The ICT sector in Belgium

François Coppens
Arnaud Hermesse
David Vivet

Introduction

This document is divided into five chapters. The first chapter explains the definition of the ICT (information and communication technologies) sector used in this study. On the basis of that definition, the second chapter estimates the economic importance of the sector in Belgium in terms of the number of firms, value added, employment, foreign trade and investment. Chapter 3 offers another assessment of the ICT sector, different from the "sectoral" approach used in the second chapter[1]. This alternative method, called the "product" approach in the remainder of this document, is not based on a definition of the ICT sector but on a description of the ICT products; it assesses the branch from a different angle, on the basis of the data from the supply-use tables for the Belgian economy. That is followed by an international comparison showing how both Belgium and the European Union stand in relation to the rest of the world, and especially the United States. Finally, the last chapter comprises a financial and social analysis of ICT firms on the basis of the annual accounts deposited with the Central Balance Sheet Office; this chapter also contains an analysis of the financial risks of the sector, based on the results of a model for predicting corporate defaults.

1. Definition of the ICT sector

The ICT sector is particularly difficult to define, partly because its boundaries are so vague and it is increasingly interwoven with the rest of the economy. Most of the literature on this sector uses the definition proposed by the OECD in 1998. The OECD defined the ICT sector as a combination of industrial sectors and service branches which satisfy the following principles:

"For manufacturing industries, the products of a candidate industry:
- *must be intended to fulfil the function of information processing and communication including transmission and display;*
- *must use electronic processing to detect, measure and/or record physical phenomena or control a physcal process.*

For services industries, the products of a candidate industry:
- *must be intended to enable the function of infor-mation processing and communication by electronic means."*[2]

On the basis of these principles, the OECD determined which branches belong to the ICT sector. The international organisation points out that this definition is only an initial approximation of the sector, and that it needs to be improved in the future, particularly by means of more detailed national sectoral classifications. In that connection, it is worth mentioning that the United States revised its nomenclature of activities in 1997, partly to take better account of ICT activities.

(1) In fact, the term "sector" should be avoided as far as possible when referring to a branch of activity (branch or industry). In the terminology of the national accounts, which are also calculated by the National Bank via the National Accounts Institute, "sector" refers to an institutional group such as households, non-financial corporations, etc. (see ESA95 methodology). In practice, however, and certainly for the non-specialist public, "sector" is a synonym for "branch". For the convenience of the reader, this study will therefore also use the two words as synonyms.

(2) See OECD (2001).

TABLE 1 DEFINITION OF THE ICT SECTOR

Subsectors	NACE-BEL	Name
ICT industry	30.0	Manufacture of office machinery and computers
	31.3	Manufacture of insulated wire and cable
	32.1	Manufacture of electronic components
	32.2	Manufacture of transmitters
	32.3	Manufacture of audio and video equipment
	33.2	Manufacture of scientific and technical instruments
	33.3	Manufacture of industrial process control equipment
ICT distribution	51.43	Wholesale of electrical household appliances and audio and video equipment
	51.64	Wholesale of office machinery and equipment
	52.487	Retail of office machinery and computers
	71.33	Renting of office machinery and computers
Telecommunications	64.20	Telecommunications
Computer & related activities	72	Computer & related activities

On that basis the US Department of Commerce devised a definition of the ICT sector which is fairly similar to the OECD definition (1).

This study uses the OECD definition, albeit with two adjustments (cf. *infra*). The ICT sector was also subdivided into four subsectors with homogeneous activities: ICT industry, ICT distribution, telecommunications, and computer & related activities. The composition of the ICT sector and the subsectors is described in table 1.

That definition is fairly close to the one given by the OECD, but two changes have been made to take account of the actual situation in Belgium. First, the NACE branch 51.65 ("Wholesale of other machinery for use in industry and trade") was disregarded because it is of little relevance for Belgium. Although a number of companies in that branch are active in the field of ICT (mainly selling electronic equipment), the principal activities of that sector are not connected with the new technologies (2). Also, the OECD definition does not cover the activities of ICT retailing, because many national nomenclatures in that area are very inaccurate. However, in Belgium, the NACE branch 52.487 ("Retail of office machinery and computers") makes it possible to separate some of those activities. That is why firms classified in that branch are included in the analysis.

The definition used is open to criticism (3). The two main objections are connected with the incompleteness of the sectoral classification system.

First, with that system it is not possible to isolate the ICT activities altogether. Some of the branches studied are too large and in some cases they contain activities which have little to do with information technologies. For instance, branch 33.2 ("Manufacture of scientific and technical instruments") includes the manufacture of drawing instruments and thermometers. Another example is branch 51.43 ("Wholesale of electrical and household appliances and audio and video equipment"), which – as the name indicates – also covers trade in coffee percolators, toasters and lighting equipment. Despite these shortcomings, those branches were still included in the analysis because a major part of their activities is connected with ICT. A number of the branches not studied here also engage in ICT activities, albeit it to a limited extent. For example, that applies to branch 51.65 mentioned above ("Wholesale of other machinery for use in industry and trade").

Second, the classification system allocates firms to a branch on the basis of their main activity. This means that firms with secondary ICT activities are classed in branches which do not belong to the ICT sector as defined here, which

(1) For example, see US Department of Commerce (2000).

(2) The OECD stresses that, if possible, wholesale activities should include only activities relating to ICT.

(3) For the objections relating to the definition and evaluation of the scope of the ICT sector, see for example Gadrey J. (2000), and Didier M. and Martinez M. (1998).

therefore rules them out of the analysis. That problem arises, for instance, in the case of companies providing business services.

An alternative approach based on the supply-use tables for the Belgian economy goes part of the way towards dealing with the objections mentioned above; this document will subsequently refer to that method as the "product" approach. It is discussed in Chapter 3. Since the ICT output of each branch of the economy can be determined fairly accurately by that method, it casts a new light on ICT in Belgium while also making it possible to test the approach on the basis of the definition of the ICT sector.

Finally, it must be pointed out that the "content" sector, mentioned in some studies on the subject of ICT[1], was not examined by the "sectoral" approach. Although that sector makes increasing use of ICT goods and services, it clearly does not belong to the ICT sector as defined here[2]. The content sector comprises firms which produce or have the facilities for producing data products or services on electronic media. Examples include the music industry and publishers distributing digital versions of their publications (daily newspapers). Some studies take account of the content sector because the firms concerned have the technical capability to distribute their products via the internet or in other electronic forms, and because it is therefore assumed that the sector spends large sums on the purchase of ICT products and the recruitment of IT experts. The content sector is therefore not an ICT producer but an ICT user: the "product" approach will confirm that view. For that reason, the said sector was not included in the "sectoral" analysis.

2. Economic weight of the ICT sector in Belgium – "sectoral" approach

The weight of the ICT sector in Belgium was estimated on the basis of the data supplied by the National Accounts Institute (NAI). The analysis focused on the number of firms, value added, employment, investments and foreign trade of the sector. To facilitate a comparison, the ICT branches were studied together with their reference sector: ICT industry was compared with industry as a whole (NACE-BEL codes C and D), ICT distribution was compared with trade as a whole (NACE-BEL code G), and finally, telecommunications and computer & related activities were compared with market services as a whole excluding trade (NACE-BEL codes H to K).

2.1 Number of firms

In 2002 the ICT sector consisted of over 20,500 VAT-registered firms, 63 p.c. of them in data computer & related activities, 29 p.c. in distribution, 5 p.c. in telecommunications and 3 p.c. in industry (table 2). The number of firms active in ICT has grown constantly since the 1990s, namely from 12,573 in 1995 to 20,577 in 2002, an increase of 64 p.c. The lion's share (almost 80 p.c.) of that growth is due to computer & related activities. The number of firms active in telecommunications, which was fairly small in 1995, has more than quadrupled over the same period, partly as a result of deregulation of the sector and the development of new technologies. In contrast, the number of firms in ICT industry and ICT distribution has remained fairly stable.

(1) See for example the Federal Planning Bureau (2002) and the Central Bureau of Statistics (2002).

(2) It must be said that in the study by the Dutch Central Bureau of Statistics the content sector is viewed separately from the branches producing ICT goods and services.

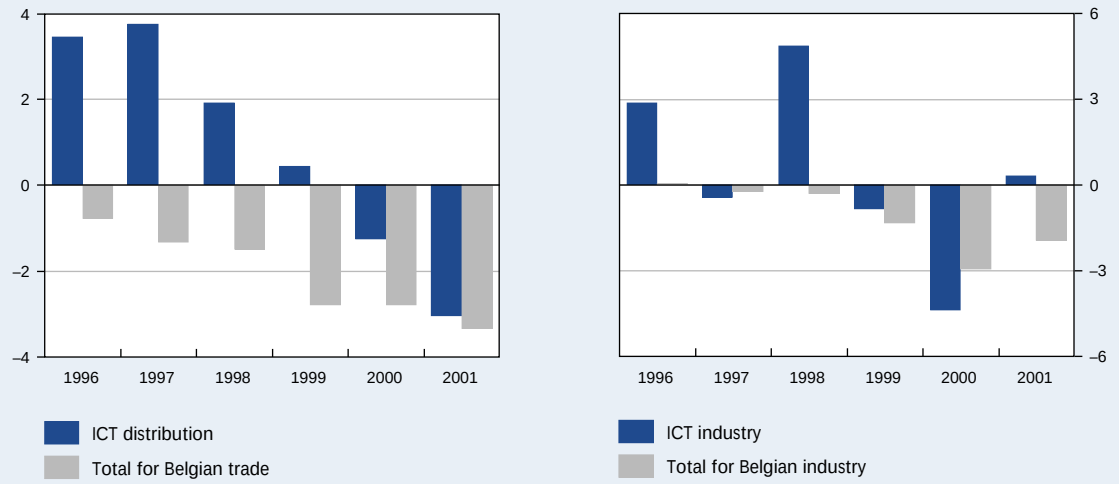
TABLE 2 NUMBER OF VAT-REGISTERED FIRMS

	1995	1996	1997	1998	1999	2000	2001	2002
ICT industry	664	682	679	712	706	677	686	684
ICT distribution	5,028	5,291	5,548	5,746	5,955	6,054	6,044	6,002
Telecommunications	215	270	376	459	568	690	823	954
Computer & related activities	6,666	7,132	7,725	8,596	9,378	10,716	12,177	12,937
Total ICT	12,573	13,375	14,328	15,513	16,607	18,137	19,730	20,577
Total Belgium	556,792	562,452	565,652	569,907	566,330	566,883	565,991	561,981
Share of ICT (in p.c.)	2.3	2.4	2.5	2.7	2.9	3.2	3.5	3.7

Source: NAI.

CHART 1 GROWTH OF THE NUMBER OF VAT-REGISTERED FIRMS IN ICT DISTRIBUTION, ICT INDUSTRY AND THEIR REFERENCE SECTOR

(Percentage changes)



Source : NAI.

The total number of firms in Belgium has grown considerably more slowly than in the ICT sector, namely from 556,792 in 1995 to 561,981 in 2002, a rise of under 1 p.c. However, while the number of Belgian firms actually declined in 2002, the number of ICT businesses continued to grow, albeit somewhat more slowly. As a result, the share of ICT firms in the Belgian economy rose from 2.3 p.c. in 1995 to 3.7 p.c. in 2002.

Furthermore, even ICT distribution and ICT industry, sectors which – during the period under review – had to contend with several years of weakening activity, performed a great deal better than their reference sector (chart 1). For example, between 1996 and 2001 the number of commercial firms declined steadily, whereas the number of firms in ICT distribution increased until 2000, after which there was a fall, but it was less marked than in the reference sector.

TABLE 3 NUMBER OF EMPLOYERS

	1995	1996	1997	1998	1999	2000	2001	Percentages of employers (2001)
ICT industry	242	234	234	246	259	263	271	40
ICT distribution	2,188	2,249	2,322	2,366	2,411	2,401	2,457	41
Telecommunications	53	79	129	165	181	214	260	32
Computer & related activities	1,458	1,568	1,719	1,848	1,984	2,215	2,458	20
Total ICT	3,940	4,130	4,404	4,624	4,835	5,094	5,446	28
Total for Belgium	176,495	177,286	185,330	187,339	188,138	189,399	195,865	35
Share of ICT (in p.c.)	2.2	2.3	2.4	2.5	2.6	2.7	2.8	

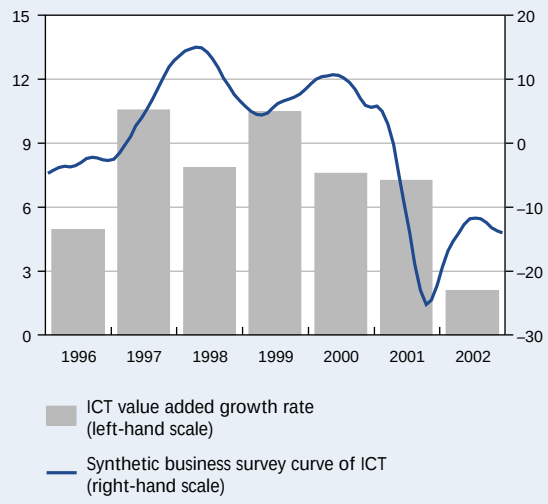
Source : NAI.

Finally, the number of ICT firms employing staff generally followed the same trend as the number of VAT-registered firms (table 3). However, the increase in the number of employers was smaller, especially in the computer & related activities sector where a high proportion of the newly established firms consists of very small entities run by self-employed persons. As a result, in 2001 the percentage of employers[1] active in computer & related activities (20 p.c.) was decidedly lower than the figure for the Belgian economy as a whole (35 p.c.).

2.2 Value added

The value added figure estimated for the ICT sector for the "sectoral" approach was 11,300 million euro (at current prices) in 2002, with telecommunications accounting for 40 p.c., computer & related activities 29 p.c., distribution 16 p.c. and industry 15 p.c. (table 4). While the total value added in the Belgian economy grew by 26 p.c. between 1995 and 2002, the figure for ICT was up by almost 63 p.c. over the same period. The bulk of that increase is due to computer & related activities and telecommunications. As a result of this strong growth, ICT's contribution to Belgium's total value added increased from 3.65 p.c. to 4.71 p.c. (table 5). Today, the ICT sector represents an economic weight comparable to the share of the chemical industry and the rubber industry.

CHART 2 CONFIDENCE AND ECONOMIC ACTIVITY IN THE ICT SECTOR[1]



Source : NBB.

(1) Smoothed and seasonally adjusted confidence curve for all ICT sectors together (industry, distribution and services).

Although the value added of the ICT sector grew significantly faster than that of the Belgian economy as a whole between 1995 and 2002, the ICT sector did not escape the current weakness of the Belgian economy. As is evident from the economic activity curve (chart 2), the confidence of Belgian ICT firms deteriorated from June 2000 onwards, before plummeting in 2001.

This is due to two phenomena which hit the sector worldwide. First, share prices of ICT companies suffered a very sharp correction from the first quarter of 2000, as a result of downgrading of their profit forecasts. Second, corporate investment in ICT equipment declined from 2001, partly because of the very high or even excessive level reached in the second half of the 1990s[2].

Despite that unfavourable climate, the ICT sector's value added (measured at current prices) in 2000 and 2001 produced respectable annual growth of over 7 p.c. (chart 2). However, the sector's "resistance" ended in 2002 when its value added growth rate dropped to 2.1 p.c., very close to the figure for the Belgian economy as a whole. The question is whether the ICT sector will ever succeed in matching the growth achieved in the second half of the 1990s. In Europe, some ICT products such as mobile telephony and personal computers, reached a degree of penetration that it will be difficult to improve on in the future : the market in those products is nowadays primarily a replacement market. However, other products such as internet connections could yet win new customers, while the development of new technologies (such as "wireless" applications) could also generate renewed growth.

Between 1995 and 2002 three of the four ICT subsectors grew faster than their reference sector (chart 3). The most impressive performance was produced by computer & related activities, where growth was five times higher than in the reference sector (services). Only the ICT industry lagged far behind its reference sector ; indeed, this subsector is losing a great deal of ground compared to many other countries. According to an OECD study which compares the weight of the ICT industry in relation to industry as a whole for 25 countries, the Belgian ICT industry is in 18th place. That study also confirms that the manufacture of computers in Belgium is virtually non-existent, in comparison with other countries studied[3].

(1) That is the ratio between the number of employers and the number of VAT-registered firms.

(2) On these two points, see National Bank of Belgium (2002 and 2003).

(3) OECD (2002).

TABLE 4 VALUE ADDED OF THE ICT SECTOR AT CURRENT PRICES

(Millions of euros)

	1995	1996	1997	1998	1999	2000	2001	2002	Change 1995-2002	Growth (in p.c.) 1995-2002
ICT industry	1,600	1,626	1,842	1,632	1,779	2,144	1,795	1,713	+113	+7
Manufacture of office machinery and computers	107	111	107	99	87	79	77	67	–40	–38
Manufacture of insulated wire and cable	264	265	260	261	246	292	281	274	+10	+4
Manufacture of audio, video and communications equipment	1,105	1,122	1,330	1,137	1,313	1,610	1,277	1,206	+101	+9
Manufacture of scientific and technical instruments and industrial process control equipment	123	128	145	134	132	164	160	166	+42	+34
ICT distribution	1,266	1,280	1,316	1,458	1,536	1,704	1,785	1,786	+520	+41
Wholesale of office machinery and equipment, electrical household appliances and audio and video equipment	1,078	1,085	1,120	1,188	1,252	1,373	1,422	1,410	+332	+31
Retail of office machinery and computers	88	100	103	108	135	140	147	152	+64	+73
Renting of office machinery and computers	100	95	93	163	148	191	216	224	+124	+110
Telecommunications	2,871	3,074	3,300	3,546	3,812	3,871	4,126	4,564	+1,693	+59
Computer & related activities	1,200	1,300	1,591	2,046	2,465	2,602	3,363	3,238	+2,038	+170
Total ICT	6,937	7,280	8,049	8,682	9,592	10,321	11,069	11,301	+4,364	+63
Total Belgian economy	190,125	194,278	202,536	210,343	218,718	228,744	235,110	239,770	+49,645	+26

Sources: NAI, own estimates.

TABLE 5 SHARE OF THE ICT SUBSECTORS IN THE TOTAL VALUE ADDED OF THE BELGIAN ECONOMY, AT CURRENT PRICES

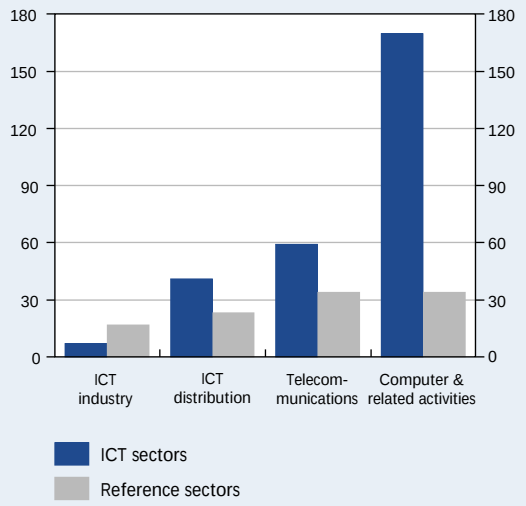
(Percentages)

	1995	1996	1997	1998	1999	2000	2001	2002	Profit 1995-2002
ICT industry	0.84	0.84	0.91	0.78	0.81	0.94	0.76	0.71	–0.13
ICT distribution	0.67	0.66	0.65	0.69	0.70	0.74	0.76	0.74	+0.07
Telecommunications	1.51	1.58	1.63	1.69	1.74	1.69	1.75	1.90	+0.39
Computer & related activities	0.63	0.67	0.79	0.97	1.13	1.14	1.43	1.35	+0.72
Total	3.65	3.75	3.97	4.13	4.39	4.51	4.71	4.71	+1.06

Sources: NAI, own estimates.

CHART 3 GROWTH RATE OF VALUE ADDED BETWEEN 1995 AND 2001 IN THE ICT SUBSECTORS AND THEIR REFERENCE SECTOR

(Percentages)



Sources : NAI, own estimates.

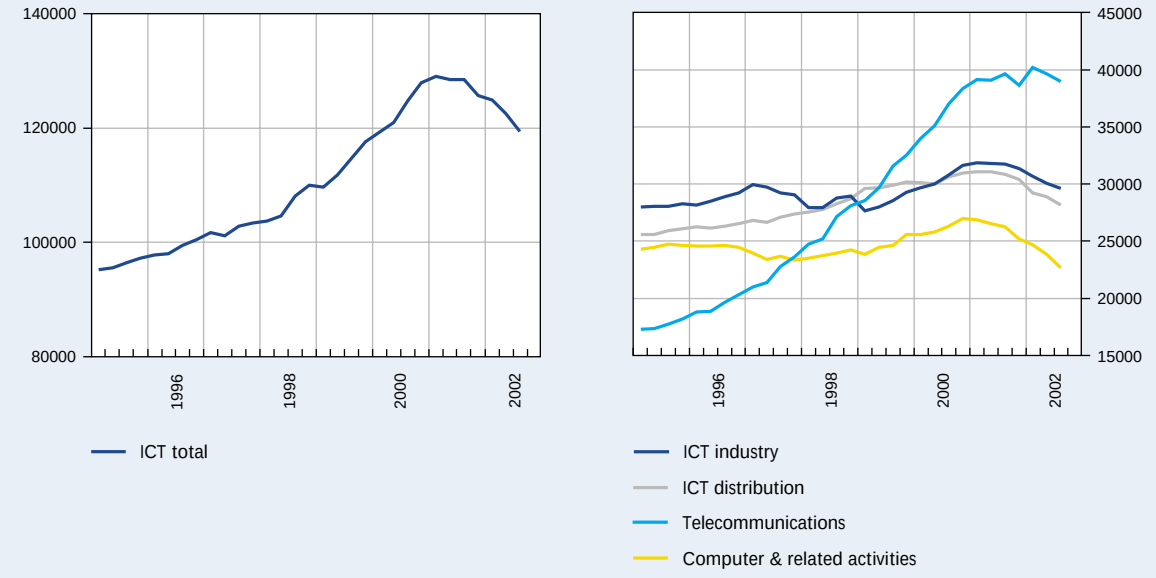
2.3 Employment

According to the estimates produced by the sectoral approach, almost 144,000 people worked in the ICT sector in 2002, 85 p.c. drawing wages (table 6). That employment is broken down as follows : 34 p.c. in computer & related activities, 27 p.c. in ICT distribution, 22 p.c. in telecommunications and 17 p.c. in ICT industry. While total employment in Belgium grew by 8 p.c. between 1995 and 2002, growth of employment reached 22 p.c. in the ICT sector over the same period, and 26,000 jobs were created. Over 80 p.c. of the new ICT jobs came about in the computer & related activities sector. As a result of that strong growth, the share of ICT in Belgian employment grew to 3.43 p.c. in 2002 (table 7).

The ICT sector was therefore an important source of employment for the Belgian economy. However, as in the case of value added, the sector did not escape the general deterioration in the economic climate : chart 4 shows that, after peaking in the first quarter of 2001, employment in the ICT sector dropped back from the second quarter of the same year, thus following the trend in Belgian domestic employment after a time-lag of a few months. The

CHART 4 QUARTERLY EVOLUTION OF PAID EMPLOYMENT IN THE ICT-SECTOR

(Number of persons)



Sources : NAI, MEL, own estimates.

TABLE 6 EMPLOYMENT IN THE ICT SECTOR

(Number of persons)

	1995	1996	1997	1998	1999	2000	2001	2002	Change 1995-2002	Growth (in p.c.) 1995-2002
ICT industry	25,713	25,772	24,847	25,081	25,889	27,413	27,462	24,958	- 754	- 3
Manufacture of office machinery and computers	909	825	875	900	952	941	854	817	–93	–10
Manufacture of insulated wire and cable	3,517	3,389	3,396	3,386	3,188	3,269	3,332	3,263	–254	–7
Manufacture of audio, video and communications equipment	17,926	17,761	16,748	16,943	17,796	19,161	19,149	16,877	–1,049	–6
Manufacture of scientific and technical instruments and industrial process control equipment	3,360	3,797	3,828	3,851	3,954	4,043	4,127	4,001	+641	+19
ICT distribution	35,582	36,572	37,197	38,388	40,345	40,792	41,127	38,940	+3,358	+9
Wholesale of office machinery and equipment, electrical household appliances and audio and video equipment	33,101	33,952	34,407	35,413	37,026	36,841	36,634	34,308	+1,208	+4
Retail of office machinery and computers	2,158	2,229	2,373	2,570	2,897	3,491	3,878	4,002	+1,844	+85
Renting of office machinery and computers	323	392	416	404	421	460	615	629	+306	+95
Telecommunications	29,470	30,075	30,879	29,759	29,720	31,866	33,012	31,453	+1,983	+7
Computer & related activities	26,778	28,567	31,318	35,327	39,519	44,955	47,880	48,276	+21,497	+80
Total ICT	117,542	120,985	124,241	128,554	135,473	145,026	149,482	143,626	+26,084	+22
Total Belgian economy	3,894,300	3,907,000	3,941,800	4,011,500	4,063,100	4,139,100	4,197,600	4,191,000	+296,700	+8

Sources: NAI, MEL, own estimates.

TABLE 7 THE SHARE OF ICT IN TOTAL EMPLOYMENT IN BELGIUM

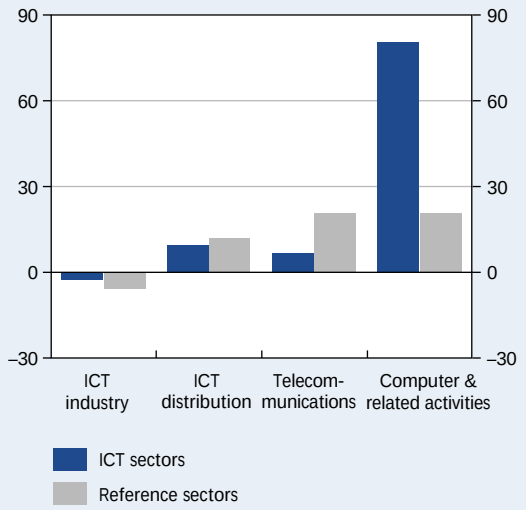
(Percentages)

	1995	1996	1997	1998	1999	2000	2001	2002	Change 1995-2002
ICT industry	0.66	0.66	0.63	0.63	0.64	0.66	0.65	0.60	–0.06
ICT distribution	0.91	0.94	0.94	0.96	0.99	0.99	0.98	0.93	+0.02
Telecommunications	0.76	0.77	0.78	0.74	0.73	0.77	0.79	0.75	–0.01
Computer & related activities	0.69	0.73	0.79	0.88	0.97	1.09	1.14	1.15	+0.46
Total	3.02	3.10	3.15	3.20	3.33	3.50	3.56	3.43	+0.41

Sources: NAI, MEL, own estimates.

CHART 5 GROWTH RATE OF EMPLOYMENT BETWEEN 1995 AND 2002, IN THE ICT SECTORS AND IN THEIR REFERENCE SECTORS

(Percentages)



Sources : NAI, MEL, own estimates.

decline in employment in the ICT sector originates from three of the four ICT subsectors : industry, distribution and telecommunications. The computer & related activities subsector stagnated, thus showing greater resistance. The future will tell whether the new technologies can still create jobs once the economic climate takes a turn for the better.

(1) On the link between technical progress and employment, see for example Sauvy A. (1980).

It must also be stressed that, for several years now, Belgian companies (taking all sectors together) have been outsourcing some or all of their data processing work, and that trend appears to be continuing at present. Of course, this may explain part of the spectacular growth of the computer & related activities sector. It must also be said that the mass use of ICT in the economy as a whole caused job losses in numerous firms. Although it is virtually impossible to estimate the exact extent of the job losses, that indirect effect also puts into perspective the impact of job creation in the ICT sector[1].

Finally, as may be seen from chart 5, not all ICT subsectors produced higher growth of employment than their reference sector during the 1995-2002 period. While the growth of ICT industry and distribution was very similar to that in the reference sectors, telecommunications lagged well behind the service sector as a result of very high capital intensiveness. Just as in the case of value added, it was computer & related activities that produced the most impressive performance, where the growth of employment was four times higher than in the service sector as a whole. The large-scale job creation in services relating to ICT is a common feature for all OECD countries, where employment in ICT industry is generally producing weak growth or even declining.

2.4 Investment

In 2002 the investments of the ICT branches came to over 2.5 billion euro, representing 4.9 p.c. of total investment in Belgium (table 8). The telecommunications branch, a highly capital-intensive sector, invested by far the most. Investment by the ICT branches grew rapidly until 2001, with computer & related activities and telecommunications

TABLE 8 INVESTMENT BY THE ICT BRANCHES, AT CURRENT PRICES

(Millions of euros)

	1995	1996	1997	1998	1999	2000	2001	2002
ICT industry	354	462	510	440	379	418	319	273
ICT distribution	210	250	262	312	285	357	351	351
Telecommunications	971	1,174	1,251	1,222	1,226	1,472	1,823	1,533
Computer & related activities	136	169	193	240	499	447	453	374
Total ICT	1,671	2,055	2,215	2,214	2,390	2,694	2,946	2,531
Total Belgium	40,192	41,156	44,338	46,444	49,308	52,626	53,091	51,558
Share of ICT (in p.c.)	4.2	5.0	5.0	4.8	4.8	5.1	5.5	4.9

Source : NAI.

TABLE 9 FOREIGN TRADE IN ICT GOODS
(Millions of euros)

	1995	1996	1997	1998	1999	2000	2001	2002
Export	5,216	6,237	7,146	7,902	8,172	12,025	12,380	10,122
Import	6,077	7,280	8,588	9,364	10,531	14,367	14,943	12,399
Balance	-861	-1,044	-1,443	-1,462	-2,359	-2,343	-2,564	-2,277

Source : NAI.

accounting for the major part of that growth. As in the case of value added and employment, the sums invested grew at a substantial rate in computer & related activities. However, in 2002 the ICT sectors followed the general downward trend of the Belgian economy.

It should also be pointed out that the ICT branches themselves invest very heavily in ICT. While 16 p.c. of investment in the Belgian economy as a whole goes on ICT products, the figure is around 70 p.c. for the ICT sector.

2.5 Foreign trade and foreign direct investment

Before concluding this chapter, it is worth just taking a look at foreign trade in ICT and at the sector's relations with other countries. In view of the relative importance of a sectoral approach to foreign trade, points 2.5.1 and 2.5.2 focus not on the foreign trade of the four ICT subsectors but on foreign trade in ICT goods and services. This is described in detail in this chapter.

2.5.1 Foreign trade in ICT goods

While the Belgian economy as a whole traditionally has a trade surplus, the balance is negative for ICT products owing to the underdeveloped ICT industry in Belgium. In 2002 the Belgian economy's net imports of ICT products were worth almost 2.3 billion euro (table 9). This negative balance is attributable mainly to massive imports of computers and data processing hardware. The deficit on the balance of trade in ICT has also risen considerably since the mid 1990s, when it was just under 0.9 billion euro. Exports, imports and the balance increased continually in size until 2000, before stabilising in 2001 and then contracting sharply in 2002. Thus, Belgian foreign trade in ICT did not escape the global downturn in trade in the new technologies.

2.5.2 Foreign trade in ICT services

The Balance of Payments figures can be used to provide a summary of Belgium's current transactions in information and telecommunications services. In contrast to the balance for ICT goods, the balance is positive in the case of ICT services, totalling 553 million euro in 2002 (table 10). For telecommunications, in particular, that surplus is evidently due to the intensive use of the Belgian network

TABLE 10 BALANCE OF PAYMENTS IN ICT SERVICES
(Millions of euros)

	1995	1996	1997	1998	1999	2000	2001	2002
Credit	999	1,229	1,463	1,755	2,303	2,813	3,112	2,920
Debit	576	700	930	1,208	1,567	2,043	2,343	2,367
Balance	+423	+529	+533	+547	+735	+770	+769	+553

Source : NBB.

TABLE 11 EQUITY OF FOREIGN SUBSIDIARIES OF BELGIAN ICT COMPANIES
(Millions of euros)

	1996	1997	1998	1999	2000	2001
ICT industry	320	114	614	610	802	1,478
ICT services	239	257	501	1,292	2,337	3,486
Total ICT	559	371	1,114	1,902	3,138	4,964
Total Belgium	20,793	27,900	37,695	44,150	75,053	88,879

Source : NBB.

by other countries and to the development of broadband services by businesses based in Belgium. As in the case of trade in ICT goods, the credit and debit figures and the net balance of ICT services grew steadily until 2000, before stabilising in 2001 and then dropping sharply in 2002.

2.5.3 Foreign direct investment

Foreign direct investment by Belgian ICT firms can be deduced from the surveys conducted by the NBB's Balance of Payments Unit. Confidentiality rules prevent publication of a breakdown for ICT distribution, telecommunications and computer & related activities. Those subsectors are therefore grouped together under the heading of ICT services in the tables in question.

In 2001 the equity of foreign subsidiaries of Belgian ICT companies totalled almost 5 billion euro, which is 5.6 p.c. of Belgium's total foreign direct investment (table 11). Recent years have seen very rapid growth in that equity, which increased ninefold between 1996 and 2001. According to the Agoria federation, the development of foreign subsidiaries in general meets the need to locate production closer to the new markets.

A further point is that reinvested profits (i.e. the net profit minus dividends paid out) of the foreign subsidiaries of ICT companies increased until 1999 before falling sharply to very negative values in 2000 and 2001 (table 12). Those massive losses occurred in the telecommunications subsector.

3. "Product" approach

3.1 Methodology

As stated in chapter 1, there are two serious pitfalls for the estimation of the economic weight of the ICT sector on the basis of the "sectoral" approach, connected with the defects in the sectoral classification system. Those pitfalls are the excessive size of some branches and the problem of additional activities in some firms. Yet the "sectoral" approach is applied systematically in publications on ICT, because it is relatively easy to use.

TABLE 12 PROFITS REINVESTED BY FOREIGN SUBSIDIARIES OF BELGIAN ICT COMPANIES
(Millions of euros)

	1996	1997	1998	1999	2000	2001
ICT industry	15	26	49	140	71	11
ICT services	–13	32	19	20	–538	–1,051
Total ICT	2	58	68	160	-467	-1,039
Total Belgium	819	1,266	2,052	1,611	1,953	–397

Source : NBB.

TABLE 13 DEFINITION OF ICT PRODUCTS

	Product names
ICT goods	– Office machinery
	– Computers and data processing equipment
	– Electronic components
	– Audio and video equipment
	– Radio and television sets; audio and video equipment and accessories
	– Measuring, adjustment and control equipment, including the automatic monitoring of industrial processes
ICT services	– Telecommunications services
	– Advice on the configuration of computers, software development, services relating to data processing and data banks
	– Maintenance and repair of computers and office machinery, other computer related activities

However, the difficulties mentioned can be circumvented by basing the assessment on a definition of ICT products (goods and services). The choice of products defined as ICT for the purposes of this document is based on the definition proposed by the OECD, which can be translated into the product codes used in the supply-use tables for the Belgian economy[1]. The products examined are described in table 13.

On the basis of that definition of ICT products, the supply-use tables developed by the National Accounts Institute can be used. Those tables indicate the various types of product supplied by each of the 121 branches of the Belgian economy. An ICT activity ratio can be calculated for each branch, equal to the output of ICT goods and services as a percentage of total output. Assuming that a particular part of the output of one branch corresponds to the same part of the value added and employment of the branch, the ratios can then be applied to the value added and employment figures available for the branches. This makes it possible to produce an estimate of the employment and value added relating to ICT for each branch of the economy.

(1) The methodology of the supply-use tables is described in the National Accounts Institute publications (2003).

TABLE 14 ICT ACTIVITY RATE FOR SOME BRANCHES OF THE BELGIAN ECONOMY (1999)

Branches	ICT activity rate (in p.c.)
ICT branches	
Manufacture of office machinery and computers	91.5
Manufacture of audio, video and communications equipment	93.3
Telecommunications	94.8
Computer & related activities	96.8
Branches not belonging to ICT	
Metalworking	3.5
Production of meat and meat products	0.1
Publishing, printing and reproduction of recorded media	0.4
Hotels	0.1
Legal services and accounting, market research and public opinion polling	3.5
Financial institutions	2.0

Sources : NAI, own estimates.

Table 14 shows the ICT activity rate for the branches defined as ICT and for other branches according to the "sectoral" approach. The ICT activity ratios for the ICT branches are high, but not equal to 100. Apart from their ICT activities, which represent over 90 p.c. of their output, those branches engage in activities which have nothing to do with the new technologies. For instance, almost 1.5 p.c. of the activity of the "Computer & related activities" branch consists of business and management consultancy.

At the same time, some branches which do not belong to ICT, such as metalworking or business services, also engage in ICT activities. Thus, 3.5 p.c. of the activity of the sector "Legal services and accountancy, market research and public opinion polling" consists of computer-related services.

Attention should be drawn to the fact that almost all branches of the Belgian economy produce computer-related services, generally to a limited extent. For example, the hotels branch or the production of meat and meat products have an ICT activity rate of 0.1 p.c. That is because the National Accounts Institute includes in the calculation of the output of the sectors the software that those firms develop for their own account. The employment and value added figures calculated on the basis of the "product" approach therefore take account, for all branches, of the activities of IT experts used for this type of work. The results are therefore not directly comparable with the data obtained via the "sectoral" approach, which only takes account of the above activities for the ICT branches.

It is also noticeable that the subsector publishing, printing and reproduction of recorded media, which is generally regarded as the core of the "content" sector, has an ICT activity rate of 0.4 p.c., attributable entirely to development of software in house for the companies'own account. That figure confirms the statement made in Chapter 1: although the content sector does not supply any ICT to other firms, it does make more use of the new technologies than the majority of the other sectors.

The principal contribution of the "product" approach is in circumventing the two problems which arise in the case of the "sectoral" approach (cf. supra): each branch is accorded an ICT activity rate that fairly accurately reflects the degree to which it is involved in the supply of ICT products. Thus, that method makes it clear that the sectors

TABLE 15 VALUE ADDED OF THE ICT SECTOR AT CURRENT PRICES - ESTIMATE BASED ON THE "PRODUCT" APPROACH

(Millions of euros)

	1995	1996	1997	1998	1999	2000	2001	2002	Change 1995-2002	Growth (in p.c.) 1995-2002
Industry (including energy)	1,908	1,973	2,189	2,054	2,264	2,497	2,260	2,223	315	+17
Construction	38	43	52	61	62	66	69	67	+29	+77
Wholesale and retail trades and repairs	1,475	1,476	1,549	1,509	1,700	1,752	1,841	1,846	+371	+25
Transport and communication	2,776	2,975	3,194	3,431	3,692	3,817	4,147	4,397	+1,621	+58
Financial services	355	414	475	602	646	599	566	525	+170	+48
Computer & related activities	1,160	1,252	1,531	1,972	2,371	2,546	3,066	3,135	+1,975	+170
Other business services	406	459	495	620	995	1,094	1,152	1,145	+739	+182
Other services	192	232	242	307	373	387	404	405	+213	+111
Other	294	231	230	34	43	46	51	51	–243	–83
Total ICT	8,604	9,055	9,957	10,590	12,146	12,804	13,556	13,793	+5,190	+60
Belgian economy as a whole	190,125	194,278	202,536	210,343	218,718	228,744	235,110	239,770	+49,645	+26

Sources: NAI, own estimates.

regarded as ICT branches in the "sectoral" approach do not only supply ICT products, and that the branches not belonging to the ICT sector do have some ICT output, albeit very small in some cases.

However, the "product" approach has one important drawback: it is based on information which is not available until rather late: owing to the work entailed, the supply-use tables are only available up to the year 1999 (1). For subsequent years, the estimates of employment and value added were extrapolated, on the assumption that the ICT activity rates have remained constant since 1999.

3.2 Estimate of value added and employment

On the basis of the "product" approach, the value added of the ICT sector in 2002 is estimated at almost 14 billion euro, and employment is put at over 176,000 persons (tables 15 and 16). The sectors regarded as ICT branches in the "sectoral" approach account for two-thirds of those totals. Most of the balance is attributable to services (business services, financial and other services). This confirms the growing link between the new technologies and services in the broad sense.

The "product" approach has two main effects on the estimate of the economic weight of ICT in Belgium. As regards the sectors classed as ICT in the "sectoral" approach, the "product" approach leads to lower estimates than the sectoral approach because it assumes that part of the activity of those sectors is not related to ICT. Conversely, the "product" approach simultaneously attributes ICT activities to branches which do not belong to the ICT sector. This second effect is much greater than the first, which means that the "product" approach for the ICT sector as a whole produces much higher estimates of value added and employment than the "sectoral" approach: the total difference between the two approaches fluctuates between 17 and 26 p.c. depending on the year.

Charts 6 and 7 show the growth of total value added and total employment respectively in the ICT sector according to the two approaches. Although the "product" approach leads to higher estimates, the developments described for both value added and employment appear to be the same as those indicated by the "sectoral" approach: the annual percentage changes are in fact very similar.

(1) The supply-use table for 2000 will be published in spring 2004..

TABLE 16 EMPLOYMENT IN THE ICT SECTOR - ESTIMATE BASED ON THE "PRODUCT" APPROACH

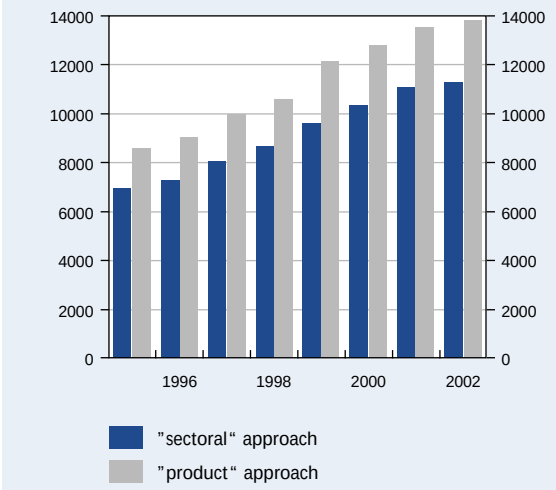
(Number of persons)

	1995	1996	1997	1998	1999	2000	2001	2002	Change 1995-2002	Growth (in p.c.) 1995-2002
Industry (including energy) ...	30,282	30,309	28,852	29,194	30,988	32,387	32,822	30,345	+64	+0
Construction	968	1,063	1,190	1,340	1,279	1,315	1,341	1,286	+318	+33
Wholesale and retail trades and repairs	35,874	35,993	36,373	35,688	38,276	38,938	39,594	39,092	+3,218	+9
Transport and communication	28,993	29,592	30,581	29,506	29,520	31,394	33,092	31,434	+2,440	+8
Financial services	3,780	4,056	4,680	5,437	5,707	5,878	5,869	5,884	+2,104	+56
Computer & related activities	26,369	27,815	30,282	33,970	38,168	43,241	47,319	47,603	+ 21,233	+81
Other business services	8,364	8,872	9,125	9,611	12,832	13,929	14,610	12,689	+4,325	+52
Other services	4,270	5,033	5,218	6,584	7,439	7,571	7,698	7,627	+3,357	+79
Other	548	481	467	195	256	264	275	272	–276	–50
Total ICT	139,449	143,216	146,769	151,525	164,464	174,919	182,619	176,232	+ 36,783	+26
Belgian economy as a whole	3,894,300	3,907,000	3,941,800	4,011,500	4,063,100	4,139,100	4,197,600	4,191,000	+296,700	+8

Sources: NAI, MEL, own estimates.

CHART 6 ESTIMATES OF TOTAL VALUE ADDED OF ICT ACCORDING TO THE " SECTORAL" APPROACH AND THE " PRODUCT" APPROACH

(At current prices, millions of euro)



Sources : NAI, own estimates.

3.3 Estimate of indirect employment associated with ICT

The supply-use tables for the Belgian economy also permit an estimate of the indirect employment associated with ICT : the ICT branches actually generate indirect employment via their purchases from suppliers. Below is a brief description of how this can be estimated [(1)].

The supply-use table (SUT) comprises two separate tables : the supply table, which shows the output of each sector, broken down by product groups, and the use table which summarises the inputs used for each sector.

The SUT can be used to determine the supplier sectors for a particular sector (e.g. telecommunications), and their degree of dependence. For this purpose, the use table identifies which inputs are used by the telecommunications sector, and then the supply table reveals which sectors produce the inputs used.

This indicates the sectors which supply the telecommunications branch and the amount of the supplies. The degree of dependence is then the fraction of the total turnover of the supplier sector represented by the supplies. If we apply that degree of dependence to the supplier's total employment, we obtain the indirect employment figure.

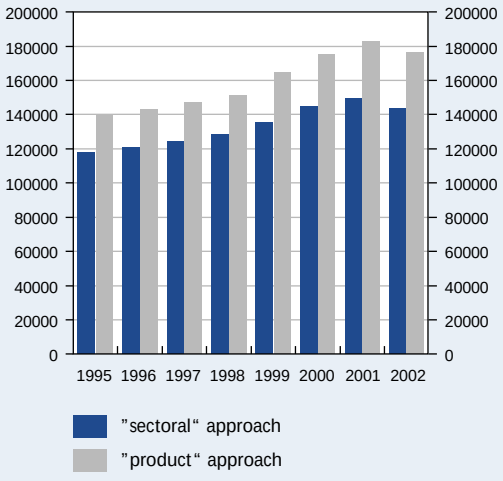
Application of the method to the ICT branches is shown in table 17. The calculation distinguishes between two levels : level 1 and level infinite [level n]. Level 1 takes account only of direct suppliers of the ICT branches. However, that is not sufficient for the estimate of total employment, since those suppliers also obtain goods from other suppliers (level 2). If this reasoning is taken further, we eventually arrive at level n or an infinite number of levels. Table 17 shows total indirect employment at 66 000 persons, or roughly 45 p.c. of direct employment. This seems a very low figure. For comparison, in the case of the motor vehicle industry indirect employment is rather more then double the direct employment figure.

The primary reason is that a great many suppliers are based abroad. In addition, there is a significant level of intra-sectoral supplies in the ICT sector, which are excluded from indirect employment in order to avoid double counting with direct employment.

(1) For a detailed description of the method, see Coppens F. and Van Gastel G. (2003)

CHART 7 ESTIMATES OF TOTAL EMPLOYMENT IN THE ICT SECTOR ACCORDING TO THE " SECTORAL" APPROACH AND THE " PRODUCT" APPROACH

(Number of persons)



Sources : NAI, own estimates.

TABLE 17 EMPLOYMENT IN THE ICT SUPPLIER SECTORS (YEAR 2001)

Sector	Employment (number of persons)		Value added (millions of euro)	
	Level 1	Level n	Level 1	Level n
Labour recruitment and provision of personnel	7,070	9,814	32.08	211.33
Investigation and security services, industrial cleaning, and miscellaneous business services	4,813	7,740	40.55	255.06
Post activities	4,100	5,245	26.99	188.12
Financial institutions	1,842	3,329	69.69	324.92
Sale, maintenance and repair of motor vehicles and related parts and accessories, sale and repair of motor cycles	2,241	3,069	12.60	143.63
Business and management consultancy, management activities of holding companies and coordination centres	1,525	2,696	147.09	630.27
Legal services, accounting, book-keeping and auditing; tax consultancy, market research and public opinion polling	1,554	2,576	34.27	199.37
Restaurants, bars, canteens and catering	1,656	2,415	7.76	60.53
Freight transport by road and removal services, transport via pipeline	1,487	2,331	5.96	133.13
Printing and related services, reproduction of recorded media	868	1,694	21.46	93.27
Technical advice, architects and engineers, technical testing and analysis	838	1,664	16.94	107.04
Cargo handling and storage, other supporting transport activities, organisation of freight transport	800	1,638	4.20	117.74
Advertising	508	1,026	3.15	58.86
Building installation	352	1,018	1.79	50.96
Activities relating to film and video, radio and television	352	955	0.15	52.83
Aviation	650	872	2.88	30.16
Other	9,710	17,546	1,961.04	1,383.13
Total	40,366	65,626	2,388.60	4,040.36

Sources: NAI, own estimates.

4. International comparison

The OECD has published various data permitting international comparisons in the ICT field. As is generally the case with this type of exercise, the information must be treated with some caution, even if only because the methods or definitions used by the countries have not been harmonised and therefore vary. In the case of ICT in particular, the comparison must be viewed with additional caution since some of the indicators were developed only very recently. Thus, certain discrepancies are evident between the statistics published by the OECD and the Eurostat figures. In its publications on ICT, the OECD does point out that comparisons between countries need to be interpreted with caution if the differences are small. Since ICT is still constantly developing, we can add that significant changes may have occurred since the last years which were available for comparison.

The information supplied below was obtained from the databanks of the OECD Directorate for Science, Technology and Industry, and is described in the following two publications: *Measuring the Information Economy* (2002) and *OECD Communications Outlook* (2003b).

4.1 Economic weight of the ICT sector

In the great majority of OECD countries, as in Belgium, the ICT sector produced strong growth in the 1990s, so that its weight in the national economies increased considerably (chart 8). However, in most countries the branch still represents only a relatively small share of GDP. As far as value added is concerned, the weight of the ICT sector in the Belgian economy is close to the OECD average and above the average for the European Union. That impressive performance is due to the development of ICT services

CHART 8 SHARE OF ICT IN THE VALUE ADDED OF THE BUSINESS SECTOR (1)

(Percentages)

Sources : OECD (2002).

(1) The OECD defines the business sector as the total economy minus activities relating to the government

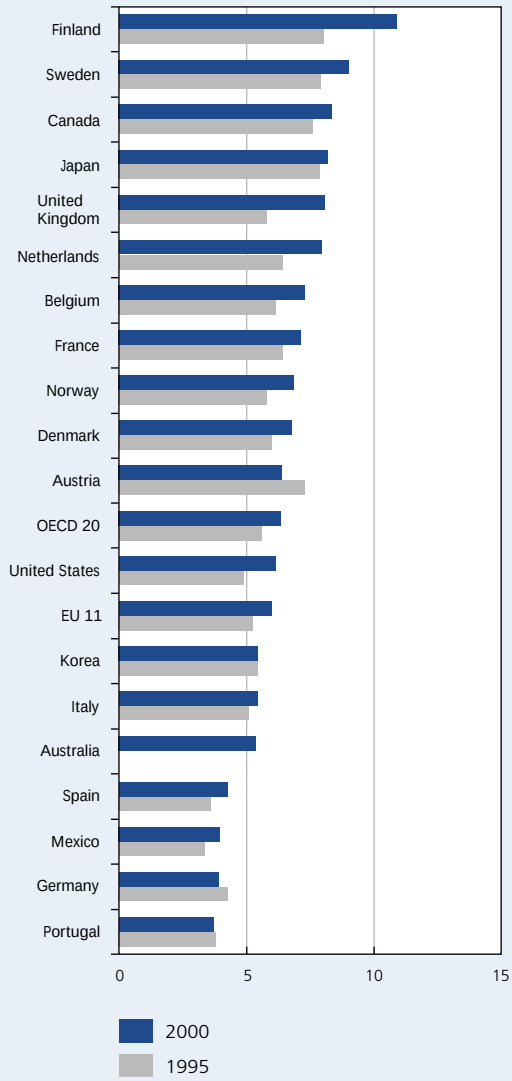
in Belgium, while the Belgian ICT industry is still not playing a sufficient role, viewed in international terms.

As regards the contribution to employment, the trend in Belgium was also comparable with that in the other OECD countries, where ICT has become a major source of new jobs in recent years (chart 9). That is attributable mainly to ICT services, as in most countries employment in the ICT industry followed the downward trend of industry in general, though the effect was less marked. The weight of the ICT sector in Belgian employment is actually higher than the average for OECD countries and EU Member States. Just as in the case of value added, this is due to the strong growth of ICT services in Belgium.

The ICT sector is also a highly innovative sector : expenditure on research and development is particularly dynamic (chart 10). In many countries, the ICT industry accounts for over a quarter of the research and development expenditure of industry as a whole. It must be emphasised that the United States represents 50 p.c. of spending on ICT research and development in the OECD area. As a result

CHART 9 SHARE OF ICT IN THE EMPLOYMENT OF THE BUSINESS SECTOR (1)

(Percentages)



Sources : OECD (2002).

(1) The OECD defines the business sector as the total economy minus activities relating to the government

of the concentrated innovation, a substantial proportion (over 16 p.c. for the OECD in 1998) of the total number of patents filed currently concerns ICT (chart 11). Belgium's performance in that area is rather modest.

According to the indicators mentioned above, the European Union as a whole is currently lagging behind the United States and, to a lesser extent, the Asian countries such as Japan and Korea. Europe has in fact never closed the gap which existed in the early 1990s. However, it must be stressed that the situation in the EU countries is decidedly variable, and that countries such as Finland and Ireland produce a performance comparable to that of the countries mentioned. Generally speaking, the further north in Europe we go, the more dynamic a country's ICT production. With regard to the large European economies, the United Kingdom performs better here, overall, than France, Germany and Italy.

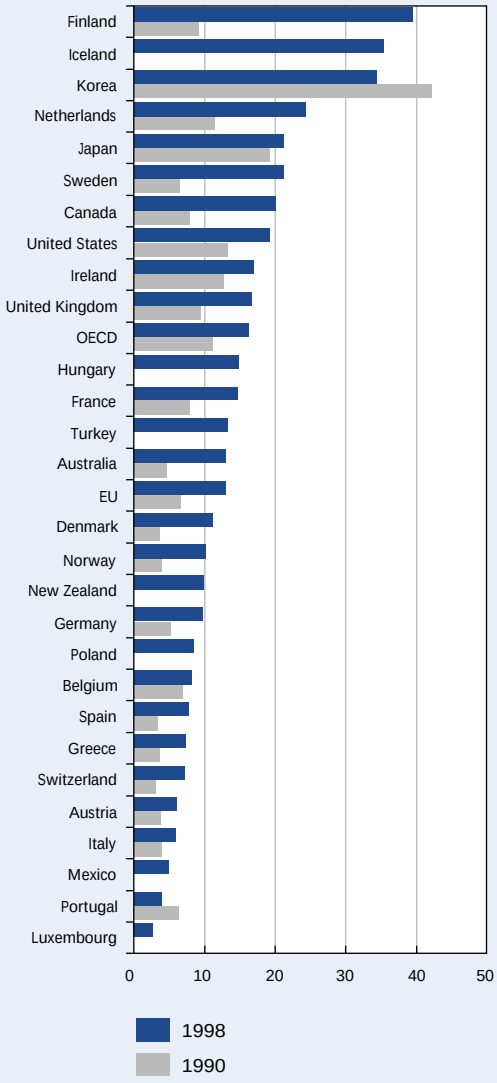
CHART 10 EXPENDITURE ON RESEARCH AND DEVELOPMENT IN THE ICT INDUSTRY

(Percentages of GDP)

Source : OECD (2002).

CHART 11 ICT PATENTS AS A PERCENTAGE OF THE TOTAL NUMBER OF PATENTS PER COUNTRY FILED AT THE EUROPEAN PATENT OFFICE

(Percentages)



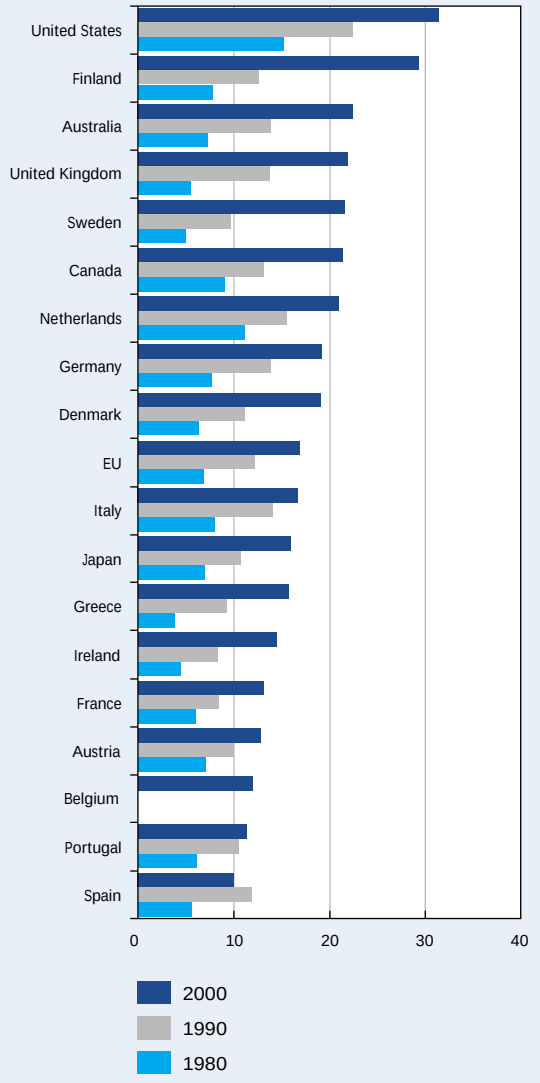
Source : OECD (2002).

4.2 Spread of ICT

In the past twenty years, the OECD countries have made increasingly intensive use of the new technologies, so that ICT consumption and investment are growing strongly. Thus, taking the OECD as a whole, the proportion of business investment in ICT hardware and software more than doubled between 1980 and 2000 (chart 12). It is noticeable that the United States invested in ICT much sooner than the rest of the world : in 1980 ICT already accounted for more than 15 p.c. investment. As for Belgium, it is third from the bottom in the OECD ranking.

CHART 12 INVESTMENT IN ICT HARDWARE AND SOFTWARE AS P.C. OF TOTAL GROSS FIXED CAPITAL FORMATION, EXCLUDING HOUSEHOLDS

(Percentages)



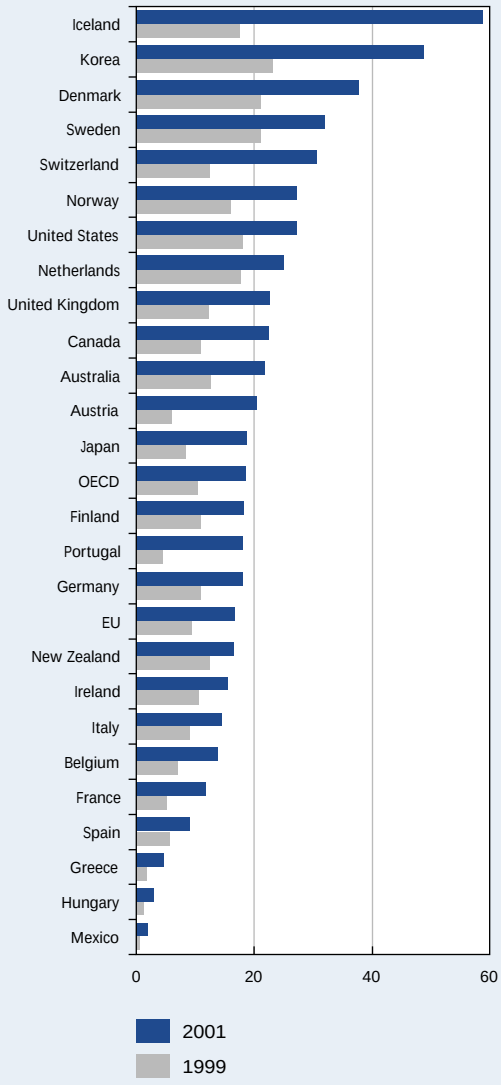
Source : OECD (2002).

CHART 13 PERCENTAGE OF HOUSEHOLDS WITH A PERSONAL COMPUTER (2000)

Source : OECD (2003b).
(1) 1999.

The use of ICT has also expanded very rapidly and continues to spread throughout society. In Belgium, 45 p.c. of households have a personal computer (chart 13), and there are almost 15 permanent internet subscriptions for every 100 inhabitants (chart 14). In regard to the first figure, Belgium is above the average for European Union countries, whereas the second figure indicates that Belgium makes little use of the internet compared to countries such as Iceland, Korea, the northern European countries and the United States. However, it must be said that, according to Eurostat, Belgium scores much higher than the European average in terms of internet access in businesses.

CHART 14 ACTIVE INTERNET SUBSCRIPTIONS PER 100 INHABITANTS

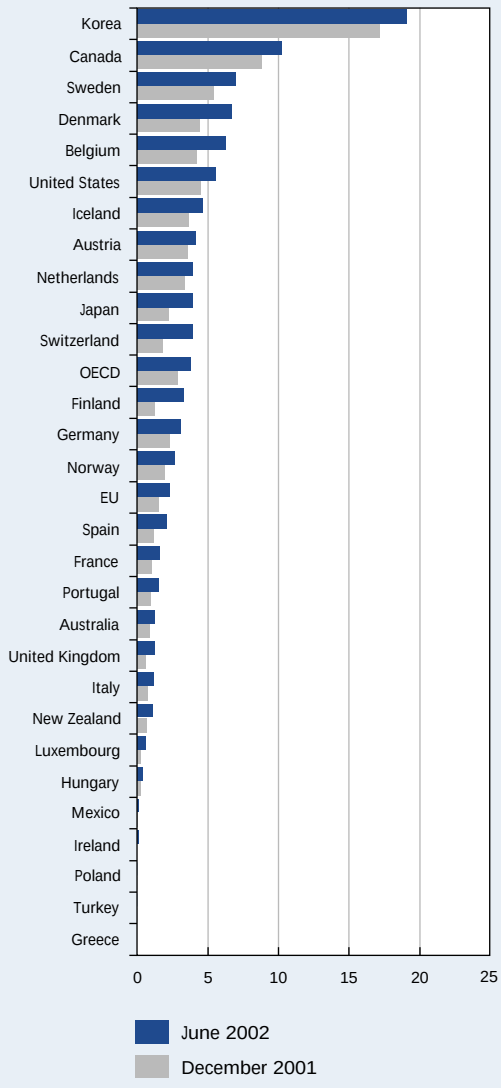


Source : OECD (2003b).

An important factor for the spread of ICT is the availability of an efficient communications infrastructure. In that regard, we are currently seeing the development of broadband technology, which offers high-speed transmission for internet access and makes the internet far more attractive. Although the European Union as a whole is lagging behind somewhat, Belgium is among the most advanced countries (with 6.3 broadband lines per 100 inhabitants in 2002) and is already ahead of the United States (chart 15). Another yardstick for infrastructure quality is e-commerce : here the infrastructure can be assessed on the basis of the number of secure servers. While there were hardly any in 1999, this type of server has since spread at a phenomenal pace in many countries, such as Iceland, the United States and the Anglo-Saxon countries in general (chart 16). In comparison with those countries, the performance produced by Belgium (and to a lesser extent the European Union) is very modest, though still comparable with that of Japan.

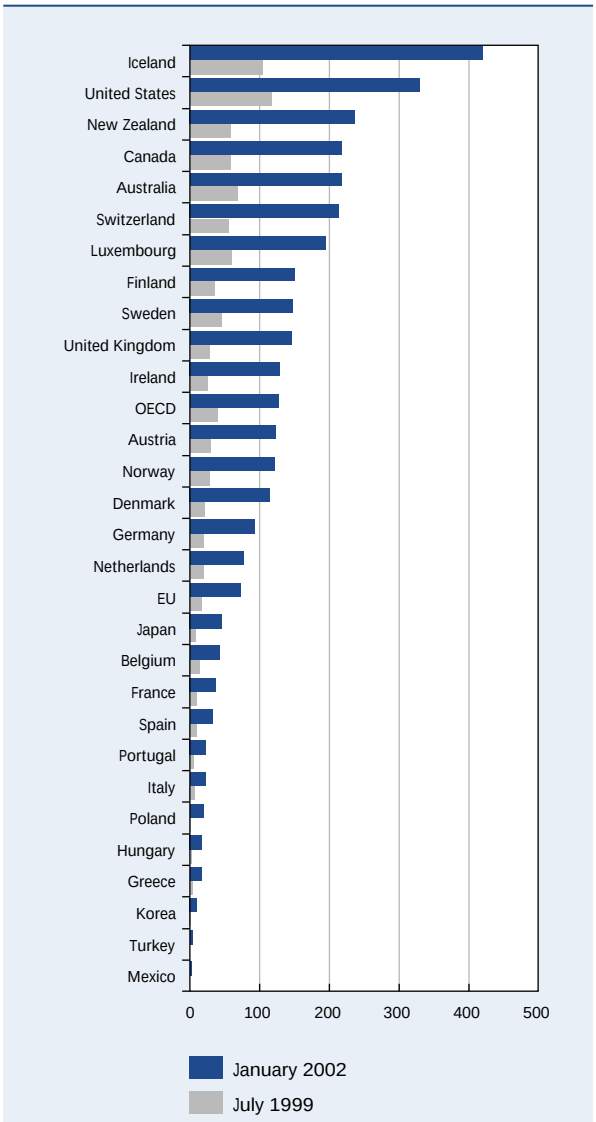
For the European Union as a whole, it is evident from all the indicators described above that the EU is now a long way behind the United States in terms of the dissemination of ICT. One reason for that gap is that the United States invested in these technologies much sooner. But

CHART 15 NUMBER OF BROADBAND CONNECTIONS (DSL, CABLE MODEM AND OTHER) PER 100 INHABITANTS



Source : OECD (2003b).

CHART 16 NUMBER OF SECURE INTERNET SERVERS, PER 1,000,000 INHABITANTS



Source : OECD (2003b).

of course, the situation is not the same for all European countries, and it is apparent here, too, that ICT is much more widely used the farther north we go. In the large European economies, the indicators show particularly low levels of penetration in France and Italy. Finally, it must be said that, overall, the countries with the most highly developed ICT sector are also the ones where ICT is most widely used. This supports the view that the creation and production of ICT in a country form a powerful stimulus for the use of ICT in that country, with all the potential advantages which ensue.

5. Analysis of the ICT sector on the basis of the annual accounts

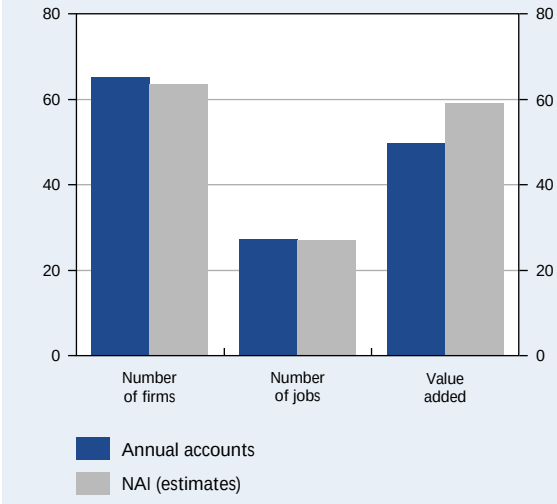
In addition to the assessment of the economic weight of the ICT sector in Chapters 1 to 3, ICT firms were also analysed on the basis of the annual accounts deposited with the Central Balance Sheet Office. The annual accounts contain detailed information on the financial and social structure of the firms, and are also available over a long period. With the aid of these data, it was possible to identify some current trends within the ICT sector. However, since the deadline for submitting the annual accounts is fairly late, it was not possible to study the 2002 financial year : the analysis relates to the period from 1991 to 2001. A further point is that certain concepts addressed in Chapter 2 from an economic angle, particularly investment and value added, were examined here from an accounting viewpoint, which is rather different.

5.1 Description and representativeness of the population studied

Although the annual accounts contain a large volume of data, they need only be submitted by firms fulfilling certain legal criteria. Furthermore, only annual accounts which have passed the quality checks of the Central Balance Sheet Office can be considered for research.

CHART 17 GROWTH OF THE NUMBER OF FIRMS, EMPLOYMENT AND VALUE ADDED IN THE ICT SECTOR BETWEEN 1995 AND 2001, ACCORDING TO THE ANNUAL ACCOUNTS AND THE NAI

(Percentages)



Sources : NBB, NAI, own estimates.

TABLE 18 NUMBER OF SETS OF ANNUAL ACCOUNTS DEPOSITED WITH THE CENTRAL BALANCE SHEET OFFICE BY ICT FIRMS

	ICT industry		ICT distribution		Telecommunications		Computer & related activities		Total
	Full format	Abbreviated format	Full format	Abbreviated format	Full format	Abbreviated format	Full format	Abbreviated format	
1991	83	225	356	1,944	25	29	205	1,926	4,793
1992	86	255	371	2,121	26	32	224	2,217	5,332
1993	87	265	386	2,297	27	36	243	2,429	5,770
1994	91	274	388	2,460	32	49	245	2,568	6,107
1995	91	296	402	2,602	34	62	255	2,790	6,532
1996	80	228	324	1,576	26	28	221	2,062	4,545
1997	90	310	388	2,886	57	123	285	3,363	7,502
1998	98	318	408	3,094	58	154	315	3,785	8,230
1999	96	340	399	3,230	78	190	369	4,351	9,053
2000	102	337	401	3,381	90	256	434	4,943	9,944
2001	100	345	415	3,433	91	337	471	5,599	10,791

Source : NBB.

The population of firms submitting valid annual accounts is therefore a subgroup of the total population of firms studied in the preceding chapters.

Table 18 describes the population of ICT firms'annual accounts examined in this chapter. A distinction is made between annual accounts submitted in the full format and those submitted in the abbreviated format, as Belgian law permits small firms to submit a shortened version of their annual accounts.

Since the valid annual accounts deposited form only a subgroup of the total population, the question is to what extent they are representative. Table 19 clarifies this point to some degree for the ICT sector. In 2001, when the total number of ICT firms (estimated on the basis of the National Accounts Institute (NAI) data) totalled 19,730 units, 10,791 lodged valid annual accounts. The representativeness of the annual accounts is thus 55 p.c. expressed in terms of the number of firms. On the other hand, firms depositing annual accounts employed almost 127,000 people, against 149,482 according to estimates based on the NAI data. As regards employment, the annual accounts are therefore 85 p.c. representative. Representativeness in terms of value added could not be tested owing to conceptual differences between the annual accounts and the national accounts. However, there is generally a strong correlation between the firms' employment and their value added. It can therefore be assumed that the representativeness of the annual accounts as regards

TABLE 19 REPRESENTATIVENESS OF ICT FIRMS SUBMITTING ANNUAL ACCOUNTS (2001)

	Annual accounts	NAI (estimate)	Representativeness of the annual accounts (in p.c.)
Number of firms	10,791	19,730	55
Employment (number of persons)	126,907	149,482	85

Sources : NBB, NAI, own estimates.

value added is very similar to that in terms of employment. Although the sample is only moderately representative in microeconomic terms, the analysis of the annual accounts is therefore highly relevant overall at macroeconomic level.

Apart from representativeness, it is also noticeable how closely the annual accounts data follow the pattern of the NAI data. Between 1995 and 2001 the growth rate for the number of firms and the number of jobs was almost identical for the two sources (chart 17). In regard to value added, the pattern is somewhat variable. The conceptual differences mentioned earlier doubtless play a significant role in that divergence.

5.2 The main ICT firms in Belgium and the degree of concentration

Table 20 shows the largest firms in terms of employment for each ICT subsector. If we look at all the sectors, Belgacom is by far the largest ICT company in Belgium with 19.598 employees in 2001, followed by Alcatel Bell (4.376) and Philips Industrial Activities (3.342). Most of the firms in this table are largely foreign owned. Some firms do not appear in table 20 because the group to which they belong has opted to split its activities into a number of separate legal entities, all filing their own annual accounts[1].

(1) The annexes contain a more detailed list of the 20 largest firms in each of the four ICT subsectors.

TABLE 20 THE MAIN ICT FIRMS IN 2001 ACCORDING TO THE ANNUAL ACCOUNTS

Firm	Number of employees[1]	Turnover (in thousand euro)	Value added (in thousand euro)
ICT industry			
Alcatel Bell	4,376	1,249,952	295,612
Philips Industrial Activities	3,342	1,190,040	287,120
Siemens ATEA	2,311	547,481	265,297
Barco	2,020	451,924	157,046
STMicroelectronics	1,113	350,304	139,517
ICT distribution			
IBM Belgium	1,858	736,486	210,076
Hewlett-Packard Belgium[2]	672	470,689	117,882
Compaq Computer[2]	671	510,883	87,698
Sony Service Centre Europe	571	1,074,261	75,656
Unisys Belgium	565	161,313	48,092
Telecommunications			
Belgacom	19,598	3,671,245	2,162,741
Belgacom Mobile	2,245	1,906,503	1,039,073
Mobistar	1,701	829,160	307,761
Base	1,097	243,360	–32,981
Telenet Operaties	926	172,282	18,704
Computer & related activities			
Cap Gemini Ernst & Young Europe	850	105,602	60,137
Siemens Business Services	804	213,220	83,183
Dolmen Computer Applications	750	160,128	51,854
Centrum voor Informatica Provincies Antwerpen en Limburg	661	100,742	38,173
Getronics Belgium	632	154,034	52,972

Source : NBB.
(1) In full-time equivalents according to the social balance sheet.
(2) The Hewlett-Packard and Compaq groups merged in 2002.

It is also interesting to examine the degree of concentration of ICT activities in Belgium. For each ICT subsector, the concentration indicator *Cn* was calculated, in which *n* ranges from 1 to 15. This indicator is equal to the share of the turnover of the *n* largest firms (in terms of turnover) in relation to the total turnover of the sector. For example, the indicator *C3* indicates the share of the three largest firms in total turnover. Here it must be borne in mind that the indicator *Cn* estimates the degree of concentration of the activity in Belgium, and not the degree of competition: as the markets become increasingly global, a firm based in Belgium may face as much competition from its foreign rivals as from those in Belgium[(1)]. This remark applies in particular to ICT industry and ICT distribution.

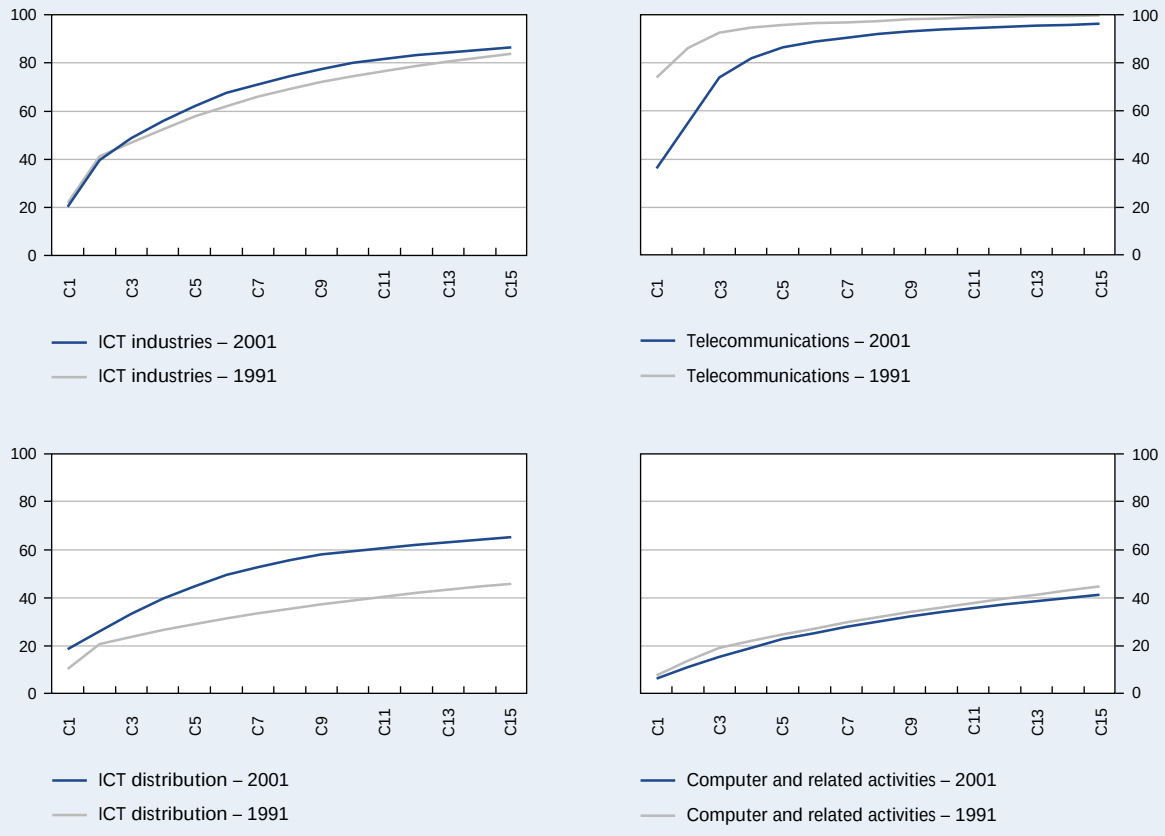
Chart 18 illustrates the degree of concentration in the four ICT subsectors and how it developed between 1991 and 2001. The ICT subsector with the highest concentration is telecommunications: in 2001 the three biggest firms in this sector accounted for three-quarters of its activity (C3) while the fifteen largest firms represented 96 p.c. (C15). Next comes industry (C15 = 86 p.c.), distribution (C15 = 65 p.c.) and computer & related activities (C15 = 41 p.c.). The low level of concentration in computer & related activities is due to the low employer's ratio in that sector (explained in Chapter 2): the activity in this sector is not created by just a few firms, but by a large number of sometimes very small entities.

The pattern of concentration varied from one ICT subsector to another. While concentration remained steady in industry and computer & related activities, it increased in distribution and declined in telecommunications. In distribution, the level of concentration is due to the development of a few large

(1) More generally, the use of concentration indicators causes a number of problems. In that connection cf. Carlton D. W. and Perloff J. M. (1999).

CHART 18 DEGREE OF CONCENTRATION IN ICT SUBSECTORS

(Percentages)



Source : NBB.

firms, usually subsidiaries of multinationals such as Sony Service Center or Compaq computer. In telecommunications, the deregulation and technological innovations of the 1990s have encouraged the establishment of new firms.

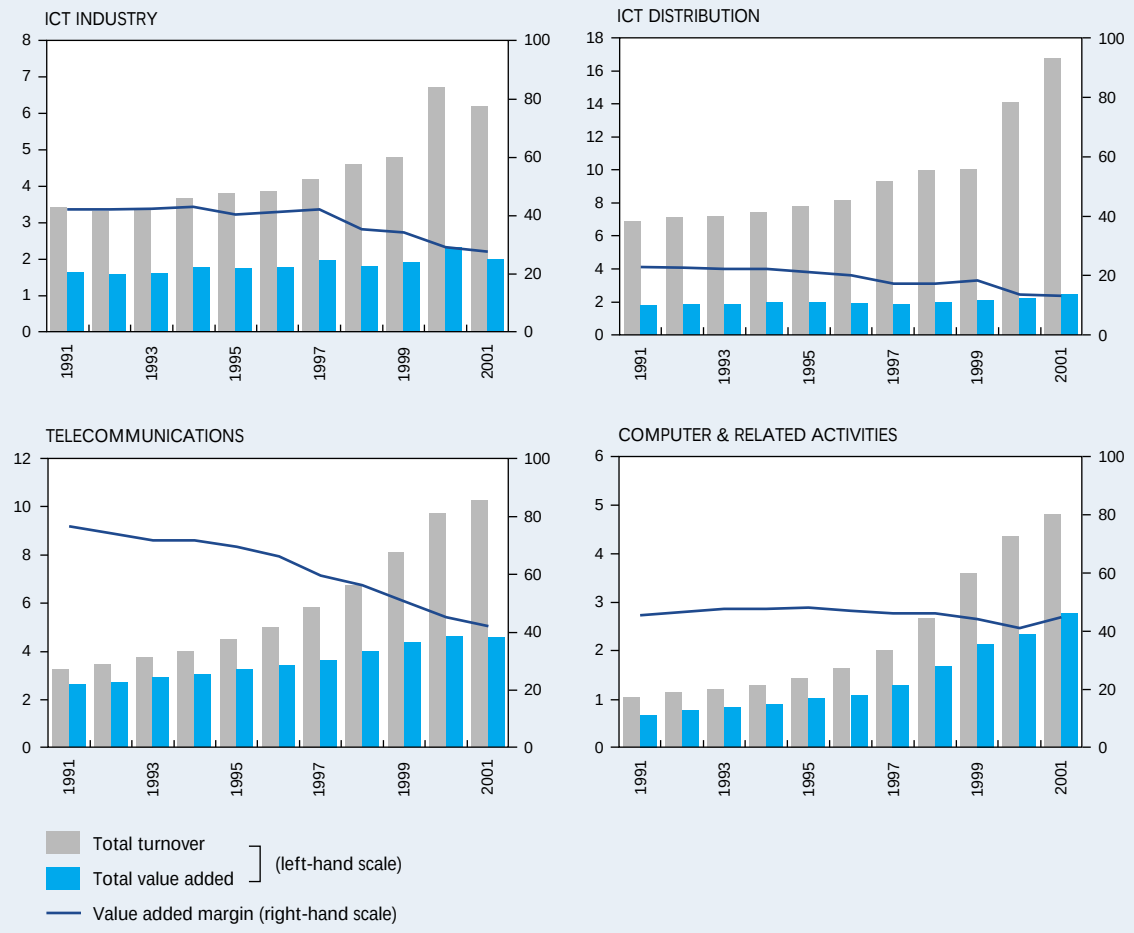
5.3 Analysis of the balance sheets, profit and loss accounts and social balance sheets of ICT companies

5.3.1 Activity

Between 1991 and 2001, turnover increased year by year in all branches of the ICT sector (chart 19). The total turnover of the technology companies rose by 159.8 p.c., from 14.6 billion euro in 1991 to 38 billion euro in 2001. In percentage terms, the biggest increase in turnover during that period was in computer & related activities and in telecommunications. In those subsectors, growth totalled 358.4 and 216.7 p.c. respectively. The sharp rise in total turnover in 2000 is also striking, in both ICT industry and ICT distribution. In the case of ICT industry, this growth between 1999 and 2000 can be ascribed mainly to two companies: Alcatel Bell, whose turnover grew by almost 500 million euro, and Philips, whose turnover increased from 1.2 to 1.5 billion euro. In ICT distribution, the growth is due mainly to Electrolux, whose turnover increased from 84 million euro to 2.1 billion euro, and Avnet, whose turnover grew from 10 to 765 million euro.

Between 1991 and 2001, value added grew by 74.2 p.c., and totalled 11.8 billion euro in 2001. The most striking increase occurred in computer & related activities (309.4 p.c.). In contrast, ICT industry produced only 21.5 p.c. growth.

CHART 19 TURNOVER, VALUE ADDED AND VALUE ADDED MARGIN
(Billions of euro)



Source : NBB.

Since the growth of turnover generally outpaced value added, the value added margin declined[1]. This ratio is particularly low in ICT distribution: in 2001 it was just 13.3 p.c., against 24.7 p.c. for non-financial corporations as a whole. The low level of this ratio can be explained by the low value added which this branch creates.

To permit a better comparison of the various branches, it is also interesting to calculate value added per employee. Chart 20 (et seq.) shows the result of this calculation from two angles: the global approach and the median approach. In the global approach, the ratio is calculated by adding together certain items for all companies in the branch in the numerator and the denominator. In order to calculate the median, firms in the branch are divided into two groups, each containing half of the firms[2]. In 50 p.c. of the firms, the ratio is below the median, and in 50 p.c. of firms the ratio is higher than or equal to the median. Using both the global approach and the median is interesting for two reasons: first, the two measures do not produce exactly the same results. Also, the global ratio is not necessarily typical of the majority of firms, as it may be largely determined by a small number of units with a decisive weight in the globalisation, while the median is not influenced by the extreme cases. The results are compared with those for non-financial corporations as a whole.

Owing to the highly capital-intensive nature of telecommunications, this subsector averaged the highest value added per employee over the whole period from 1991 to 2001. In 2001 the figure was 121,973 euro per employee, 2.7 p.c. lower than in 2000. This fall can be attributed mainly to Belgacom, Base and Mobistar, as the number of employees in those companies rose faster than value added. However, the figure recorded in telecommunications is well above the total ratio for non-financial corporations as a whole (71,319 euro per employee). Also, 1996 stands out from other years in this period because of the sharp fall in the ratio in most ICT branches. That fall is due to the introduction of the social balance sheet by the Royal Decree of 4 August 1996, as that decree altered certain items relating to employment and caused a break in the series for value added per employee. For instance, since 1996 staff expenses item 62 no longer includes the remuneration and pensions of directors, managers and self-employed partners, or the costs of agency staff. From that date on, these various items are included under item 61 "Services and miscellaneous goods", and that affects the value added figure.

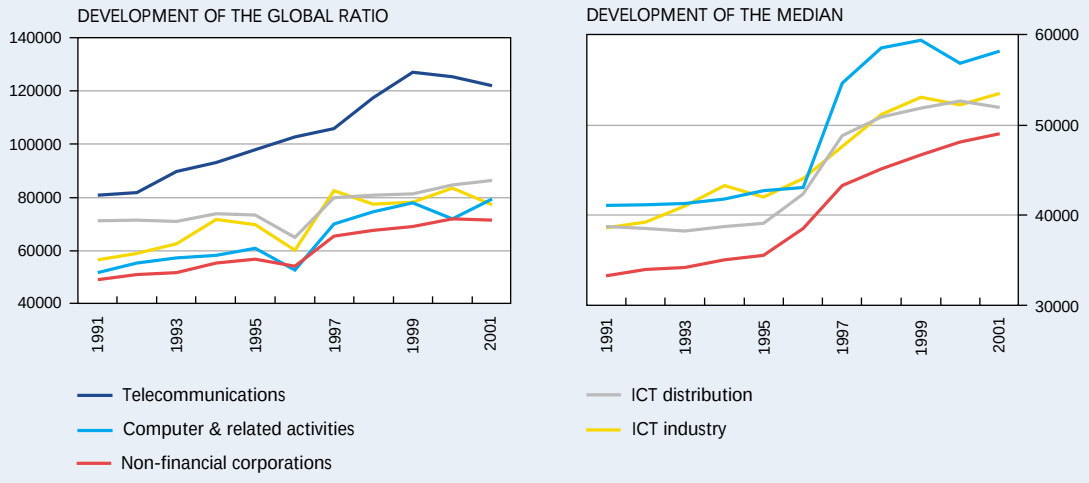
Calculation of the median reveals a slightly different version of the problem. While value added per employee in general, and according to the global approach, is lowest in computer & related activities, that branch has had the highest median value since 1996: 58,175 euro in 2001.

(1) This ratio and the other financial ratios discussed in this document are defined in the annex.

(2) This method was not applied to the telecommunications branch as no coherent median value could be calculated owing to the small number of firms.

CHART 20 DEVELOPMENT OF THE VALUE ADDED PER EMPLOYEE

(Euro)



Source: NBB.

5.3.2 Profitability

There are various ratios which can measure the relative performance of businesses. One of them is the return on equity after tax. This ratio corresponds to the return for shareholders or partners, no matter how the profit is allocated. It links the profit or loss for the year to the book value of the equity (1).

Chart 21 depicts the movement in the profitability ratio on the basis of the total amounts. This chart is not easy to explain, as the results differ considerably from one year to the next, and trends are hard to detect. However, there was clearly a sharp deterioration in the profitability of ICT industry in 2000 and 2001 (the same applies to telecommunications). This poor result is attributable mainly to a few large firms, such as Telindus in 2000 and Alcatel and Barco in 2001. In the case of computer & related activities, two curves were shown for the year 2000, depending on whether or not the company Lernout & Hauspie was taken into account. If this company is included, there is a negative return of –126.3 p.c. for the year 2000.

In contrast, the median chart is easier to interpret. This shows that the median firm in each branch achieved a strong improvement in profitability over the years up to 1999. In that year, the median ratio in computer & related activities was actually 15.5 p.c. In contrast to the picture for non-financial corporations as a whole, technology firms saw their profitability decline in 2000, doubtless following the advent of the new millennium. In 2001, however, computer & related activities staged a modest recovery (14.3 p.c.).

5.3.3 Liquidity

Liquidity measures the ability of firms to meet their short-term liabilities. The ratio illustrated here, showing liquidity in the broad sense, links the total realisable and available assets to the short-term liabilities. The higher this ratio, the more assets the firm has available to meet its liabilities.

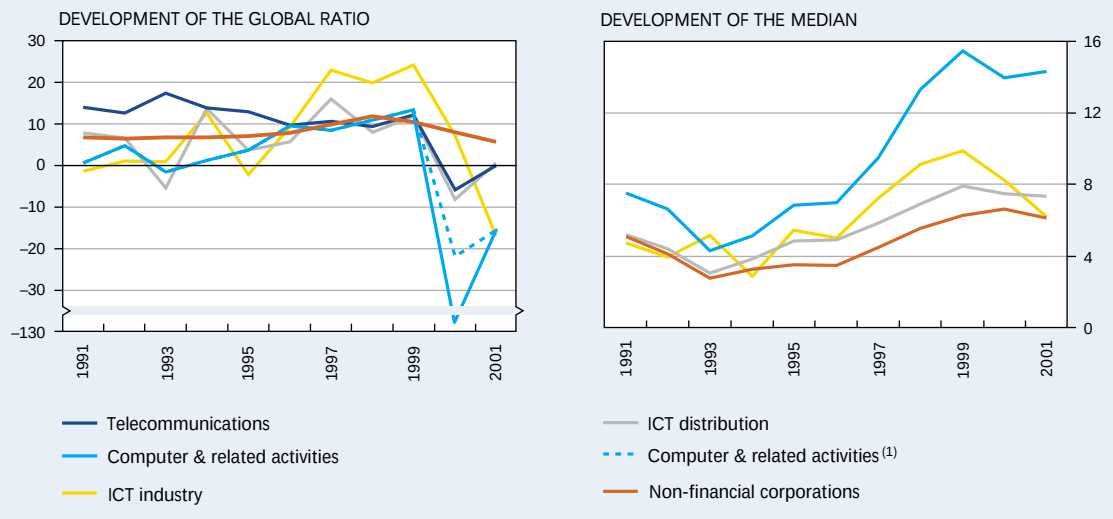
The liquidity ratio of ICT firms calculated on the basis of the global figures is generally lower than that of non-financial corporations as a whole (chart 22). That is particularly true of telecommunications, where liquidity was less then one throughout the period. except in 1994 (2). This means that, in this branch, the realisable

(1) Certain companies had to be excluded from the ratio calculation, in particular:
– companies with negative equity;
– companies with a financial year not equal to twelve months.

(2) The peak in 1994 can be explained by financial movements in Belgacom's accounts. In that year, new cash investments were effected in order to set up an external pension fund. In addition, debts at over one year falling due within the year declined significantly as a result of the repayment of a government loan and various private loans.

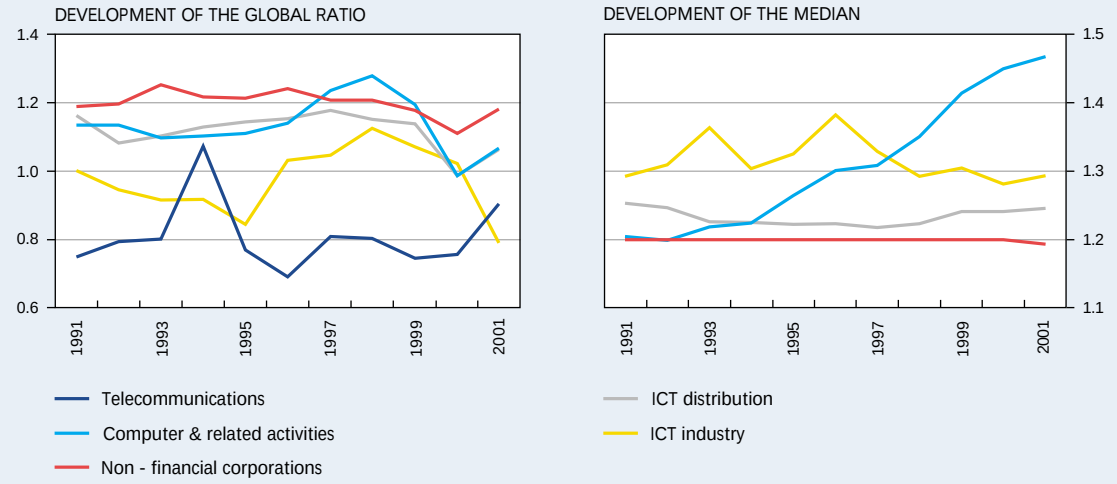
CHART 21 DEVELOPMENT OF THE NET RETURN ON EQUITY AFTER TAX

(In p.c.)



Source : NBB.
(1) Without Lernout & Hauspie

CHART 22 DEVELOPMENT OF THE LIQUIDITY IN THE BROAD SENSE



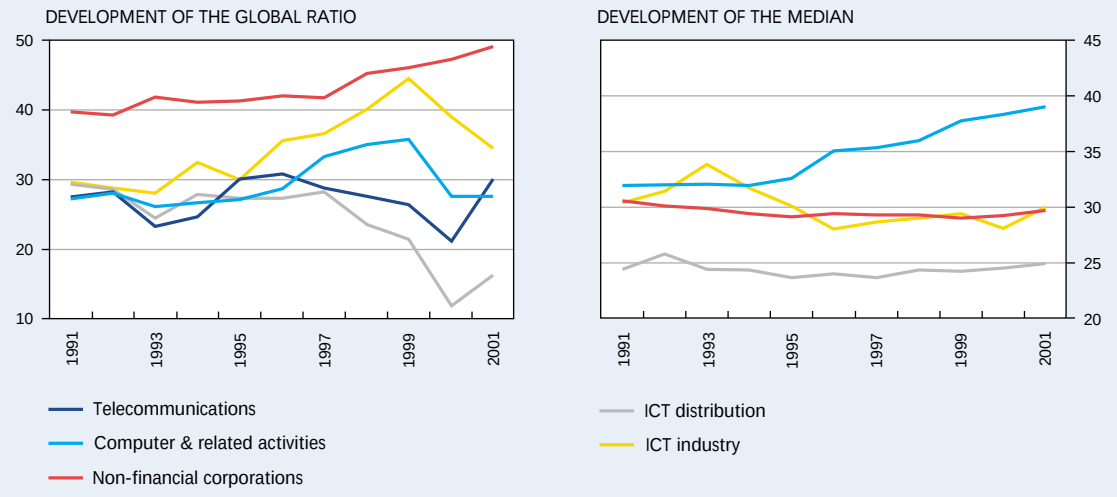
Source : NBB.

assets and those available at short notice are not sufficient to cover the short-term liabilities. In other words, some telecommunications companies have potential liquidity problems that could lead to financial difficulties later on. Another striking feature is the marked deterioration in the ratio in the ICT industry in 2001, due mainly to the reduction in stocks and trade receivables at Alcatel.

In contrast, the median value of the ratio for each ICT branch is higher than the median for the companies as a whole. The liquidity of computer & related activities improved gradually during that period. In 2001 the median value for this branch was 1.47, which is a very high figure.

CHART 23 DEVELOPMENT OF THE SOLVENCY

(Percentages)



Source : NBB.

5.3.4 Solvency

Solvency means the ability of firms to meet all their long-term financial liabilities: repayment of debts on the due dates, regular interest payments, etc.

On the basis of the overall figures, the solvency of each branch is lower than that for companies as a whole (chart 23). However, between 1991 and 1999 the solvency of ICT industry and of computer & related activities improved strongly. In ICT industry it rose from 29.6 p.c. to 44.5 p.c. during that period, while in computer & related activities it increased from 27.2 p.c. to 35.8 p.c. In contrast, the solvency of ICT distribution deteriorated over the same period, reaching a low point in 2000 (12 p.c.)

The chart showing the movement in the median reveals a slightly different picture, as the subsector computer & related activities is more solvent than companies as a whole if their respective medians are considered. In contrast, ICT distribution is still definitely the branch with the lowest solvency.

5.3.5 Investment

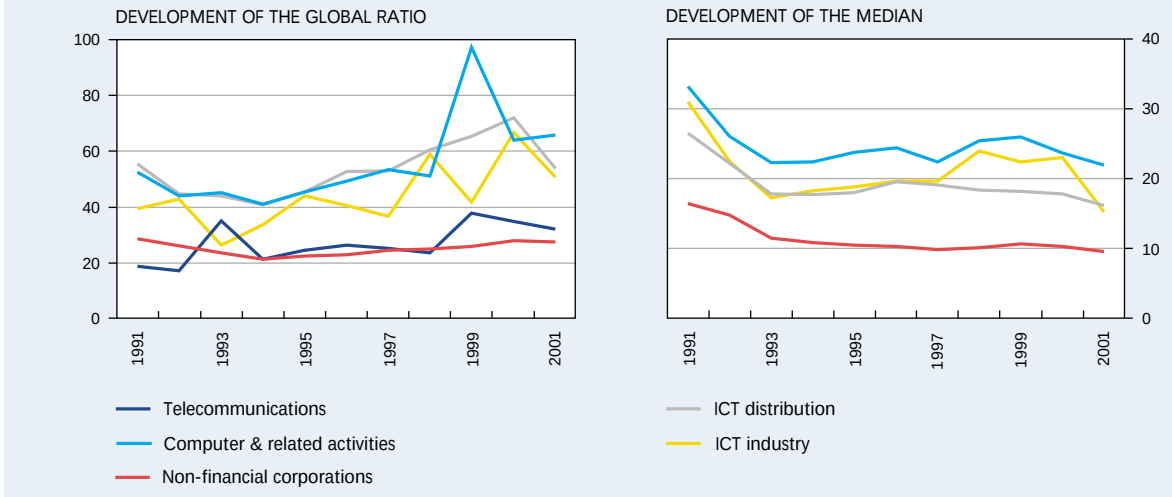
The amount which businesses devote to investment during a financial year can be measured by various ratios. One of these is the ratio stating purchases of tangible fixed assets in relation to the tangible fixed assets available during the preceding financial year[(1)].

During the 1991-2001 period, the total investment ratio of the ICT branches was consistently higher than that for all companies taken together, except in the case of telecommunications (chart 24). In that branch the average investment ratio based on the total amounts was up to four times lower during that period than the ratio for all companies taken together. That is because telecommunications is a highly capital-intensive sector: the denominator of the ratio is therefore high, producing a lower ratio. If investment spending is measured by a yardstick other than the investment ratio, the picture in the telecommunications sector is very different. For example, in 2001 the ratio of "the proportion of value added devoted to investment" was over 40 p.c. in telecommunications, against less than 30 p.c. in non-financial corporations in general. Although there is a relatively low rate of capital renewal in telecommunications, this sector therefore allocates a significant proportion of its value added to the financing of new investment.

(1) the numerator of the investment ratio comprises the tangible fixed assets acquired during the year (including produced fixed assets) and the increase in value of tangible fixed assets acquired from third parties, less depreciation and reductions in value of tangible fixed assets acquired from third parties. The denominator comprises the acquisition value and increases in value of tangible fixed assets available during the preceding year, less depreciation and reductions in value of tangible fixed assets at the end of the preceding year.

CHART 24 DEVELOPMENT OF THE INVESTMENT RATIO

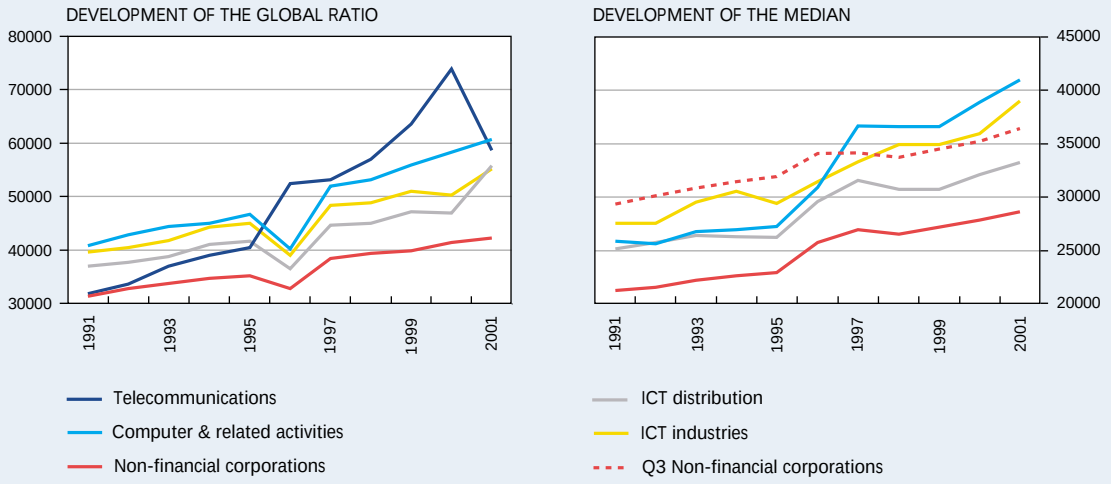
(Percentages)



Source: NBB.

CHART 25 DEVELOPMENT OF THE LABOUR COST PER EMPLOYEE

(Euro)



Source : NBB.

The substantial investments in computer & related activities in 1999, in connection with the new millennium and the introduction of the euro, are also plain to see.

While the chart showing the overall ratio appears to indicate an improvement in the investment ratio during the period, the median reveals the opposite trend. The increase in the investment ratio within the overall ratio can therefore be ascribed to a small number of firms.

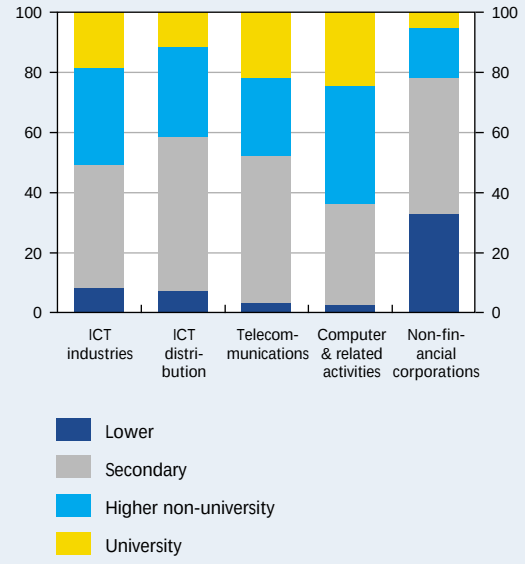
5.3.6 Labour costs

Labour costs per employee can also be examined. However, it is necessary to bear in mind that high costs per employee do not indicate an unsound financial situation : research by the National Bank in connection with the development of an internal instrument for predicting the risk of business failures has proved that financially sound companies generally pay their staff better than companies in difficulty.

In all ICT branches, staff are generally better paid than in non-financial corporations as a whole (chart 25). This is connected with the high level of skills among employees in the sector. In most branches, labour costs per employee declined in 1996. In methodological terms, that fall is due to the introduction of the social balance sheet, for the reasons mentioned earlier. Another noticeable feature is the peak level reached in telecommunications in 2000. In

CHART 26 STANDARD OF EDUCATION OF STAFF RECRUITED IN 2001

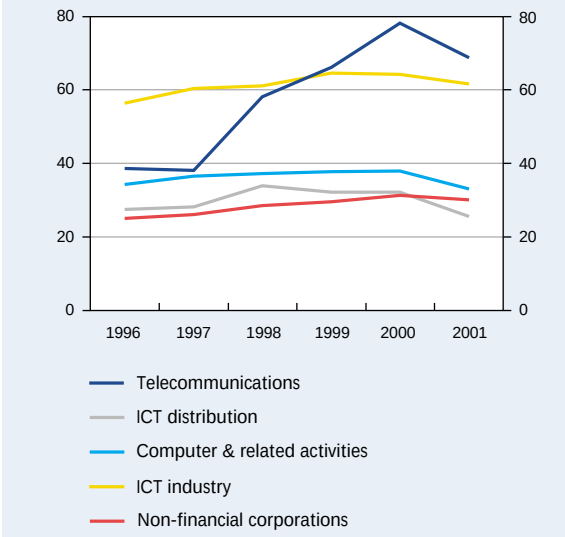
(Percentages)



Source : NBB.

CHART 27 DEVELOPMENT OF THE TRAINING PROVIDED IN BUSINESS

(Percentages)



Source : NBB.

that year, Belgacom paid an exceptionally large sum into the pension fund for its officials.

The chart illustrating the trend in the median for non-financial corporations also includes the figure for their third quartile (Q3). For a number of years now, staff in computer & related activities and in ICT industry have generally been better paid than the staff of 75 p.c. of firms. In 2001, labour costs per employee in computer & related activities and in ICT industry totalled 40,941 and 38,992 euro respectively. However, the biggest difference in relation to non-financial corporations in general was recorded in telecommunications. In that branch, the median in 2001 was 42,537 euro.

5.3.7 The social balance sheet

Since its introduction in the 1996 financial year, the social balance sheet has contained a whole set of data on various aspects of employment in firms. This study will deal with only a few characteristics of employment in ICT firms, notably the standard of education of the employees, the amount of training and the number of jobs for agency staff and women.

The information contained in the social balance sheet does not permit any distinction between employees on the basis of their standard of education. Nevertheless, it is possible to gain some idea of this by examining the standard of education of staff recruited during 2001 (1).

Chart 26 reveals that technology firms seek staff with a higher standard of education. Depending on the ICT branch, 41.2 to 63.7 p.c. of the workers recruited by these firms held a higher education diploma or university degree, compared to 21.8 p.c. for the companies as a whole.

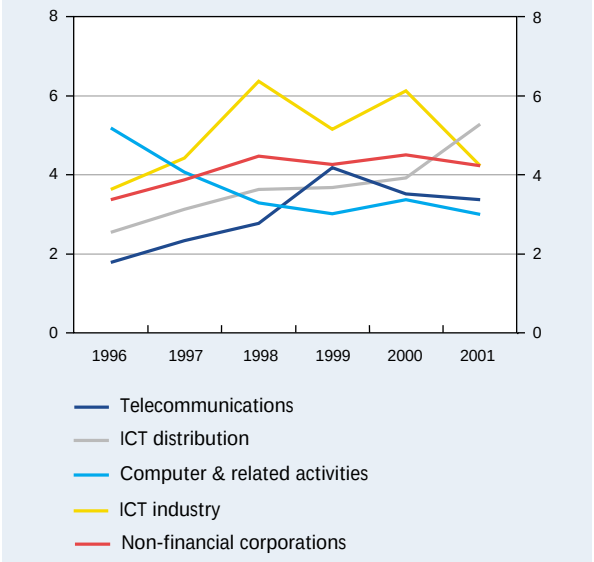
Companies completing the social balance sheet items on staff training provided training for 30.1 p.c. of their employees, on average, in 2001 (chart 27). Although that is higher than the 1996 figure, it is still well below the level in telecommunications (68.6 p.c.) and ICT industry (61.5 p.c.)

The extent of agency working can also be examined on the basis of the social balance sheet. However, it should be noted that only companies filing full-format accounts provide data on agency workers and persons seconded to the company.

(1) It must be pointed out that only companies filing full-format annual accounts are required to provide information on the standard of education of their staff.

CHART 28 DEVELOPMENT OF THE PROPORTION OF WORKERS WITH THE STATUS OF AGENCY EMPLOYEES OR WORKERS ON SECONDMENT TO THE COMPANY

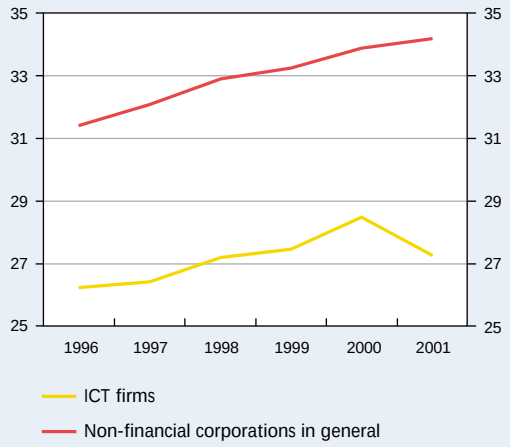
(Percentages)



Source : NBB.

CHART 29 DEVELOPMENT OF THE POSITION OF WOMEN ON THE LABOUR MARKET

(Percentages)



Source : NBB.

In 2001, 95.8 p.c. of employees in non-financial corporations filing full-format accounts were on the permanent staff (chart 28), down 0.8 percentage points against 1996, in favour of agency workers and persons seconded to the company. The latter now represent 4.2 p.c. in large companies, as opposed to 5.3 p.c. in ICT distribution and just 3 p.c. in de computer & related activities. It is also clear that the proportion of workers employed under those two types of arrangement in ICT distribution is constantly growing.

Finally, on the basis of the social balance sheet it is possible to assess the relative position of women in the labour market. In 2001, women represented 27.7 p.c. of workers in ICT firms, 0.8 percentage points down against the previous year (chart 29). This figure is well below the percentage for companies as a whole (34.2 p.c.). Women are therefore still seriously under-represented in the ICT sector.

The percentage of women in the total workforce of technology firms nevertheless increased during the 1996-2000 period, rising from 26.2 p.c. in 1996 to 28.5 p.c. in 2000 (chart 30). Most of this increase is attributable to telecommunications.

(1) See in particular Beaver W. H. (1966) and Altman E. I. (1968).

(2) A summary of these models can be found in Ooghe H., Joos P. and De Bourdeaudhuij C. (1995).

5.4 Analysis of the financial risks in the ICT sector

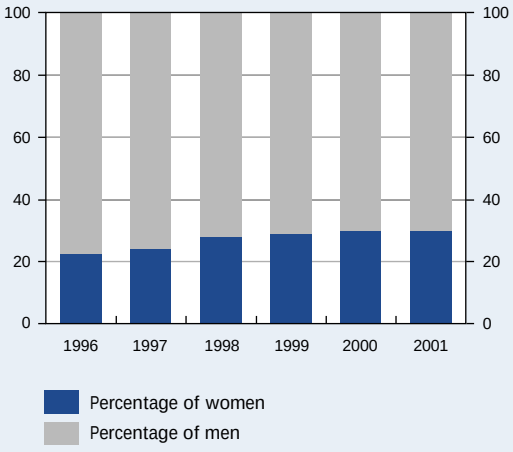
5.4.1 Development of a corporate default prediction model

In order to assess the financial risks for companies, the National Bank has developed an internal model for the prediction of corporate default. That model is described in detail in the annex 3. The first models for the prediction of default were developed in the late 1960s[1] Since then, interest in this subject has increased steadily, particularly in financial institutions that want to detect credit risks at an early stage. The models have led to the establishment of scoring systems permitting companies to be ranked on the basis of their financial risk. Most of the models were based on relatively small samples (a few hundred companies or less) and often examined the large firms in a particular sector, generally the industrial sector. In Belgium, the most important corporate bankruptcy prediction models were developed by Ooghe and Verbaere in 1982 and by Ooghe, Joos and De Vos in 1991[2].

The model developed by the National Bank uses the data from the annual accounts filed by companies with the Central Balance Sheet Office. The methodology consists in analysing, on the basis of the annual accounts for a particular year, the differences between the financial profiles of two types of firm : non-failing firms and failing firms within the ensuing three years. The definition used for default is based on a legal criterion : a failing firm is one

CHART 30 DEVELOPMENT OF THE MALE/FEMALE DISTRIBUTION IN TELECOMMUNICATIONS

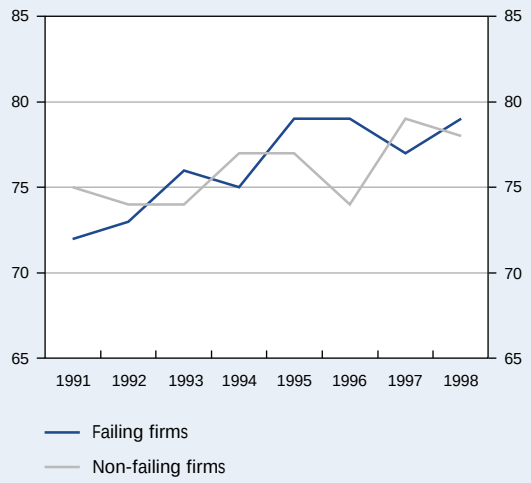
(Percentages)



Source : NBB.

CHART 31 DEGREE OF CORRECT CLASSIFICATION OF THE MODEL VALIDATION POPULATIONS

(Percentages)



Source : NBB.

that is declared bankrupt or applies for a scheme of composition, while other firms are regarded as non-failing.

This model was developed for the population of firms which submit their annual accounts according to the full format and is based on the logistic regression technique. Using this technique, each firm in the study can be assigned a score indicating its financial risk. The advantage of this technique is that relatively few assumptions are made, especially in comparison with discriminant analysis. The explanatory variables are financial ratios. Various models were first estimated on the basis of a sample of 1,200 firms, and then validated on the basis of all companies which submitted their annual accounts in the full format between 1991 and 1998 (1). The model ultimately selected has eight explanatory variables, most of them being liquidity and solvency variables. This is closely linked to the legislation on bankruptcy and composition, in which the question of the suspension of payments is central. The level of arrears of tax and social security contributions, indicating acute cash flow problems, is a variable which has proved particularly reliable in distinguishing between failing and non-failing firms. "Time taken to submit the annual accounts" was also included as a variable : the more time a firm takes to submit its annual accounts, the greater the financial risk.

(1) Between 7,000 and 8,000 firms for each year examined.

The model looks like this :

L = –1.3

+27.1 (Arrears of tax and social security contributions / total assets)

+17.1 (Debt burden / total assets)

–3.4 (Gross profit before tax, debt burden and depreciation / total assets)

–2.9 (Cash flow / borrowings)

+2.3 (Amounts owed to credit institutions / debts at up to one year)

–0.4 (Equity / total assets)

–0.2 (Current liquid assets / short-term borrowings)

+0.5 (Time taken to submit the annual accounts, in number of days).

NB : all coefficients are statistically significant at the 95 p.c. level (t test).

The coefficient of a variable determines the change in the risk score L if that variable rises or falls by one unit, all other things being equal. For example, if the cash flow / borrowings ratio rises by 0.1, the L score falls by 0.29.

By combining a number of variables, the model reduces all aspects of the financial situation of a firm to a single value : the risk score L. On the basis of that score it is possible to determine a threshold score for ranking the firms : below that threshold, the model regards the firms as non-failing and above that threshold it regards them as failing. On that basis, the degree to which firms are correctly classified can be calculated in order to assess the discriminatory capacity of the model. In that connection, there are two yardsticks of correct classification to be considered : one is the percentage of firms going bankrupt and classed as failing by the model, and the other is the percentage of firms not going bankrupt and classed as non-failing by the model. Chart 31 shows the percentages computed by the model on the basis of the validation populations from 1991 to 1998. Naturally, this model cannot classify all firms correctly. The number of correct classifications averages 77 p.c., a very pleasing result in relation to comparable studies.

TABLE 21 DISTRIBUTION OF FIRMS AMONG THE RISK CLASSES (2001)

(Percentages)

	Class 1	Class 2	Class 3	Class 4	All risk classes
ICT industry	63.0	19.2	8.2	9.6	17.8
ICT distribution	55.5	23.4	11.5	9.6	21.1
Telecommunications	52.3	13.6	6.8	27.3	34.1
Computer & related activities	51.6	24.9	5.6	17.9	23.5
ICT as a whole	54.3	22.9	8.0	14.7	22.7
Non-financial corporations in general	54.4	28.2	10.4	7.0	17.4

Source : NBB.

5.4.2 Determination of risk classes

Risk classes were defined on the basis of the risk score estimated for each firm and past bankruptcies. These classes divide the firms into homogenous risk zones on the basis of the percentage of firms actually going bankrupt in each class. In this way, four classes were created on the basis of intervals of the L score :

- class 1 : $L < -0.84$; risk-free class (risk of default virtually nil) ;
- class 2 : $-0.84 \leq L < 0.21$; neutral class (risk of default comparable to the average) ;
- class 3 : $0.21 \leq L < 1.10$; high risk class (risk of default 3 to 4 times higher than average) ;
- class 4 : $1.10 \leq L$; very high risk class (risk of default more than 10 times higher than average).

However, this classification of the firms must be interpreted with caution. For one thing, only a tiny proportion (rather less than 1.5 p.c.) of the firms studied actually went bankrupt or applied for composition. The classification should therefore be regarded more as an indication of financial soundness rather than a bankruptcy predictor : firms in classes 3 and 4 are not necessarily doomed to bankruptcy, but they do face serious problems as regards liquidity, debts or profitability. Apart from bankruptcy, these financial difficulties may cause delay in paying off debts or in paying suppliers, or lead to restructuring or even the cessation of activity. Also, some Belgian firms in difficulties belong to major multinationals which are prepared to provide them with financial support, at least temporarily.

Furthermore, the classification is only a partial assessment of the firms' economic situation, since it is based solely on analysis of the annual accounts. Thus, other important aspects such as the quality of the management team, the competitive environment or future prospects are disregarded. The classification of the firms should therefore be regarded as a strictly financial assessment of the firms at a particular moment in time.

5.4.3 Financial risks in ICT

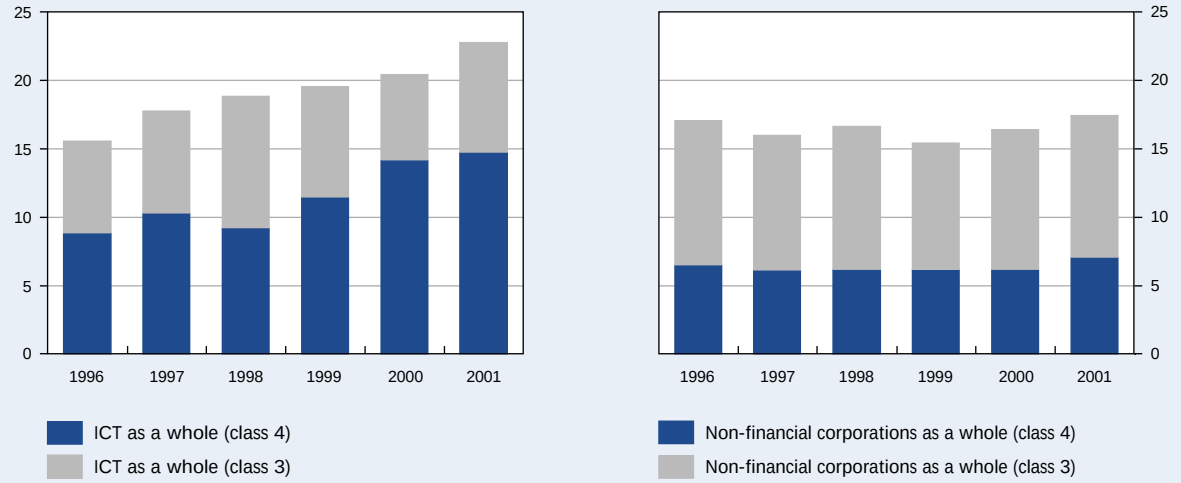
Table 21 shows the distribution of firms among the financial risk classes for the 2001 financial year. Overall, the risks in the ICT sector are decidedly greater than for other firms. In the ICT sector as a whole, the proportion of firms at risk (i.e. firms in class 3 or 4) is more than 5 percentage points higher (22.7 p.c. against 17.4 p.c. for non-financial corporations in general). Even more striking is the fact that the number of ICT firms at very high risk is more than twice as high as the national average (14.7 p.c. against 7 p.c.).

Although the financial risks are decidedly higher in the ICT sector as a whole, the risks also vary from one subsector to another. Despite the higher proportion of ICT industry firms in class 4, the risks in that subsector are very similar to those for the rest of the economy. The figure for firms at risk in ICT distribution is 3.7 percentage points higher, so that the risk in that sector is substantially above the average.

In the other two ICT sectors, the risks are far higher than in the rest of the economy. Thus, almost 18 p.c. of firms in computer & related activities and over 27 p.c. of telecommunications companies are at high financial risk. These firms in difficulties are usually very young companies. In the telecommunications sector, they are firms which have entered the market recently, with moderate profitability as yet and a high level of debts, mainly as a result of the substantial cost of their initial investments. Indeed, the heavy debt burden in telecommunications companies is a common feature for the

CHART 32 DEVELOPMENT OF THE PERCENTAGE OF FIRMS IN CLASS 3 AND 4 IN THE ICT SECTOR AND IN NON-FINANCIAL CORPORATIONS IN GENERAL

(Percentages)



Source : NBB.

OECD countries[1]. In computer & related activities, a growing number of firms face severe liquidity problems.

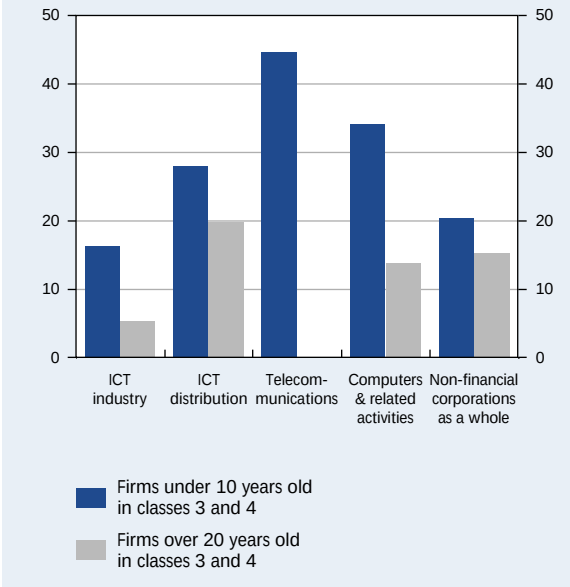
Since 1996, the financial risks in ICT have followed a very different pattern from those in other economic sectors. While the number of firms at risk in the economy as a whole remained fairly steady, the vulnerability of ICT firms has increased over the years (chart 32). The increasing financial risks in ICT are connected mainly with the rise in the number of firms in class 4. Computer & related activities and ICT industry were the main contributors to this development. The risks in telecommunications have remained relatively stable, but are well above average. Although the ICT sector was relatively healthy in the mid 1990s, it is now one of the riskiest segments of the Belgian economy.

That situation is due to two phenomena confronting the ICT sector worldwide since 2000, namely the slump in share prices of companies in the sector and the cut-backs on ICT investment by firms (see 2.2 above). Those events have naturally had repercussions for the risks of Belgian ICT firms since 2000, but the results of the model show that the risks have actually been rising ever since 1996.

Chart 33 shows that the financial risk of ICT firms is very dependent on the firm's age. Although the age criterion influences the risk for all non-financial corporations (rather more than 20 p.c. of firms under 10 years old constitute a financial risk, while the figure for firms over

CHART 33 FINANCIAL RISK AND AGE OF FIRMS

(Percentages)



Source : NBB.

(1) OECD (2003a).

20 years old is 15 p.c.), this criterion is much more significant in ICT firms: in ICT industry and computer & related activities, the number of firms at risk drops by 50 p.c. between the group of firms under 10 years old and the group over 20 years old. In telecommunications, no firm over 20 years old constitutes a risk.

6. Conclusion

This study has revealed a number of striking facts regarding the ICT sector in Belgium. The economic weight of the sector was estimated via two approaches. The first, namely the "sectoral" approach, is fairly traditional and uses a definition of ICT based on the Belgian economic sectors. In 2002 the value added of ICT was estimated on the basis of this approach at over 11 billion euro (at current prices) and employment at over 143,000 units. Since this first method of analysis has a number of conceptual defects, it was supplemented by a second, fairly innovative approach: the "product approach". This method uses the supply-use tables for the Belgian economy and permits a fairly accurate estimate of the ICT output of each economic sector. Use of this method offered two advantages: it shed a different light on ICT and made it possible to test the "sectoral" approach. The "product approach" was used to assess the value added of ICT at almost 14 billion euro and employment at over 176,000 units. Depending on the approach used, ICT represents between 4.7 and 5.8 p.c. of total Belgian value added.

The sector produced particularly strong growth during the second half of the 1990s. ICT in Belgium therefore made an active contribution towards the creation of firms, value added and jobs. The same tendency was apparent in international trade in ICT goods and services. However, the beginning of the third millennium was less favourable for the sector. While ICT stood up well to the general deterioration in the economic climate in 2001, that was not the case in 2002, a year in which employment in the sector declined for the first time. This reversal was due to two phenomena facing the ICT sector worldwide from 2000 onwards, namely the steep fall in share prices of companies in the sector and the cut-backs in ICT investment by businesses as a whole. The future will show whether ICT will be able to continue creating activity at a rapid rate if the economic context improves.

In international terms, Belgium demonstrated the same tendencies as most other developed countries, in both the economic weight of ICT and its dissemination. In the European Union, Belgium is about average. However, in reality there are contrasts: while Belgium lags behind in certain areas, such as ICT investment in businesses, it leads the field in other areas, especially broadband connections. For the European Union as a whole, at least two trends emerge. First, the EU is now lagging significantly behind the United States and certain Asian countries. Second, the ICT sector is more developed with more widespread use of ICT products the further north in Europe we go. Generally, ICT production is also most highly developed in those countries where use of ICT is most widespread.

An analysis was also conducted on the basis of the annual accounts of ICT firms. This revealed a number of financial and social tendencies within those firms. Financially, the year 2000 was a low point with a simultaneous deterioration in the liquidity, solvency and profitability of firms in the sector. According to the bankruptcy prediction model developed in connection with this study, the risk of financial failure in ICT firms is also greater than for firms in other sectors. Moreover, that risk has increased steadily since the mid 1990s. Finally, at social level, the study of the annual accounts yielded two significant findings: first, the staff recruited in this sector have a substantially higher standard of education than staff in other sectors; and second, ICT firms invest very heavily in training their staff.

Annex 1 : The largest firms in the ICT sector

TABLE A THE TWENTY LARGEST FIRMS IN ICT INDUSTRY ACCORDING TO THE ANNUAL ACCOUNTS (2001)

	Number of jobs (1)
Alcatel Bell	4,376
Philips Industrial Activities	3,342
Siemens ATEA	2,311
Barco	2,020
STMicroelectronics	1,113
Câblerie d'Eupen	1,051
Tyco Electronics Belgium	1,029
BCComponents	1,002
Tyco Electronics Raychem	917
Nexans Benelux	7l82
Alcatel ETCA	672
Heraeus Electro-nite International	494
Egemin Electriciteit voor goederen-behandeling, marine en industrie	399
ESKO Graphics	342
Scientific Atlanta Europe	341
Cherokee Europe	332
Pioneer Technology Belgium	306
Ensysta	262
C-Mag Electromag	213
Thales Communications Belgium	208

Source : NBB.
(1) According to the social balance sheet.

TABLE B THE TWENTY LARGEST FIRMS IN ICT DISTRIBUTION ACCORDING TO THE ANNUAL ACCOUNTS (2001)

	Number of jobs[1]
IBM Belgium	1,858
Hewlett-Packard Belgium	672
Compaq Computer	671
Sony Service Centre Europe	571
Unisys Belgium	565
CEBEO	433
Xerox	421
Tech Data	412
OCE-Belgium	398
Rexel Belgium	395
Canon Belgium	313
Minolta Business Equipment Belgium	305
Avnet Europe	292
CREO Europe	255
GDB International	227
Bull	220
Ericsson	219
Systemat	207
Ingram Micro	145
Pioneer Europe	137

Source : NBB.
(1) According to the social balance sheet.

TABLE C THE TWENTY LARGEST FIRMS IN TELECOMMUNICATIONS ACCORDING TO THE ANNUAL ACCOUNTS (2001)

	Number of jobs (1)
Belgacom	19,598
Belgacom Mobile	2,245
Mobistar	1,701
Base	1,097
Telenet Operaties	926
SWIFT	913
Telindus	618
Belgacom Skynet	336
European Payment Systems Services	259
Coditel Brabant	235
Versatel Belgium	226
Worldcom	210
United Pan-European Communications Belgium	141
Telindus GSM	139
Damovo Belgium	136
Equant Belgium	118
Mobistar Corporate Solutions	99
Tiscali	98
Techteam Europe	98
BASF IT Services	92

Source : NBB.
(1) According to the social balance sheet.

TABLE D THE TWENTY LARGEST FIRMS IN COMPUTER & RELATED ACTIVITIES ACCORDING TO THE ANNUAL ACCOUNTS (2001)

	Number of jobs (1)
Cap Gemini Ernst & Young Belgium	850
Siemens Business Services	804
Dolmen Computer Applications	750
Centrum voor Informatica Provincies Antwerpen en Limburg	661
Getronics Belgium	632
Real Software	548
Atos Origin Belgium	510
Econocom Services	507
Infoco	421
Ardatis	404
Apem	374
Trasys	370
Oracle Belgium	342
CSC Computer Sciences	334
Tele Atlas Data Gent	329
CMG Belgium	310
Skillteam	306
Computer Task Group Belgium	292
Magnetic Data Belgium	278
The Capital Markets Company	231

Source : NBB.
(1) According to the social balance sheet.

Annex 2: Definition of the financial ratios

	Codes used in the accounts format	
	full [1]	abbreviated
1. VALUE ADDED MARGIN		
Condition for calculating the ratio		
The item "merchandise, raw materials and consumables, services and miscellaneous goods" must be completed	(Mandatory item)	60/61>0
Numerator (gross value added)		
Goods and services supplied	+70/74	
Operating subsidies and compensatory amounts received from the government	–740	
Merchandise and miscellaneous goods	–60	
Services and miscellaneous goods	–61	
Estimate of gross value added:		
Gross operating margin		
Positive balance		+70/61
or negative balance		+61/70
Denominator		
Goods and services supplied	+70/74	
Operating subsidies and compensatory amounts received from the government	–740	
Estimate of goods and services supplied:		
Gross operating margin		
Positive balance		+70/61
or negative balance		+61/70
Merchandise, miscellaneous goods, services and miscellaneous goods		+60/61
Ratio = T/N*100		
2. VALUE ADDED PER EMPLOYEE		
Condition for calculating the ratio		
The financial year must be 12 months long	12 months	12 months
The average workforce calculated in full-time equivalents. Finished goods and goods for resale must be positive	9087+9090 > 0	9087+9090 > 0
Numerator (gross value added)		
Identical with that for the value added margin		
Denominator		
The average workforce calculated in full-time equivalents	9087+9090	9087+9090
Ratio = T/N (EUR)		
3. NET RETURN ON EQUITY AFTER TAX		
Condition for calculating the ratio		
The financial year must be 12 months long	12 months	12 months
The denominator must be positive	10/15 > 0	10/15 > 0
Numerator		
Profit for the year	+70/67	+70/67
or Loss for the year	+67/70	+67/70
Denominator		
Equity	10/15	10/15
Ratio = T/N*100		

(1) The associated profit and loss account is given in the form of a list.

	Codes used in the accounts format	
	full [1]	abbreviated
4. LIQUIDITY-CURRENT RATIO		
Condition for calculating the ratio		
None	–	–
Numerator		
Stocks and orders in progress	+3	+3
Receivables at up to one year	+40/41	+40/41
Cash investments	+50/53	+50/53
Liquid resources	+54/58	+54/58
Prepayments and accrued income	+490/1	+490/1
Denominator		
Debts at up to one year	+42/48	+42/48
Accruals and deferred income	+492/3	+492/3
Ratio = T/N		
5. SOLVENCY		
Condition for calculating the ratio		
None	–	–
Numerator		
Equity	10/15	15/15
Denominator		
Total liabilities	+10/49	+10/49
Ratio = T/N*100		
6. RELATIVE IMPORTANCE OF THE ACQUISITION OF TANGIBLE FIXED ASSETS COMPARED TO PREVIOUS YEAR		
Condition for calculating the ratio		
The financial year must be 12 months long	12 months	12 months
Numerator		
Tangible fixed assets acquired during the year (including produced fixed assets)	+8169	+8169
Increase in value of tangible fixed assets acquired from third parties	+8229	+8229
Depreciation and reduction in value of tangible fixed assets acquired from third parties	–8299	–8299
Denominator		
Value of tangible fixed assets at the end of the previous financial year	+8159	+8159
Increase in value of tangible fixed assets at the end of the previous financial year	+8209	+8209
Depreciation and reduction in value of tangible fixed assets at the end of the previous financial year	–8269	–8269
Ratio = T/N*100		
7 LABOUR COSTS PER EMPLOYEE		
Condition for calculating the ratio		
The item “Salaries, social security contributions and pensions” must be positive	62>0	62>0
The average workforce calculated in full-time equivalents must be positive	9087+9090>0	9087+9090>0
Numerator		
Salaries, social security contributions and pensions	+62	+62
Denominator		
The average workforce calculated in full-time equivalents	9087+9090	9087+9090
Ratio = T/N (EUR)		

(1) The associated profit and loss account is given in the form of a list.

Annex 3: Corporate default prediction model

To assess the financial risks for firms, the National Bank has developed an internal model for the prediction of corporate defaults. The method consists in examining, on the basis of the annual accounts for a particular year, the differences between the financial profiles of two types of firm: non-failing firms and firms failing within the three ensuing years. The default definition used is based on a legal criterion: a failing firm is one which is declared bankrupt or has applied for a scheme of composition, while other firms are regarded as non-failing.

The first models for predicting bankruptcies were developed in the later 1960s [1]. Since then, interest in this subject has increased steadily, particularly in financial institutions that want to detect credit risks at an early stage. The models have led to the establishment of scoring systems permitting companies to be ranked on the basis of their financial risk. Most of the models were based on relatively small samples (a few hundred companies or less) and often examined the large firms in a particular sector, generally the industrial sector. In Belgium, the most important corporate bankruptcy prediction models were developed by Ooghe and Verbaere in 1982 and by Ooghe, Joos and De Vos in 1991 [2].

1. Population examined

1.1 Selection of firms

The information used for this model comes from the databanks of the NBB's Central Balance Sheet Office, on which basis it is possible to observe all the sets of accounts filed in any particular year. The analysis was confined to large firms, i.e. those submitting their annual accounts in the full format, because – for the analysis on the basis of financial ratios – it is generally better to focus on one sector or a clearly defined category of firms. The statistics published by the Central Balance Sheet Office reveal clear differences between firms submitting full-format accounts and those submitting accounts in the abbreviated format.

In view of the varying situations encountered in firms submitting annual accounts, it was also not possible to examine the entire population of 'full-format'firms, as a number of firms present atypical patterns of financial behaviour which can be attributed to specific economic situations. For example, the analysis excluded the accounts of "dormant" firms or firms which have gone into liquidation, terminated their activities or been wound up. Furthermore, to permit comparison of the data, annual accounts relating to a financial year of less than 6 months or more than 24 months were disregarded, as were those which did not satisfy the checks carried out by the Central Balance Sheet Office.

These exclusions mainly concern the smallest firms, and led to the exclusion of just under half of the firms submitting full-format accounts. Although this meant losing a large number of firms, the population examined is still quite representative in macroeconomic terms, as it covers over 75 p.c. of the value added and employment of full-format firms as a whole.

1.2 Bankruptcy and non-bankruptcy

Corporate bankruptcy is first and foremost an economic concept. It results from the general deterioration in a firm's situation, and is reflected in its accounts. Ideally, economic criteria for bankruptcy should be defined, such as the imbalance between certain items in the balance sheet or profit and loss account. However, when making a statistical analysis of a large population it is not easy to define a precise economic line of demarcation between firms which are in difficulty and firms which are not.

In addition, the economic failure of a firm is eventually expressed at legal level: if the economic failure is not remedied quickly, the firm is declared bankrupt or obliged to apply for composition. This legal approach to bankruptcy offers the advantage that it can be readily applied from a statistical angle. For that reason, firms in difficulty are defined as those which have been declared bankrupt or have applied for a scheme of composition [3].

In legal terms, bankruptcy applies to firms which have permanently suspended their payments and have lost their creditworthiness. In contrast, a court may arrange a scheme of composition for a firm which is temporarily unable to meet its liabilities, or whose continuity is threatened by difficulties which may – sooner or later – lead to suspension of payments [4].

(1) See in particular Beaver W. H. (1966) and Altman E. I. (1968).

(2) A summary of these models may be found in Ooghe H., Joos P. and De Bourdeaudhuij C. (1995).

(3) The fact that composition offers some firms a chance of survival after the end of the proceedings was disregarded. The fact that composition proceedings are initiated in itself indicates that the firm is failing, regardless of whether the scheme of composition is successful for the firm concerned.

(4) For the laws on bankruptcy and composition, see for example the Belgian Bankers' Association (1997).

TABLE 1 POPULATION EXAMINED
(Number of firms)

	F1	F2	F3	NF	Total
1991 . . .	24	56	44	2,746	2,910
1992 . . .	20	43	45	4,513	4,694
1993 . . .	22	49	74	5,736	5,881
1994 . . .	29	59	53	5,861	6,190
1995 . . .	35	44	29	6,596	6,704
1996 . . .	23	35	56	7,009	7,123
1997 . . .	12	50	41	7,182	7,285
1998 . . .	36	43	49	7,348	7,487

Source : NBB.

The Central Balance Sheet Office records changes in the legal position of firms in its data banks, so that cases of insolvency can be traced. Thus, the code for the legal situation of a firm is changed if the firm is declared bankrupt ; the same procedure is followed in the case of composition. The vast majority (98 p.c.) of insolvency cases concern bankruptcy.

Bankruptcy can only be predicted in the short term, or at most the medium term : a firm's accounts do not show signs of weakness until a few years before the event. The model therefore concentrates on predictions between one and three years prior to bankruptcy. For a given year N, the population examined was subdivided into two groups :

– firms non-failing in the next three years (NF)
– firms failing in the next three years (F).

Since the financial profile of the firms is also heavily dependent on the amount of time still to go before their bankruptcy, the population of firms F was further subdivided into three groups :

– firms failing in N+1 (F1)
– firms failing in N+2 (F2)
– firms failing in N+3 (F3).

1.3 Period examined

The model concentrates on the annual accounts relating to financial years which ended between 1991 and 1998, and consequently on bankruptcies occurring between 1992 and 2001. Moreover, the population was not defined in the same way from one year to the next : a firm that was not examined in a particular year (e.g. because it did not file accounts or the accounts were invalid) may be considered the next year. This approach is fully justified by the fact that firms in difficulty are less inclined to submit their annual accounts (cf. *infra*).

1.4 Presentation of the population examined

The population examined is described in table 1. This table calls for an important remark : firms which are close to bankruptcy, particularly firms F1, are inclined to cease filing their annual accounts. This phenomenon is attributable mainly to the fact that the bankruptcy of firms F1 may pre-date the deadline for submitting annual accounts. For example, in 1995 44 F2 firms complied with their obligations, compared to only 23 sets of accounts filed by F1 firms in 1996. The population of firms in difficulty, particularly after one year, is therefore seriously distorted and the resulting financial picture is probably less gloomy than reality.

2. Explanatory variables

The independent variables which were tested for this model were derived partly from the financial analysis of the annual accounts and partly from a more general analysis of the firms'situation.

The financial variables tested in the model were composed on the basis of three sources : the general theory on the interpretation of annual accounts [1], the ratios defined by the Central Balance Sheet Office, and earlier Belgian and foreign studies on the prediction of corporate bankruptcies. In addition, various specific ratios were constructed, some of them relating to the financial result, with due attention to the growth of that result in preceding years [2]. Thus, around sixty financial variables were tested ; they represent the four main financial analysis topics : liquidity, solvency, profitability and value added.

Apart from the financial variables, more general variables were also considered : age, size (number of workers, balance sheet total, and type of accounts format submitted), legal form and time take to submit annual accounts.

(1) See the following reference manuals: Institute of Auditors (1994), Lurkin P, Descendre N. and Lievens D. (1990), and Ooghe H. and Van Wymeersch C. (1996).

(2) In this connection, see the National Bank of Belgium (2001).

TABLE 2 ESTIMATION SAMPLE

Type of firm	Number
F1	76
F2	141
F3	160
NF	802
Total	1,179

Source : NBB.

3. Modelling techniques

Discriminant analysis and logistic regression are among the most commonly used econometric techniques in bankruptcy prediction models. Other methods are also used, in particular the probit regression (1) and – increasingly – the "neural network" approach (2). For this study, discriminant analysis and logistic regression were tested. These two methods naturally lend themselves to problems relating to the separation of two populations (3).

Historically, discriminant analysis is the technique most widely used in models to predict firms in difficulty. However, for optimum efficiency if this method is used, several assumptions need to be satisfied. The one which imposes most constraints is undoubtedly that concerning the multivariate normal distribution of the independent variables; however, that assumption is not satisfied by the financial ratios (4). Furthermore, statisticians have found that discriminant analysis is ill-suited to the use of binary or discrete explanatory variables. However, it is questionable whether these limitations actually affect the results obtained. Moreover, studies comparing various econometric methods have shown that the results of discriminant analysis tally closely with those produced by other techniques (5).

On the basis of the logistic regression, populations can also be classified according to explanatory variables. The assumptions underlying this method are less restrictive than those of discriminant analysis, particularly because the method does not assume any normal distribution of the explanatory variables (6).

The results presented in this document were obtained from a logistic regression: following a number of tests, this method was the one that appeared the most stable. In contrast, discriminant analysis proved highly sensitive to some variables, a finding which is undoubtedly connected with the assumptions made by this method.

4. Multivariate analysis

As already stated, multivariate analysis is based on a logistic regression. In the first instance, a number of models were estimated on the basis of an estimation sample composed of accounts relating to the 1996, 1997 and 1998 financial years. All firms which had filed annual accounts for those years and were in difficulty within three years were considered. A random sample of the non-failing firms was composed. Table 2 shows the estimation sample. That sample permitted testing of the classification ability of the various methods.

The models thus estimated were then validated on the basis of the total populations for years 1991 to 1998. The validation phase is crucial, because it is during this phase that the prediction ability of a model can be evaluated. The model ultimately selected is the model demonstrating the greatest prediction ability and the greatest stability over time (cf. *infra*).

4.1 Selection of the explanatory variables

The explanatory variables to be incorporated in the model were selected in three separate phases. First, the correlations between the variables for each year were analysed in order to reveal the links between the various dimensions of financial analysis. Next, models were developed in the form of classification trees (7), which were used to identify certain variables with substantial discriminating ability, some of which form part of the chosen logistic model. Although the classification trees performed well as regards the classification of the firms, they have certain drawbacks for the logistic regression. Finally, the variables were also selected using variable selection methods available in the SAS software. Although these methods offer the advantage of being systematic and automated, they were nevertheless treated with a degree of caution because they may result in models which are difficult to interpret.

(1) See for example Skogsvik K. (1988).

(2) See for example Altman E. I., Marco G. and Varetto F. (1994) and Bardos M. and Zhu W. (1997).

(3) The neural network technique was not used because it is primarily an advanced statistical method with hardly any advantages over the two other techniques; furthermore, its interpretation is less direct.

(4) With regard to the problems of applying discriminant analysis to bankruptcy prediction, see for example Eisenbeis R. A. (1978) and Goudie A. W. (1987).

(5) In this connection, see for example: Altman E. I. and Narayanan P. (1997), Altman E. I., Marco G. and Varetto F. (1994) and Bardos M. and Zhu W. (1997).

(6) For a detailed description of logistic regression, see for example Agresti A. (1990).

(7) On the subject of the classification tree technique, see Breiman L., Friedman J. H., Olshen R. A. and Stone C. J. (1984).

4.2 General presentation of the logistic model

The model ultimately selected comprises eight explanatory variables and takes the following form:

L = –1.3

+27.1 (Arrears of taxes and social securitycontributions/total assets)

+17.1 (Liabilities/total assets)

–3.4 (Pre-tax profit, liabilities and depreciation/total assets)

–2.9 (Cash flow/borrowings)

+2.3 (Amounts owed to credit institutions/debts at up to one year)

–0.4 (Equity/total assets)

–0.2 (Current liquid assets/short-term borrowings)

+0.5 (Time taken to file the annual accounts, in number of days).

Note: all coefficients are statistically significant at the 95 p.c. level (t test).

The fundamental benefit of this model is that it reduces the information provided by the different variables to a single value, the risk score L. The higher this score, the greater the financial risk for the firm. The coefficients estimate the change in score L if the associated variable changes by one unit, all other things being equal. For example, if the ratio (cash flow/borrowings) increases by 0.1, the score L falls by 0.29.

The variables incorporated in the model are mostly liquidity and solvency variables. This is closely connected with the laws on bankruptcy and judicial composition, in which suspension of payments is the key issue. Thus, the level of arrears to the tax and social security authorities – an indicator of a serious cash flow crisis – is a variable which was particularly good at discriminating between failing and non-failing firms. Another notable feature is the variable "Time taken to file the annual accounts": the later a firm submits its annual accounts, the higher its financial risk.

4.3 Analysis of the degree of correct classification

An essential phase in estimating the prediction efficiency of the model is the analysis of the degree of correct classification of firms in categories F and NF. Each firm was placed in one or other category according to the score estimated by the model: if this score is higher than the score chosen as the threshold, the firm is placed in category F; otherwise it is placed in category NF. The score L used as the threshold is the score which maximises the level of correct classification of both firms F and NF; the score L in question equals – 0.036. The criterion selected to determine the threshold therefore implies that that the aim is to achieve the same accuracy of classification for firms F and NF. Since the ratios in the population are very unequal, it would be useless to choose the criterion "overall percentage of correct classifications": if all firms were simply placed in category NF, this criterion would result in no models being tested, as the overall error rate is equal to the percentage of failing firms in the population – i.e. under 2 p.c.

Table 3 describes the classification of firms F and NF by the model selected: the model places 78 p.c. of the failing firms in the sample in the failing firms category, while 78 p.c. of non-failing firms are also classed as non-failing.

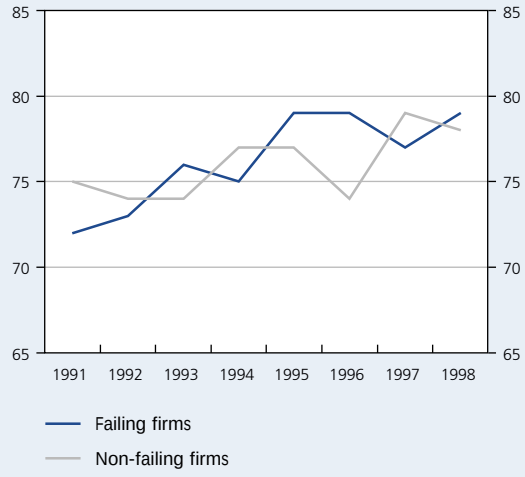
TABLE 3 ESTIMATION SAMPLE - CLASSIFICATION TABLE FOR FIRMS F AND NF

Model estimate	Actual classification (in p.c.)	
	F	NF
F	78	22
NF	22	78
Total	100	100

Source: NBB.

CHART 1 DEGREE OF CORRECT CLASSIFICATION OF THE VALIDATION POPULATIONS

(Percentages)



Source: NBB.

TABLE 4 ESTIMATION SAMPLE - CLASSIFICATION TABLE FOR FIRMS F1, F2 AND F3

Model estimate	Actual classification (in p.c.)		
	F1	F2	F3
F	84	75	68
NF	16	25	32
Total	100	100	100

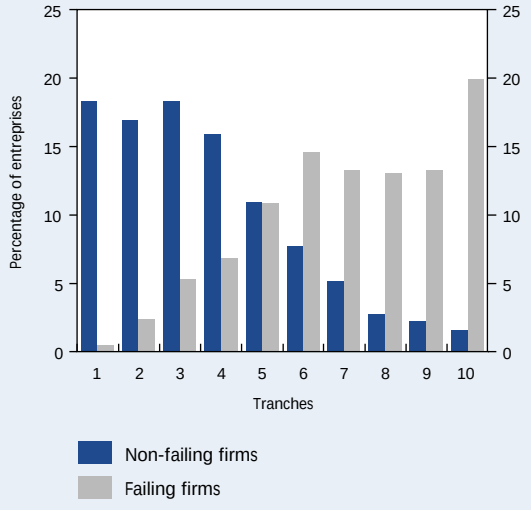
Source : NBB.

The model therefore generates fairly low error rates, taking account of the size of the populations studied. These results compare favourably with those of earlier, similar studies [1]. Table 4 confirms that the bankruptcy can be predicted only in the short term, or at most in the medium term : the prediction capability of the model declines the longer the time elapsing before the bankruptcy. Thus, firms F1 present the most successful classification rate (84 p.c.), followed by firms F2 (75 p.c.) and firms F3 (68 p.c.)

Chart 1 shows the classification of firms F and NF for the validation populations. Logically, the correct classification rates are slightly lower for the validation populations (average 76 p.c.) than for the sample. The model proposed here was selected from the various models tested on account of the quality and stability of its correct classification rates over time : for the validation populations – both failing and non-failing firms – the correct classification rates fluctuate within a narrow margin, ranging from 72 p.c. to 79 p.c.

CHART 2 RISK DISTRIBUTION FAILING AND NON-FAILING FIRMS

(Percentages)



Source : NBB.

4.4 Risk distribution

The risk distribution for the various categories of firms studied can be analysed on the basis of the estimated score L for each firm. To show this distribution in graph form, score L was changed to represent values ranging between 0 and 1. This interval was then subdivided into 10 tranches of 0.1 each. The first tranche contains the lowest scores and is therefore the least risky, while the tenth tranche contains the highest scores and is therefore the most risky.

Chart 2 shows the distribution of the scores of firms F and NF. This chart indicates that there is a marked difference between the distribution of non-failing firms and that of failing firms. Logically, failing firms present an asymmetrical distribution towards the right, in which almost 60 p.c. of the firms are found in the four riskiest tranches. The distribution of the non-failing firms is asymmetric to the left, with almost 70 p.c. of the firms found in the four least risky tranches.

4.5 ROC curves

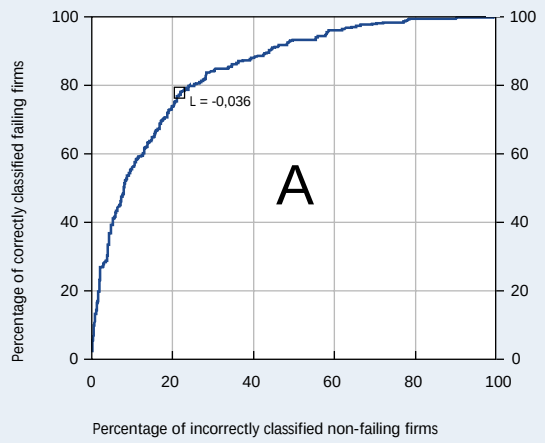
Although accuracy of classification is an essential yardstick for the prediction capability of the model, the information which it offers about the performance of the model is nevertheless very variable. The main limitation is that it takes no account of the overall risk distribution. The ROC (receiver operating characteristic) curve methodology helps to overcome this by applying the analysis of the correct classification table in more general terms : a number of score thresholds is considered which is equal to the estimated scores of the population studied [2]. For each estimated score, the ROC curve links the percentage of correctly classified failing firms to the percentage of incorrectly classified non-failing firms. The lower the score threshold, the higher the first percentage and the lower the second.

(1) See for example Banque de France (1998)

(2) On the subject of ROC curves, see for example Hanley J. A. (1989) and Pepe M. (2002). These curves are used mainly in connection with medical research.

CHART 3 ROC CURVE OF THE MODEL SELECTED

(Percentages)



Source : NBB.

The chart below shows the ROC curve for the estimation sample. Each point on the curve corresponds to one specific threshold. The first point (at the bottom left of the graph) corresponds to the maximum score threshold : for this threshold, all firms examined are regarded as non-failing, since the probability is less than or equal to this score for all firms ; consequently, all non-failing firms are correctly classified (i.e. 0 p.c. incorrect classifications) while all failing firms are incorrectly classified (i.e. 0 p.c. correct classifications). Conversely, the last point on the curve (at the top right) corresponds to the minimum score threshold. At this threshold, there is 100 p.c. correct classification of failing firms, while the figure for non-failing firms is 0 p.c. The intermediate points on the curve correspond to intermediate thresholds. For example : for threshold L = –0.036 used for the table of correct classifications, the curve indicates that 78 p.c. of failing and non-failing firms are correctly classified.

Area A below the ROC curve provides an excellent measure of the discriminating capability of the model : the better the model is at discriminating, the closer the curve to the top left of the chart and the larger the area A. For example : if the percentage of incorrectly classified non-failing firms is constant, the accuracy of classification of failing firms increases the higher the curve. Area A varies from 0 to 1 depending on the discriminatory ability of the model ; it is 0.85 for the model selected. An effort was made to maximise this area during the modelling.

Area A has probabilistic significance too, and indicates the probability that any failing firm picked at random from the population will have an estimated score which is greater than that of any other non-failing firm selected at random (1). Thus, for the model selected, this probability is 85 p.c.

4.6 Determination of risk classes

Risk classes were defined on the basis of the risk score estimated for each firm and past bankruptcies. These classes divide the firms into homogenous risk zones on the basis of the percentage of firms actually going bankrupt in each class. Thus, four classes were created on the basis of intervals of the L score :

- class 1 : $L < -0.84$; risk-free class (risk of default virtually nil) ;
- class 2 : $-0.84 \leq L < 0.21$; neutral class (risk of default comparable to the average) ;
- class 3 : $0.21 \leq L < 1.10$; high risk class (risk of default 3 to 4 times higher than average) ;
- class 4 : $1.10 \leq L$; very high risk class (risk of default more than 10 times higher than average).

This classification makes it easier to interpret the model results.

(1) As regards the meaning of the area below an ROC curve, see for example Bamber D. (1975) and Hanley J.A. and McNeil B. (1982).

Bibliography

National Bank of Belgium (2002), "Report 2001, Part 1 – Economic and financial developments", Brussels.

National Bank of Belgium (2003), "Report 2002, Part 1 – Economic and financial developments", Brussels.

Federal Planning Bureau (2002), "Production and diffusion of ICT in Belgium", Working paper 1-02, Brussels.

Carlton D. W. en Perloff J. M. (1994), "Modern Industrial Organization", Addison Wesley Longman, New York.

Central Bureau of Statistics (2002), "De digitale economie 2002", CBS, Voorburg.

Cohen D. and Debonneuil M. (1998), "Nouvelle économie", La documentation française, Paris.

Coppens F. and van Gastel G. (2003), "De autonijverheid in België: Het belang van het toeleveringsnetwerk rond de assemblage van personenauto's", National Bank of Belgium, Working paper nº 38.

Didier M. and Martinez M. (1998), "Le poids des technologies de l'information et de la communication dans le système productif – une comparaison entre la France et les Etats-Unis", in Cohen D. and Debonneuil M. (1998), "Nouvelle économie", La documentation française, Paris.

Gadrey J. (2000), "Nouvelle économie, nouveau mythe?", Flammarion, Paris.

National Accounts Institute (2003), "Aanbod- en gebruikstabellen 1995, 1997 en 1999", National Bank of Belgium.

OECD (2000), "Perspectives des technologies de l'information de l'OCDE – TIC, commerce électronique et économie de l'information", Paris.

OECD (2001), "Defining the ICT sector", Paris.

OECD (2002), "Measuring the information economy", Paris.

OECD (2003a), "After the Telecommunications Bubble", in Perspectives économiques de l'OCDE, 2003/1, nº 73.

OECD (2003b), "OECD Communications Outlook 2003", Paris.

Sauvy A. (1980), "La machine et le chômage – Le progrès technique et l'emploi", Dunod, Paris.

US Department of Commerce (2000), "Digital Economy 2000", Economics and Statistics Administration, Washington.

Bilbliography relating to the corporate default prediction model

Agresti A. (1990), "Categorical Data Analysis", John Wiley & Sons, New York.

Altman E. I. (1968), "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy", The Journal of Finance, vol. 23.

Altman E. I., Marco G. and Varetto F. (1994), "Corporate distress diagnosis: Comparisons using linear discriminant analysis and neural networks (the Italian experience)", *Journal of Banking and Finance*, nº 18.

Altman E. I. and Narayanan P. (1997), "An International Survey of Business Failure Classification Models", *Financial Markets, Institutions & Instruments*, New York University Salomon Center, vol. 6, nº 2.

Belgian Bankers'Association (1997), "Wetten op het concordaat en de faillissementen", Brussels.

Bamber D. (1975), "The area above the ordinal dominance graph and the area below the receiver operating characteristic graph", *Journal of Mathematical Psychology*, 12.

Banque de France (1998), "Le score BDFI – Du diagnostic individuel à l'analyse de portefeuille", *Les études de l'observatoire des entreprises*, Enterprise Directorate, Paris.

Bardos M. and Zhu W. (1997), "Comparaison de l'analyse discriminante linéaire et des réseaux de neurones – application à la détection de défaillances d'entreprises", *Revue de statistique appliquée*, XLV (4).

Beaver W. H. (1966), "Financial Ratios as Predictors of Failure", *Journal of Accounting Research*, vol. 4.

Breiman L., Friedman J. H., Olshen R. A. and Stone C. J. (1984), "Classification and Regression Trees", Wadsworth Inc., Belmont.

Eisenbeis R. A. (1978), "Problems in applying Discriminant Analysis in Credit Scoring Models", *Journal of Banking and Finance*, n°2.

Goudie A. W. (1987), "Forecasting Corporate Failure: The Use of Discriminant Analysis within a Disaggregated Model of the Corporate Sector", *Journal of the Royal Statistical Society*, vol. 150, nº 1.

Hanley J. A. (1989), "Receiver operating characteristic (ROC) methodology: the state of the art", *Critical Reviews in Diagnostic Imaging*, 29,3.

Hanley J. A. and McNeil B. (1982), "The meaning and use of the area under a receiver operating characteristics (ROC) curve", Radiology, 143, 1.

Hastie T. J., Tibshirani R. J. and Friedman J. (2001), "The Elements of Statistical Learning. Data Mining Inference and Prediction", Springer, New-York.

Institute of Auditors (1994), "Interpretatie van de annual accounts: analyse met behulp van de ratiomethode", Brussels.

Lurkin P., Descendre N. and Lievens D. (1990), "États financiers – analyse et interprétation", De Boeck-Wesmael, Brussels.

National Bank of Belgium (2001), "Results of non-financial corporations in 2000", Economic Review, November 2001.

Ooghe H., Joos P. and De Bourdeaudhuij C. (1995), "Financial Distress Models in Belgium: The Results of a Decade of Empirical Research", *The International Journal of Accounting*, nº 30.

Ooghe H. and Van Wymeersch C. (1996), "Traité d'analyse financière", Wolters Kluwer Belgique et Presses Universitaires de Namur.

Pepe M. (2002), "Receiver operating characteristic methodology", in *Statistics in the 21st century*, Chapman & Hall.

Skogsvik K. (1988), "Predicting failure by means of financial ratios", *Skandinaviska Enskilda Banken Quarterly Review*, nº 2.

Summaries of Articles

This study describes the main evolutions in the ICT (Information and Communication Technologies) sector in Belgium for the most recent years. The economic weight of the sector has been assessed using two different approaches. The first one, called "sectors" approach, is quite traditional and uses an ICT sector definition close to the OECD one and based on the sectors of the Belgian economy. Due to some conceptual shortcomings of this first analysis, a second one, called "products" approach, has been carried out. This approach is quite innovative and uses the supply-use tables of the Belgian economy. Applying this method leads to a precise estimate of the ICT production of each branch of the economy.

The paper also gives an international comparison on the development of the ICT sector and the diffusion of its products throughout the society. This comparison allows to situate Belgium and the European Union from an international point of view and especially against the United States.

The last part of this paper is dedicated to a financial and social analysis of the Belgian ICT enterprises. Using data from the Central Balance Sheet Office, this part shows the main trends since the beginning of the nineties in the financial structure of the companies. Moreover, a failure prediction model has also been developed in order to assess the financial risks run by the large ICT companies.

JEL Classification: L96, L86, C67, G30, G33.

Abstracts of the Working Papers Series

42. "Modeling the term structure of interest rates: where do we stand?" by K. Maes, Research series, January 2004

No-arbitrage term structure models are becoming increasingly important to policy makers and practitioners alike. Several factors justify this trend. First, modeling progress has been tremendous over the last years, allowing a much better fit of actual yield curve dynamics and increased model realism (see Dai and Singleton (2002a, b)). Second, increases in computing power allow the efficient panel estimation of term structure models. Given that term structure models have implications for both the cross-section and time series dimension of yields, panel estimation techniques are to be preferred over either cross-section or time series techniques. Third, term structure models have recently been extended in ways that are of direct interest to policy makers. Example given, Dewachter and Maes (2001) model the international term structure of interest rates, taking into account the role of the exchange rate in a no-arbitrage economy, while amongst others Hördahl et al. (2002) and Dewachter et al. (2002) jointly model the term structure of interest rates with the dynamics of macroeconomic variables. The latter approach allows to study (*i*) the driving factors behind the term structure and the risk premia in terms of clearly interpretable macroeconomic variables and their determinants, and (*ii*) the effects of monetary policy on the term structure of interest rates and macroeconomic variables within a consistent no-arbitrage framework.

Conventional signs

–	the datum does not exist or is meaningless
p.c.	per cent

Abbreviations

ICT	Information and communication technologies
MEL	Federal Ministry of Employment and Labour
NACE-BEL	Belgian version of the statistical nomenclature of economic activities in the European Community
NAI	National Accounts Institute
NBB	National Bank of Belgium
NSSO	National Social Security Office
OECD	Organisation for Economic Co-operation and Development
ROC	Receiver operating characteristic
US	United States
VAT	Value added tax

Editor

J. HILGERS
Director

National Bank of Belgium
boulevard de Berlaimont 14 - BE-1000 Brussels

Contact for the review

Ph. QUINTIN
Head of the Communication Service

Tel. +32 2 221 22 41 - Fax +32 2 221 30 91
philippe.quintin@nbb.be

Layout: NBB Prepress
Cover: NBB Multimedia

Published in March 2004