCP/IP networking protocol and offers services to the general public; it did not include online service providers such as America Online, which uses proprietary networking protocols.
6. Department of Commerce (Margherio *et al.*, 1998) definition of IT-related occupations; US Bureau of Labor Statistics data and employment forecast.