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Europe's Digital Competitiveness Report

Vol. I

EN EN

Executive Summary

The Digital Competitiveness Report analyses recent developments in important policy areas of the European information society and provides a significant evidence base for the European Digital Agenda — the European Commission's policy framework in the digital area and one of Europe 2020's flagships[1]. Europe 2020, the new economic strategy for Europe, identifies Information and Communication Technology (ICT) as one of the key drivers for the smart, sustainable growth necessary to lead Europe out of the crisis.

This year's report focuses on significant developments in the area of broadband, use of internet services and eCommerce, the digital divide, online public services, the economic impact of ICT and the ICT sector. The report benchmarks the relative performance of the EU Member States, where possible compared with other major non-European economies such as the US, Japan and Korea.

In 2009, the European digital economy continued to grow in size and scope, with 60 % of the EU population using the internet on a regular basis. Broadband is available to 94% of the EU population, and is accessed by 56 % of households and 83 % of enterprises. The growth in the popularity of social networks and online videos, with 80 million people having uploaded self-created content last year, has changed the way people are entertained and informed, with major social and economic impacts.

The economic impact of ICT is well known: Over the period 1995-2004, ICT drove half of all productivity gains in the EU, mainly through efficiency gains in the ICT sector and investment in ICT. The latest available evidence (2004-7) shows that Europe might have entered a second phase in the impact of ICT, delivering efficiency gains well beyond the ICT sector in the economy at large. However, it remains to be seen whether the recent financial crisis has disrupted this mechanism. The value added by the European ICT industry is around 600 billion euros (4.8 % of GDP), with ICT services accounting for 80 %. R&D is carried out mostly in the smaller manufacturing segments, but accounts for 25 % of total business R&D in the EU. The variation in this contribution across EU countries is largely related to differing industrial structures. While EU spending is below that of the US, the spending gap can to a large extent be explained by the smaller size and different composition of the EU ICT sector. However, the ICT gap is largely responsible for holding back total EU R&D relative to the US.

As ICT and the internet permeate throughout the European economy, thanks to the increased use of broadband applications and services, together with the spread of wireless devices including smartphones and their applications, their impact on the structures and dynamics of European society has also become significant. ICT is an enabler of transformative potential and accelerates societal processes, such as globalisation or mobility. It impacts on organisational aspects, on network building, on people's capacity to manage information in a lifelong learning process, on sociability, on the contribution of users to the pool of knowledge and to the creation of content.

The main driver of social and economic change has been the spread of broadband communications. In 2009 the EU broadband market was, once again, the largest in the world, with a number of EU Member States topping the ranks in terms of penetration rates. The

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1 http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/225&format=HTML&aged=0 &language=EN&guiLanguage=en.

fixed-broadband penetration rate in the EU reached 24.8%, an increase of 2.3 percentage points over the previous year, although the growth rate is slowing down. Most EU broadband lines are based on xDSL technologies but mobile broadband is growing. Nevertheless, some countries (RO, BG, LT, EE, LT, SK and CZ) show a completely different pattern in their choice of broadband technologies. In these countries, the lack of legacy infrastructure has allowed them to leapfrog older technologies in favour of enhanced ones. However, the average deployment of high-capacity broadband in Europe is currently limited: while 80% of fixed broadband lines in the EU offer speeds above 2 Mbps, only 18% of them are above 10 Mbps, with even slower effective speeds.

Current speeds are sufficient for basic web applications (e-mail, web-browsing, slow music and film downloading, basic single-channel IPTV) but are not fit for the delivery of rich services such as high-definition TV, fast downloading of images, simultaneous use within households, etc. Upload speeds over the network are also becoming an increasingly important determinant of innovative capacity. There is a trend towards higher speeds to accommodate needs and to stimulate both the use and the development of innovative applications and services. Innovations such as smart grids, telemedicine, intelligent transport, interactive learning and cloud computing will require fast communication networks to operate efficiently. A faster and better infrastructure will also stimulate the development of future applications we cannot yet imagine.

Technically, it is not possible to achieve much higher speeds for EU consumers on current fixed networks without upgrading to new-generation technologies. High-speed broadband is already widely available in countries such as Korea and Japan. The market in Europe, however, has been very cautious about migration to higher capacity, as investment costs are high and business models are not yet developed. Many operators blame uncertainty surrounding regulatory approaches as well as uncertainty regarding demand. To stimulate migration to this 21st century infrastructure, Europe 2020 has set broadband targets for all Europeans to have access to broadband by 2013 and to much higher internet speeds (30 Mbps or more) by 2020, with 50% or more of European households having subscriptions above 100 Mbps.

As speeds increase and take-up continues, broadband is furthering the use of the internet by all sectors of the community and in all spheres of life. More and more people are going online: 60% of the EU population (a similar rate to that in the US) now use the internet regularly (at least once a week) and most do so every day. Indeed, it seems that once people start to use the internet they quickly become regular or frequent users. Nonetheless, one third of the population has never used the internet, with the causes mainly related to age and education levels. Furthermore, take-up varies across countries (as well as socio-economic groups), though catch-up is visible.

The range of available online services has expanded and internet users are becoming extensive users of such services. Developments are being driven by the young, so-called 'digital natives', who are extensive users of advanced and often recreational services. They are also above-average users of services relating to job search and education and training. At the dawn of professional life, these digital natives exemplify the growing impact of the internet and ICT on European society.

The internet has a huge potential to strengthen the single market by providing individuals and businesses with access, at their finger tips, to the entirety of the EU single market, by making them more informed market participants and by making prices more transparent. However, the level of eCommerce and eBusiness varies across Member States, and cross-border transactions are limited. 54% of internet users in the EU now engage in eCommerce (ordering or buying) but only 22 % of those e-shoppers have ordered from other EU countries. The main barriers to buying online are the perceived lack of need, security, trust and privacy concerns, and lack of skills. Online businesses also face regulatory and practical barriers to cross-border trading. As a result, more than 60% of cross-border transactions cannot be completed because traders refuse to serve consumers abroad. However, a genuine Digital Single Market, an important source of economic growth, is essential to stimulate the growth of businesses through larger markets and to provide consumers with more choice and lower prices.

Progress in the use of the internet is reflected in the increased availability of online public services — though the availability of services for businesses is much higher (83 %) than for citizens (63 %) and there are significant differences between countries. For businesses, use has kept up with supply, and the take-up of advanced services is also high. Progress for citizens is less positive than for businesses: take-up is lagging significantly behind supply. Evidence indicates that the large gap between availability and take-up may be linked to issues of usability as well as to rates of internet take-up.

Age and education are the two main factors influencing the way people use internet services. Their level of education significantly affects their chances of using most online services, but especially the advanced services. Lack of education and skills are the primary sources of disadvantage among groups at risk of exclusion from the digital society, though equipment costs also play a role. These groups are catching up in terms of their regular use of the internet. However, some groups, especially the old and low-educated/low-income, including young people, have much lower rates of internet use than the average. The same groups have fewer digital skills, with the gap increasing with the level of skills. Furthermore, women have lower skill levels than men and the low-educated young have lower skills than their better educated counterparts. Internet use has a strong regional dimension, with lagging regions on the whole also lagging in terms of internet use. However, some countries characterised by significant internal income gaps (AT, BE, DE, UK and SK) have managed to lift their entire territories, including lagging regions, above the EU average. In terms of skills, the pattern is less clear-cut. The regional distribution of skills, particularly high skills, does not seem to reflect the traditional core-periphery divide. This suggests that there is scope for disadvantaged regions to achieve high digital skills, thus gaining a competitive advantage through ICT. In international comparisons, while patterns of use among socio-economic groups are similar in the EU and US, this is less the case for Korea, where differences between groups are less marked.

ICT take-up by European businesses is increasing and Europe is beginning to see signs of efficiency gains in all sectors. Nevertheless, the latest academic research also shows that in order to make the most of the productivity potential of ICT, investment in ICT on its own is not sufficient. Complementary organisational changes, in particular involving management practices and decentralisation, as well as skills also matter. US firms have been more successful in implementing organisational changes, but have also invested more in ICT and skills. These factors help explain the differing productivity experiences of the two regions. And they will contribute to the recovery, providing opportunities for the smart, sustainable and inclusive growth the European Union is striving to achieve.

1. 1. ICT IN THE EUROPEAN AND GLOBAL ECONOMY

The ICT industry is an important contributor to the growth of the European economy: while representing 5 % of GDP, it drives 20 % of overall productivity growth. Accounting for 1 % of GDP, the ICT manufacturing sector is responsible for one quarter of total R&D investment. Together with ICT investment and take-up by enterprises, the sector drives half of productivity growth, as was the case before the recent economic crisis.

This chapter looks at the size of the ICT sector in the EU economy and analyses its contribution to productivity growth using the latest EUKLEMS data. It looks at the impact of the economic slowdown on R&D investment and on the performance of the main ICT segments. Finally, it identifies changes in broadband mobile communications as the main structural challenges for ICT markets in 2009.

1.1. 1.1. Size and share of the ICT industry

For the EU-27, the value added by the ICT industry at current prices amounted to € 592.7 billion in 2007[2], representing around 5 % of GDP. This is less than in the US (6.4 %) and Japan (6.8 %).[3]

The ICT industry includes ICT manufacturing[4] and ICT services[5]. In 2007, the value added by the ICT manufacturing sectors amounted to € 130.6 billion or 1 % of GDP and for ICT services came to € 462 billion or 4 % of GDP. Japan shows a much higher specialisation in ICT manufacturing (2.9 % share of GDP) and the US specialises more in ICT services (5 % share of GDP) (Figure 1.1). Other Asian countries (Korea, China, etc.) show growing specialisation in ICT manufacturing, often even higher than in Japan.

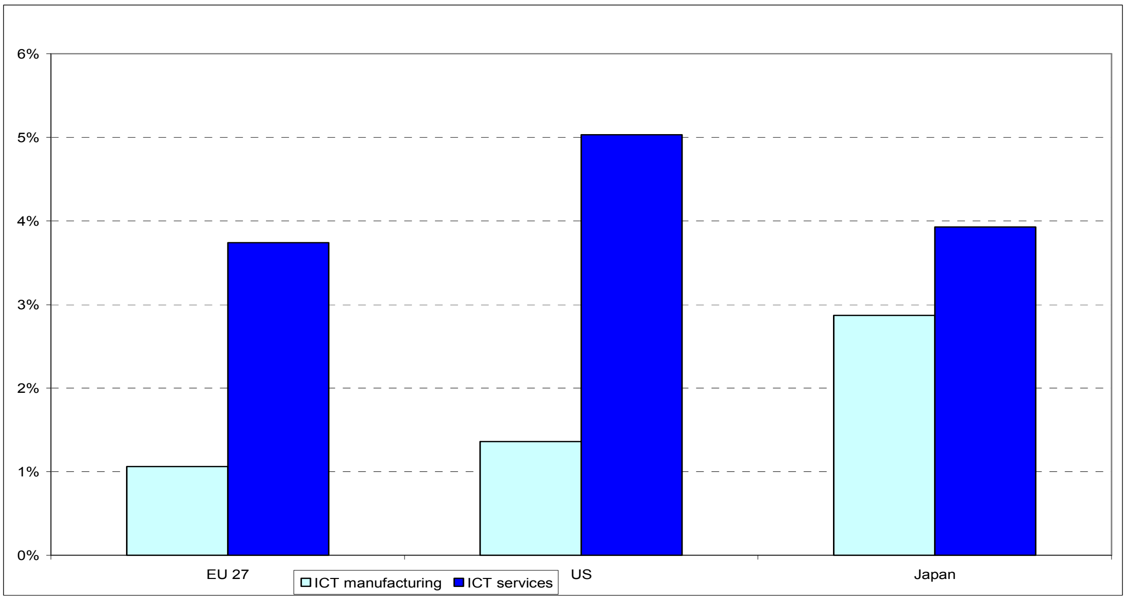
2 Latest available data. Source: Eurostat and JRC-IPTS.

3 Postal services have to be included to allow comparison with the US and Japan. Excluding postal services, the value added by the EU ICT industry amounts € 540 billion, or 4.9 % of GDP.

4 The manufacturing sectors are NACE 30 to 33, covering IT equipment (computers, printers, etc.), components (semiconductors, printed circuits, LCDs, TV tubes, etc.), telecom and multimedia equipment, measurement instruments (sensors), and industrial process control equipment.

5 The ICT services are NACE 64, post and telecommunication services, and NACE 72, computer services (hardware and software consultancy and supply, databases, internet, maintenance and repair).

Figure 1.1: **ICT value added in % GDP**

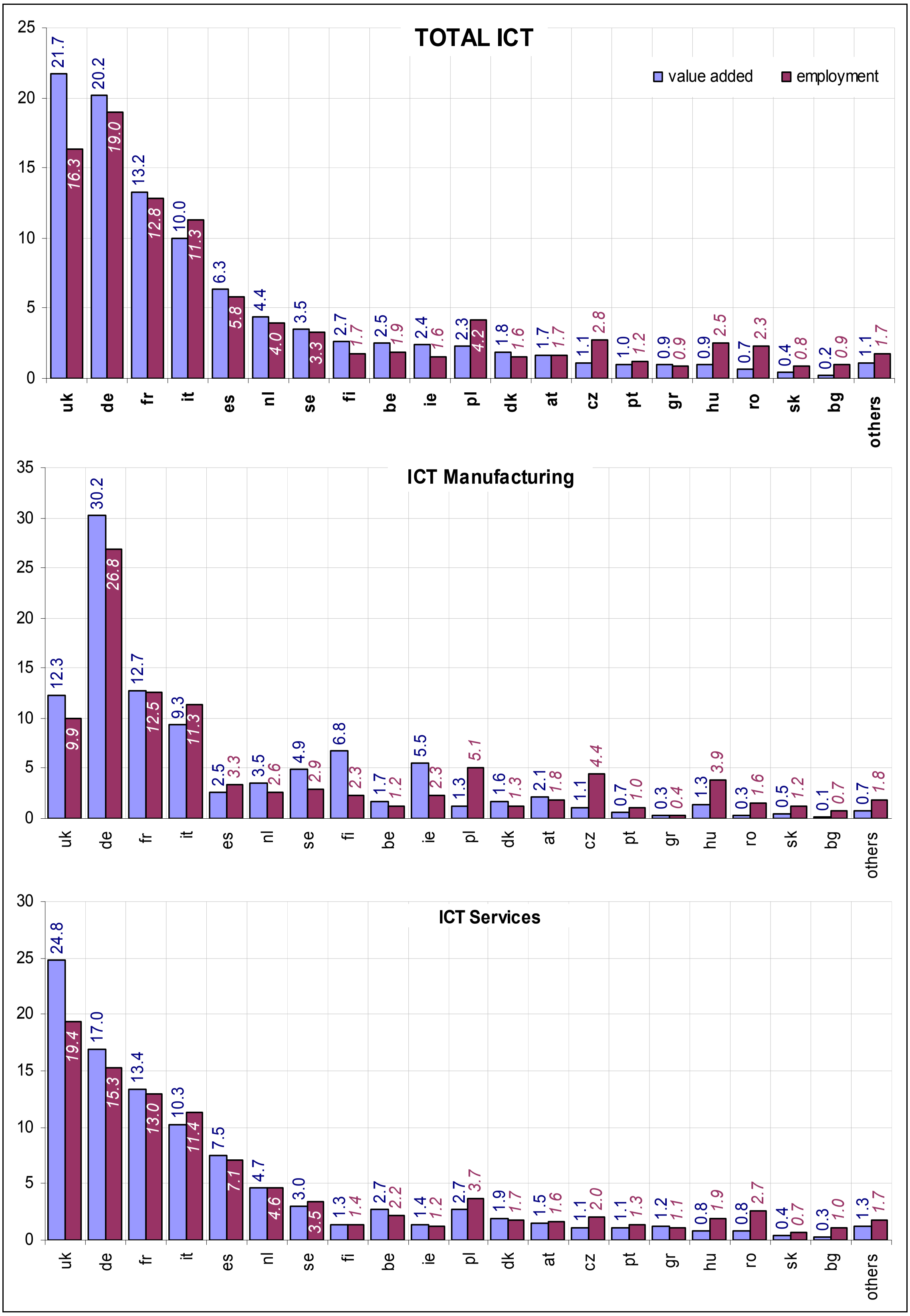


Source: Eurostat and IPTS-JRC

Within the EU, the five largest EU economies (DE, UK, FR, IT, and ES) accounted for more than 70 % of total ICT value added and for two thirds of employment in 2007. As in previous years, the UK led in value added, while Germany had the highest share in employment (Figure 1.2).[6]

[6] IPTS estimates based on SBS industry-level national data. It is important to note that for value added these are adjusted to KLEMS (National Accounts) data, which results in a slightly higher overall value and some differences in relative industry shares, due to an upward correction for IT equipment and computer services and a downward correction for the remaining industries.

Figure 1.2: **Country shares (%) in EU ICT value added and employment: manufacturing, services and total, year 2007**



Source: IPTS estimates based on Eurostat SBS
The group 'Others' includes SI, LT, LV, MT, EE, CY, LU

1.1.1. *ICT manufacturing*

The European ICT manufacturing industry represents 13 % of the value added by total manufacturing, one of the largest industrial sectors. ICT companies are often global in nature, meaning that their value added in one country only represents one part of their global value added. The most knowledge-intensive part often remains domestic. Indeed, though representing 5 % of EU GDP, the ICT industry has a 25 % share in total business R&D.

In ICT manufacturing, where Germany alone accounts for more than a quarter of EU employment and a third of value added, France and the UK have been the most affected by the fall in employment in this sector. In contrast, Hungary, the Czech Republic and, lately, Poland have recorded significant increases in ICT manufacturing employment. This has brought them just behind the four largest EU economies, with Poland reaching a share of 4.2 % of total ICT employment in the EU, above Sweden and the Netherlands.

Comparing this ranking with the ranking in terms of value added, though, reveals that these emerging countries in manufacturing employment are typically hosting mainly lower-end activities, or that the value added does not stay in the country. Indeed, the combined share of Poland, the Czech Republic, Hungary, Romania, Slovak Republic and Bulgaria in EU ICT manufacturing comes to 17 % for employment but only to 4.6 % for value added. In contrast, the Netherlands, Sweden, Finland and Ireland together account for 10 % of employment and almost 21 % of value added in ICT manufacturing, i.e. nearly as much as France and Italy together.

1.1.2. *ICT services*

In ICT services, the UK remains the leading country for employment and, by far, for added value, accounting for 19.4 % and 24.8 %, respectively, of the EU totals in 2007. Compared with the peak in 2000-2001, nearly all countries (except Germany) have lost employment in telecom services, while employment has been growing everywhere in the computer services and software industry.

Overall, the contribution of ICT to total employment in the non-financial business economy varies widely among the EU countries, ranging from less than 3 % in Portugal, Greece, Spain, Latvia, Cyprus and Lithuania to more than 6 % in Hungary, 7 % in Sweden, and 8 % in Finland and Ireland.

1.1.3. *ICT in non-ICT sectors*

A significant and increasing amount of ICT-related production and R&D is performed outside the ICT sector. According to the OECD, the share of ICT in total patent applications (EPO) submitted by European firms in 2004 per industry was as high as 31 % in transportation equipment and 27 % in pharmaceuticals.[7] Similarly, both sectoral and national economic analyses illustrate the important share of ICT-related activity, employment and value creation across all sectors of the economy, reflecting the growing role of ICT as a general-purpose technology.[8]

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7 Dominique Guellec (OECD): R&D expenditure: What effects on productivity and the economy?

8 Geomina Turlea, 2010, Measuring the economic impacts of Embedded Systems in the European economy: A methodology. IPTS-JRC (forthcoming, available at: http://ipts.jrc.ec.europa.eu/publications/index.cfm. Robinson, Juliussen, 2010, The Competitiveness of European Embedded Software industry for the Automotive Sector. IPTS-JRC (forthcoming, available at: http://ipts.jrc.ec.europa.eu/publications/index.cfm).

1.1.4. *More for Less*

Last but not least, ICT goods and services have seen their prices decreasing over time, essentially due to technological progress, with the resulting gains (productivity) for most part being passed on to the end user (Table 1.1). The decrease in the prices for ICT (post and telecommunications, and IT and telecom equipment) is accompanied by an increase in value added in terms of volume. This decrease in price and increase in volume exceed that of any other sector.

Table 1.1

Index 1995=100	VA price indices	VA volume indices
Total industries	+9%	+34%
IT manufacturing	-12%	+88%
Post and telecom	-34%	+131%

1.2. 1.2. ICT R&D

Europe's total R&D spending [9] is below 2% of GDP, compared to 2.6% in the US and 3.4% in Japan. In 2008[10], it was higher than 3% of GDP only in Finland and Sweden. In 2007, total R&D spending in ICT amounted to €39.4[11]. The biggest contribution comes from business R&D expenses (BERD) with €36.6 billion. Compared to total BERD, R&D performed by the ICT industry represents a share of 25% and reflects its high R&D intensity. The ICT sector is the largest R&D investing sector in the EU economy (and in the US and Japan).[12]

Within the EU, in absolute terms, ICT business R&D is dominated by the largest economies, i.e. Germany, France and the UK (which together account for more than half of the total EU-27 ICT BERD), followed by Sweden, Finland and Italy (Figure 1.3). The EU-15 countries contribute almost 98% of ICT business R&D expenditure, with the new Member States (EU-12) contributing only 2.6%. With the exception of the Czech Republic, most of the increase in ICT R&D in the new Member States is to be found in the service sectors, accounting for more than half of total national ICT R&D. The Nordic states Finland, Sweden and Denmark invest the highest amounts in ICT R&D in relation to the size of their economies. However, while Finland has an outstanding ICT R&D intensity, its non-ICT R&D intensity is close to the EU-27 average. In the case of Sweden, the high ICT contribution is accompanied by the highest non-ICT R&D intensity of all Member States. While Finland's R&D is specialised in ICT, ICT R&D in Sweden is part of a generally high R&D effort.

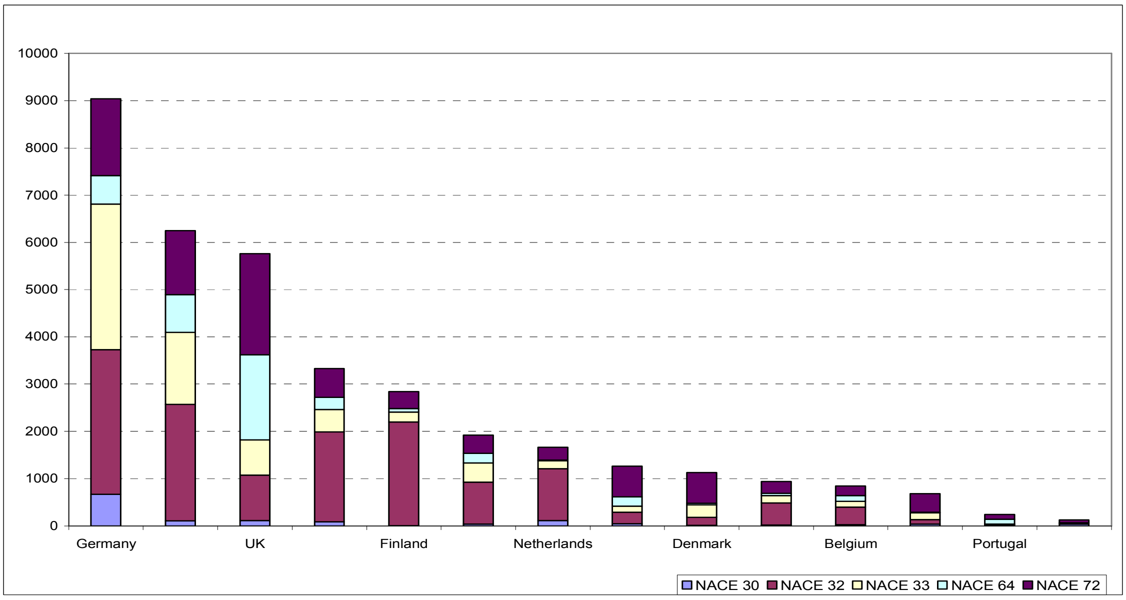
9 Gross Domestic Expenditure on Research and Development (GERD), covering public and business expenses in R&D.

10 Latest data available.

11 €36.7 at purchasing power parity (ppp-

12 In absolute amounts for the year 2007, ICT BERD came to:
€ 1.33 billion in the IT equipment sector,
€ 14.1 billion in the component, multimedia and telecom equipment sector,
€ 7.6 billion in the measurement instruments sector,
€ 4.3 billion in telecom services,
€ 9.3 billion in IT services.

Figure 1.3: **ICT BERD 2007 (in millions of euros)**

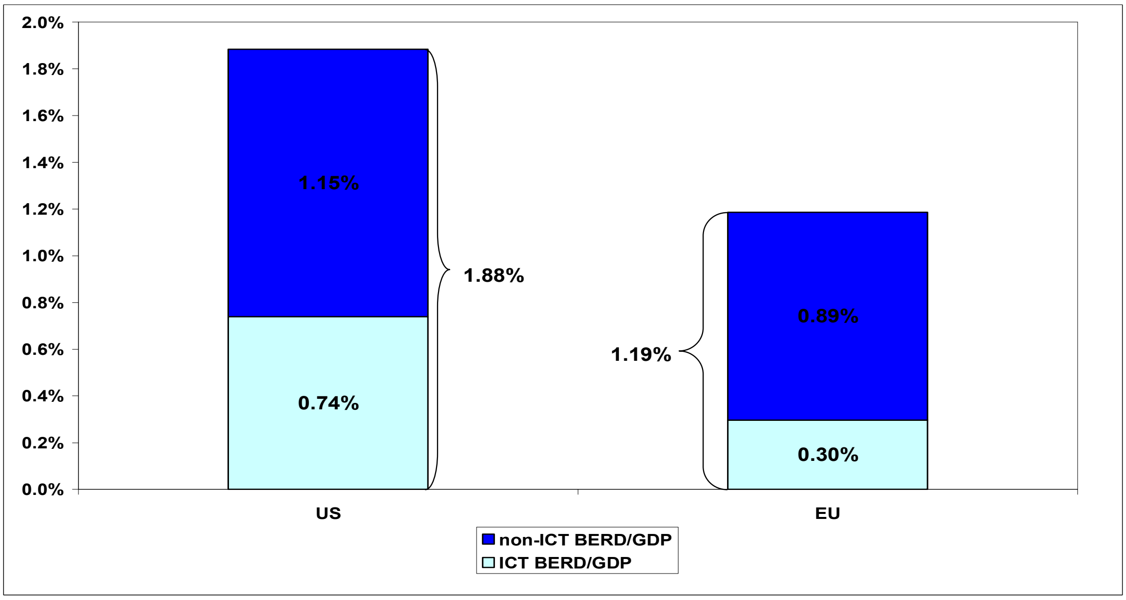


Source: Eurostat and IPTS

NACE 30: IT equipment. NACE 32: Components, telecom and multimedia equipment. NACE 33: Industrial process control equipment. NACE 64: Post and telecom services. NACE 72: Computer and software services.

Although impressive, the contribution of the European ICT industry to total BERD (24.9%) is much lower than in Japan and the US, where ICT drives 32.4% and 39.2% of total R&D, respectively. ICT explains most of the business R&D gap between the US and the EU (Figure 1.4).

Figure 1.4: **Contribution of ICT and non-ICT sectors to total BERD intensity (% GDP, 2007)**

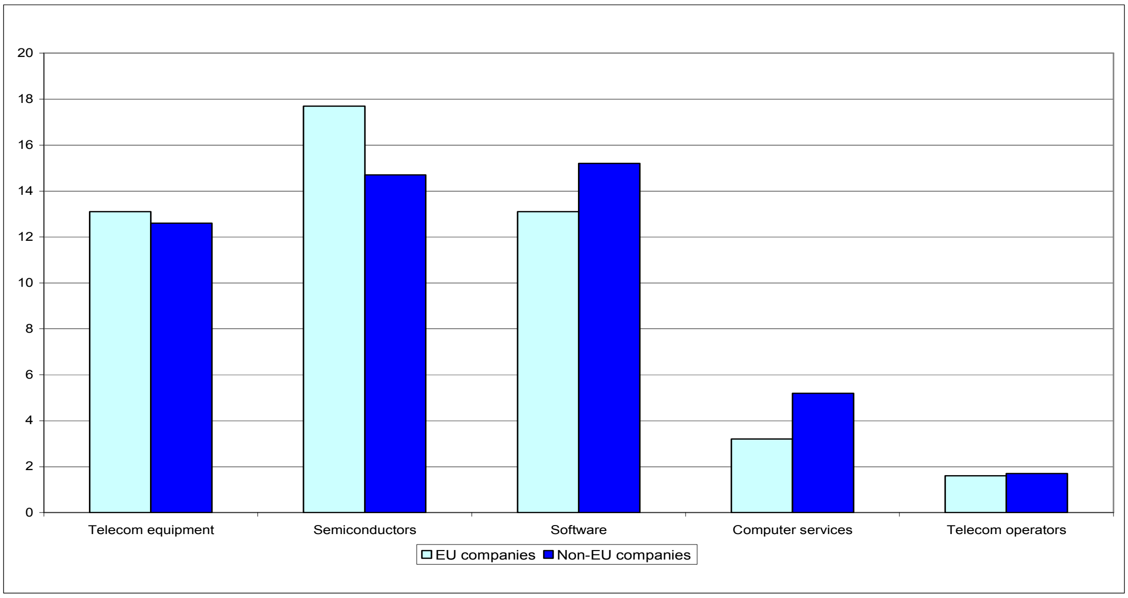


Source: IPTS-JRC

This gap has two aspects: first, a quarter of the gap is due to the fact that the ICT business sector is a smaller part of the economy in the EU than in the US; second, three quarters of the gap is explained by a lower R&D intensity (BERD/VA) due, in part, to the composition of the ICT industry.

This comparative analysis of R&D spending does not mean that there are intrinsic behaviour differences in R&D spending at firm level. Indeed, according to the 2009 Industrial R&D Investment Scoreboard, the aggregate R&D intensity of EU companies is well short of the US, but sector by sector it is similar or greater, confirming that the R&D gap is mainly explained by the size and composition of the ICT industry.

Figure 1.5: **R&D in % net sales**



Source: JRC-IPTS/DG Research 2009 Industrial R&D Investment Scoreboard[13]

1.3. 1.3. Investment in ICT

On the basis of the growth accounting approach (chapter 7), this section briefly analyses the latest data released by EU KLEMS [14], including data for 2007.[15]

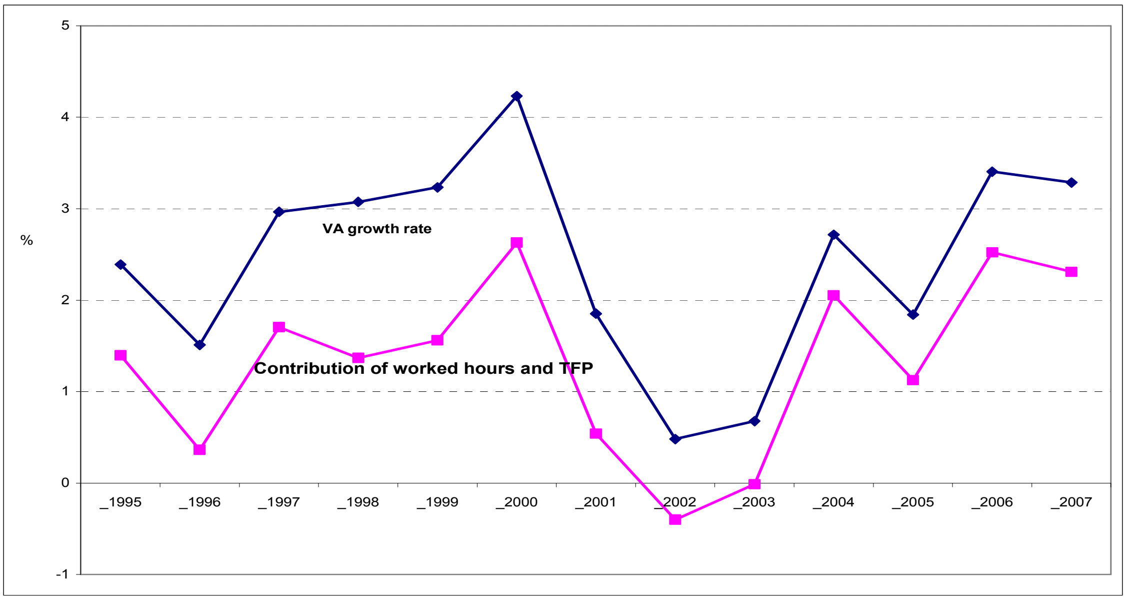
Economic growth fluctuates (business cycle), and in the short term changes in employment (total hours worked) and efficiency (total factor productivity — TFP) explain most of the change in economic growth (Figure 1.6). The notion of 'efficiency' is manifold. It includes disembodied technological progress but also changes in the degree of utilisation of production capacities.

13 http://iri.jrc.ec.europa.eu/research/scoreboard_2009.htm.

14 EU KLEMS is a database for growth accounting, funded under the 6th and 7th Framework Programmes.

15 The following figures refer to Member States for which growth accounting could be performed, namely: AT, BE, DK, ES, FI, FR, DE, IT, NL and UK.

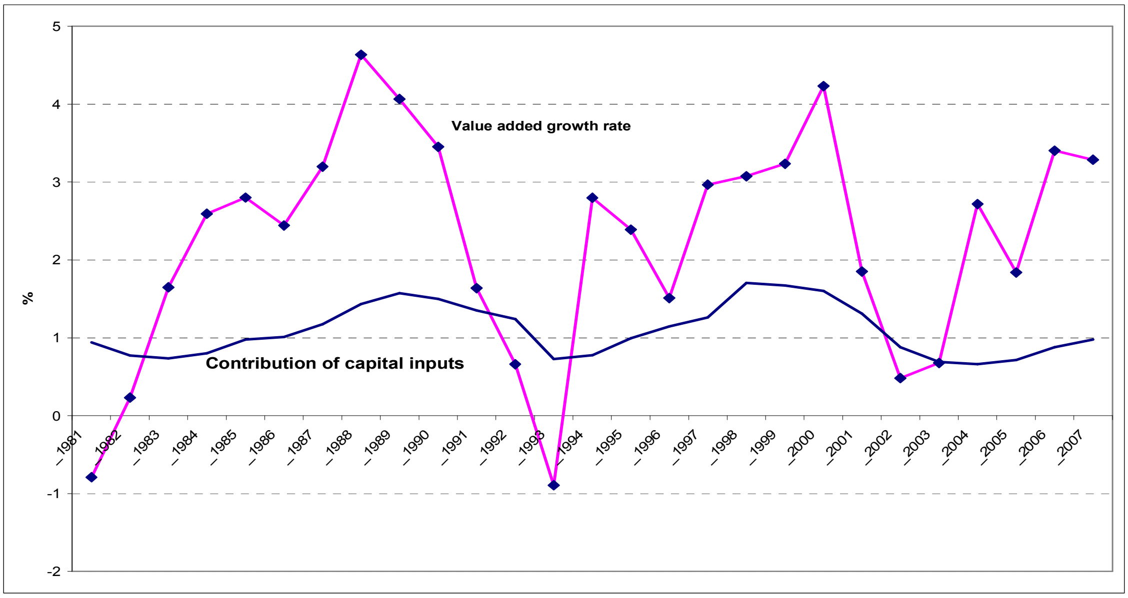
Figure 1.6: **Contribution of labour and TFP (in percentage points) to value added growth**



Source EU KLEMS

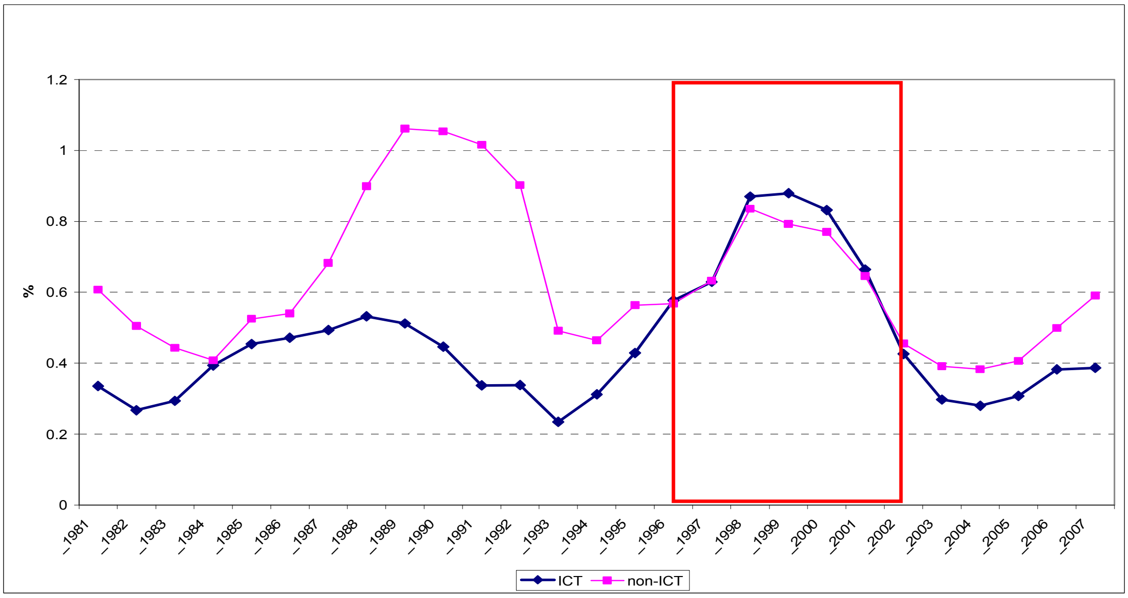
The contribution of capital is much more stable over time and, along with technological progress, is the main driver of long-term economic growth (Figure 1.7). The share of ICT capital in the contribution of capital inputs to economic growth reached 50% between 1995 and 2002, meaning that ICT capital inputs alone contributed to economic growth as much as all other forms of capital equipment together (Figure 1.8).

Figure 1.7: **Contribution of capital in percentage points to value added growth**



Source: EU KLEMS

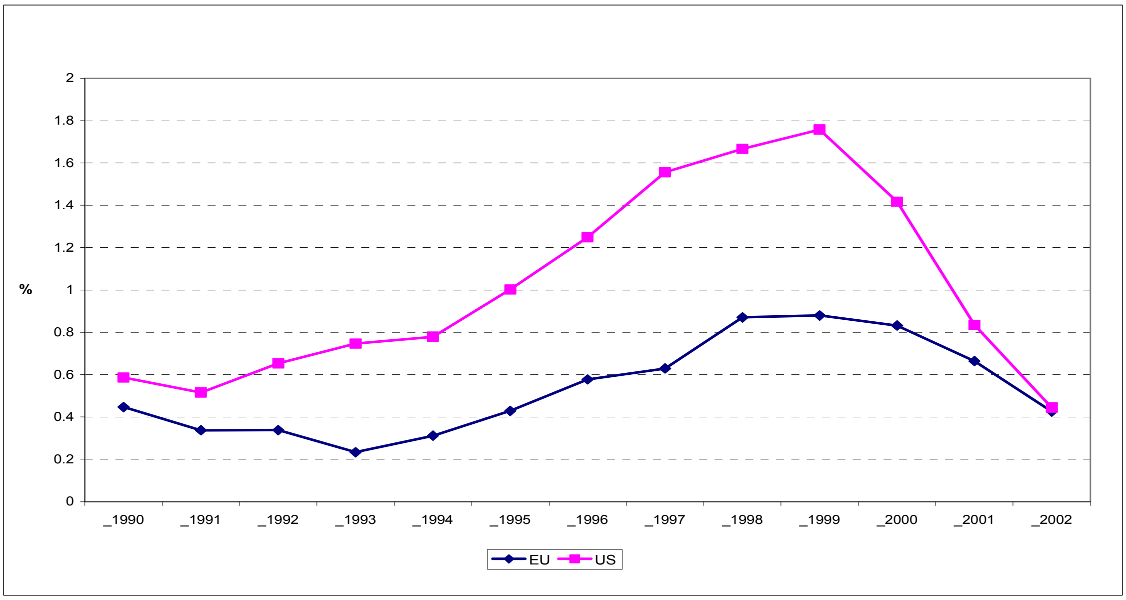
Figure 1.8: **Contribution of ICT and non-ICT capital**



Source: EU KLEMS

During 1995-2000, the gap between the EU and the US in terms of the contribution of ICT capital to economic growth increased considerably (Figure 1.9), and became one of the most analysed and discussed topics in recent years.

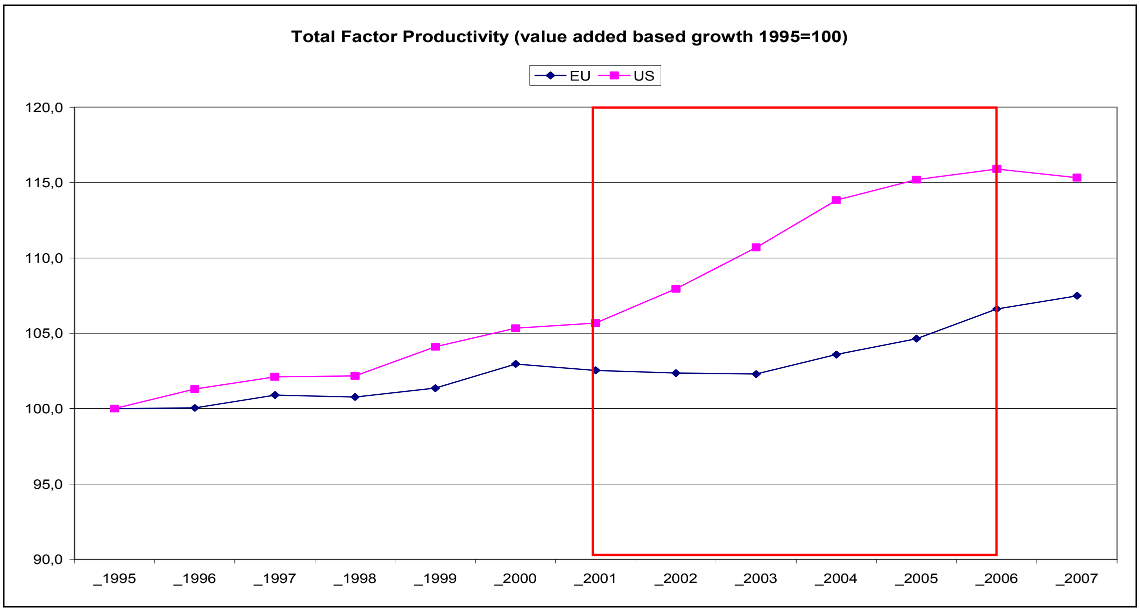
Figure 1.9: **Contribution of ICT capital to value added growth in percentage points**



Source: EU KLEMS

Between 1995 and 2000, Europe invested far less than the US in ICT capital (a gap of more than 20%). Moreover, there is also a growth potential in making better use of this capital and changing the business organisation (chapter 7). Indeed, the US-EU difference in ICT capital led to a similar gap in TFP after 2000 (Figure 1.10).

Figure 1.10 **Total Factor Productivity (value added based growth 1995=100)**



Source: EU KLEMS

The gap in TFP growth mainly concerns services. There is no gap in manufacturing, except for the ICT manufacturing sector. It took longer for the European ICT manufacturing industry to recover from the dotcom crash, given the relative size of the telecom equipment sector. The gains in TFP in post and telecom services are particularly high, but here Europe seems to be on the same track as the US (Table 1.2).

Table 1.2: **Cumulative TFP (value added-based) growth 2000-2007**

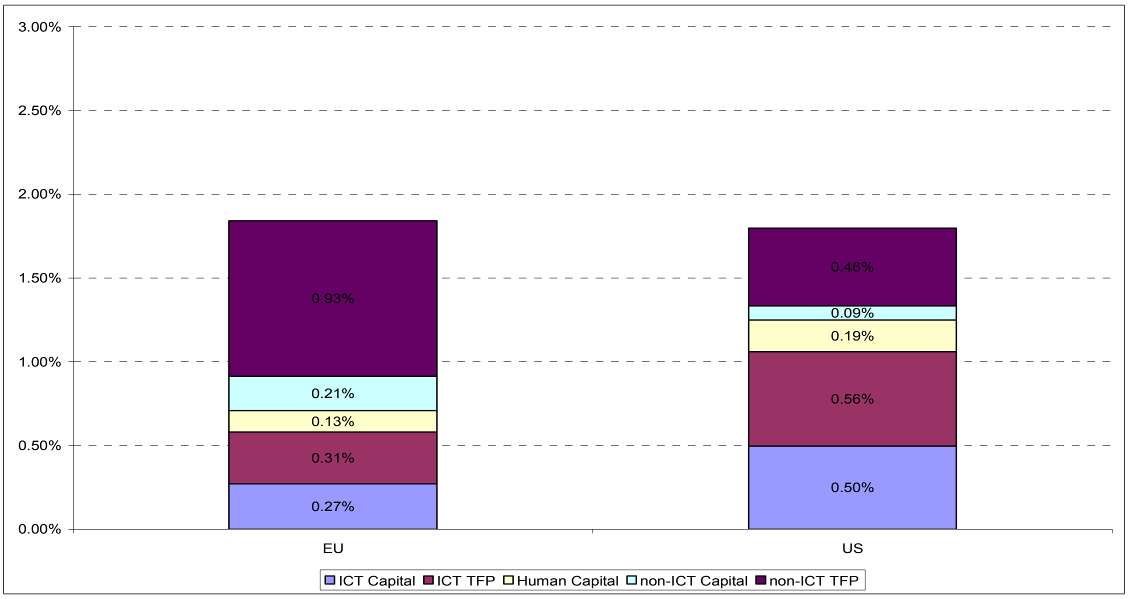
Cumulative TFP (value added-based) growth 2000-2007		
	US	**EU**
Total market economy	9.5%	4.4%
Total manufacturing excluding ICT manufacturing	10%	10%
Total market services excluding post and telecom	11.5%	0.7%
ICT manufacturing	114%	32%
Post and telecommunication services	36%	28%

Source: EU KLEMS

The above evidence is confirmed by the decomposition of productivity growth. Differences in ICT capital deepening explain almost all of the gap between the EU and US in productivity growth rates in 1995-2000, while TFP growth, both ICT-related and non-ICT-related, explains the remainder. Hence, almost all of the productivity gap between the US and the EU in 1995-2000 (on average 1.1% per year) can be attributed to ICT, in the form of ICT investment or efficiency gains in the ICT-producing sector. What happens after 2000, however, is different: although ICT capital deepening and efficiency gains in the ICT-producing sector contribute equally to half of the still wide productivity growth gap between the US and the EU (1%), the main driver of US productivity growth is efficiency gains in non-ICT sectors of the economy, mostly in market services. The two main drivers of growth in the two different time periods for the US are indeed related: the huge investment in ICT capital in all sectors of the economy (and especially in market services), accompanied by organisational changes, is thought to explain the large increases in efficiency experienced after 2000. The same mechanism seems to have been missing until recently in the EU, which has been lagging behind both in ICT investment and in changes to the institutional settings that discourage the kind of organisational revolution that happened in the US.

Data for the latest available years (2003-2007) show a recovery in productivity growth in the EU, mostly driven by efficiency gains in market services (especially trade finance and business services) and manufacturing (Figure 1.11). Although it is too early to draw definitive conclusions, it appears that ICT-driven organisational changes are starting to stimulate efficiency gains in the EU economy as well, albeit at a lower level than in the US. Moreover, these factors seem equally at work in the EU manufacturing sector, where high pressure from global competition is stimulating firms to reorganise work. In the US in the same period, the push from ICT remains strong, but efficiency gains outside the ICT sector seem to have stalled, probably due to large increases in employment after the layoffs that followed the dotcom crash (value added growth remained strong). However, as some preliminary macro-data show, the years following the financial crisis (2009 and, in part, 2008) mark a huge drop in output and, for the EU, in productivity as well, as layoffs have been much lower than in the USA. Therefore, the transmission of efficiency gains from ICT to the economy in the EU may have slowed as a consequence, temporarily halting the closing of the gap in productivity growth between the EU and the USA.

Figure 1.11: **Average labour productivity growth in 2003-2007 and its sources (market economy aggregate)**



Source: EU KLEMS

1.4. 1.4. Impact of the economic crisis on global ICT companies

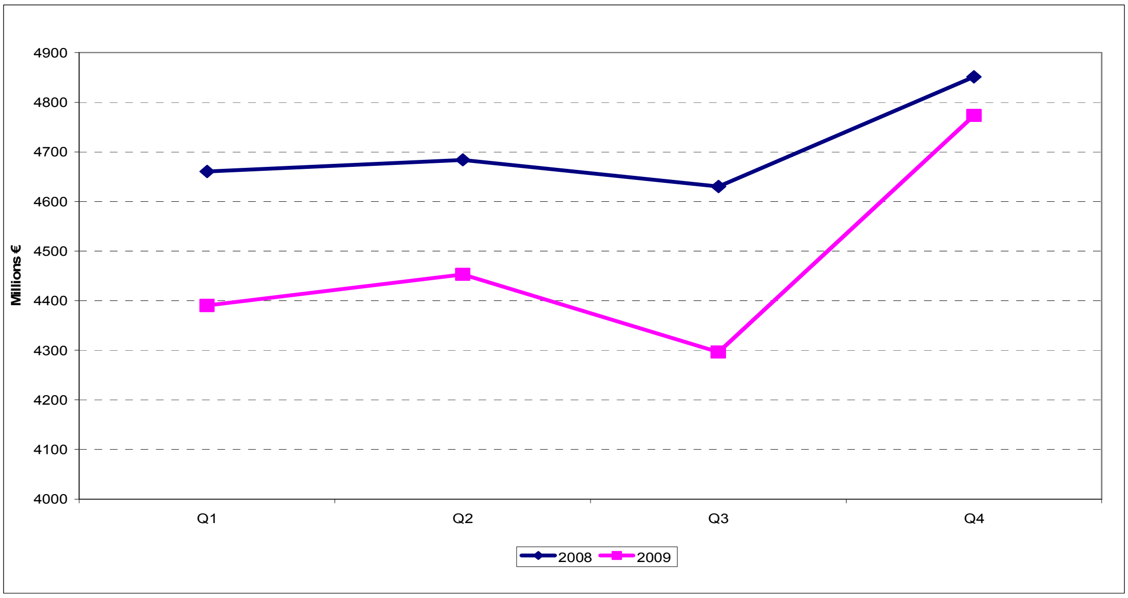
The financial crisis started to hit the global economy in the summer of 2007, but it was in September 2008 that the world economy dramatically changed. A free fall in consumer and business confidence led to a near standstill in the world economy during the last quarter of 2008.[16] Given the delay in the availability of official statistics, analysis of the impact of the economic crisis relies on companies' accounts.[17] For each sector, a representative sample of companies has been selected, based on the 2009 EU Industrial R&D Investment Scoreboard.[18] The comparison between 2008 and 2009 uses a constant exchange rate (December 2010).[19]

The semiconductor industry, given its role in the ICT supply chain and its inventory cycle, was the earliest of all ICT sectors to be hit by the crisis. Following a time lag, the telecom equipment industry was hit by the decline in capital expenditure by business and telecom operators. The macroeconomic and business environment also had a negative impact on the revenues of telecom operators and software companies. Internet-related services seemed to be immune to the crisis. However, the outlook released by global ICT companies in their quarterly financial reports ending in December 2009 is more positive than one year ago.

The impact of the crisis on ICT R&D spending

In particular because this crisis started as a financial crisis, R&D spending faced possible credit constraints. ICT R&D spending in 2009 by global ICT companies decreased, less than total revenue and far less than other capital expenditure. Combined R&D spending by a representative sample[20] of European global ICT companies decreased by 4.7% in 2009, less than the 14% decrease in their combined sales. In the last quarter of 2009, with the recovery, R&D spending decreased only by 1.6% compared to Q4/08 (Figure 1.12).

Figure 1.12: **R&D spending by a sample of EU global ICT companies**



Source: Annual and quarterly reports

[16] For a complete analysis of the crisis: ECFIN European Economy 7/2009, Economic Crisis in Europe: Causes, Consequences and Responses.

[17] Annual and quarterly financial reports.

[18] European Commission, JRC/IPTS.

[19] Swedish krona:10.4; US dollar: 1.46; UK pound: 0.90.

[20] Sub-sample representing 85% of the Scoreboard ICT sample (excluding telecom operators, which in most cases do not report R&D spending in quarterly reports).

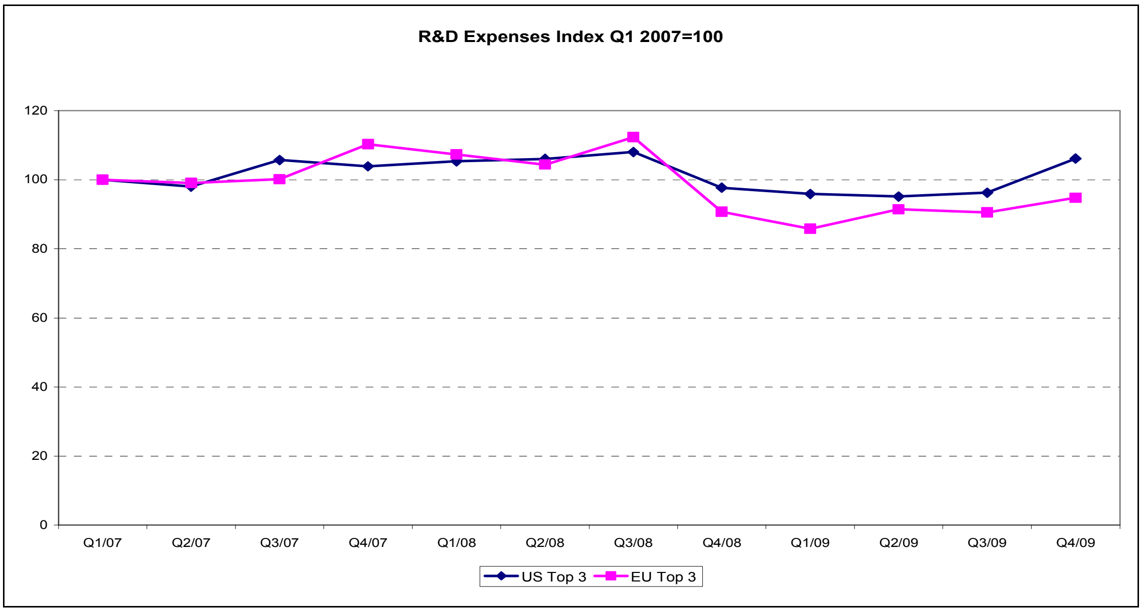
Analysis by sector

1.4.1. The semiconductor industry

The semiconductor industry faced a near-record decline in revenue between the third quarter of 2008 and the first quarter of 2009. A robust recovery started in the second quarter of 2009 and by the end of the year sales suffered less than feared, reaching $ 226.3 billion according to the Semiconductor Industry Association, down 9 % from the $ 248.6 billion recorded in 2008. In their outlook for the first quarter of 2010, semiconductor companies expect positive growth and, according to iSuppli[21], worldwide spending on semiconductor manufacturing equipment will rise by 46.8 % in 2010 compared to last year, after three years of decline.

Though market leaders in many integrated circuit segments, European companies need to develop cost reduction programmes, in R&D through partnerships and in production, through access to independent foundry capacities. This structural change in the business model explains why two of the three main European semiconductor companies substantially reduced their R&D spending in 2008 and 2009.

Figure 1.13: **Semiconductors – R&D Expenses Index Q1 2007=100**



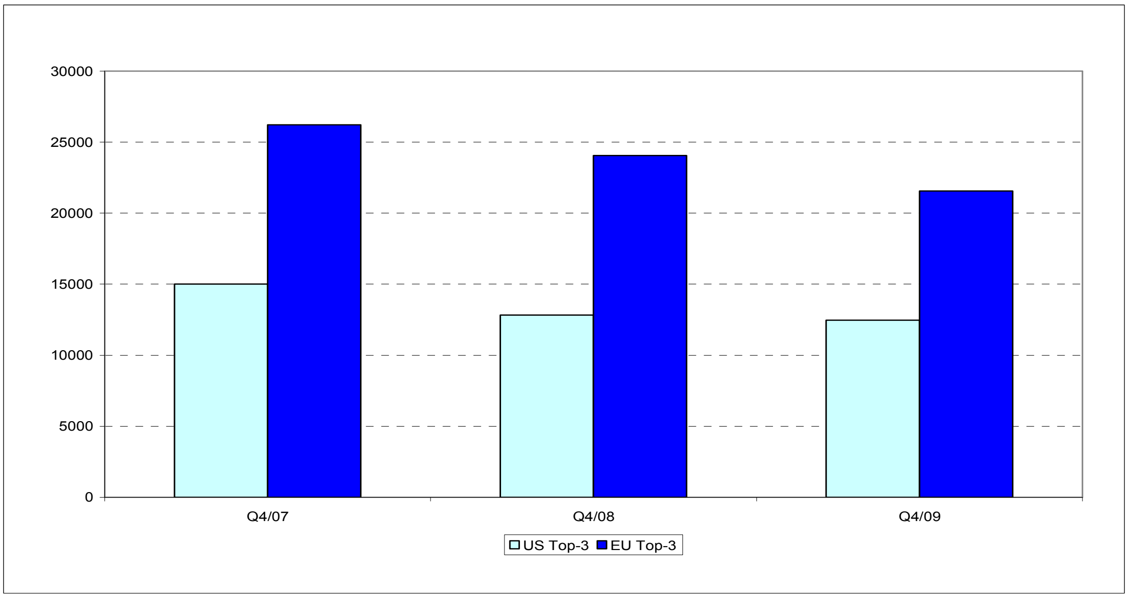
Source: Annual reports

1.4.2. Telecom Equipment Industry

2009 was a very challenging year for the European telecom equipment industry, a stronghold of the European ICT sector. Beyond the 2008-9 macroeconomic context, this industry has to cope with maturing markets and structural changes in network equipment (IP transformation and the migration to 3G+). The industry also faces global competition in network equipment from China and in mobile devices from the US.

[21] iSupply News, 5 March 2010.

Figure 1.14: **Top three equipment companies in the EU and US — quarterly revenue (in € at constant $/€ exchange rate)**



Source: Quarterly reports

a) Networks

Although the medium- and long-term outlook is favourable, with mobile broadband becoming the main growth driver, the telecom equipment market is going through a stormy period. Sales were impacted by reduced capital spending by telecom operators and the business sector (investment cycle), the shift from voice telephony to mobile broadband investment (market trend) and the migration to 4G/LTE and IP networks (technological trend). Companies are reorganising their business structure to align with these various trends.

b) Mobile handsets

According to EITO, the global mobile phone market is experiencing an historic downturn with shipments falling by at least 7 % in 2009. In this situation, both mature and some emerging markets are being hit. However, this cannot not hide the fact that the key technological and market trends in ICT are emerging in this sector.

The email PDA market was a niche market less than two years ago, but is now becoming a mass market with the introduction of smart phones and netbooks. These new devices have had a tremendous impact on all ICT sectors: in the semiconductor sector through low-power chips; in the software sector through new operating systems and application stores; and of course in the telecom equipment and operator industries through broadband internet networks and services. In 2009, a new generation of smart phones[22] and netbooks with enhanced capabilities became mainstream, with a huge impact on mobile networks. After the personal computer and fixed internet eras, the world may be entering the reign of mobile internet computing.

Increasing computing power and improved screens (e.g. touch screens and higher resolutions) have resulted in more powerful handsets. These new devices have boosted data service usage

22 Sales grew by 33 % in 2009, while the overall handset market declined. Source: Informa.

on mobile networks, overcoming a barrier (user-friendly, powerful devices) to the development of mobile broadband. In Europe, moreover, lower mobile data roaming tariffs have encouraged the take-off. Increases in the take-up of mobile broadband are, however, putting pressure on network capacity and hence on investment. LTE (Long Term Evolution) is considered a solution to accommodate increasing demand in traffic, but operators will be forced to overcome the gap between the cost of upgrading to satisfy the demand and current tariffs. Cost-cutting is also to be expected, with operators consolidating and gaining scale.

Mobile internet platforms and operating systems

A mobile ecosystem is defined by the relations between application developers, networks, devices, content, applications and services. The main mobile internet platforms have integrated their own mobile operating systems in their devices. Through innovation in devices and services, they are becoming pacesetters on the mobile broadband market due to their control over the content, services and applications for the final user. In some cases, they are replicating the same control they enjoy in the fixed internet world. However, unlike the computer, a mobile device is tightly linked to a specific consumer, paving the way for more targeted services and revenues through advertising.

Several operating systems (the software managing all the device's resources and capabilities) are currently competing in the market, giving rise to questions of interoperability and openness. Unlike the personal computer world, the mobile environment actually has a myriad of operating systems competing to be the gateway to mobile internet services. Some models are funded by the sale of applications while others rely on online advertising (these favouring greater openness). Some service providers are developing applications for free in order to provide a better user experience and to confine users to their specific environment. In that particular case, the 'walled garden' would not be in the hands of an operator but in the hands of the mobile platform.

Application stores

The fragmentation of mobile operating systems in the absence of common standards may slow down the development of the market and innovation. The application stores are part of a larger chain, as they are designed for a specific mobile operating system and specific devices. The companies competing for the control of mobile applications (and the projected revenues from the mobile advertising market) are again the internet giants and the handset manufacturers: Apple, Google, Nokia, Rim and Microsoft).

There are more than 15 application stores in the market at present. Ten were launched in 2009. The reasons for their success, compared to the traditional portals of the mobile operators, can be found in the improved user experience due to better integration between the handset and applications. Different companies are competing with a different degree of openness through open innovation models. The objective is to attract the largest number of independent developers and content to their platforms in order to increase the value through network effects. As each platform has its own application store for a certain type of handset, the majority of content providers have to publish in several stores at the same time. The fragmentation of the market between several application stores for different handsets makes it difficult for developers and content providers to choose, forcing them to develop their products for several different platforms. This increases development costs and complicates submission, marketing and billing practices.

1.4.3. Global internet utilities and social networking sites

Google, Facebook, YouTube, Microsoft Live.com, Wikipedia, eBay[23] and Amazon are so widely used in the world that they may be called global internet utilities. They are utilities in so far as they offer generic services such as search, email, encyclopaedic knowledge or news and also because they cater to global markets (Amazon, eBay). They have not suffered from the economic crisis and some have even extended the boundaries of their business (Google in smart phones and Amazon in eBooks). At the same time, social networks are becoming more and more internet platforms offering a wide range of services, and providing a complete experience of the web inside their pages (from communicating to exchange of content and navigating). This expansion into a variety of new fields raises a variety of new regulatory issues and may subject companies to increased regulatory scrutiny, particularly in the US and Europe.

European social networking sites have lost their leadership in their domestic markets. diVZ in Germany, Skyrock in France, Tuenti in Spain and Hyves in the Netherlands were at one time undisputed leaders in their domestic markets. They had limited international expansion, but had deep roots in their home countries. MySpace made little inroads against them, but Facebook, which in 2007 started a big effort to localise its site, has become the market leader in European countries.[24] Nevertheless, local social networking sites are still very active in countries like Latvia, Poland, Slovakia, Hungary and Slovenia.

Table 1.3: **Top 5 internet sites**

Austria	Google	Facebook	YouTube	Orf	Wikipedia
Belgium	Google	Facebook	Windows live	YouTube	Msn
Bulgaria	Google	Facebook	vbox7	abv	YouTube
Croatia	Google	Facebook	net.hr	Index.hr	Iskon.hr
Cyprus	Google	Facebook	YouTube	Yahoo	Live
Czech Rep.	Seznam.cz	Facebook	Google	YouTube	SZN
Denmark	Google	Facebook	YouTube	Live	eksstrabladet
Estonia	Google	YouTube	Delfi	Neti	Facebook
Finland	Google	Facebook	YouTube	iltalehti	Wikipedia
France	Google	Facebook	Live	YouTube	Orange
Germany	Google	YouTube	Facebook	eBay	Wikipedia
Greece	Google	Facebook	YouTube	Blogger	Yahoo
Hungary	Google	iwiw	YouTube	Freemail	Facebook
Ireland	Google	Facebook	YouTube	Yahoo	Wikipedia
Italy	Google	Facebook	YouTube	Yahoo	Live
Latvia	Draugiern	Google	Inbox	YouTube	Delfi
Lithuania	Google	Facebook	YouTube	One	Delfi
Luxembourg	Google	Facebook	YouTube	Live	Yahoo
Malta	Google	Facebook	YouTube	Live	Wikipedia
Netherlands	Google	YouTube	Hyves	Live	Facebook
Poland	Google	Nasza-klasa	Onet	Allegro	YouTube
Portugal	Google	YouTube	Facebook	Live	Hi5
Romania	Google	Yahoo	Hi5	Facebook	Blogger
Slovakia	Google	Facebook	Azet	YouTube	Zoznam
Slovenia	Google	Facebook	YouTube	24ur	Najdi
Spain	Google	Facebook	Live	YouTube	Blogger
Sweden	Google	Facebook	YouTube	Live	Aftonbladet
UK	Google	Facebook	YouTube	Yahoo	BBC

Source: Alexa.com, February 2010

[23] On 19 November 2009, eBay completed the sale of a majority holding in Skype to an investor group.
[24] Maija Palmer, A future alongside Facebook, Financial Times, 25 February 2010.

The online advertising market

Online advertising has traditionally been a growing market ever since the dotcom bubble. Even during the crisis its performance seemed resilient. Despite a slowdown in the first half of 2009[25], revenues over the whole year are positive. However, growth rates in the market are declining.

Figure 1.15 Global wired and mobile Internet advertising market growth

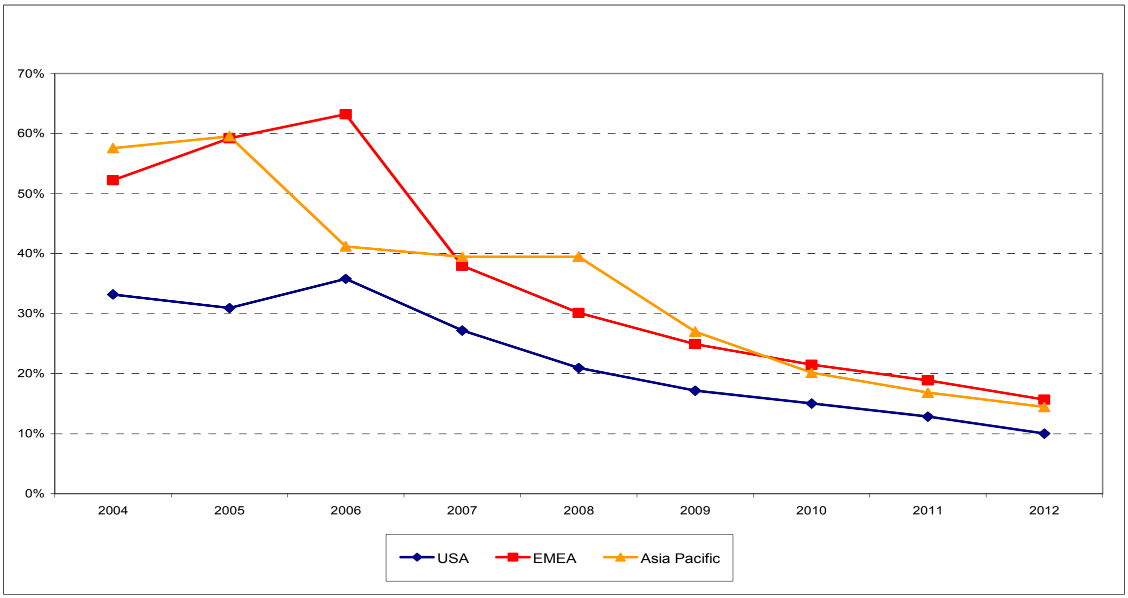
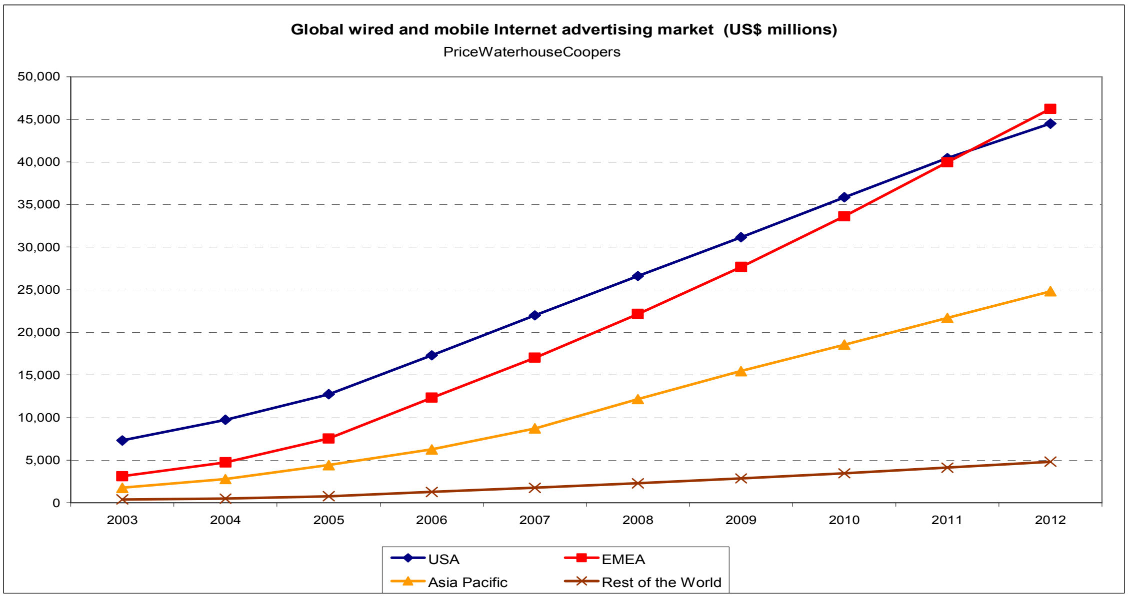


Figure 1.16 Global wired and mobile Internet advertising market (US$ millions)



Source: PricewaterhouseCoopers, Global Entertainment and Media Outlook 2008-2012.

25 Revenues from internet advertising in the US went down by 5.3% in the first half of 2009 to $10.9 billion. IAB Revenue Report.

Not all online advertising segments show the same performance. Search advertising continues to be the leading segment, followed by display and classifieds[26].

Google is the world leader on the search advertising segment. During 2009, Google advertising revenues grew by 8 % (compared to 29 % in the previous year)[27].

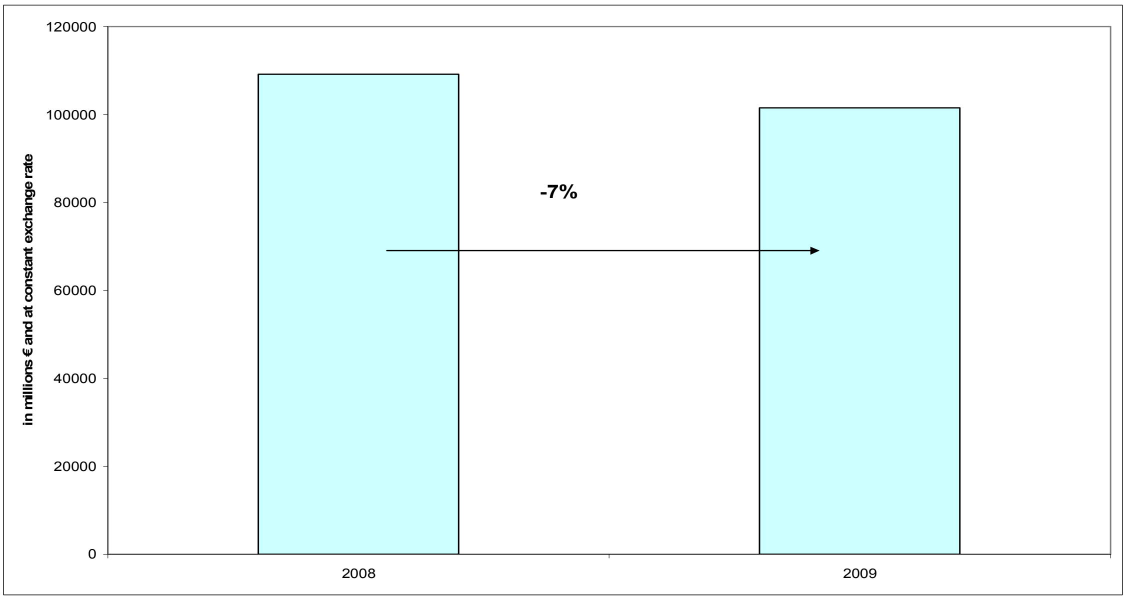
While the volume is increasing in the mobile networks with the development of mobile broadband, there are concerns as to how to extract revenues from this increase. Operators are focusing on connectivity and finding new sources of revenue from traffic. Internet companies are leading the development of new content through their platforms and operating systems.

The mobile advertisement market with the development of mobile broadband is a very promising market in terms of growth, and several actors (telecom operators, internet and software companies and equipment manufacturers) have entered it.

1.4.4. Software and IT services

The consulting and IT services market, which had demonstrated remarkable resistance in 2008, slowed considerably in 2009, particularly in the second half of 2009, when it was hit by a substantial slump in demand. The combined revenues of a sample of these companies shows a decrease of about 7 % (Figure 1.17). The medium-term prospects, however, remain quite good.

Figure 1.17: **Combined revenues of a sample of companies in the software and IT services sector**



Source: Annual and quarterly reports

According to EITO, the main drivers for the software and IT services markets remain, on the one hand, the willingness of companies and institutions to invest in IT and, on the other, their sourcing policy (in-house versus subcontracting / outsourcing or purchase of software products). While the current economic situation forces many companies to postpone

26 Search advertising (accounting for 47 % of revenues in this period and controlled by companies like Google) grew by 1.7 % in the US. Display advertising represented 35 % of the total. IAB Revenue Report.

27 Company's income statement.

investment, business models like outsourcing or software as a service help them bring their IT forward with limited cash going out. Moreover, the pace of hardware maintenance is expected to remain more or less the same in 2009 and 2010.

Internet-based services, also called cloud computing, are expected to change this trend. Cloud computing offers reduced prices and is expected to bring major benefits to small and medium-sized enterprises in the European economy.

1.4.5. Telecom operators

The sector is facing its biggest transformation since liberalisation, with the transition to an all-IP environment in both fixed and mobile networks. Voice communications are increasingly being replaced by internet-based calls or being included in broadband bundles. The sector's organic growth based on new subscriptions is slowing down in the legacy mobile and broadband markets. At the same time, increases in data traffic are not yet compensating for declining prices and decreasing voice traffic.

The economic climate in 2008 and 2009 led to weakened user spending (corporate spending in particular), yielding near-zero revenue growth while access to credit was restricted temporarily. Major cost-cutting plans (in particular in terms of capital expenditure — CAPEX), combined with business models based on flat rates, have nonetheless ensured continued profitability throughout the crisis. While achieving significant growth is challenging, there are some good prospects for a return to positive growth rates in 2010/2011, driven by the recovery of GDP and increased consumer spending. Furthermore, continued cost-cutting strategies are expected to fuel profitability and provide scope for increased investment in network upgrades and next-generation access.

Revenues for the EU electronic communications sector were €351 billion in 2008[28], accounting for about half of the total for the entire ICT sector. Seven of the ten largest telecoms operators in the world are European. 50% of the sector's revenues are driven by fixed voice telephony and broadband (both business and private users), while the remainder is provided by mobile communications (voice and data). The growth rate for revenues in the electronic communications sector (both wholesale and retail markets) is estimated to have been close to zero in 2009[29] (Table 1.4). As European markets mature, revenue growth is stronger for those operators active in markets outside the EU[30].

Telecom operators in the 2009 EU Industrial R&D Investment Scoreboard[31], covering fiscal year 2008, had a combined workforce of around one million employees and R&D spending of slightly over €4,500 million.

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28 Data from national regulatory authorities.

29 EITO 2009.

30 This includes the US, China, India, South Africa and Latin American countries. Despite the strong impact of the economic slowdown, telecom revenue growth in the US, for example, is estimated to have been positive in 2009, albeit below 1%, driven by growth in mobile markets. The US in 2009 started off from a lower penetration rate than the EU (89% in June 2009 in the US compared to 121% in October 2009 in the EU). However, it was the more dynamic development of mobile data services, led in particular by the earlier arrival of a particular brand of smart phone, that accounted for the difference with Europe in 2009.

31 European Commission, DG RTD and JRC.

Table 1.4

	Growth rate	Share in telecom service revenues
Fixed voice telephony and internet access and services	-2.5%	36%
fixed voice telephony	*-6.3%*	*24%*
internet access and services	*5.6%*	*12%*
Mobile voice telephony and mobile data services	0.6%	47%
mobile voice telephony	*-1.8%*	*36%*
mobile data services	*9.3%*	*11%*
Business data services	0.6%	7%
Pay TV	11.7%	10%
Total telecom services (carrier services)	0%	100%

Source: EITO (2009)

To offset the slow revenue growth in 2009, incumbent operators focused on cost-cutting strategies using two main approaches: restructuring activities (OPEX) and cutting investment (CAPEX). Furthermore, operators are seeking agreements to share infrastructure and spectrum with competitors. Investment is declining at a faster pace than revenues. The intensity of investment as measured by the CAPEX/revenue ratio is declining and is estimated to be around 11%[32] (from a level of 14% in 2008 and 15% in 2007).

1.5. 1.5. Conclusions

The ICT sector represents 5% of GDP but is the largest R&D investing sector in the economy. On average, however, R&D investment in relation to GDP is lower in the EU compared to its main international competitors, and there are large differences between Member States, with the Nordic countries and Austria and Germany clearly the top EU investors (in relation to GDP) and most Eastern Member States and Greece having the lowest ratios.

Lower private R&D intensity in the EU does not however necessarily mean that individual EU companies invest less in R&D than their competitors. On the contrary, their levels of R&D intensity are similar to the levels of their main competitors. One of the reasons for lower EU performance is the structure of the EU ICT sector, in terms of the number and size of companies.

Recent data released through the EU Klems database confirm the importance of ICT in driving productivity growth. Almost all of the productivity gap between the US and the EU in

32 Data for 2009 come from the European operating revenues of the 27 top telecom operators between January and September 2009.

1995-2000 (on average 1.1% per year) can be attributed to ICT, either in the form of ICT investment or efficiency gains in the ICT producing sector. After 2000, ICT capital deepening and efficiency gains in the ICT producing sector continue to contribute half of productivity growth in the EU, but the main difference between the EU and the US has been efficiency gains in non-ICT sectors of the economy, mostly in market services. However, these gains have also started to appear in Europe, and are an important driver in the catch-up process for European living standards.

2. 2. BROADBAND

In 2009 the EU broadband market continued to be the largest in the world, with some Member States leading in terms of penetration rates. The fixed broadband penetration rate in the EU as a whole was 24.8 %[33] (Figure 2.1), an increase of 2 percentage points (pp) over the previous year despite a significant slowdown in the growth rate. Most EU broadband lines are based on xDSL technologies. Mobile broadband take-up is growing but the deployment of high-capacity broadband is currently limited: while 83.4 % of fixed broadband lines in the EU offer speeds above 2 Mbps, only a quarter of them are above 10 Mbps. Retail prices are declining, mostly as a consequence of quality (speed) upgrades, and bundled offers are on the rise.

Since July 2003 the incumbents' market share in the fixed broadband market has been following a downward trend, stabilising in 2010 at around 45 %. In some countries, however, the incumbents are regaining market share. Local loop unbundling (fully unbundled lines and shared access) is the principal means by which new entrants can offer retail DSL services (73.7 % of new entrants' DSL lines, up from 69.2 % in January 2009), mostly at the expense of resale, which shrank by 3 percentage points during the last year.

1.6. 2.1. Growth in fixed broadband lines has been the lowest since 2003

Broadband markets in 2009 continued to be a positive source of revenue growth for the electronic communications sector, although at lower rates than in previous years. In January 2010, there were 123.7 million fixed broadband lines, up 9 % since January 2009, and the average fixed broadband penetration rate[34] in the EU reached 24.8 %, up 2 percentage points over one year. Nevertheless, with 10.2 million new fixed broadband lines, i.e. 28 199 net additions per day, the growth rate was 24 % lower than a year earlier and the lowest in the last five years (Table 2.1).

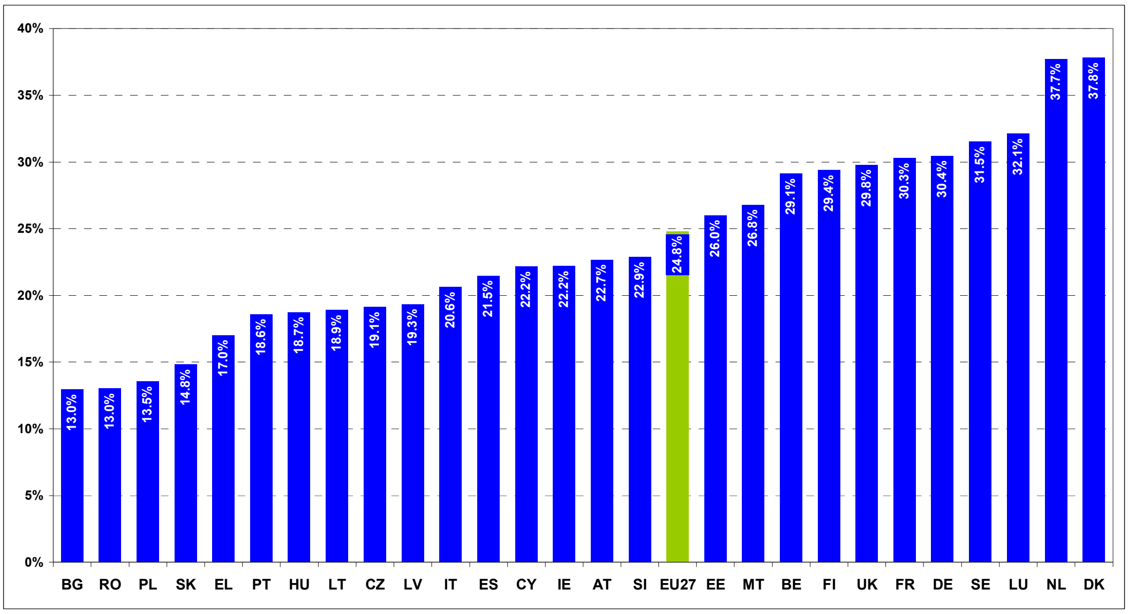
Table 2.1

Period	January 04	January 05	January 06	January 07	January 08	January 09	January 10
Broadband lines	23,302,070	39,488,334	59,348,726	80,117,975	99,812,771	113,446,213	123,738,940
Broadband penetration	4.9 %	8.2 %	12.1 %	16.3 %	20.2 %	22.8 %	24.8 %
New lines per day	28,752	44,225	54,412	56,902	53,958	37,250	28,199

Overall growth in fixed broadband penetration has been slowing down over the past two years, and only in five countries (LU, HU, PT, SK and SE) was the number of net additions in 2009 greater than in 2008. In a number of cases, markets appear to be approaching maturity, which in some cases is combined to some extent with fixed/mobile broadband substitution. This would appear to be the case in countries such as Denmark or Finland, for instance.

33 Penetration rate based on population as of 1 January 2010.
34 Number of fixed broadband lines per 100 population.

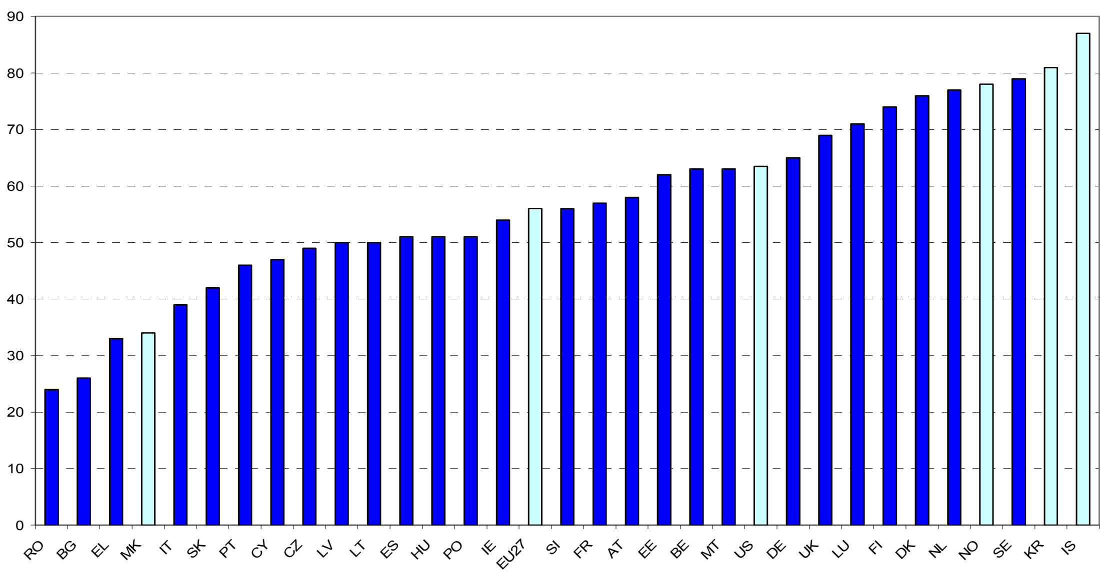
Figure 2.1: **Broadband Penetration Rate, January 2010**



Source: Communication Committee

The Netherlands on the other hand has the highest penetration rate in the EU and in the world, but still experienced an increase of 1.6 pp in the number of lines, slightly below the EU average. France and Germany, which together account for 36 % of the EU broadband market, also saw a near 3 pp increase in fixed broadband subscribers. Hence, it appears that there is still some margin for growth in the broadband market. Data on household take-up, a good proxy for the growth potential of broadband markets, suggest that there are still a high proportion of EU households that do not have a broadband connection. In the Netherlands and Denmark, only around 25 % of households do not have a connection, but in the EU on average more than 40 % of households are not yet connected to broadband (Figure 2.2).

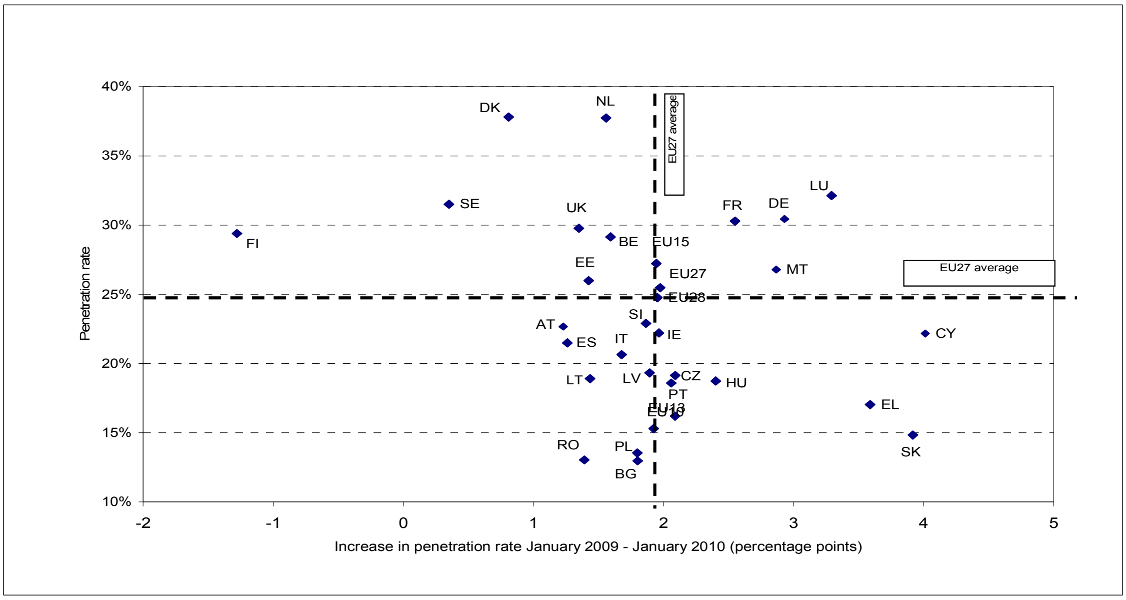
Figure 2.2: **% of households using a broadband connection**



Source: Eurostat Community Survey on ICT usage by Households and Individuals (2009)

Growth in countries where broadband markets are far from being mature also shows a mixed picture. Cyprus had the highest year-on-year increase in fixed broadband lines (4 %). Slovakia and Greece, which have penetration rates below average, have also displayed higher growth rates and are thus catching up with the EU average. However, AT, ES, RO, LT, IT, PL, BG, SI and LV only had growth rates between 1 and 2 pp, failing to catch up with the EU average and even falling further behind (Figure 2.3).

Figure 2.3: **Penetration rate and speed of progress, January 2010**



Source: Communication Committee

The impact of the economic slowdown in 2009 on the broadband market is mixed. EU GDP declined by 4.2 %[35] in 2009 compared with 2008, whereas fixed broadband lines grew by 9 % (January 2009–January 2010). While the fixed broadband market in some countries with a stronger than average GDP decline (SK, EL, HU, CZ and DE) grew faster than in the EU, countries such as BE, ES, AT, PL and IT lagged behind average broadband growth despite a lower than average GDP decline.

Despite these disparities, the broadband gap, i.e. the difference between the highest and the lowest level of penetration, was 25 pp in January 2010, 1.2 pp lower than in 2009, and continues to fall. Growth in mobile broadband was significant in a number of EU countries in 2009. Although the penetration of dedicated mobile broadband cards was limited to 5.2 % of the EU population in January 2010, the mobile broadband market is growing rapidly (86 % growth in mobile broadband cards between January 2009 and January 2010). In three Member States (Finland, Portugal and Austria) the penetration rate exceeds 15 %. The estimated number of dedicated mobile broadband cards (25.1 million) corresponds to about 20 % of all fixed broadband connections, up from 10 % in 2008.

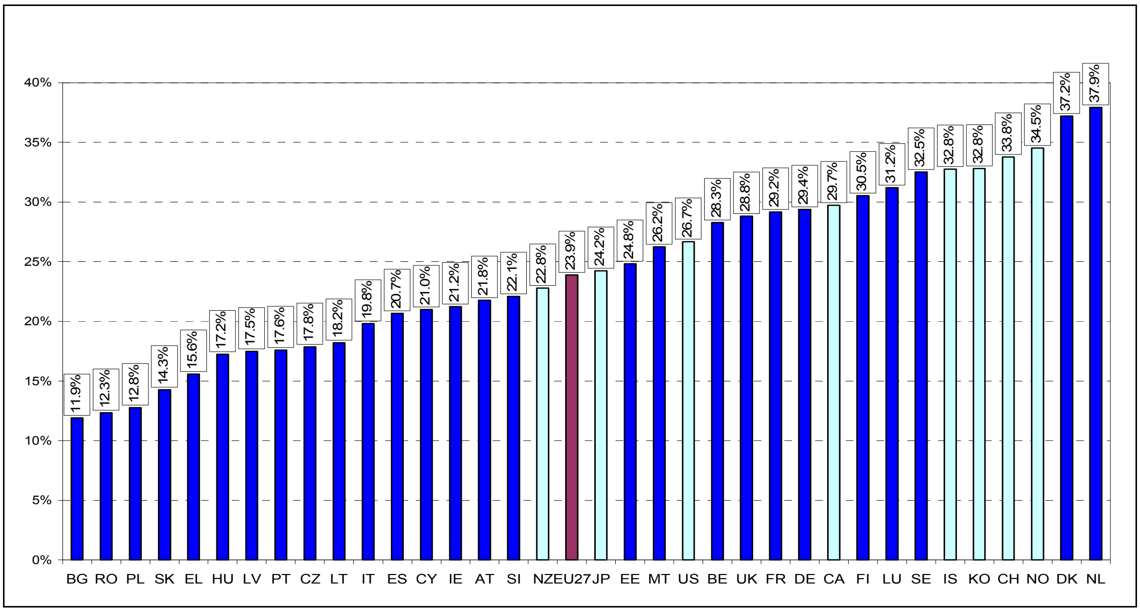
[35] Source: EUROSTAT, http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&plugin=1&language=en&pcode=tsieb020.

1.7. 2.2. International comparison

The EU continues to be the largest broadband market in the world, and some EU Member States have the highest penetration levels. In terms of ranking, there have not been any significant changes since 2008: The Netherlands and Denmark continue to be the best performers, followed by Sweden, Finland and Luxembourg, which have penetration levels above 30% of the population, along with a group of four non-EU countries, Norway, Switzerland, Korea and Iceland (Figure 2.4).

The EU is catching up with the US in broadband take-up. The gap in penetration rates was down to 2.8 percentage points in July 2009[36], from 3.4 points in July 2008. The US broadband market grew by 8.2% (compared with 10.6% in the EU) between July 2008 and July 2009 to reach a penetration level of 26.7%. This may be partly explained by the greater impact of the economic slowdown in the US, as well as the fact that the US market is more mature than the European.

Figure 2.4: **International fixed broadband penetration rates, July 2009**



Source: OECD

At global level, growth in the broadband market has been driven by strong increases in developing markets. The total number of broadband subscriptions was estimated to be around 440 million[37] at the end of July 2009, with a year-on-year growth rate of 16%. Among the largest broadband markets, China, Russia, Mexico, India and Vietnam have experienced the biggest increases in broadband subscriptions, thereby reducing the EU share in the global total.

Growth rates in developing countries (India 62%, China 23%, Russia 39%, Brazil 23%, Mexico 54%) have outpaced the levels of developed countries, though from much lower levels of penetration. Many EU telecom operators have been very active in these growing markets.

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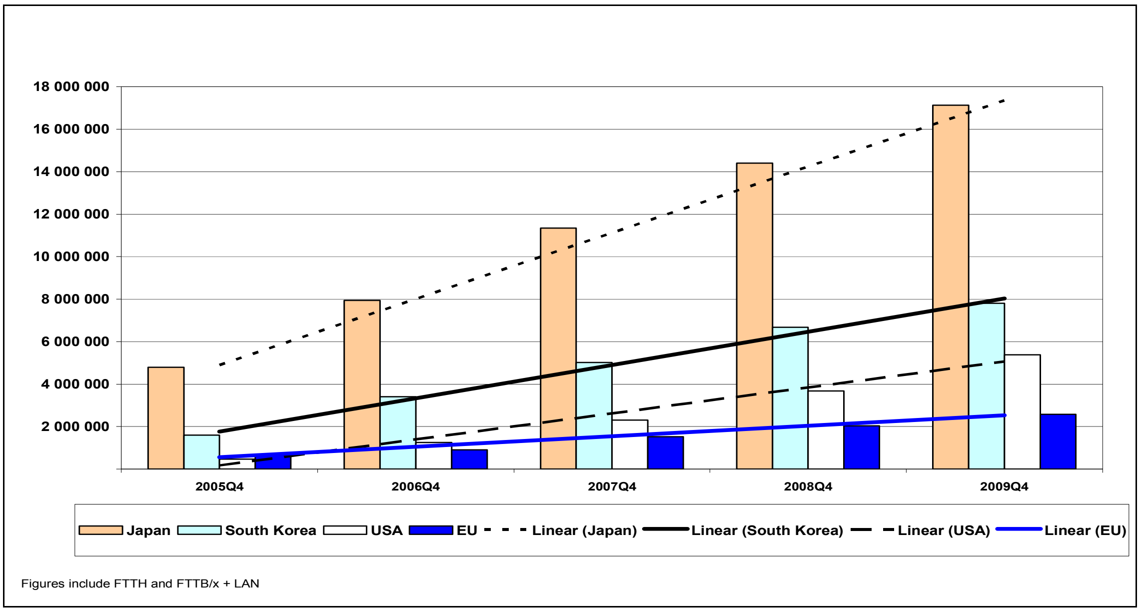
36 OECD data for January 2010 are not available.

37 EC, based on different sources (Informa, Point Topic).

Despite the good penetration rates, most EU broadband lines are based on xDSL technologies and average speeds are usually lower than in other developed countries with high broadband penetration rates. Lines based on fibre-to-the-home (FTTH) solutions and fibre + LAN only represent between 2 and 5 % of all broadband lines, while this share is much higher in countries such as Japan (51.4 %) or Korea (46 %). In the US, FTTH lines represent 6 % of all broadband lines. Although FTTH deployment accelerated in 2009 (Figure 2.5) differences are still very apparent. Price levels also reflect these differences. In October 2009, broadband standalone access at 100 Mbps was available at around 30 euros per month in Japan and 20 euros in Korea. These prices are between 20 and 50 % lower than prices for similar products in those EU countries where these are available.

Figure 2.5: **FTTx deployment in the EU, US, Japan and South Korea**



Source: Commission, on the basis of Point Topic

The pattern of high-capacity broadband deployment is different in advanced markets compared to emerging markets. In Japan, the US, South Korea and Taiwan, growth appears to be largely driven by operators' efforts to persuade DSL and cable subscribers to switch to FTTx, whereas in the less developed markets such as Russia and China, large numbers of first-time broadband customers have signed up to FTTx, often because it is the only technology available to them. This pattern may enable currently less developed markets to leapfrog the advanced broadband economies in the future.

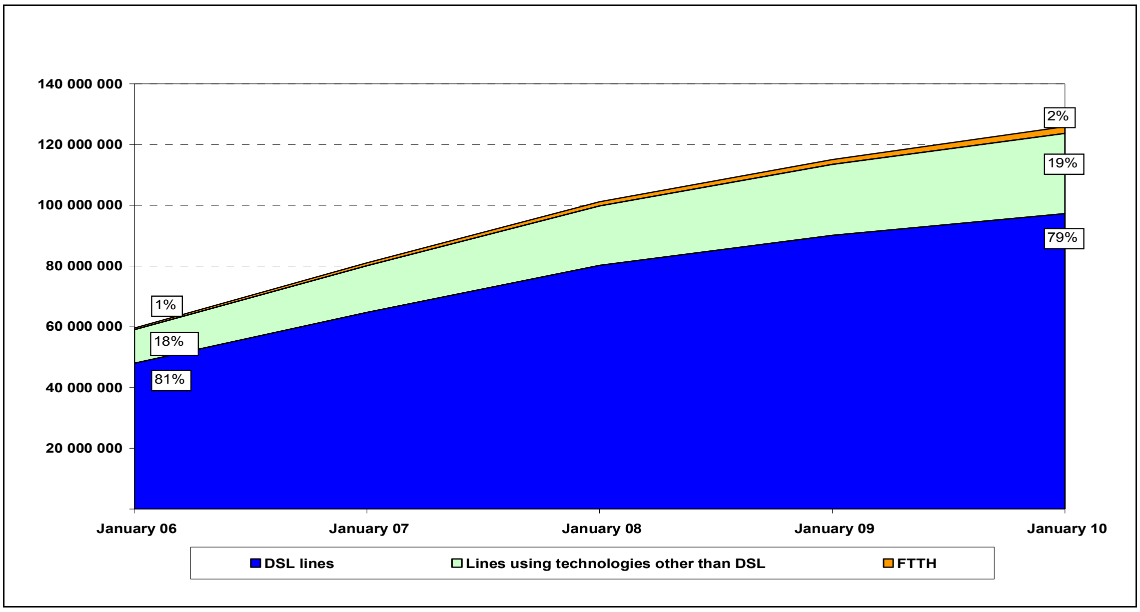
1.8. 2.3. Market developments — the emergence of fibre and mobile broadband

DSL continues to dominate the EU broadband market, although its share of the market has slightly decreased to 79 % from the peak of 81 % in January 2006 (Figure 2.6).

In the period between January 2009 and January 2010, 70 % of new lines were provided by means of xDSL technologies and 30 % were connections using other types of technologies, an increase of 3 pp compared to the year before.

In the fixed broadband market, the largest relative growth was experienced by broadband lines based on fibre to the home and fibre + LAN, which together increased by 26 %, admittedly from a lower base than DSL or cable modem lines, technologies that showed an increase of around 8 %.

Figure 2.6: **EU fixed broadband lines by technology**



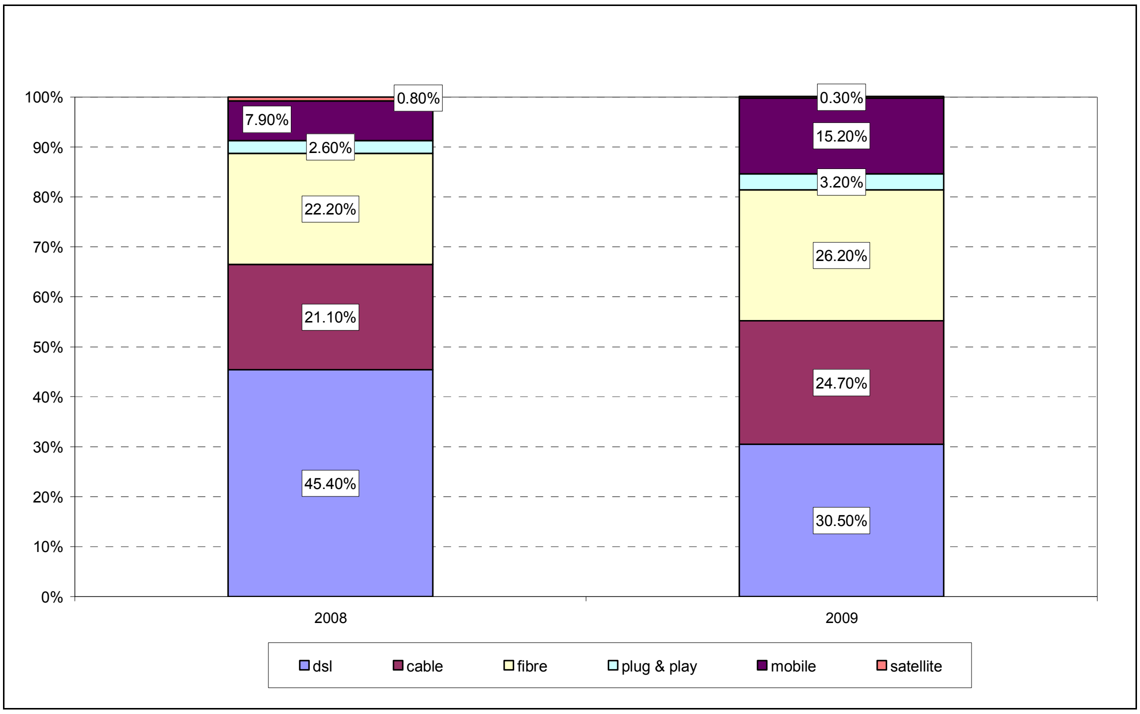
Source: Communication Committee

Most operators have expanded the number of broadband products based on fibre. Of a sample of 2 700 broadband products offered by the largest and most representative operators in the EU Member States in October 2009, 26 % are based on fibre technologies[38], 4 pp up on 2008 (Figure 2.7). Products based on cable modem also experienced a significant increase. The availability of high-speed, fibre-based products is still limited to some parts of major urban areas and new offerings are often used by operators to assess consumer interest in switching to upgraded broadband access.

Nevertheless, the highest growth occurred in the mobile broadband market, where take-up increased by 115 % (January 09-January 10). The number of new mobile broadband products offered by mobile operators also doubled in 2009.

38 Van Dijk, 'Broadband Internet Access Costs', a study for the European Commission.

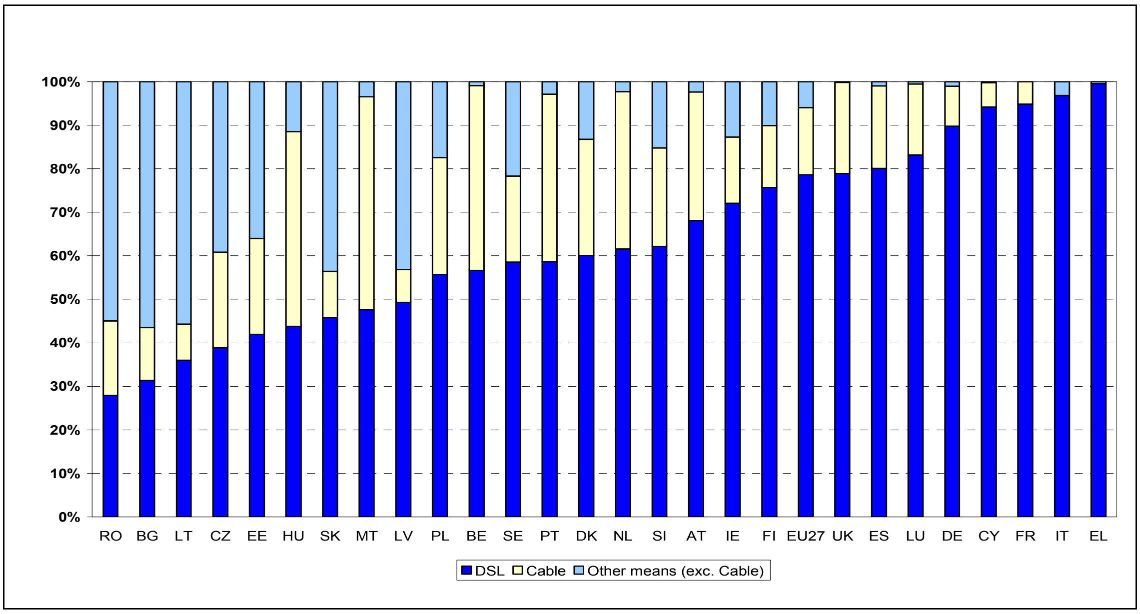
Figure 2.7: **EU broadband offerings by technology**



Source: Commission Services on the basis of Van Dijk

Some countries show completely different patterns in their choice of broadband technologies, especially Member States where the lack of legacy infrastructure has triggered investment in other technologies. In RO, BG and LT and, to a lesser extent, in EE, LV, SK and CZ, the deployment of fixed broadband lines is very much based on fibre access (Figure 2.8).

Figure 2.8: **Fixed broadband lines by technology, January 2010**

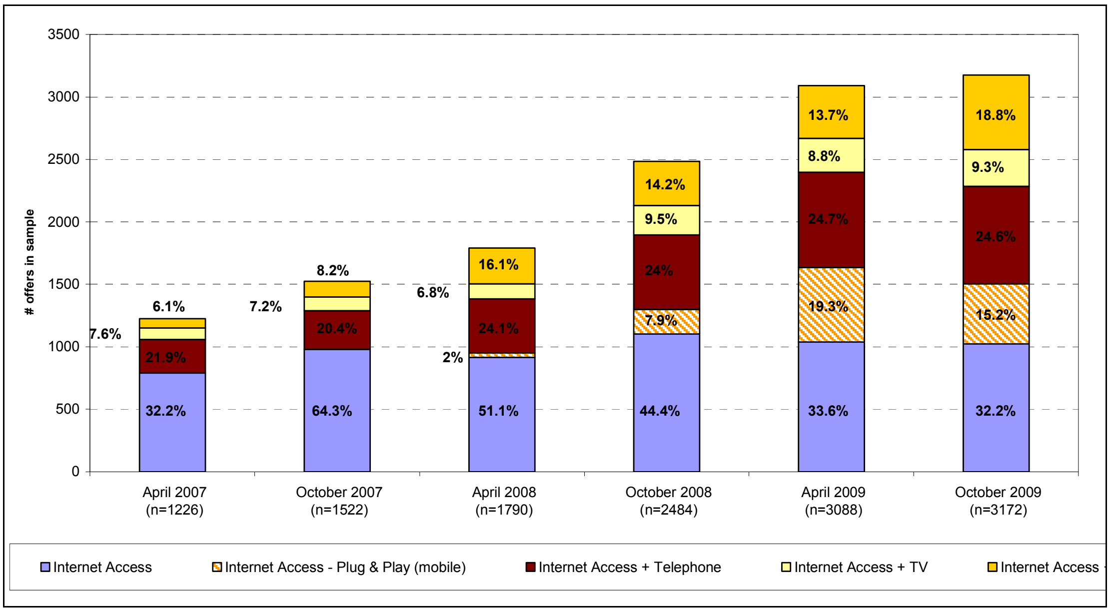


Source: Communication Committee

Despite the higher proportion of FTTx lines in these Member States, it seems that actual speeds provided by these fibre access lines are in many cases comparable with or even lower than ADSL2+ speeds[39].

The slowdown in broadband subscriptions experienced in 2009 was accompanied by some price reductions, or speed increases for the same price, in broadband products as well as by a rise in the number of bundled offers, which often have the advantage of putting a cap on retail prices but risk locking in customers and reducing churn. As of October 2009, it is estimated that almost 68% of broadband products from the largest broadband operators consisted of bundles of services, broadband combined with telephone being the largest (Figure 2.9). In April 2007, bundled services constituted only 36% of operators' offerings. More and more consumers perceive bundles as a way to reduce spending on communication services.

Figure 2.9: **Number of broadband product offers by type of bundle**



Source: Commission Services on the basis of Van Dijk

In 2009, there was a wide debate about the transition to next-generation access networks, although in reality the market has been very cautious about the move.

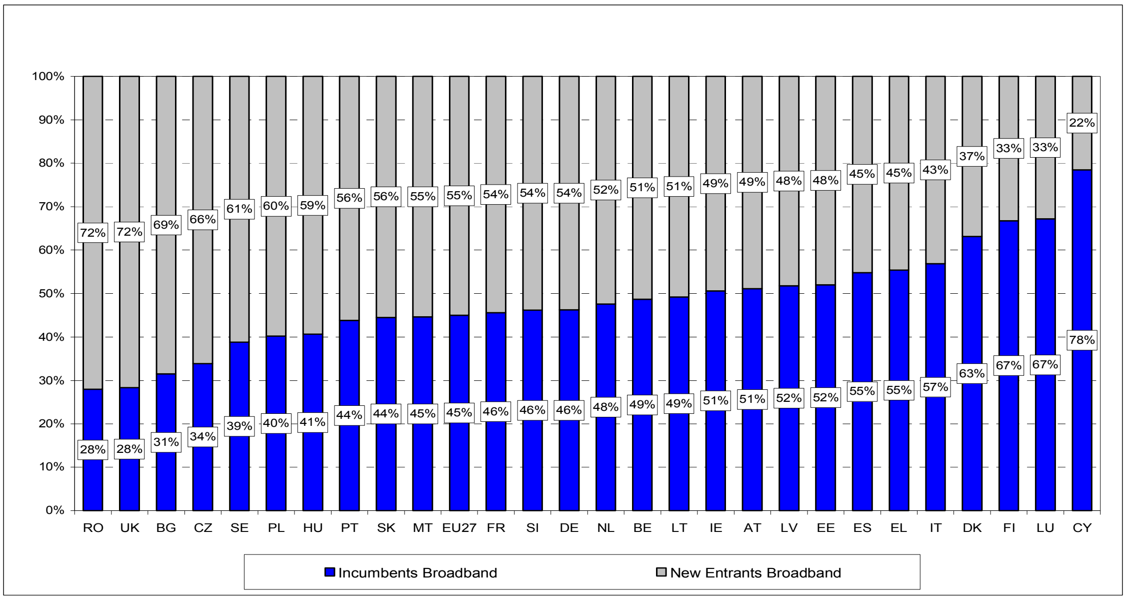
Many operators blame uncertainty surrounding regulatory approaches and uncertainty as to demand, as currently only a fraction of consumers use 80% or more of the network capacity available to them. Hence, it appears that only a few customers would be willing to pay a premium for very fast broadband when other speeds at lower prices are available and fit the current needs of most broadband users. In a flat-rate-based IP environment, an increase in traffic does not automatically translate into an increase in revenues. This has an impact on operators' profitability and their capacity to invest in expanding their network capacity. Operators are thus searching for new and sustainable business models, also by focusing on applications, services and content.

39 Informa's Telecom Markets, Issue No 597, September 2009.

1.9. 2.4. Competition stagnates in the DSL market

The market share[40] of the incumbent fixed operators since July 2003 has followed a downward trend, which is now stabilising around 45 % of the broadband market. In some cases, incumbents are even regaining market share. The decline in their market share in 2009 was the lowest since data began to be collected, only 0.5 pp compared to 0.6 and 0.8 pp drops in the past two years and losses of between 3 and 4 pp in previous years. In most of the largest EU Member States, incumbents still control a large share of the market (Figure 2.10), affecting the EU average (IT 57 %, ES 55 %, DE 46 %; FR 46 %, PL 40 %).

Figure 2.10: **Percentage broadband lines by operator**



Source: Communication Committee

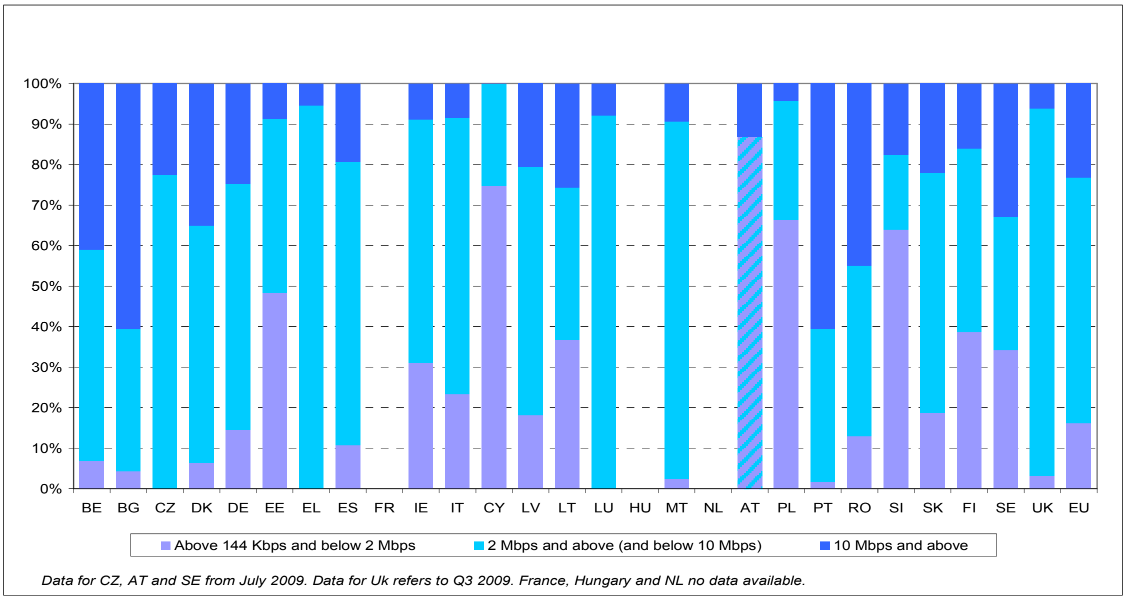
The UK is the exception, where the incumbent has the lowest market share of all EU Member States after Romania. In 2009, however, the incumbent operator in the UK gained market share. Incumbent operators have also gained market share in Denmark, Latvia, Austria and Finland. They have also done so in BE, BG, CZ, MT, PT and RO, countries where the incumbents' market share is below 50 %.

1.10. 2.5. A shift in broadband speeds and a slight fall in prices

As at January 2010, two thirds of fixed broadband lines in the EU offered speeds between 2 and 10 Mbps (Figure 2.11). The most significant development is the shift in the two other categories of lines: low-speed broadband lines with download rates between 144 Kbps and 2 Mbps represented only 16 % of all fixed broadband lines in January 2010, down from 25 % in 2009, while the fastest category of lines (10 Mbps and above) increased its share, from 14 % in 2009 to 23 % of all fixed broadband lines in January 2010.

40 Based on subscribers.

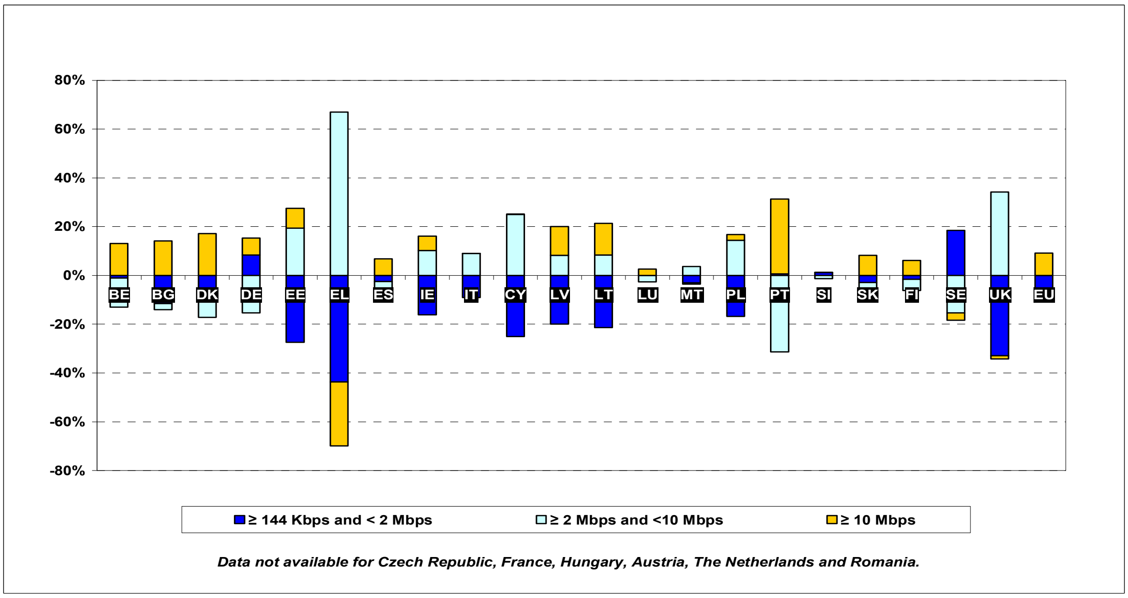
Figure 2.11: **Fixed broadband lines by speed, January 2010**



Source: Communication Committee

Therefore, while on average the increase in broadband speeds is not yet significant, there is a clear trend towards faster access lines. In terms of volume, most net fixed-broadband additions in 2009 were for speeds in the range of 10+ Mbps while most EU countries saw a reduction in the proportion of low-speed fixed broadband lines (Figure 2.12).

Figure 2.12: **Trends in the breakdown of BB lines by speeds, January 2009 to January 2010**



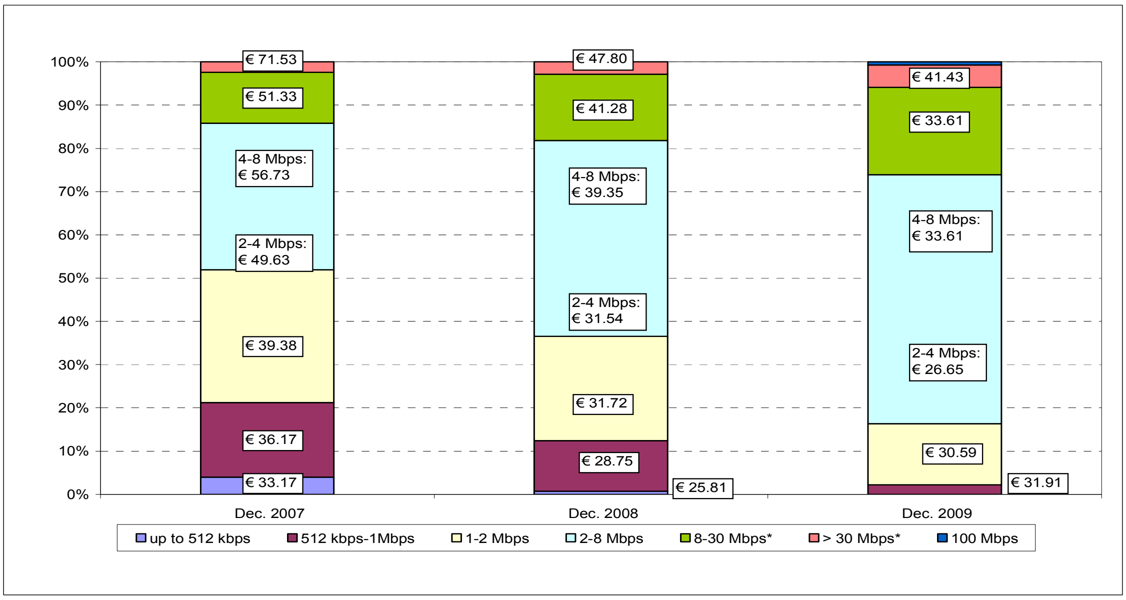
Source: Communication Committee

The rise in the number of high-speed broadband lines follows the major increase in the number of high-speed fixed broadband offers. Between October 2008 and 2009, the number of broadband products (broadband standalone and bundles) with speeds higher than 20 Mbps doubled, thus becoming the category of lines with the highest number of offers in the EU.

Products with speeds greater than 20 Mbps represent 33 % of all products offered by broadband operators. Lines with speeds between 8 and 20 Mbps follow with 23 %. Offerings with speeds between 2 and 8 Mbps, which represent the bulk of active broadband lines in the EU, only account for 23 % of all broadband products.

With regard to broadband retail prices, the median price for offers with download speeds between 2 and 4 Mbps in the EU-27 countries slightly decreased in 2009 (Figure 2.13). For broadband lines with speeds between 4 and 8 Mbps, prices decreased significantly in the newer Member States while remaining more stable in the rest of the EU.

Figure 2.13: **Broadband subscribers by download rates and broadband (median) prices in the EU, 2007-2009**



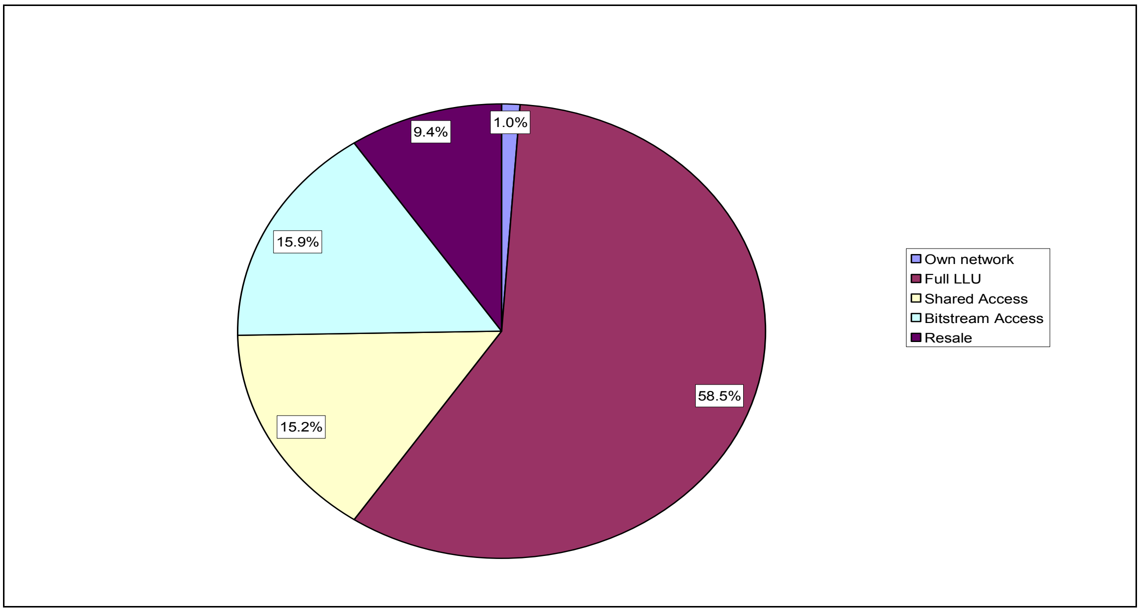
Source: Commission Services on the basis of Van Dijk, Idate and Communication Committee

1.11. 2.6. The DSL market is stabilising

2.6.1. Market shares

Local loop unbundling (fully unbundled lines and shared access) has recorded positive growth and has become the main form of wholesale access for new entrants, with 73.7 % of DSL lines, up from 69.2 % in January 2009 (Figure 27). New entrants' use of bitstream access for local loop unbundling in the provision of broadband services has remained stable (down by only 1 pp since January 2009). The share of lines based on resale, a type of access suited to low-investment new entrants, has shrunk by 3.5 percentage points over the last year.

Figure 2.14: **New entrants' DSL lines by type of access (EU-27 — January 2010)**



Source: Communication Committee

Resale is used only in a limited number of Member States (especially the UK, DE and LU, but also BE, SE, DK and NL), and in almost all countries local loop unbundling or bitstream is the predominant means of access. The EU average hides wide differences between EU Member States, which reflect diverse regulatory approaches in the broadband wholesale market.

For example, in the cases of Bulgaria, Romania and the Czech Republic, the broadband market follows completely different patterns. In the first two countries, due to the absence of legacy infrastructure based on PSTN, competition is based on cable modem networks and, in new local networks, fibre + LAN. DSL lines only represent around 30 % of all broadband retail lines and new entrants hardly rent any PSTN lines from the incumbent. In the Czech Republic, only 39 % of broadband lines are based on DSL, with fixed wireless access and cable modem predominating. Alternative operators only rent 5 % of all fixed broadband lines from the incumbent operator. Similar situations are found in LV, LT, EE, SK and MT, where the incumbent operator fully, or almost fully, controls the DSL market (Table 2.2). With the exception of Slovakia, in none of these countries is DSL the predominant technology.

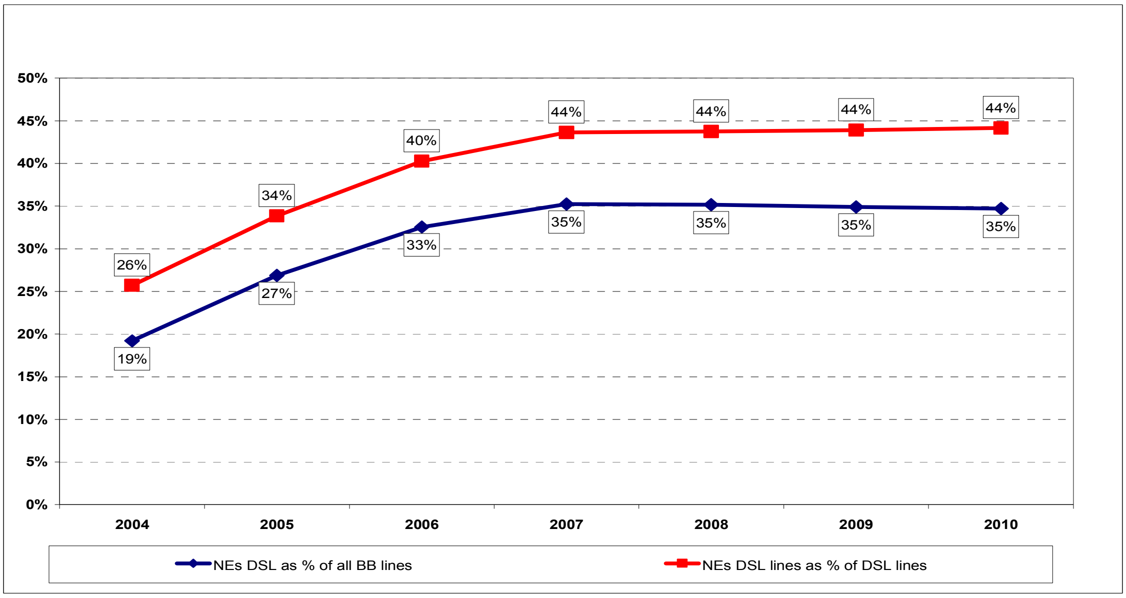
Table 2.2: **Percentage of new entrants' (NE) DSL broadband lines per Member State**

Country	NEs DSL as % of all fixed broadband lines	NEs DSL lines as % of all DSL lines	DSL as % of all fixed broadband lines
BG	0	0	31%
RO	0	0	28%
LV	0	0	49%
LT	0	1%	36%
EE	2%	6%	42%
MT	3%	6%	48%
SK	4%	8%	46%
CZ	5%	13%	39%
BE	8%	14%	57%
HU	10%	23%	44%
PL	16%	28%	56%
CY	16%	17%	94%
PT	16%	27%	59%
NL	16%	26%	62%
DK	16%	27%	60%
LU	17%	20%	83%
AT	17%	25%	68%
SI	21%	34%	62%
IE	23%	31%	72%
SE	23%	39%	59%
FI	24%	32%	76%
ES	26%	32%	80%
EU-27	35%	44%	79%
IT	40%	41%	97%
DE	44%	49%	90%
EL	44%	44%	100%
FR	49%	52%	95%
UK	51%	64%	79%

Source: Communication Committee

Along with platform-based competition, effective sector regulation has been a key factor in driving competition, in particular in those countries where DSL is the predominant technology. Sector regulation has fostered competition and growth in the DSL market, thus significantly lifting the broadband market. In the last three years, however, the share of DSL retail lines offered by new entrants has only increased by 0.6 pp at EU level (Figure 2.15), which is a major change compared to previous years. In many countries, the growth in new entrants' DSL lines has been flat or even negative. This can be partly explained by the small contraction in the DSL market, the maturity of some markets and the (albeit small) increase in the relative share of lines based on new technologies, where new entrants have been more active, as well as possible anti-competitive conduct on the part of incumbent companies[41]. Although new entrants have continued investing in the DSL wholesale market (growth in local loop unbundling products is still significant), the DSL retail market has stabilised and major shifts in market shares are no longer expected.

Figure 2.15: **DSL as a % of all fixed and xDSL broadband lines, 2004-2010**



Source: Communication Committee

2.6.2. Local Loop Unbundling (LLU) pricing

Decreases in LLU prices in 2009 were not significant compared to the reductions seen in 2008. On average, prices for fully unbundled lines only decreased by 2 %, while prices for shared access declined by 5 %. These reductions are similar to the 2007 levels.

There were slight increases in LLU prices in DK, IT, CY, FI, SE and UK. Prices did not change in BE, BG, DE, IE, LV, LU, MT, NL, PL, PT, RO and SI. In all other countries prices decreased.

With regard to shared access lines, prices went up in DK, FI, SE and UK, and remained constant in BE, BG, DE, EE, IE, FR, CY, LV, LU, MT, NL, PL, PT, RO and SI.

1.12. 2.7. Broadband coverage in rural areas

Total DSL coverage increased from 92.7% of population in December 2008 to 94% in December 2009, while rural coverage reached 80% of rural population by end 2009 as opposed to 76.6% a year ago. Only six member states have DSL coverage below 90% (Figure 2.16). However, rural DSL coverage is still an issue in a large number of countries. In BG, RO and CY rural coverage is still below 50%, although Romania and Cyprus made significant progress relative to the previous year. The gap in national coverage in 2009 between the best and worst performing country decreased by 6 pp and in rural coverage by 18 pp. As for total DSL coverage, the highest growth took place in RO (6.4 pp), PL (4.9 pp) and SK (4.1 pp).

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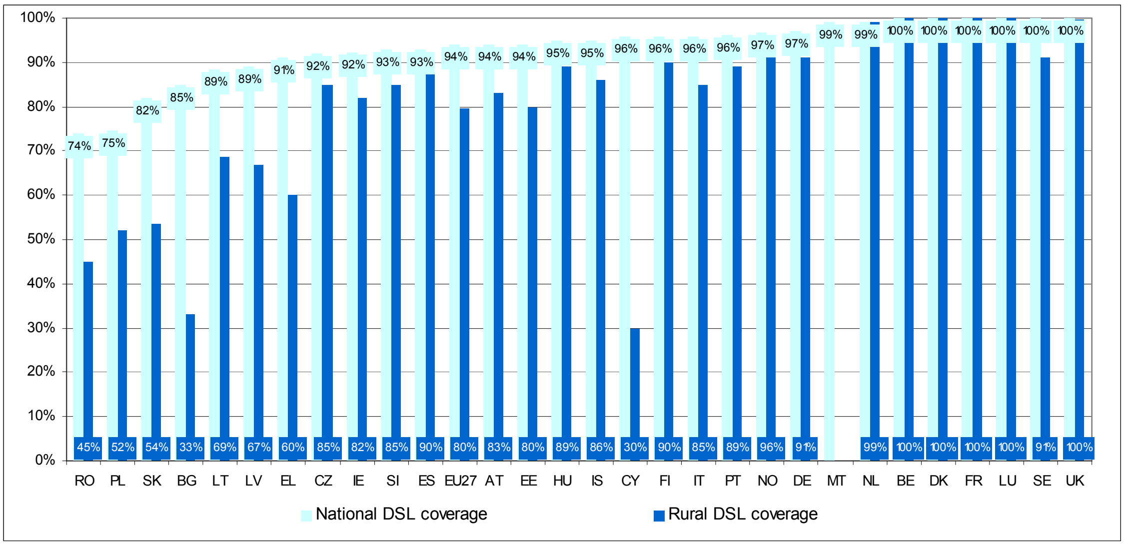
41 The Commission is investigating such alleged conduct for example in Poland and Slovakia.

Figure 2.15: **DSL national and rural coverage, December 2009**



Source: Communication Services on the basis of Idate[42]

In 2009, spurred on by the economic crisis, there was considerable interest in public funding for broadband deployment, as several recovery packages (including the EU's) regarded broadband as an important instrument to foster sustainable economic growth (although only a third of the budget made available by the Union through the Rural Development Programme was effectively implemented by the Member States). A "Broadband for All" objective was set for 2013.

In order to provide legal certainty for public support to install broadband as well as high-capacity broadband (Next Generation Access) in under-served areas, the Commission adopted guidelines on 17 September 2009 on how public funding can be provided for broadband in line with EU state aid rules. These guidelines explain how public funds can be used to deploy basic broadband networks (e.g. to upgrade legacy copper networks) as well as Next Generation Access (NGA – mainly new fibre-based architectures) in areas where private operators do not intend to invest.

The primary objective is to foster a wide and rapid roll-out of broadband networks while at the same time preserving market dynamics and competition in a sector that is fully liberalised and subject to ex-ante regulation. The guidelines also ensure that whenever state aid is granted to private operators, the aid must foster competition by requiring the beneficiary to prove open access to the publicly funded network for third party operators.

The guidelines also contain specific provisions concerning the deployment of Next Generation Access networks, allowing public support to foster investment in this strategic sector without creating undue distortions of competition.

The distinction between different areas in terms of competition is due to the situation of NGA networks (where deployment, as noted before, is still at an early stage). The guidelines here require Member States to take into account not only existing NGA infrastructures but also concrete investment plans by operators to deploy such networks in the near future. A number

[42] Idate, "Broadband developments in Europe", a study for the European Commission, forthcoming

of crucial safeguards (such as detailed mapping, open tendering, open access obligations or technological neutrality and claw-back mechanisms) are set out in order to promote competition and avoid the 'crowding out' of private investment.

In 2009 the European Commission took decisions on thirteen broadband projects involving public funding. Twelve were found to be compatible with the Treaty (Article 4(3) decision types), while one was not considered aid but rather relating to a service of general economic interest[43]. The total amount of public funding authorised was €467 million.

Table 2.3[44]

#	Decision name	MS	Decision date	Decision type
1	N238/2008 — DE — Broadband infrastructure development	DE	23/02/2009	Article 4(3)
2	N153/2009 — DE — Amendment of the State aid broadband scheme N266/2008	DE	19/05/2009	Article 4(3)
3	N183/2009 — LT — RAIN project	LT	17/07/2009	Article 4(3)
4	N243/09 — DE — Extension of broadband coverage in Niedersachsen	DE	14/08/2009	Article 4(3)
5	N331/2008 Réseau à très haut débit en Hauts-de-Seine	FR	30/09/2009	Article 4(2)
6	N172/2009 — SL — Broadband development in Slovenia	SI	19/10/2009	Article 4(3)
7	N418/2009 — UK — Northern Ireland	UK	5/11/2009	Article 4(3)
8	N388/2009 — FI — High-speed broadband pilot projects in Finland	FI	not yet	Article 4(3)
9	N607/2009 — IE — Rural Broadband Scheme	IE	4/12/2009	Article 4(3)
10	N423/2009- CY — Cyprus Broadband	CY	10/12/2009	Article 4(3)
11	N323/2009 — ES — Broadband Asturias	ES	14/12/2009	Article 4(3)
12	N368/2009 Amendment of the State aid broadband scheme N115/2008	DE	22/12/2009	Article 4(3)
13	N388/2009 – FI – High-speed broadband pilot projects in Finland	FI	16/12/2009	Article 4(3)

Investment in the deployment of high-speed broadband networks is also being financed by the European Investment Bank. In particular, alternative operators in Italy, Germany, Portugal

43 N 331 2008 Réseau à très haut débit en Hauts-de-Seine.
44 A complete list of state aid broadband decisions is available at http://ec.europa.eu/competition/sectors/telecommunications/broadband_decisions.pdf

and France have used the bank to finance the upgrading of their networks and the roll-out of next-generation fibre networks. According to the Commission, these projects are likely to foster the development of competition and advanced electronic communications services.

Finally, a recent Commission report[45] concluded that investment supported by Structural Funds in the area of the digital economy - rolling out broadband and exploiting ICT use in the public and business sectors - is slower than average with uneven performance and called on Member States to improve implementation of programmes. With a view to reaching 100% coverage at EU-level by 2013, there is a clear need to step up investment efforts in the roll-out of broadband especially in convergence regions where the bulk of broadband infrastructure investments (EUR 2.3 billion in EU27 for the period 2007-2013) are concentrated. In addition to the significant investments in broadband infrastructure, the total budget foreseen in the cohesion programmes for the period 2007-2013 in ICT is €12.9 billion, which represents 3.7% of the total cohesion policy spending in the EU-27.

1.13. 2.8. Conclusions

The EU continues to be the largest broadband market in the world and some EU Member States have the highest penetration levels. In a number of cases, however, markets appear to be approaching maturity, in some cases combined to some extent with fixed/mobile broadband substitution.

The fixed broadband penetration rate in the EU has reached 24.8 %[46], an increase of 2 pp over the previous year despite a significant slowdown in the growth rate. In terms of ranking there have not been any significant changes since 2008: the Netherlands and Denmark continue to be the best performers, followed by Sweden, Finland and Luxembourg, which have penetration levels above 30 % of the population, along with a group of four non-EU countries, Norway, Switzerland, Korea and Iceland. The EU is catching up with the US in broadband take-up. The gap in penetration rates was down to 2.8 pp in July 2009[47], from 3.4 points in July 2008.

The slowdown in broadband subscriptions experienced in 2009 was accompanied by price reductions, or speed increases for the same price, in broadband products as well as by a rise in the number of bundled offers, which often have the advantage of putting a cap on retail prices but risk locking in customers and reducing churn.

Mobile broadband take-up is growing. Increases in traffic will require capacity improvements, both in networks and in spectrum availability. The deployment of high-capacity broadband on the other hand is currently limited: while 83.4 % of fixed broadband lines in the EU offer speeds above 2 Mbps, only 23.2 % are above 10 Mbps.

The incumbents' market share in the fixed broadband market has been following a downward trend since July 2003, stabilising in 2010 at around 45 %. In some countries, however, the incumbents are regaining market share.

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45 COM(2010)110
46 Penetration rate based on population as at 1 January 2010.
47 OECD data for January 2010 are not available.

Despite the good penetration rate levels, most EU broadband lines are based on xDSL technologies, and average speeds are usually lower than in other developed countries with high broadband penetration rates.

Regarding very high-speed lines, Europe is lagging behind. Lines based on fibre-to-the-home (FTTH) solutions and fibre + LAN only represent between 2 and 5 % of all broadband lines, while this share is much higher in countries such as Japan (51.4 %) or Korea (46 %). In the US, FTTH lines represent 6 % of all broadband lines.

Many operators blame uncertainty surrounding regulatory approaches to next-generation networks and uncertainty as to demand, as currently only a fraction of consumers use 80 % or more of the network capacity available to them. Operators are thus searching for new and sustainable business models, also by focusing on applications, services and content. The European Commission will soon publish a Recommendation on the regulatory approach to Next Generation Access.

In 2009, spurred on by the economic crisis, there was considerable interest in public funding for broadband deployment, as several recovery packages (including the EU's) regarded broadband as an important instrument to foster sustainable economic growth. In order to provide legal certainty for public support to install broadband as well as high-capacity broadband (Next Generation Access) in under-served areas, the Commission adopted guidelines on 17 September 2009 on how public funding can be provided for broadband in line with EU state aid rules.

3. 3. INTERNET USE AND ECOMMERCE IN THE EU AND BEYOND

The spread of broadband is stimulating the take-up of online services. Not only are traditional services such as email and information search gaining more users, but broadband is leading to a rapid take-up of communication and image-based services such as chat, web TV and web radio, also stimulating participation in social networks.

The social impact of the spread of ICT can be seen and felt all around us. ICT is spreading throughout many areas of our lives, affecting how we learn, work and consume as well as how we socialise and interact with each other, with producers of goods and services and with public authorities. It is also blurring the boundaries between these many different areas of life and helping us to overcome social, economic and geographic boundaries.[48]

Despite increasing use, however, cross-border eCommerce is not yet developing at satisfactory rates, limiting the impact of the internet on the single market. This chapter analyses the latest developments in regular use of the internet in the EU. It also looks at patterns in the use of internet services by the online population in the EU and compares them to patterns in other leading online societies, such as the US, Japan and Korea. Finally, it looks in more detail at developments in the use of eCommerce.

1.14. 3.1. Developments in the proportion of the population using the internet

Regular internet use (defined as at least once a week) has become a mainstream phenomenon in Europe. In 2009, 60 % of European citizens aged 16-74 years were regular internet users, an increase of 4 pp over 2008 (Figure 3.1). The share of those who have never used the internet remains significant, however, dropping by only 2 pp to 30 %.

In other major online societies, internet use appears higher[49]. While in the US 68 % of the population (aged 3 and over) claim to have used the internet, in Korea the figure is 81 % (for the last 3 months), while in Japan 54 % of households have a member who has used it. The most comparable figures for the EU are the proportions of individuals that have used the internet in the last three months (65 %) or any time (69 %), which are remarkably similar to the figures for the US. As regards non-users, the US (32 %) registers a marginally larger proportion and Korea (16 %) a substantially smaller proportion. In Japan, the members of 44.3 % of households have never used the internet.

In Europe, the share of the population regularly using the internet still varies widely across countries. While the Nordic countries (Denmark, Sweden, Iceland and Norway), the Netherlands and Luxembourg lead the way with take-up rates exceeding 80 % (significantly above international leaders such as South Korea), 40 % or less of Bulgarians, Greeks and Romanians use the internet regularly.

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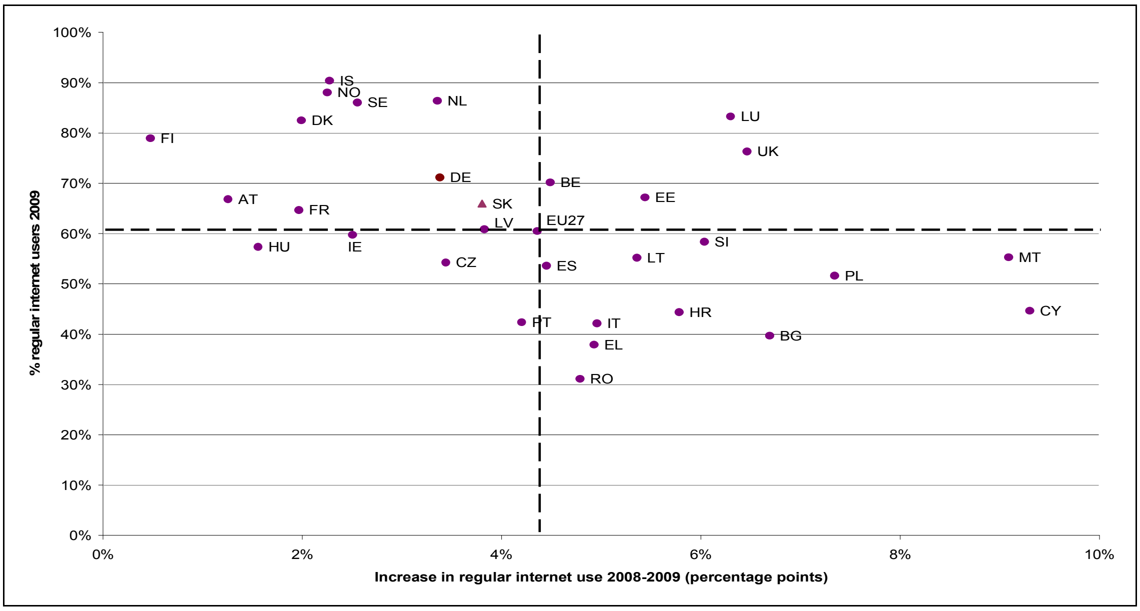
48 See ‘The Social Impact of ICT’, a forthcoming study for the European Commission.

49 The data sources used for the following international comparisons are: for the EU, the April 2009 Community survey on ICT usage in households and by individuals; for Korea: May 2009 survey on the internet usage, NIDA statistics report; for the US: most data are from the October 2009 Census Population Survey, special Internet Use Supplement, in ‘Digital nation’ by the US Department of Commerce; and for activities and frequency of internet usage: April 2009 survey by Pew Research Center’s Internet & American Life Project; for Japan: summer 2009 survey of Household economy, Ministry of Internal Affairs and Communications.

Figure 3.1: **Trend in % of regular internet users in the EU, Iceland, Norway and Croatia, 2008-2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Despite significant country disparities, regular internet use increased in all countries during 2009. Encouragingly, growth rates are inversely related to the rate of use, suggesting catching up. That is, countries with the lowest rates of regular internet use saw the largest growth rates between 2008 and 2009. Conversely, countries with already high rates of regular internet use have witnessed lower rates of growth. Indeed, some Member States with the lowest rates of regular internet use, such as Bulgaria (7 pp) and Romania (5 pp), made particularly good progress in the last year. The highest increases over the last year were seen in Cyprus and in Malta, which is now not far from the EU average. Despite already having above-average rates of regular internet use, Luxembourg and the United Kingdom have also seen a large increase in regular internet use over the last year.

In order to further advance towards a true information society, internet use patterns will have to intensify. Frequent use of the internet, defined as daily or almost daily usage, has reached 48% of the EU population. While frequent usage is significantly higher in South Korea (60%), and in the US (56%).

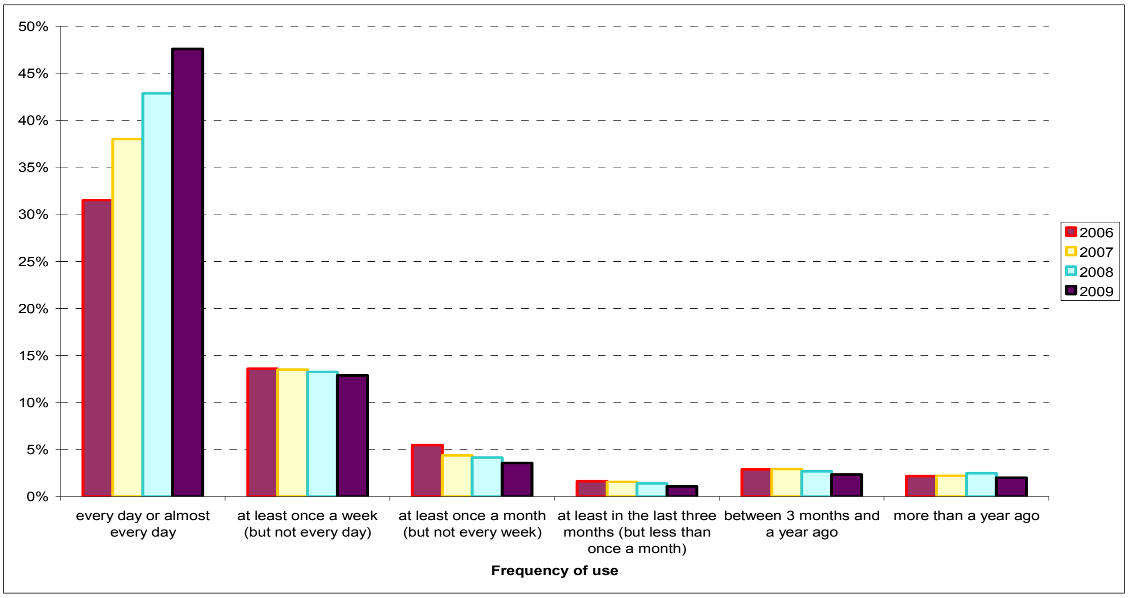
The pattern of frequent (daily) internet use across Europe is similar to the picture for regular internet use[50]. Frequent internet use is widespread in Sweden, Denmark, Island and Norway, the Netherlands and Luxembourg with daily use rates exceeding 70%. The highest rates of growth (over 8 pp) in frequent use are found in Cyprus, Malta, Estonia and Croatia, although they are still around the European average. Fewer than 30% of Greeks and Romanians use the internet on a daily basis. Moreover, Greece and Romania seem to be falling behind even further, with rates of increase below the EU average.

Developments in the frequency of internet use show that once people have used the internet once they are likely to carry on using it and over time use it more frequently. Indeed the proportion of those who have ever used the internet (69%) is similar to the figures for regular

[50] The correlation between the two variables is 97%.

users (60 % of the total population aged 16-74) and, over time, user profiles have shifted from less frequent to more frequent use (Figure 3.2).

Figure 3.2: **Internet use as a % of population (EU-27) by usage frequency**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.15. 3.2. Barriers to broadband take-up

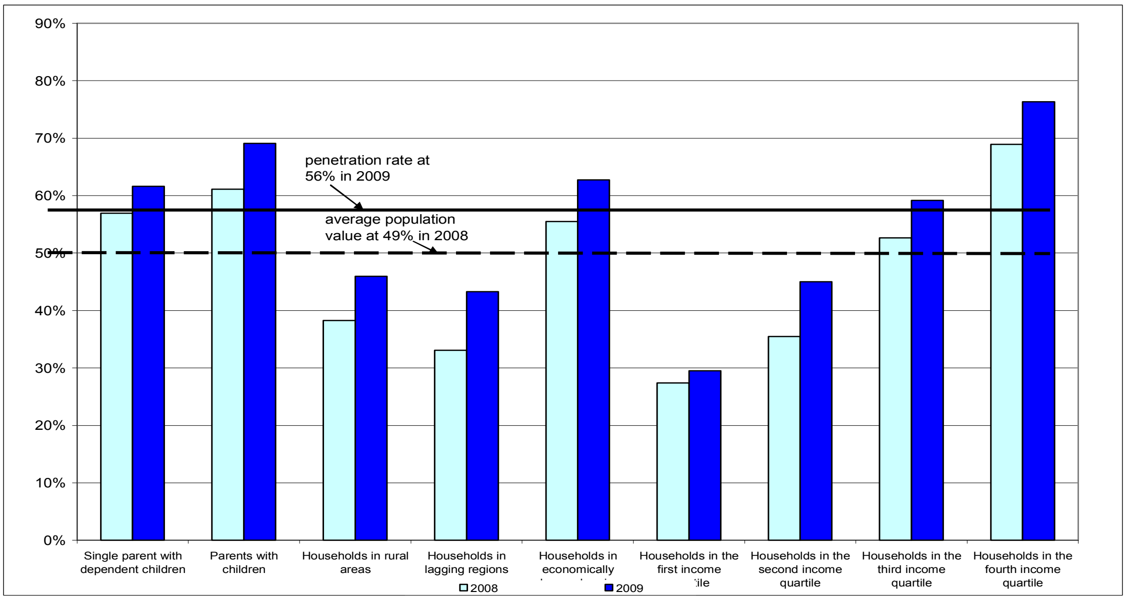
Lack of broadband, as well as lack of skills, may hinder or limit the intensity with which households use higher-quality internet-based applications. Such disparities in terms of quality of use, often termed the Second Digital Divide, are a growing concern as the internet expands and diversifies, offering an increasing variety of ever more complex services.

Broadband penetration increased substantially over the past year to 56 % (up from 49 % in 2008) of European households (86 % of individuals living in households with broadband access regularly use the internet), among all socioeconomic groups. Having children, living in economically advanced regions[51] and higher incomes are drivers of acquiring a broadband connection at home. Below-average broadband penetration is prevalent among households with lower incomes and those living in rural or in lagging or least developed regions (by definition, also on low incomes)[52]. While the latter group has improved its penetration rate over the past year, the increase is substantially below that for people in higher income groups, resulting in increased digital inequality between households in different income brackets, in line with the evidence noted above for regular internet use.

51 This refers to the so-called Regional Competitiveness and Employment regions, with GDP levels exceeding 75 % of the EU-27 average.

52 Rural areas refer to households in sparsely populated areas (less than 100 inhabitants per km^2); lagging regions refer to so-called Convergence regions in European regional policy and Eurostat's database.

Figure 3.3: **Broadband penetration by type of household (%)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

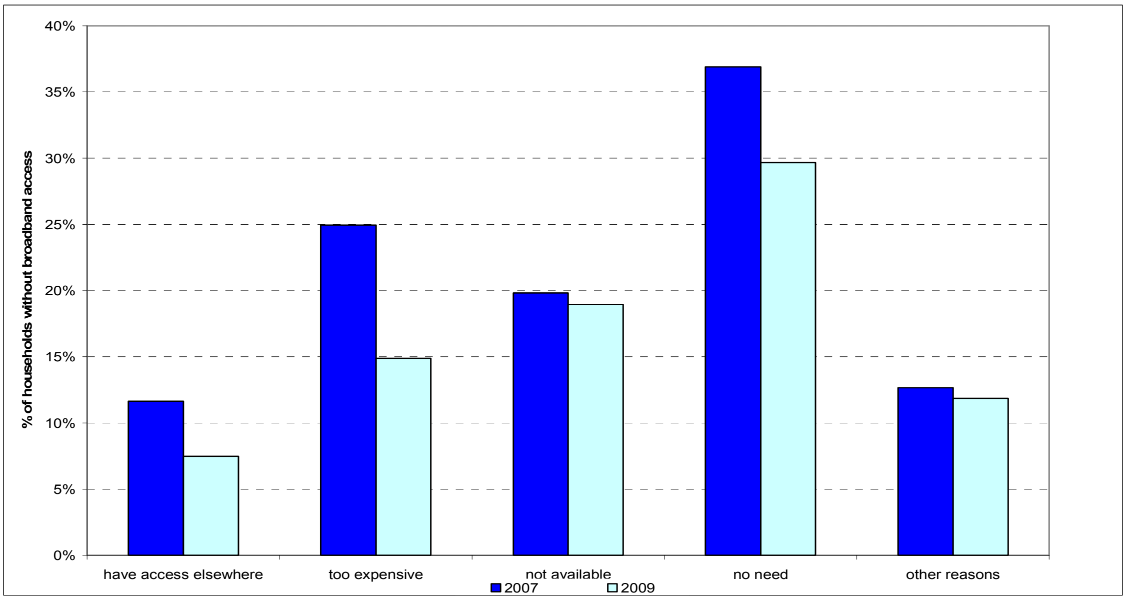
The main barrier to broadband take-up for households not currently connected to high-speed internet remains the perception that a high-speed connection is not needed — 29.7%, although this figure fell by over 7 pp in the last year (Figure 3.4). The role of prohibitive costs has been shrinking significantly since 2007 (down from 25% to 15%). Lack of access remains an issue for almost one fifth of European households (19%) that do not have a broadband connection. Non-availability of broadband is, however, the main barrier to broadband take-up for households in rural, i.e. thinly populated, areas (over 30%; Figure 3.5). 'Too expensive' is the answer given by the largest proportion of households in lagging regions; it is the second most important barrier after 'no need' for this group. Having children seems to increase the perception of need and willingness to pay for broadband, while living in a lagging region aggravates the barriers. The barriers faced by other socio-economic groups (Figure 3.5) are similar to those for the average household.

As regards reasons for not having internet access at home in general, lack of skills was also an issue for 24% of internet non-users in 2008, in addition to a perceived lack of need (38%), equipment costs (25%) and access costs (21%).

Hence, more and more Europeans are starting to appreciate the value of having an internet connection and, in particular, a broadband connection at home and find it worth paying for, as evidenced by the significant drops in the 'no need' and 'too expensive' categories compared to 2007. However, they remain the main reasons given for not having broadband, while the non-availability of broadband prevents about one fifth of the European population and over 30% of those living in rural areas from benefiting from high-speed internet.

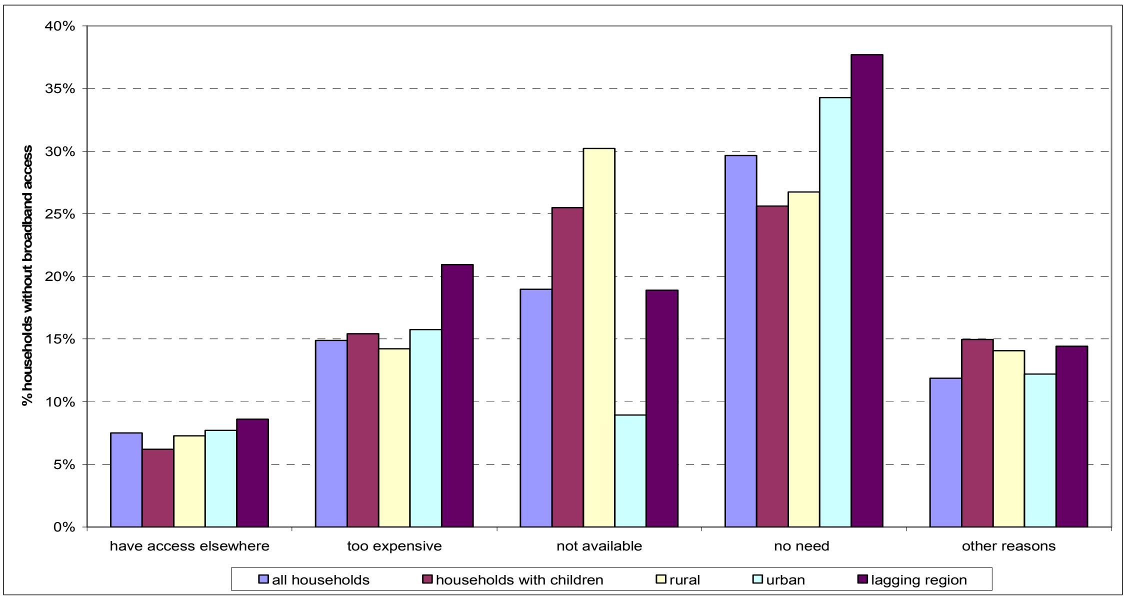
Interestingly, the main reasons for not having broadband, i.e. perceived lack of need and prohibitive costs, are very similar for the EU and US. In Korea, however, cost seems to be less of a problem.

Figure 3.4: **Reasons for not having broadband at home, 2007 and 2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Figure 3.5: **Reasons for not having broadband at home across socio-economic groups (2009)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.16. 3.3. Patterns in the use of internet services in the EU, US, Japan and South Korea

A comparison between patterns of internet usage in the EU, US, Japan and Korea is complicated by differences in the definition of internet users — in most cases, the definition for the US is the proportion of users ever having performed online activities while in the EU, for example, the data relate to use in the last three months. On the whole, however, there is a strong overlap in the types of activities for which data are gathered, which makes it possible to make at least some international comparison.

3.3.1. Communication

Levels of use for communication purposes are similar between the EU, the US and Korea. 88 % of internet users in the EU[53] have sent or received *e-mails* (in the previous three months), 90 % of internet users in the US[54] have done so (at some time). In Korea, 75 % of internet users[55] have used e-mails in the last three months (96 % for internet users in their 20s).

In the EU, 26 % of internet users have used the internet for *telephoning* or *video calls* (during the last three months). In the US, 20 % of internet users have (ever) made teleconference or video calls over the internet.

In the EU, 43 % of internet users have used the internet, in the last three months, for *posting messages to chat sites, blogs, newsgroups or on-line discussion forums or for instant messaging*. In Korea, 47 % of internet users have used instant messengers in the last three months (80 % for internet users in their 20s).

3.3.2. Information search and on-line services

Information search and use of online services seems to be more widespread in the US than in the EU and Korea. While *reading or downloading online news/newspapers/news magazines* is an activity performed by 48 % of internet users in the EU (last three months), 72 % of American internet users have viewed news online (at some time) and over half of internet users read newspapers online in Korea (almost 70 % in their 20s).

In the EU, 37% of internet users have used the internet for *listening to web radio and/or watching web television* (last three months). In Korea, two-fifths of internet users (aged 6 and over) have watched TV online (nearly two thirds in their 20s), of whom 93 % use it at least once a month, and 31 % listen to online radio (46 % in their 20s), of whom 95 % at least once a month. In the US, 35 % of internet users have watched a television show or movie online at some time.

23 % of EU internet users have used the internet for *job search* (during the last 3 months), compared to 52 % of US internet users (ever).

3.3.3. Banking

Rates of use of internet banking are similar across the three regions, once differences in definitions are allowed for. 50 % of internet users in the EU have used the internet for *internet banking* (last three months). 37 % of Korean internet users aged 12 and above have used it for this purpose (last three months), but 53 % of individuals in their 20s have done so. 57 % of US internet users have used the internet for online banking at some time.

53 Individuals aged 16-74 who have used the internet in the last 3 months in the EU-27 (information collected in 2009).

54 Adult population aged 18 years or over.

55 Individuals aged 6 years and over.

3.3.4. eCommerce

In Korea, 62 % of internet users (age 12 and over) have *purchased goods and services* (including making reservations) over the internet in the last year. More females (70 %) than males (56 %) use internet shopping. The most active are individuals in their 20s (89 %).

75 % of US internet users have bought a product online at some time. 54 % of European internet users have bought or ordered goods or services over the internet in the last 12 months.

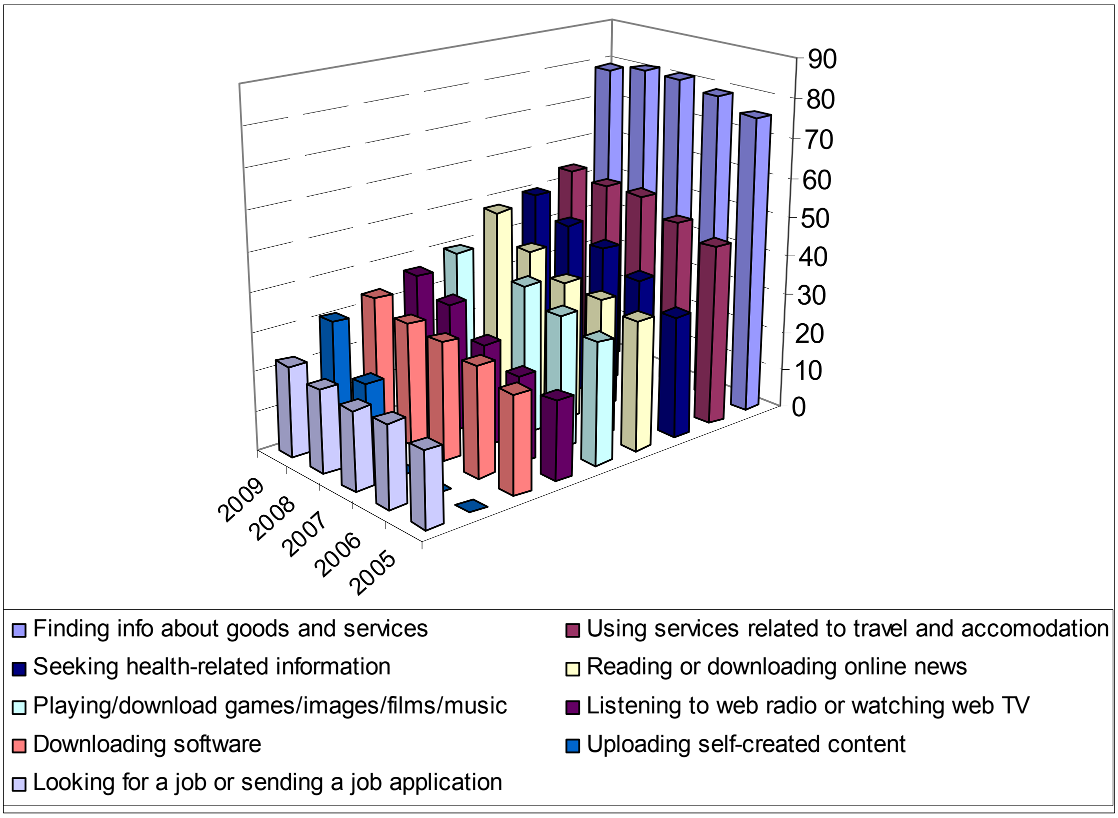
28 % of European internet users have purchased *travel and holiday accommodation* in the last 12 months. 66 % of Americans internet users have bought or reserved a travel service online at some time.

1.17. 3.4. The use of internet services in the EU

As the internet grows and develops, so the variety of online services increases (Figure 3.6). For example, while *sending and receiving emails* has always been a popular activity — with 88 % of internet users using email in 2009 — other forms of communication are becoming increasingly popular. *Telephoning over the internet* was once a rather niche activity, but in 2009 over a quarter (26 %) of internet users in the EU-27 reported doing this.[56] Other forms of communication, such as *posting messages to chat sites* (43 % in the EU in 2009) are also growing in importance. This service is particularly popular in Lithuania (63 %), Iceland (61 %), Denmark and Hungary (both 59 %).

[56] In some countries this service is now extremely popular: the countries with the highest rates of use in the EU-27 are Bulgaria (64 %), Lithuania (58 %) and Latvia (49 %); outside the EU-27, Macedonia (65 %) is the country (of those European countries for which data are available) with the largest percentage of internet users making use of this service.

Figure 3.6: **Use of the internet for seeking information and for online services 2004-2009 — % of internet users in the EU-27**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Other particularly popular services are *using services related to travel and accommodation* (54 % in 2009), *seeking health-related information* (50 %), and *reading or downloading online news* (48 %). Further, quite popular services include: *playing or downloading games, images, films or music* (40 %), *listening to web radio or watching web TV* (37 %), *downloading software* (34 %), *uploading self-created content* (31 %) and *looking for a job or sending a job application* (23 %).

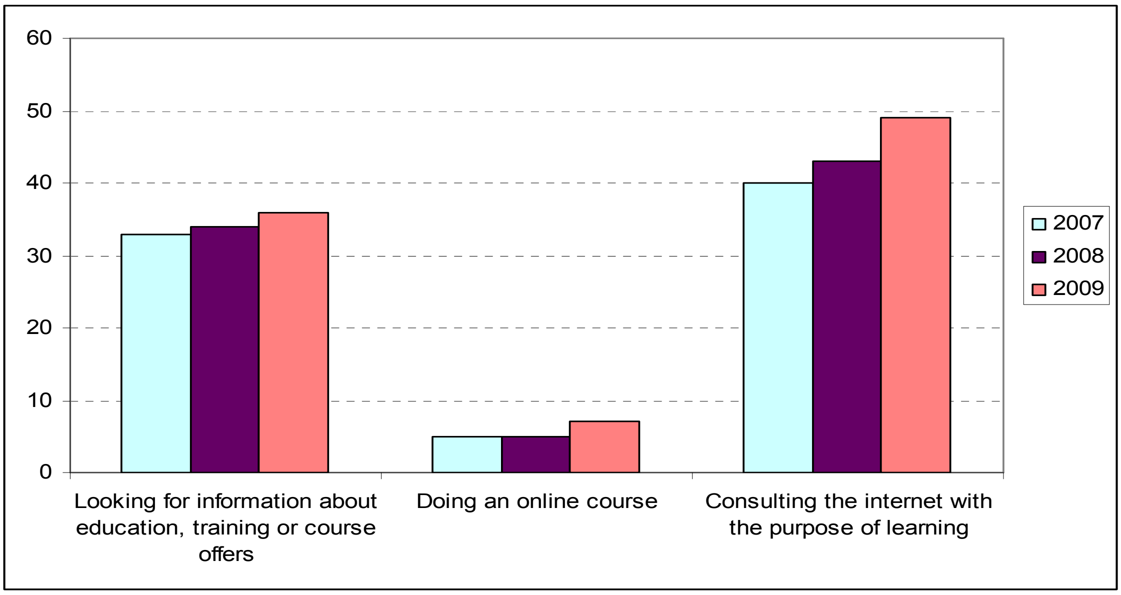
While most of these activities have seen gradual growth, *uploading self-created content* (+12 pp since 2008) and *listening to web radio or watching web TV* (+17 pp since 2005; +4 pp since 2008) have shown particularly strong growth in popularity over the past few years, in line with trends in social networking and the digitisation of traditional media. *Reading and downloading online news* (+6 pp over 2008) and *seeking health-related information* (+5 pp) also saw substantial increases in 2009.

In particular, with regard to *uploading self-created content*, some countries have seen very large increases in take-up rates over the last year: LT (+30 pp), LU and IS (both +25 pp), RO (+24 pp), DK (+22 pp), LV (+21 pp), IT (+20 pp), HU (+19 pp) and SI (19 pp). As a result, the countries with the highest rates of use for this service among internet users are: LV (53 %), HU (48 %), IS (47 %), LU and LT (44 % each), RO (43 %), EE (42 %), and UK (41 %).

Use of the internet for *training and education* is also steadily rising in the EU. Almost half of internet users now report that they *consult the internet for learning purposes*, up from 40 % in 2007. Countries with the highest reported internet use for this purpose include: PT (83 %), FI

(80%), FR (74%) and IS (73%). The number of internet users *looking for information about education, training or courses* rose to 36% in 2009. Furthermore, while still only representing a small proportion of internet users, the percentage of those doing an online course also rose to 7% in 2009. Therefore, the internet evidently continues to be used more as a direct learning tool in itself than as a medium for facilitating more formal course-based learning (see also chapter 4 on eInclusion for a further discussion of the impact of ICT on education and learning).

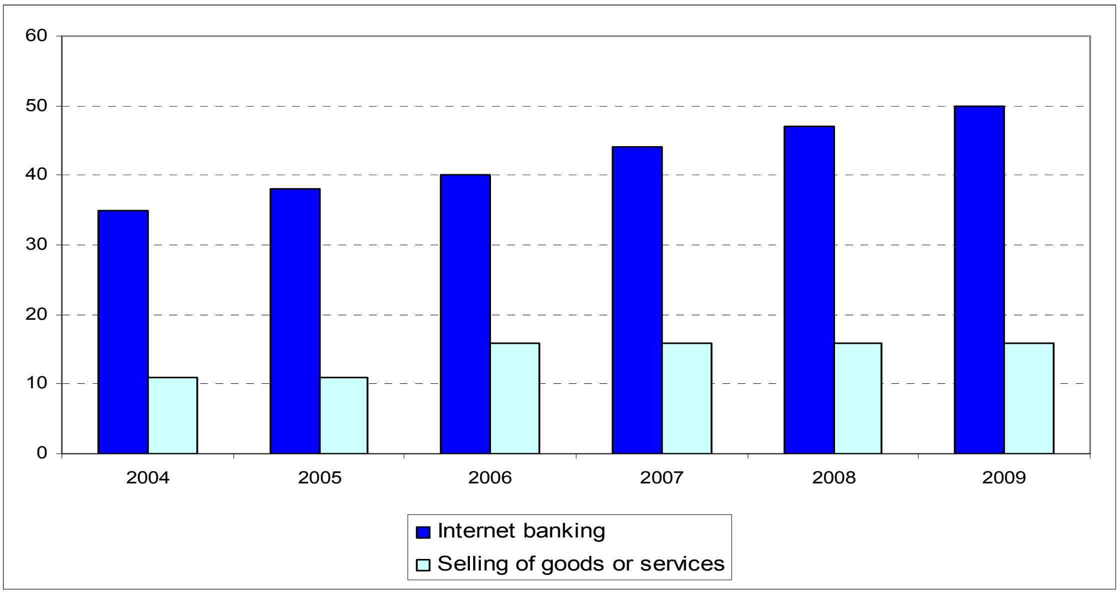
Figure 3.7: **Use of the internet for training and education 2007-2009 — % of internet users in the EU-27**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

The evolution of take-up across services may change significantly according to needs. For example, services such as *internet banking* and *selling over the internet* have evolved in very different ways (Figure 3.8). While the former has grown substantially in popularity with internet users (up from 35% in 2004 to 50% in 2009), the latter remains an activity undertaken only by a minority of users, around 16%, a figure that has not changed for the past four years. Moreover, the use of internet banking varies widely across Europe. In some countries it is extremely popular among internet users: FI (87%), EE (87%), NO (85%), NL (82%), SE (79%), IS (78%), and DK (77%). In others, however, it is rarely used: BG (4%), RO (7%), and EL (13%).

Figure 3.8: **Use of the internet for internet banking and for selling goods and services 2004-2009 — % of internet users in the EU-27**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.18. 3.5. Patterns of use among different groups of the population

While internet usage has a variety of drivers, some insights on take-up can be gathered by looking at population characteristics such as age, gender and education.

3.5.1. Age

For some basic services like *email* and *looking for information on goods and services,* which are widespread among internet users (with 88 % and 79 % of internet users utilising these services, respectively), rates of use are similar across different age groups. The same goes for *reading news*. For other services, usage is lower among the young compared with average users (around 30 % lower), to a large extent reflecting a lower need for these services. These services include: *seeking health related information*, *services related to travel and information*, *internet banking* and *eGovernment services*. The use of *eCommerce* (i.e. ordering or buying goods or services in the three months prior to the survey) peaks (49 %) among the 25-34 age group, after which it slowly declines — to only 36 % of 65-74 year-old internet users.

Other services have a clear declining pattern of use by age — in this case, also largely related to need. This is the case for *finding a job* and *training and education,* which concern more the young, since most are about to enter or have just entered the active population and therefore need both more training to find a job and more tools to look for it. Finally, there are some services for which the young (16-24 years old), the so-called 'digital natives', are massive users compared to the rest of the population. The most striking example is the *use of internet for posting messages to chat sites, blogs, newsgroups, or online discussion forums, or for instant messaging*, which is much more popular among the young (74% of internet users) than among the general population (43 % of internet users), irrespective of their education level, with use declining rapidly with age. Another advanced communication service like *telephoning or video-calling by internet* shows a similar pattern, although with a lower disparity. This differing pattern of use shows a culturally different approach by new generations to new forms of communication.

'Digital natives' are also massive users of recreational internet services (30% to 60% higher than the average) like *downloading games, images films or music*, *listening to web radio or watching web television*, *downloading software* and *uploading self-created content*. While the young are more intensive users of recreational services in general, there is certainly a cultural element at work.

3.5.2. Education

Education is a big driver of usage inequality among the population (see chapter 4). The lowest disparities observed are in the use of basic search services, communication services (email, chat and internet telephony) and in some recreational activities (e.g. uploading digital content, playing games). Encouragingly, there is also little disparity in the use of the internet for educational purposes, although disparities remain high in *reading news on the internet* and advanced services like *eGovernment, internet banking*, *eCommerce* and services related to *travel and accommodation*.

3.5.3. Unemployment

Given their status, unemployed people are massive users of the internet for seeking a job or sending a job application (69% of unemployed internet users compared to a 23% average for all internet users). They are also more likely to use the internet *for doing an online course*, to retrain for a new job. On the other hand, their use of some 'advanced' services like eBanking, eCommerce and eTourism is around 20-30% less than for the average internet user. The higher usage of 'recreational' services among the unemployed can probably be explained by the higher incidence of young persons among this group.

1.19. 3.6. eCommerce[57]

An increasing number of Europeans are making purchases online. As internet use spreads, an increasingly higher proportion of internet users acquire the 'know how' and the trust in this type of commerce: from 2006 to 2009 the number of internet users who ordered goods or services in the previous year grew from 47 to 54%.[58] Progress has been faster in countries like PL, NL, SI, EE, LV, UK, CY, FR, BE, SK, and MT, which gained between 12 and 22 pp in the last three years. This progress is seen in both more mature and developing markets (Figure 3.9). Countries with low growth in the period 2006-2009 include RO and BG, but also IT and DE. Among the 'leaders', the UK and DK are still recording significant increases, albeit at lower rates.

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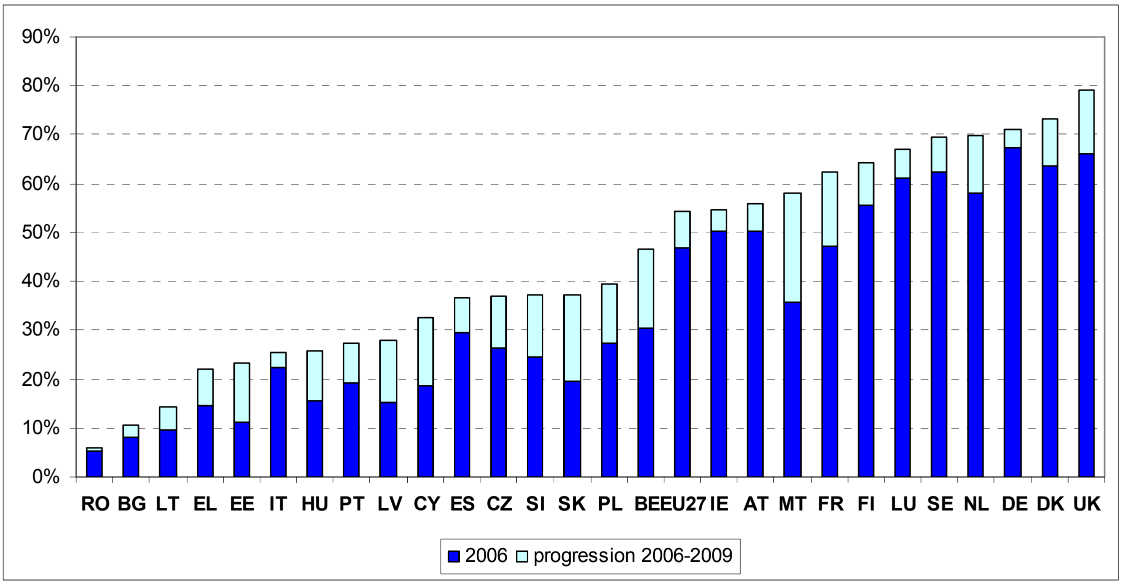
57 The term 'eCommerce' refers to transactions conducted over computer networks, by methods specifically designed for the purpose of placing or receiving orders for the sale or purchase of goods and services. These transactions can take place between enterprises, households, individuals, governments and other public and private organisations. The different forms of eCommerce adopted by public administrations, mainly as platforms for electronic procurement, are presented and discussed in chapter 3.

58 Some countries have collected information to estimate how many times individuals placed orders and what their total value was. The median value appears to be around 5 purchases during the last 3 months.

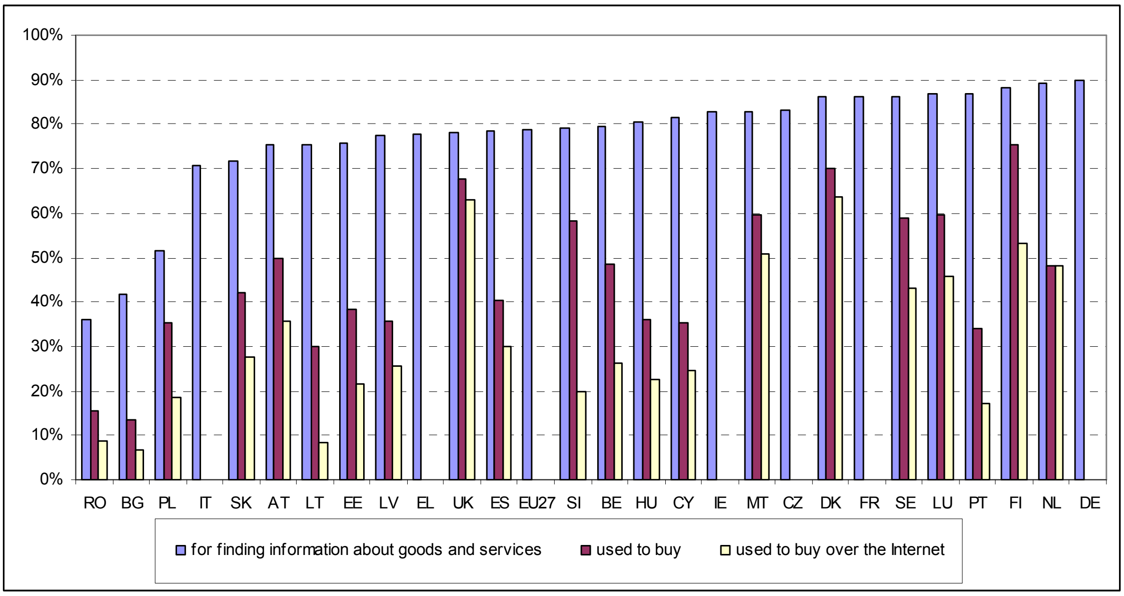
Figure 3.9: **% of internet users that have ordered goods or services over the internet for private use within the last year**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

About 80% of internet users (within the last three months) surf to find information about goods and services (Figure 3.10). This surfing activity has relevant economic effects, as individuals say they use the information gathered to purchase offline (50 to 90% depending on the country) or online (30 to 80% depending on the country).

Figure 3.10: **% of internet users in the last 3 months who have used the internet to find information about goods and services and behaviour related to buying**

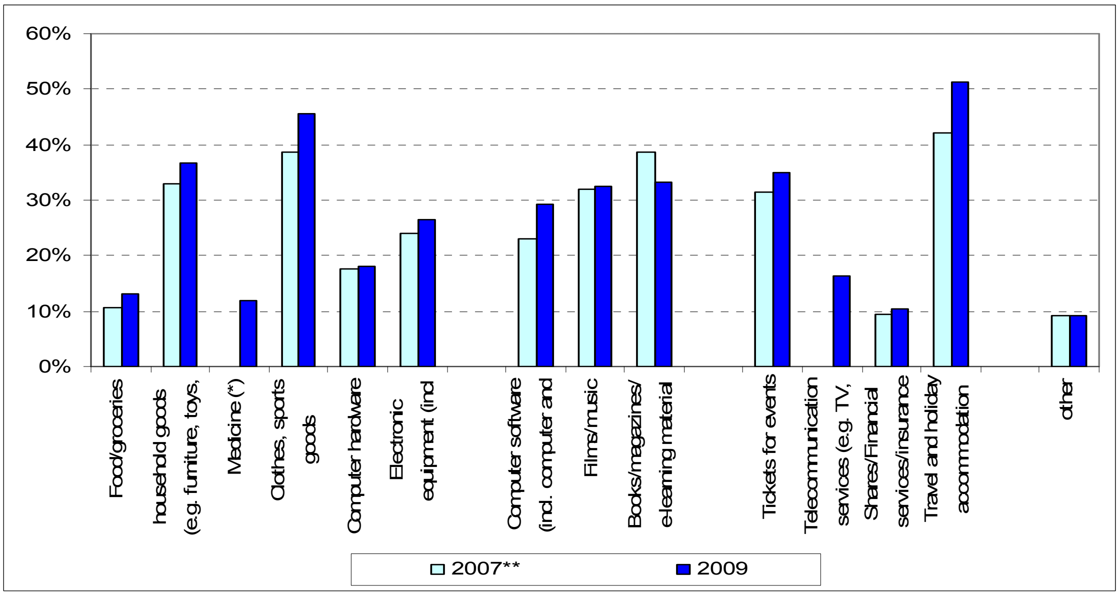


Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

The value of the eCommerce market is similar in the EU and the US: between € 100 and 150 billion per year[59].

The purchase categories favoured by the around 140 million Europeans ordering online every year are changing over time. Travel and accommodation remain the most popular category among services, and clothes and sports among goods. Comparing the 2009 data with those for the three earlier years, some categories are declining in interest (books/magazines/e-learning) or are simply less relevant for the wider population of eConsumers (computer hardware, financial services) (Figure 3.11).

Figure 3.11 — **Type of goods or services purchased (% of individuals who ordered goods or services over the internet, for private use, in the last year)**



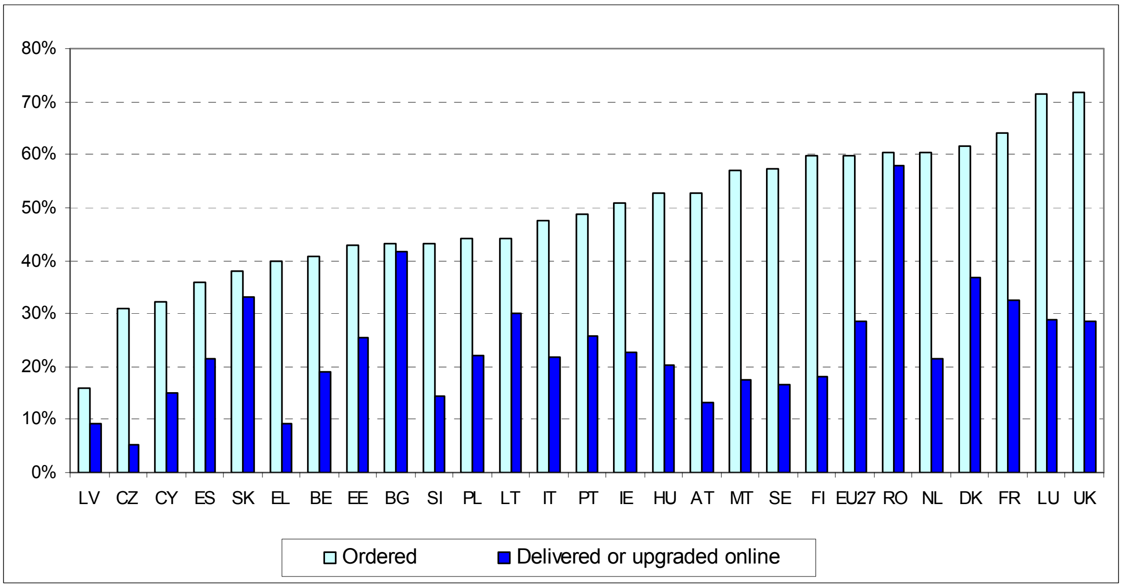
(*) Medicine and Telecommunication services were introduced only in the 2009 survey.
(**) average 2006-2007-2008
Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Some of these trends compare with the evolution of information search on the internet. Around 30 % of those who have used the internet during the last 3 months have used it for downloading content (newspapers, films, music, web TV, software) and one person in three paid (at least once) for that. Variations in the amount of what is offered for free or for payment can explain the dynamic of eCommerce in these areas.

Some of the goods and services ordered can also be delivered online. In general, half of those who have ordered goods or services online have also had them delivered online. The proportion varies across EU countries[60]. In Romania and Bulgaria, electronic markets are still small and characterised by niche consumers.

59 Source: Forrester Consulting, produced by DIW-econ.
60 Data for DE not available.

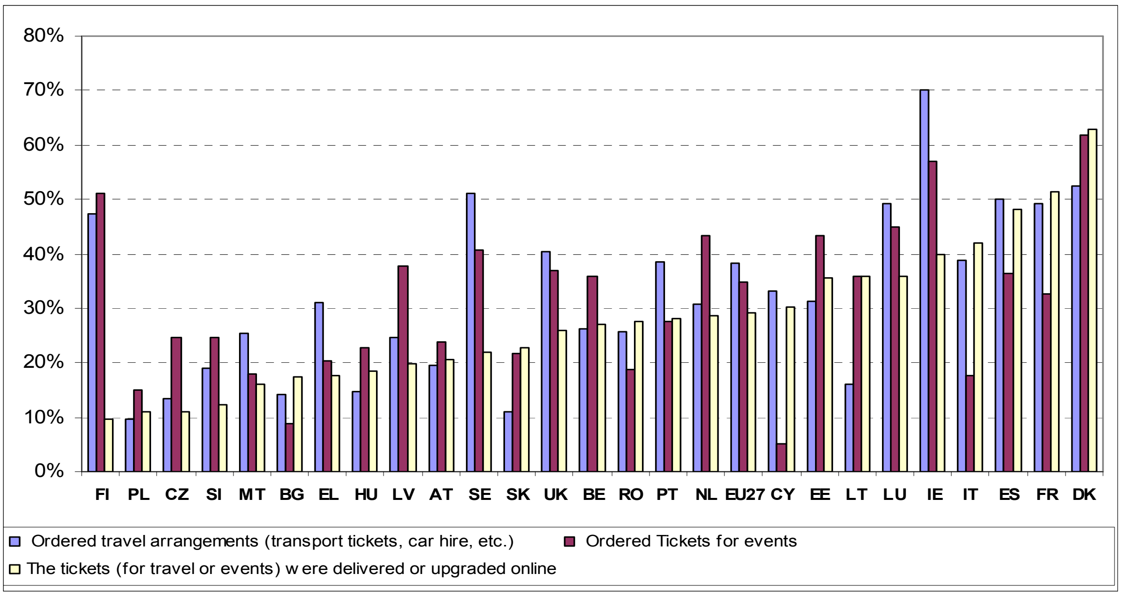
Figure 3.12: **Digital goods and services such as films/music or books/magazines/e-learning material or computer software (incl. video games) (in % of individuals who ordered in the last year)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Another popular category for download is tickets for travel or events, although the situation differs across Member States given the variety of cultural and economic models. Moreover, the practice of downloading tickets does not appear to be simply related to the popularity of ordering: it may depend on consumer preferences and on business models available on the supply side.

Figure 3.13: **Ordering and downloading of tickets for travel or events (% of individuals who ordered in the last year)**

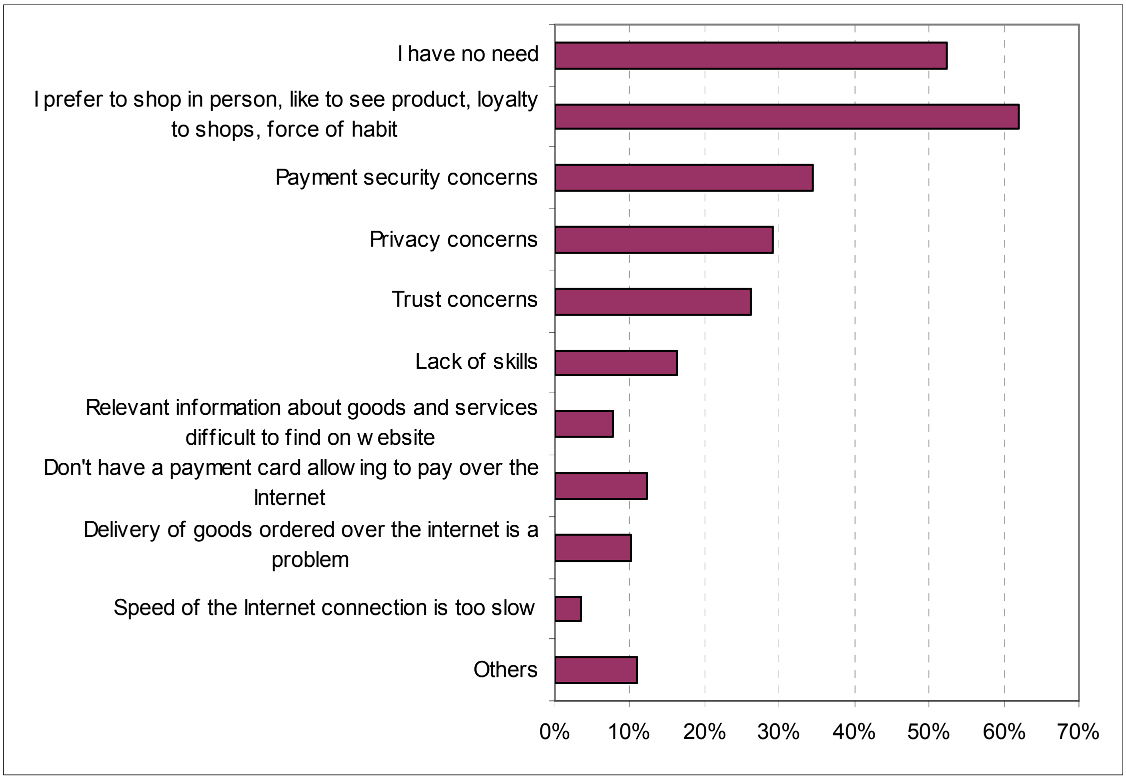


Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Those users who have not ordered online during the last year consider the following to be the main barriers (Figure 3.14):

- there is no perceived need or wish to change habits (true for more than 50 %)
- there are highly diffused security, trust or privacy concerns
- lack of skills (and websites difficult to use) and technical difficulties (delivery).

Figure 3.14: **Reasons for not buying online (% of individuals that have not ordered online during the last year)**



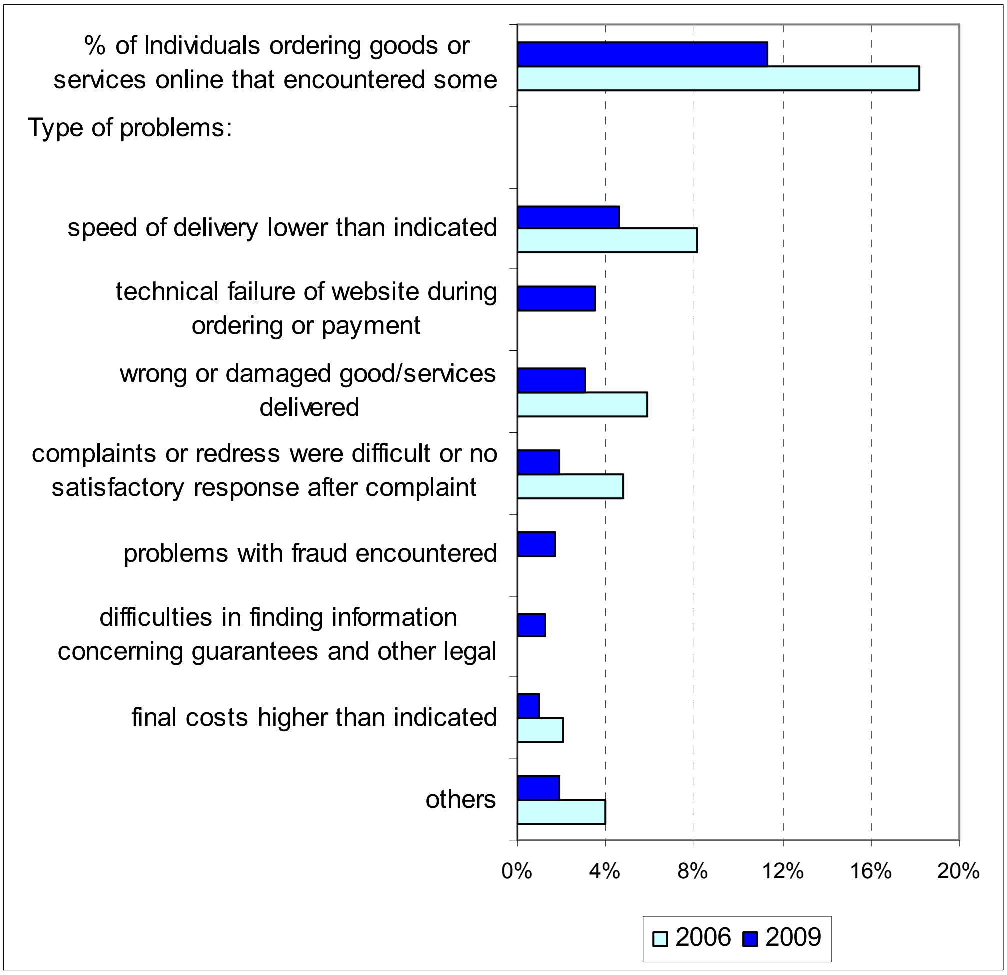
Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

eCommerce requires first of all a change in habits, which half of internet users are not prepared to entertain. Security, trust and privacy concerns point to worries about a wide range of threats associated with transactions in the online environment.

Those concerns are justified when considering that 11 % of internet users that have ordered online during the last 12 months have actually encountered problems (down from 18 % in 2006). Despite the considerable rise in the number of internet users and in their propensity to buy online, the absolute number of persons encountering problems has remained around 16 million. The main problems cited concern delivery (slow, wrong or damaged) or failure of the website during ordering or paying (Figure 3.15). There are also the 2 % who have experienced fraud problems or difficulties with complaints or redress[61]. Finally, problems are reported mainly by young adults with a high education and ICT skills, who buy online more frequently.

[61] For more information about complaints, consult the EC Consumer Markets Scoreboard http://ec.europa.eu/consumers/strategy/docs/2nd_edition_scoreboard_en.pdf

Figure 3.15: **Problems encountered buying online (% of individuals that have ordered online during the last year), 2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

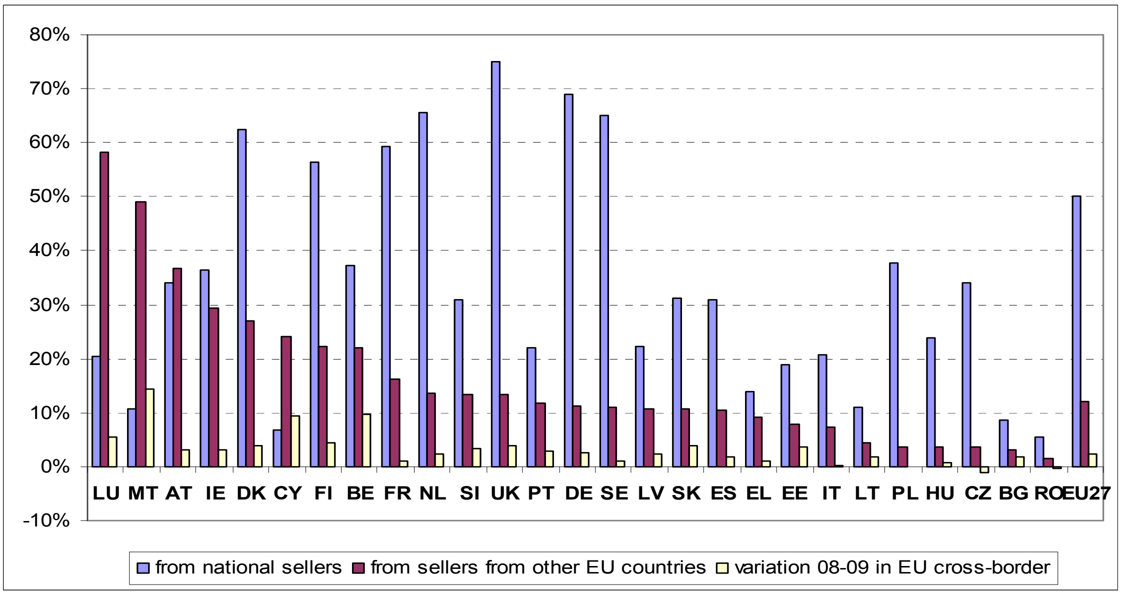
3.6.1. The extent of cross-border eCommerce

Cross-border eCommerce has grown from 10% of internet users in 2008 to 12% in 2009 (more than 30 million Europeans). The phenomenon is influenced by the maturity of domestic eCommerce, the legal rules/barriers, the size of the country, and linguistic neighbours. It is accordingly possible to distinguish five main groups of countries:

- LU, MT and CY rely mainly on sellers from other EU countries (and have also common languages with other EU countries)
- AT, IE and also BE rely on neighbouring countries with the same language
- DK and FI have significant domestic and cross-border eCommerce, double the EU average
- FR, NL, UK, SE and DE have a large domestic market in which more than a half of their internet users participate, but cross-border ordering remains between 10 and 15%
- in the other countries, both domestic and cross-border eCommerce are starting from low levels

The countries registering the highest growth in cross-border eCommerce from 2008 to 2009 were: MT, BE and CY, gaining 10 pp, and LU, UK and FI, gaining 4 or 5 points, twice the EU average.

Figure 3.16: **Domestic and cross-border internet purchases, 2009 (in % of internet users during the last year)**



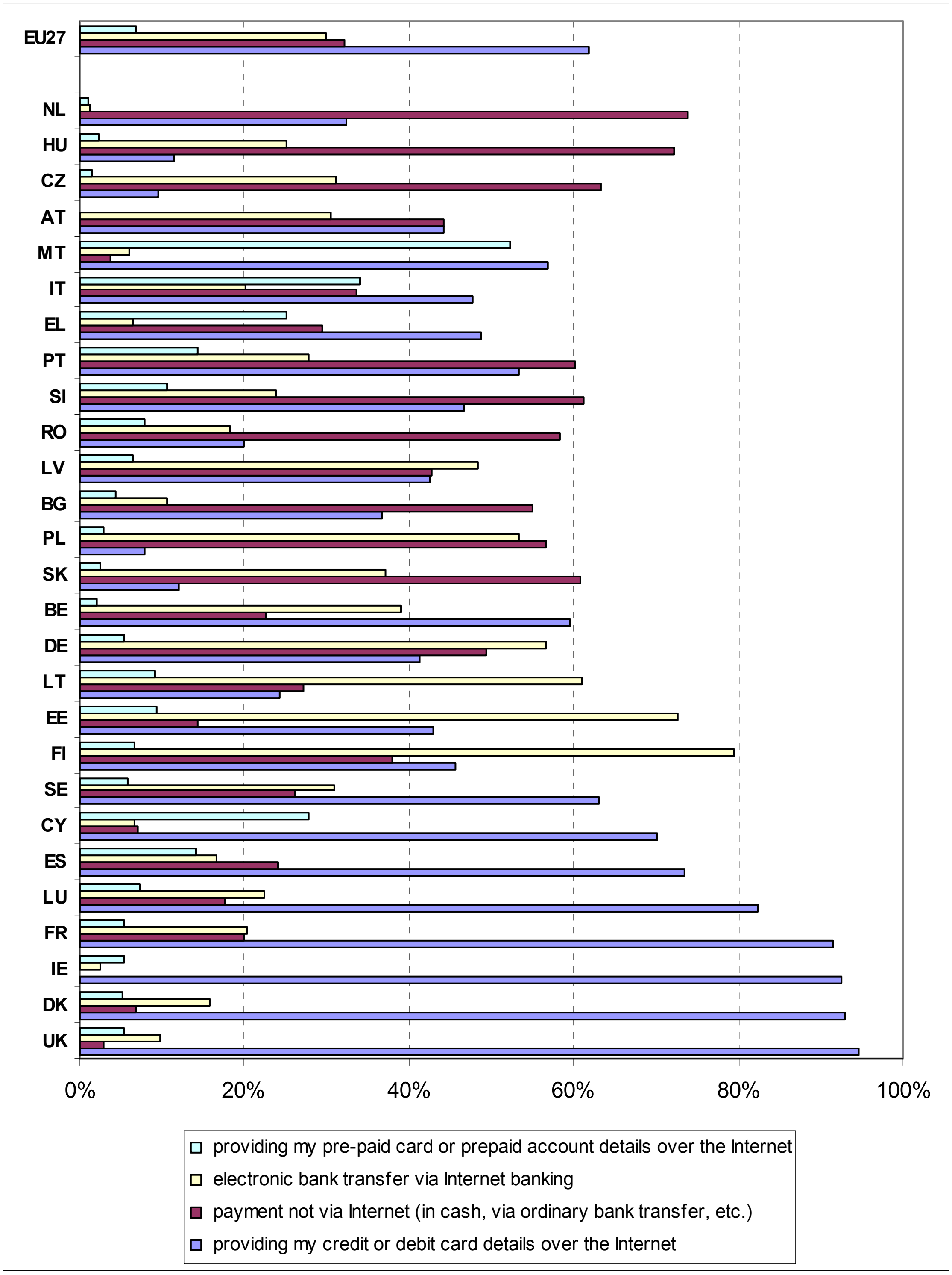
Note: Variation is expressed in percentage points
Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Another factor that contributes to the current fragmentation of the single 'electronic' market is the wide variation in ways of paying for goods and services ordered online. In some countries, like IE, DK or UK, the use of credit cards is dominant, whereas in LT, EE and FI the majority of online consumers use eBanking. Prepaid cards or accounts are common in MT, CY, EL and IT.

Online businesses also face regulatory and practical barriers to cross-border trading. As a result, many online shops are not prepared to sell to consumers from every EU country. Technical or legal reasons such as refusal of non-domestic credit cards cause as many as 60% of attempted cross-border internet shopping orders to fail. This highlights the urgency of tackling the regulatory barriers holding back European businesses from trading cross-border. Regulatory barriers to cross-border e-commerce originate in the fragmentation of rules that are implemented differently from one Member State to another, giving rise to a business environment that is complex, costly and unpredictable for those businesses considering selling cross-border.[62]

[62] Communication on Cross-Border Business to Consumer e-Commerce in the EU, COM (2009) 557.

Figure 3.17: **Ways of paying for internet purchases, 2009 (in % of individuals that have ordered online in the last year)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.20. 3.7. Conclusions

Broadband is expanding and this is having an impact on the extent and intensity of internet use in Europe. More and more people are going online and using the internet more and more often: the majority of internet users are now frequent users — using the internet on average daily or almost daily. In addition, the range of services available has expanded and internet users are becoming extensive users of these various services. Most services are being increasingly used by the online population, which in turn is also increasing substantially. While traditional services (such as email, searching for information about goods and services, and use of services related to travel and accommodation) remain the most popular, other previously less popular services (such as searching for information related to health, internet banking and online news) are increasing in popularity, and some newer services (e.g. telephoning over the internet, uploading self-created content and posting messages on chat sites) are growing rapidly. The latter, in particular, are being driven by new internet users, who appear to use the internet in different ways to previous generations.

The two main factors behind differences in the use of internet services among the population are age and education. The young use certain services, for job search, training and education, in significantly larger numbers than other age groups, in part due to their relatively higher need for such services. They are also above-average users of new communication services, such as telephoning over the internet and posting messages on websites etc., as well as recreational services, such as downloading media and uploading self-created content. Education levels seem to affect the use of nearly all services, but especially advanced services.

Finally, in terms of the use of eCommerce, all countries are progressing fast, with more than half of internet users having made eCommerce transactions. In contrast, the percentage of people selling online has not increased over the past years. The young at the start of their professional life are the most active in purchasing over the internet, and this is largely influenced by education levels.

However, the use of the borderless online market remains limited. Despite its potential to strengthen the internal market, the internet is not yet succeeding in facilitating cross-border trade because of barriers mainly relating to legal certainty, different regulations and trust. As a result, not only consumers fail to take advantage of more choice and cheaper prices abroad, but enterprises are also limited in their access to the wide European market. The lack of a borderless single market hence also limits growth and opportunities for the many small and medium-sized enterprises that characterise the European economy. The take-up of ICT and eCommerce by enterprises is analysed in more detail in chapter 5.

4. 4. eINCLUSION: REGULAR INTERNET USE AND SKILLS AMONG GROUPS AT RISK OF EXCLUSION

Achieving a more inclusive information society is one of the key ambitions in information society policy. The Riga Ministerial Meeting in 2006 turned this challenge into tangible targets, including halving the disparities in regular internet use and digital literacy between 'disadvantaged' citizens and the average population in Europe. Progress towards these targets is measured by the so-called Riga Indicators, which relate the share of people in disadvantaged groups[63] who regularly use the internet and possess digital skills to the corresponding share among the average population.

At aggregate level, the steady increase in the Riga Indicators is testimony to recent improvements in eInclusion. However, analysis at a more disaggregated level reveals significant shortcomings, especially in terms of differences in the level of digital skills. Although the most disadvantaged groups are catching up, there is still a significant gap with the average population, in particular in terms of high digital skills. An emerging challenge concerns the disparities among young people's digital skills depending on education levels. Such fragmentation may increasingly pose a challenge to an inclusive information society in addition to the traditional generational divide.

Another aspect in the eInclusion debate is the varying performance of regions in participating in the digital era. In particular, the so-called 'Convergence Regions' (or 'lagging regions') with GDP levels below 75 % of the European average and receiving EU regional development funding are struggling to keep up with the pace of change. However, the dividing lines are not clear-cut. A series of lagging regions are leading in terms of the availability of high digital skills, and lagging regions are in general catching-up. However, further efforts are required to address the challenges noted above in order to achieve a more e-inclusive Europe.

1.21. 4.1. Disparities in regular internet use across socio-economic groups

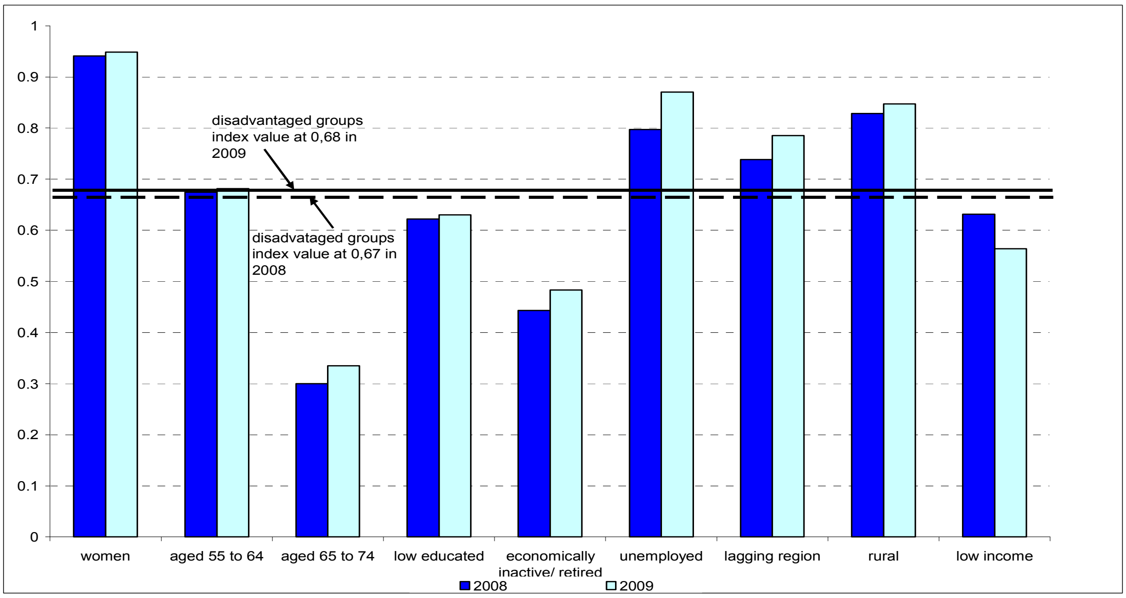
Overall, disadvantaged socio-economic groups experienced a small improvement in regular internet usage in 2009 (Figure 4.1), as witnessed by an increase of 0.02 to 0.68 in the Riga Indicator for regular internet use in 2009, confirming the positive trend of the last few years (from 0.60 in 2005 to 0.66 in 2008 — see Table A1 in the annex).[64] Having said this, significant disparities remain among different disadvantaged socio-economic groups. In particular, the old (0.33), the economically inactive (0.48) and the low-educated (0.63)/low-income groups (0.56) continue to have significantly lower rates of regular internet use than the average population. Furthermore, the progress made by individual disadvantaged groups in the last year has diverged. While the majority have improved their position with respect to

[63] This chapter examines recent achievements in digital inclusion for a wide range of disadvantaged groups, including senior citizens, women, low-educated people, individuals with low incomes, the unemployed, the economically inactive or the retired and those living in rural, i.e. thinly populated or lagging regions, or Convergence Regions.

[64] The groups defined for Riga as disadvantaged include older people, people with disabilities, women, lower educated groups, the unemployed and residents of 'less developed regions'. For calculating the Riga indicator, data on the following groups are used: women, people aged 55-64, those aged 65-74, the low-educated, the retired and economically inactive, the unemployed and those living in rural areas. The calculated un-weighted average thus does not include objective I regions or low-income groups. Due to the lack of data it also does not include people with disabilities. A hypothetical Riga indicator with a value of 1 indicates a perfectly equal society while values closer to zero reflect higher inequality in terms of disparities in regular internet use between disadvantaged people and the average population.

the average population, people on low incomes (a group not targeted by Riga and therefore not included in the calculation of the Riga indicator) have seen a significant fall in regular internet use relative to the average population (-0.06). A more detailed look at internet use among these groups shows that this increased disparity is more to do with the large increase in regular internet use among the average population than a decline in internet use among people on low incomes. In fact, regular internet use in this group did increase marginally, but to a much lesser extent than for the average population. Nevertheless, this is of obvious concern and could well be an outcome of the economic crisis. In addition, while a large increase in regular internet use has been seen among the unemployed (+0.07), this is also likely, at least partly, to be due to the increased level of unemployment caused by the economic downturn. The large increase in regular internet use among individuals living in lagging regions (+0.05) is an encouraging development.

Figure 4.1: **Riga Indicator on regular internet use, 2008-2009**



Source: Commission services on the basis of Eurostat Community Survey on ICT Usage by Households and by Individuals

1.22. 4.2. Socio-economic patterns in the use of the internet in international comparison

In 2009, 81 % of Koreans aged 3 and over had used the internet in the last three months and 84 % had ever used the internet. 68 % of Americans (aged 3 and over) were internet users. In the EU, 65 % of individuals aged 16-74 had used the internet in the previous 3 months and 69 % had ever used it. 54 % of Japanese households had one or more members who used the internet.

The internet is used by almost all Koreans in the age range 10-39, over 80 % of people in their 40s, over half of those in their 50s and one fifth of the population over 60 years of age. As in the EU, men use the internet more (82 %) than women (72 %). Usage increases with the level of education — from below 60% of the population with elementary school or less, to 97.5 % for those with college graduation and above — as well as with the level of income — over 85 % of household members with a monthly average income of above 2 million won (approximately 1400€) use the internet, while internet usage among those with less than 1 million won is just above one quarter.

In 2009, 81 % of American 'digital natives' (18-24 years), over 65 % of those aged 25-54 and 46 % of people aged 55 years or older used broadband at home. Looking at all aged 3+, there is almost no gender difference in the use of broadband at home (59 %). For household members aged 25 years or older in 2009, 84 % of those with college degrees had broadband access at home, whereas only 28 % of those without a high school diploma did. The percentage of persons using broadband at home increases with family income. Fewer than 3 in 10 Americans with an annual family income of less than $ 15,000 use broadband at home while almost 9 in 10 Americans with annual family income of $ 150, 000 or more do so.

Looking at frequent (daily) use of internet by age, 9 in 10 Koreans in their 20s and almost three quarters of those aged 16-24 in the EU use the internet daily, while nearly 6 in 10 US young adults (18-29) use the internet daily at home. Among the older population, 14 % of Europeans aged 65-74 and 12 % of Koreans aged 60 or over are daily internet users, while almost a quarter of the American population aged 65 or over use the internet daily at home.

Once one is an internet user, income continues to play a role in the EU and the US; higher-income households also use the internet more often. In Korea, household income has only a relatively small impact on frequency of use.[65]

The US (32 %) and the EU (30 %) are comparable in terms of non-internet users, while the percentage of non-internet users is significantly lower in Korea (23 % of individuals had not used internet in the last month and 16 % had never used it).

Reasons for not using the internet/broadband are very similar in the EU, US and Korea.With the first reason being no need/no interest. The other main reason for not using the internet in Korea is the lack of confidence, knowledge or skill. In the US they relate to cost and no computer/computer inadequate. In the EU, they relate to the lack of availability of the service in the area and cost[66].

Looking at age, 80 % of the population aged 60 and above have not used the internet in the last month in Korea, when 61 % of the population above 65 in the US and 73 % of the 65-74 age group in the EU are non internet users. Among ‘digital natives’, only 0.3 % did not used the internet in the last month in Korea (20s), while 5 % in the EU (16-24) and 11 % in the US (18-29) are non internet users.

1.23. 4.3. Developments in digital literacy

In line with the rise in internet use in Europe, more and more Europeans are acquiring digital skills.[67] In 2009, 64 % of Europeans had at least some level of digital skills[68]. This represents a 3 pp increase compared to 2007. However, this overall picture masks a very diverse landscape of digital skills distribution in Europe. In DK, LU, NL, IS and NO, over 80 % of people possess digital skills. At the same time, more than 50 % of Greeks and Poles and more than 60 % of Bulgarians and Romanians do not possess any skills to participate in the digital

65 Korea: 79 % of internet users for highest incomes; 77 % for lowest. US: 72 % for highest incomes, 43 % for lowest. EU: 79 % for highest incomes, 67 % for lowest.

66 Different items proposed in the questions in the three geographical areas.

67 In the following, digital skills are proxied by the narrower category of computer skills. Internet skills data were not surveyed for 2009. However, the correlation between internet and computer skills (aggregating all skill levels) exceeds 0.99, and for each skill level separately exceeds 0.94 (for 2007 data).

68 Digital (computer) skills are defined as having performed at least one of the following computer-related activities: copying or moving a file or folder, using copy and paste tools to duplicate or move information within a document, using basic arithmetic formulas in a spreadsheet, compressing (or zipping) files, connecting and installing new devices, writing a computer programme using a specialised programming language. Low skills refers to being able to do one or two of these computer-related activities while medium skills requires three or four, and high skills five or all of them.

age. This picture is similar to the pattern of internet use, with the correlation between both variables exceeding 93 %.

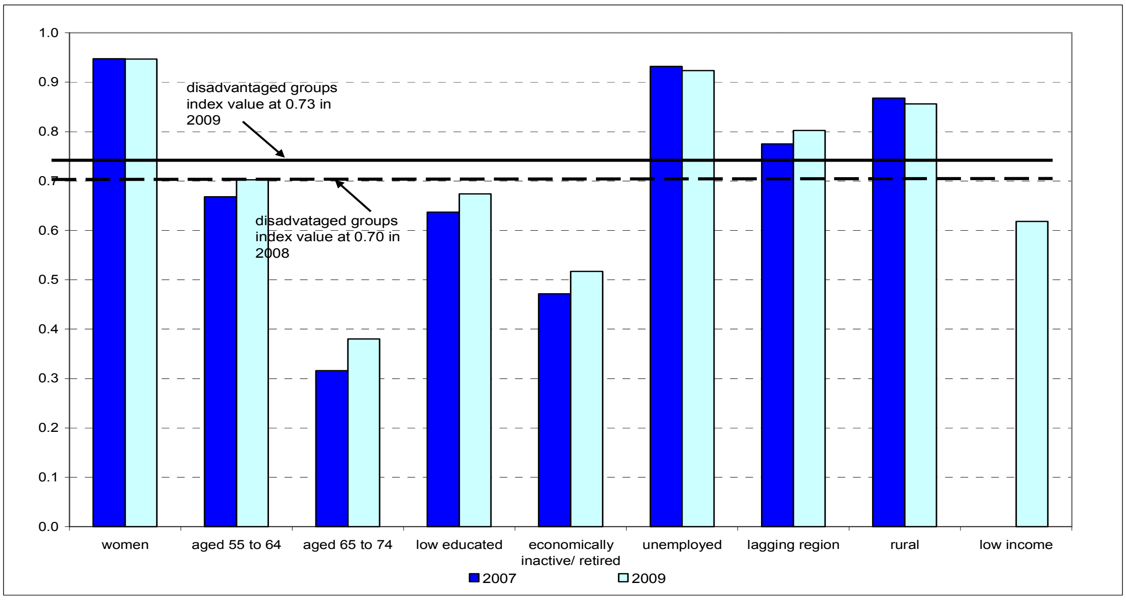
Recent developments in digital skills acquisition have been very heterogeneously spread across Europe. The greatest increases in the take-up of digital skills have been in those countries with already high levels of digital skills, in particular FR (9 pp) and LU (7 pp). The same applies, however, to catch-up countries such as RO and HR, all with increases of over 7 pp compared to 2007. At the same time, a drop in digital skills has been noted in some leading countries (AT, IE, SE and IS) as well as in others already lagging behind (the CZ, EL and LV), all with negative growth rates of between -1 and -3 pp. While these figures cannot tell us the reasons for the drop in skills, they are mostly quite small and could well be due to the standard error in sampling. Nevertheless, this will need to be followed closely in future to ensure that a negative trend does not emerge.

1.24. 4.4. Disparities in digital literacy across socio-economic groups

There are still significant disparities in digital skills not only among European countries, but also among different socio-economic groups. However, the Riga Indicator for digital skills rose by 0.02 in 2009 compared to 2007 (Figure 4.2 and Table A2 in the annex). The most digitally skilled groups among disadvantaged citizens include women (0.95), the unemployed (0.92) and people living in lagging (0.80) or rural (0.86) areas. Significantly lagging behind are senior citizens aged 65 to 74 (0.38) and economically inactive people (0.52).

Nevertheless, the improvement in the share of people with digital skills is highest for those groups lagging behind the most (+0.06 for people aged 65 to 74 and +0.05 for the economically inactive, compared to 2007). Data on skills by income group have only been available from this year, so it is not possible to see whether there has been a decline in the relative skills of people in low income categories, as for regular internet use. However, one year is unlikely to see the economic crisis erode people's digital skills to any large degree. Nonetheless, the unemployed are one of the few groups that have witnessed a decline relative to the average in digital skills, together with those living in rural areas, suggesting some impact of income on skills acquisition.

Figure 4.2: **Riga Indicator for digital literacy, 2007-2009**



Source: Commission services on the basis of Eurostat Community Survey on ICT Usage by Households and by Individuals

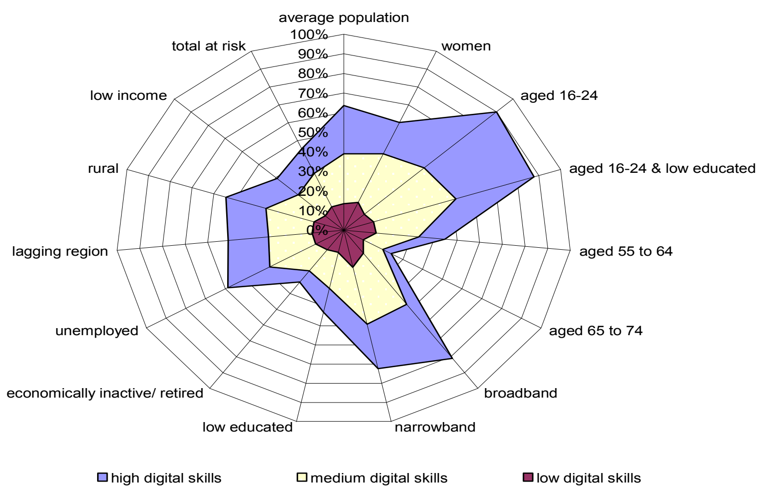
1.25. 4.5. Disparities in digital literacy across different skill levels

Lack of skills is one of the main reasons for not having internet at home. Moreover, higher digital skills may facilitate more sophisticated and intensive internet use. Hence, it is interesting to look at different levels of digital skills in more detail. Figure 4.3 illustrates the prevalence of low, medium and high digital skills among different groups of the population with the help of the shaded areas in the radar diagram. The intersection points with the percentage axes represent cumulative skills availability[69].

Looking first at overall rates of skills for different socio-economic groups, 64 % of the average population possess digital skills while, on average, only 45 % of people in disadvantaged groups do so.[70] Among these groups, while women and the unemployed have rates of digital skills close to the population average, senior (34 %), low-educated (43 %) and economically inactive (33 %) citizens, as well those on low incomes (39 %), have digital skill levels below the average for disadvantaged groups. Furthermore, over one third (36 %) of the European population still do not have any digital skills at all.

By contrast, young people[71] (90 %), independently of their level of education (88 % for low-educated young people), and individuals with an internet connection at home, of any type (72 %; 81 % for broadband), have digital skill levels well above the average.

Figure 4.3: **Levels of digital skills (2009)**



Source: Commission services on the basis of Eurostat Community Survey on ICT Usage by Households and by Individuals

Looking at different skill levels shows that disparities widen with increasing levels of skills. On average, 14 % of the European population have low digital skills, and this is relatively similar across all socio-economic groups — with disadvantaged groups having caught up over

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69 Hence, the outermost intersection point represents the percentage of individuals with any (hence, total) skill levels. The percentage of individuals with high skills specifically can be found by subtracting the intersection point of the middle area with an axis, e.g. for women, from the intersection point of the outer area with that axis.

70 Again, based on the disadvantaged groups targeted by Riga (see footnote 7).

71 Young people are defined as individuals aged 16 to 24.

the last year (Figure A1 in the Annex). By contrast, 25 % of Europeans possess medium digital skills, but on average only 19 % of people in disadvantaged groups do so (Figure A2 in the Annex). Finally, while 25 % of the average population exhibit high digital skills, on average only 13 % of people in disadvantaged groups do so (Figure A3 in the Annex).

Encouragingly, for medium skill levels at least, the most disadvantaged groups (the low-educated, old and economically inactive) are catching up the fastest. For higher skills, this is not the case. The largest growth rates for high skills are shown by the young, with the highest growth rate among the low-educated young, while women and lagging regions are also showing above-average growth.

Other interesting insights include the skills profile of women. While at aggregate level women exhibit digital skills similar to the average, the breakdown by skill level is, on average, skewed more towards low and medium skills: while women have 1 pp more low skills and 2 pp more medium skills, they have 7 pp less high skills. However, the data also show that over time women are increasing their skill level and catching up.

Moreover, the type of internet access seems to be related to the availability of sophisticated digital skills. 12 pp fewer narrowband users possess high digital skills compared to people with broadband access at home. This emerging 'Second Digital Divide' concerns the different quality of computer use depending on the availability of high-speed internet. While households with an internet connection have witnessed a relatively strong reduction in high skills over the last year (-2.8 pp for broadband and -1.8 pp for narrowband), this is part of an ongoing trend and is likely a compositional effect: as internet access at home becomes 'normal', more individuals with lower skill levels are acquiring an internet/broadband connection, resulting in a decline in the average level of skills of those with such a connection and, for broadband at least, convergence with the skill levels of the average total population.

Finally, while young people exhibit a disproportionately large incidence of high and medium skills, young low-educated individuals tend to have lower skills (-9 pp for high skills compared to the average for young people). Although their high-skills growth rate (2.9 pp) is greater than for individuals of the same age group with higher education levels, it has to be kept in mind that they are starting from a lower base than their higher-educated peers. As a consequence, in addition to the existing age divide, a new disparity in terms of education levels seems to be arising among the younger generation.

Hence, the informal acquisition of digital skills among young people outside the framework of formal education may not be sufficient to attain high levels of sophistication. Moreover, the role of schooling may be even more important for acquiring non-technical digital skills.

To fully participate in a society increasingly dominated by knowledge- and information-rich environments and technologically mediated communication, direct ICT-related skills are required. However, technical user skills need to be complemented by digital literacy skills more broadly. These include not only information and strategic skills, but also the ability to analyse and evaluate critically the vast information available and to be aware of the potential risks posed by online content, which go far beyond the mere capacity to master a personal computer and to browse the web. However, there is substantial evidence to suggest that Europeans at risk of social exclusion tend to lack these analytical and critical skills more than they lack operational skills.

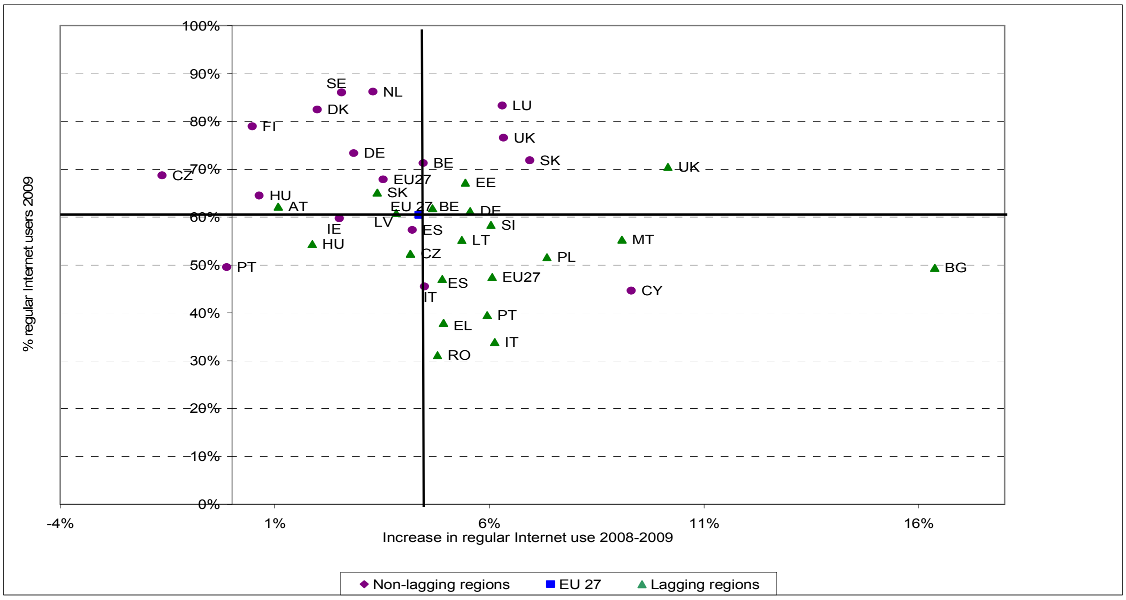
Performance tests have shown that mastery of operational skills is reasonably widespread, but that average performance in information and strategic skills on the internet is far below expectations — even in the younger generation, which is often assumed to be 'digitally native' almost by default. Further basic skills needed for lifelong learning are critical thinking skills, for example to evaluate the results of information searches on the web. In the face of an explosion in information availability, caused mainly by the success of the internet, a well-grounded and critical attitude towards information and media must be learned and cultivated.

Solid formal education and generic skills may be conducive to developing such non-technical digital skills.[72]

1.26. 4.6. The regional dimension of regular internet use in Europe

Although general internet usage trends are encouraging, there is still a significant gap between 'lagging regions'[73], with only 47 % of the population regularly using the internet, and 'non-lagging regions'[74], with a 68 % share (Figure 4.4). This is not surprising given the importance of the cost/income factor for internet use, as well as the lower availability of broadband. Nevertheless, despite the economic crisis, lagging regions have caught up to some degree in the last year, with a more than 6 pp growth in regular internet use compared to 4 pp for the average population.

Figure 4.4: **Trend in % regular internet users in EU regions, 2008-2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

While the majority of regions with a higher internet take-up than the European average are non-lagging regions, a few lagging regions are successfully keeping up with the leaders (Map 1).[75] These regions include: Burgenland in Austria, all of the Slovakian regions except Bratislava (which is a non-lagging region), Hainaut in Belgium, Eastern Germany, all Estonian regions and all British lagging regions. Consequently, a few countries characterised by significant internal income gaps have already managed to lift their entire territory,

72 A more in-depth analysis of this issue is provided in the *Study on the Social Impact of ICT, Chapter 4 'Consumption', Oxford internet Institute, p.190* for reference to this specific argument.

73 Formerly, Objective 1 regions, but now termed Convergence Regions.

74 Now termed Regional Competitiveness and Employment.

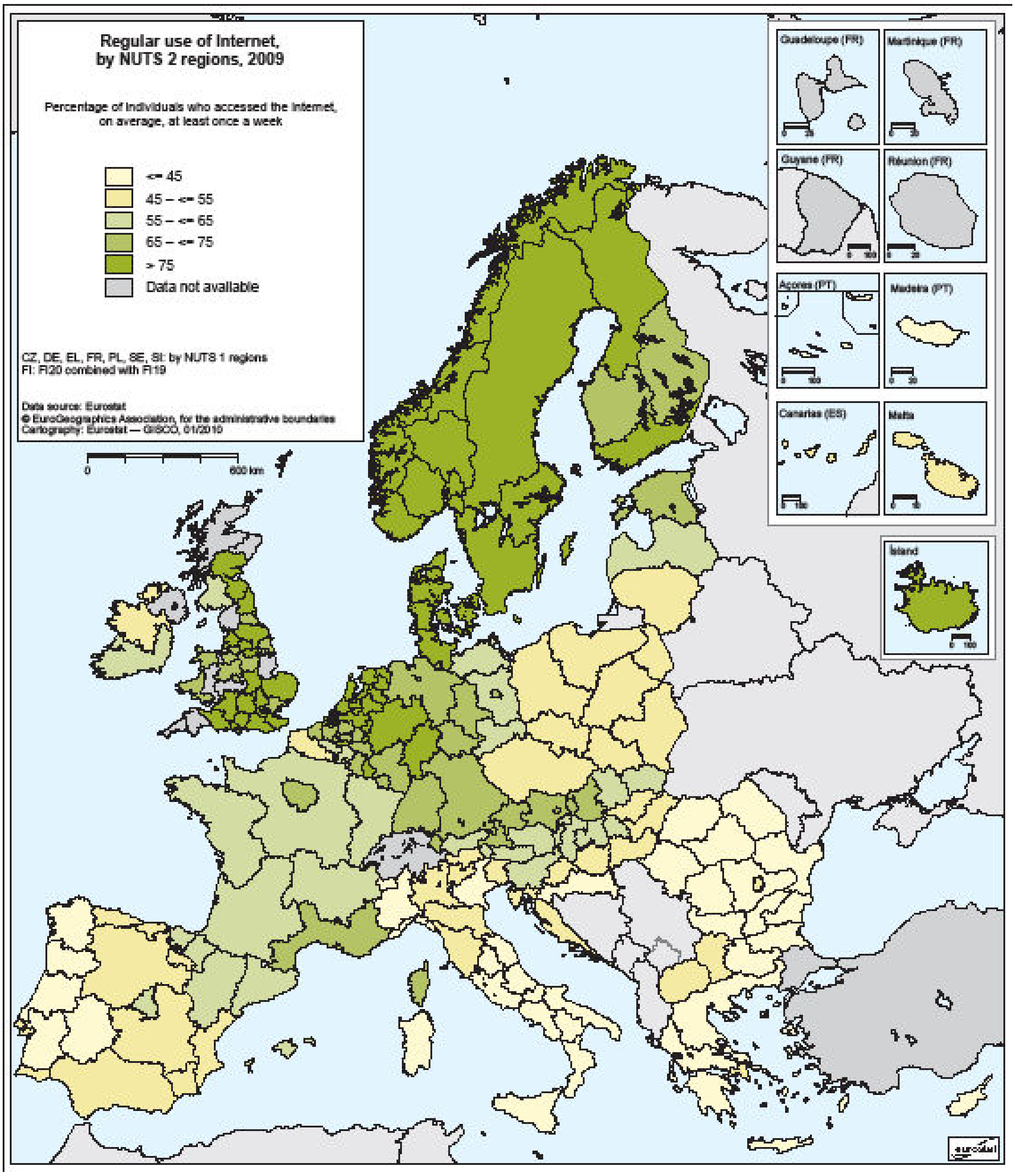
75 Map 1 illustrates the spread of regular internet use in European regions, whereby the lower two categories (<=45 and 45-<=55) indicate below-average performance and the upper two categories (65-<=75 and >75) above-average performance.

including lagging regions, above the European average in terms of regular internet use. These countries include AT, BE, DE, UK and SK.

Most lagging regions, however, have relatively low rates of regular internet usage, although recent growth rates show they are catching up. Geographically, these regions are situated in Central, Eastern and Southern Europe. Lagging regions in Romania and Bulgaria have the lowest regular internet use levels in Europe. However, Bulgaria has recently seen the highest increase in Europe (16 pp; see Figure 4.4). While close to the European average, all regions in IE, LV, ES, CZ (except Prague) and HU (except the Budapest region) exhibited below-average internet use and growth in internet use in 2009. The only regions with (small) reductions in regular internet use were Lisbon in Portugal and Prague in the Czech Republic.

Hence, internet use seems to have a clear regional dimension, linked to economic development. The best performers include the Nordic Member States, those in North West and Central Europe as well as the region of the capital of Hungary and the entire territory of Slovakia and Estonia. Lagging behind, but catching up, are the lagging regions of all the other New Member States (except Estonia and Slovakia), in particular Bulgaria and Romania. In addition, the lagging regions of Southern European Member States are still performing below-average. This applies in particular to Greece, Italy and Portugal. In order to help lagging regions catch up, the EU has decided to earmark more than one billion euros under the European Economic Recovery package for broadband deployment in rural and lagging areas. As shown above in the analysis of barriers to broadband adoption (chapter 3), lack of availability is a major reason for households not having broadband in these regions. Compared to the average of 60% of European citizen aged 16-74 using the internet regularly (at any location), the value is 23.2 pp more for individuals regularly using the internet and living in households with broadband access. Hence, broadband deployment is expected to enhance participation by citizens from lagging regions in the information society.

Map 1: **Regular internet use in EU regions (2009)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.27. 4.7. Disparities in digital literacy across European regions

Regional data on levels of digital skills (computer skills) show that lagging regions have lower levels than non-lagging regions. While the gap is small for low-level skills (0.2 pp), it increases to 8.6 pp for medium skills and 9.3 pp for high skills. However, lagging regions are catching up, with growth rates for all skill levels above those for non-lagging regions in 2009.

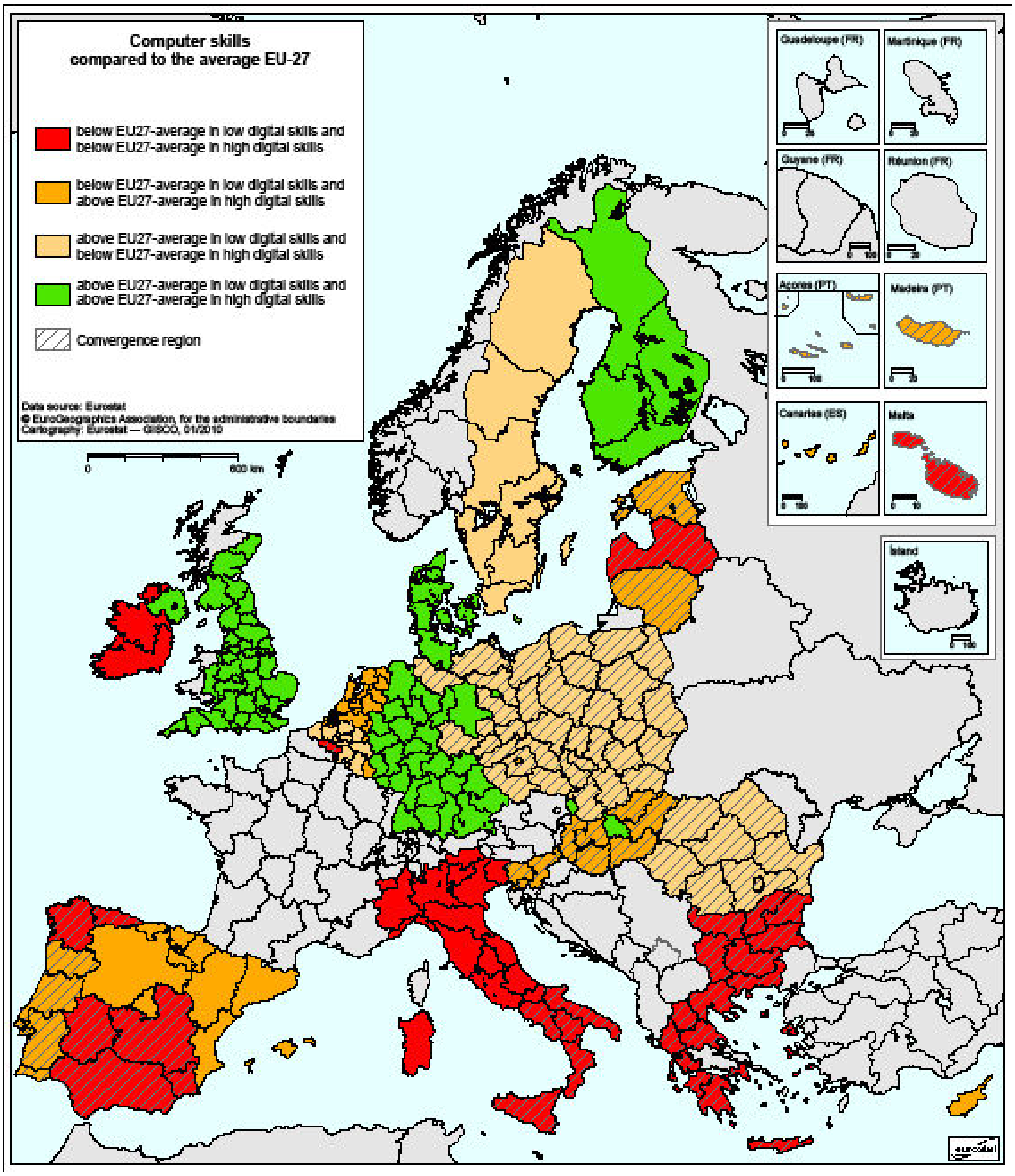
A more detailed look at the geographical skills distribution at regional level reveals some interesting insights (Map 2). First of all, some regions consistently underperform, with below-average levels in all skill categories. These regions therefore have a general weakness in digital skills. Geographically, these regions are predominantly located in Southern Europe and belong to the group of lagging regions, in particular those in EL, IT, MT and also LV. Remarkably, Ireland, which no longer has any regions characterised as lagging, also shows similar characteristics.

By contrast, a second group of regions lead in the higher skill categories but have low levels of low skills. This may be regarded as a consequence of a skills distribution skewed towards higher skill levels, which can found in some non-lagging regions such as Prague region in the Czech Republic, the Netherlands and Luxembourg. However, this group also includes an unexpected and fundamentally different set of regions, including e.g. Portugal (lagging and non-lagging regions), Cyprus (entire territory non-lagging), Spanish non-lagging regions as well as Estonia, Lithuania and Slovenia (entire territory lagging). All these areas remain below average in the two lower skill categories but have above-average levels of high skills. Hence, the availability of high skills at regional level does not necessarily seem to be strongly linked to the spread of internet use or lower digital skills.

A third group of regions in Europe lead in high skills, but are still characterised by above-average rates in the lower skill categories, as well. These include non-lagging regions in DK, DE, FI, and UK for example.

Finally, a fourth group of European regions is falling behind in high skills. These areas are characterised by a high level of lower skills only, but often do have high rates of regular internet use. This includes the Belgian lagging region Hainaut, Sweden (entire territory non-lagging) and the lagging regions of SK, CZ, PL and RO. The skills distribution in the latter lagging regions may be because the catch-up process is starting with lower skill levels. However, Sweden in particular seems to be experiencing a high skills shortage despite the fact that it has traditionally been characterised by a relatively large take-up and economic importance of ICT. Hence, the geographical distribution of high skills does not always reflect a traditional core-periphery pattern.

Map 2: **Digital skills distribution in EU regions (2009)**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

1.28. 4.8. Conclusions

The eInclusion efforts under the i2010 strategy have continued to pay off in the last year. Both regular and frequent use of the internet has grown, among the population at large as well as among almost all disadvantaged groups. Nonetheless, significant gaps remain, especially for senior citizens and people with low education or income levels. Indeed those on low incomes experienced a decline in regular internet use in 2009, suggesting that the economic crisis has had an impact on the digital inclusion of those on low incomes. Similarly, Europe is divided between leading countries in terms of regular internet use and those lagging behind significantly. However, the latter group, predominantly consisting of Eastern and Southern European countries, has recently seen encouraging catch-up rates. While patterns of use among socio-economic groups are similar in the US and EU, this is less the case with Korea, where differences between groups are less marked.

A major prerequisite for realising an e-inclusive society is the promotion of digital skills. Underperformance in terms of digital skills among disadvantaged groups, in particular older people, those with a low education or those on low incomes, puts them at a disadvantage in the emerging digital society. In particular, these divides are significantly deepening with the increasing sophistication of digital skills. While certain disadvantaged groups such as women are performing even better than the average population in terms of lower digital skill levels, they are significantly falling behind in high digital skills. Among young people, a solid formal education seems to be important to be able to develop high digital skills. Hence, without further efforts to promote eInclusion, a major digital divide in terms of different education levels may emerge among young people, in addition to the existing generational gap. For designing future eInclusion policy, it may also be useful to take into account the observation that broadband access at home seems to be related to higher digital skills and regular internet use.

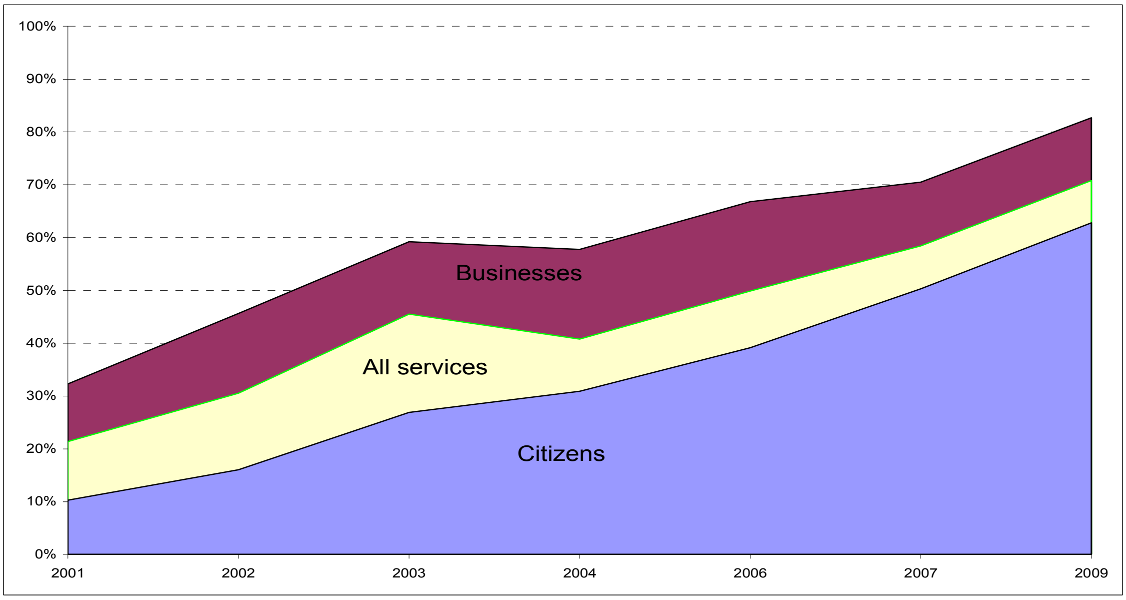
Finally, this chapter has identified a regional dimension to the eInclusion debate. Regular internet use seems to be linked to economic development, with disadvantaged regions lagging behind more economically advanced areas. However, the regional distribution of digital skills, in particular high skills, does not seem to reflect a traditional core-periphery pattern. There may therefore be scope for disadvantaged regions to achieve leading levels of high digital skills and hence a competitive advantage in the digital economy. Nonetheless, many lagging regions have not yet found the means for such success. The upcoming Digital Agenda will therefore have to tackle important challenges to ensure that all European citizens can actively participate in the information society.

5. 5. ONLINE PUBLIC SERVICES

1.29. 5.1. eGovernment

Europe has continued to make progress in the delivery of online public services towards meeting the objectives of the Lisbon Agenda and the i2010 eGovernment Action Plan. The online delivery of basic services[76] has continued to increase steadily in recent years: their *full online availability*[77] went from 21 % in 2001 to 71 % in 2009[78] (Figure 5.1). However, this increase masks substantial differences between services for businesses and services for citizens: the former have almost reached saturation with 83 % availability while the latter, with 63 % availability, show a significant shortfall.

Figure 5.1: **Full online availability, trend from 2001 to 2009 for EU-27+**



Source: CapGemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009.

The progress made also hides considerable fragmentation among Member States (Figure 5.2). The gap between the best and worst performers is large (68 pp), although it has declined since last measured (85 pp in 2007). Four countries (AT, MT, PT and UK) provide full online availability for all 20 basic services considered, while the first ten countries show full online

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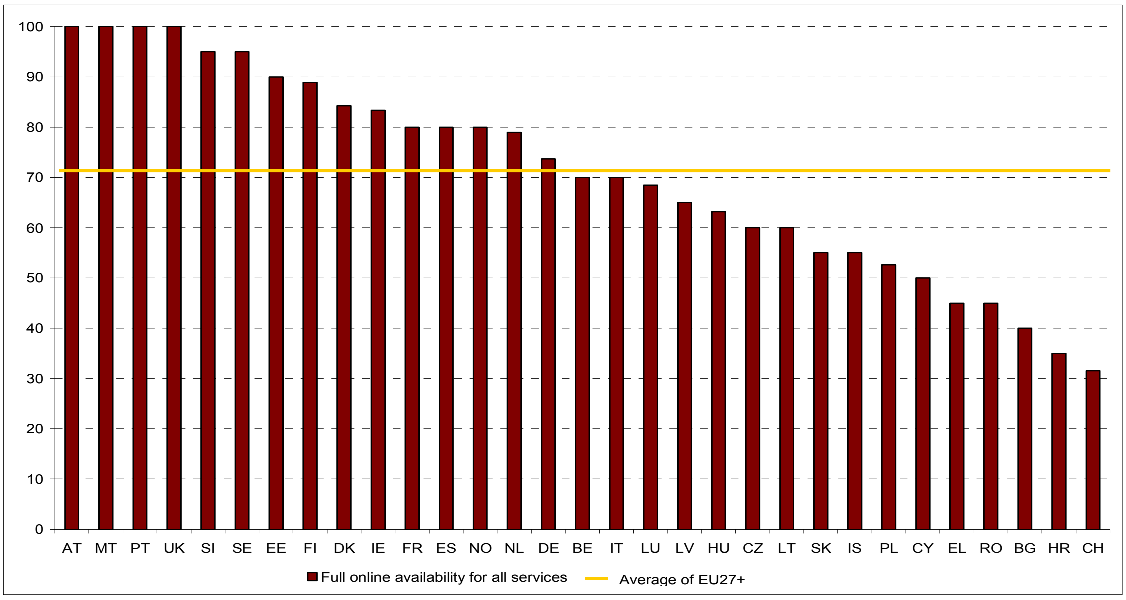
76 'Basic' refers to the 20 services (12 for citizens, 8 for businesses) used to benchmark the online availability of public services (full definition in the 'Smarter, Faster, Better eGovernment' Report, see next footnote). These are: income taxes, job search, social security benefits, personal documents, car registration, building permissions, declaration to police, public libraries, certificates, enrolment in higher education, announcement of moving, health-related services (citizens), social contributions, corporate tax, VAT, company registration, statistical data, customs declaration, environment-related permits, public procurement (businesses).

77 Full online availability is a binary indicator that measures whether the service is delivered in a completely electronic way without the need to interact through traditional (i.e. paper, face-to-face) channels. It corresponds to level 4 and above on the sophistication indicator explained below (see footnote 77). The composite indicator is an average of the values of the binary indicator (either 0 or 100 %) for the 20 services.

78 The small decrease in 2004 is due to enlargement of the sample to include the New Member States: until 2003 the sample included only EU-15 countries.

availability for more than four fifths of the services. Large countries tend to lag behind, with only the UK ranking among the top ten. On average, the 'new' Member States started off with relatively low levels of availability but have been catching up in recent years (16 pp on average since 2007, compared to 13 pp for the EU-15).

Figure 5.2: **Full online availability for all services**



Source: Cap Gemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009.

5.1.1. eGovernment for businesses

eGovernment for businesses has progressed fast (Figure 5.1). It has also reached a high level of sophistication (91% in 2009)[79]. Some crucial services for enterprises like VAT, corporate tax, customs declarations and social contributions are fully available online in almost every EU country. However, services for the registration of new companies are still some way behind, although they are considered crucial to the European Growth and Jobs Strategy.

In general, the use of online public services by businesses has kept up with the supply (Figure 5.3): on average, use was 71% in 2009 for the EU-27 (up from 68% in 2008). Levels of use are also quite even across countries. With the exception of Romania, eGovernment usage by businesses is above 60% in all countries, with almost half having usage rates above 80%. Moreover, a handful of countries (DK, FI, IS, LT and SK) appear to have reached saturation, with take-up rates close to or above 90% and limited change over one year. Take-up is also relatively high for advanced ways of interacting with the public administration (PA): 55% of enterprises use the internet to return completed forms and 43% had complete electronic transactions with the PA.

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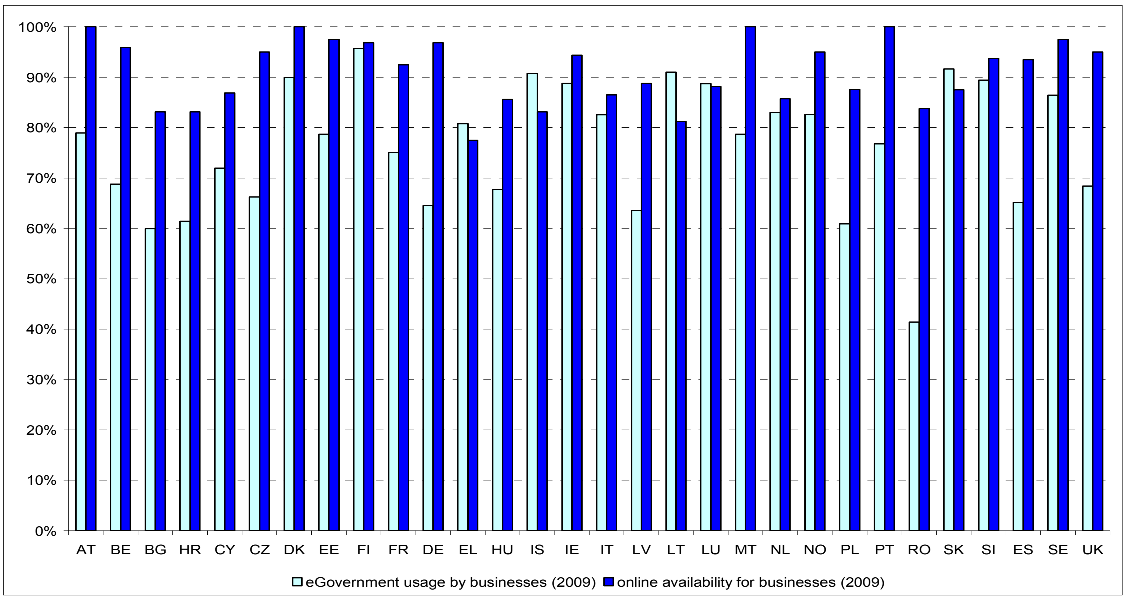
[79] Sophistication is an indicator that measures the degree of interaction possible between the citizen and the PA on the delivery of a given service. It consists of 5 possible levels: information about the service: one-way interaction (downloadable forms), two-way interaction (electronic forms), transaction (full-electronic case-handling), personalisation (pro-active, automated).

Figure 5.3: **Supply vs take-up -- businesses**[80]



Source: Cap Gemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009, and Eurostat, Community Survey on ICT Usage and eCommerce by Enterprises, 2009.

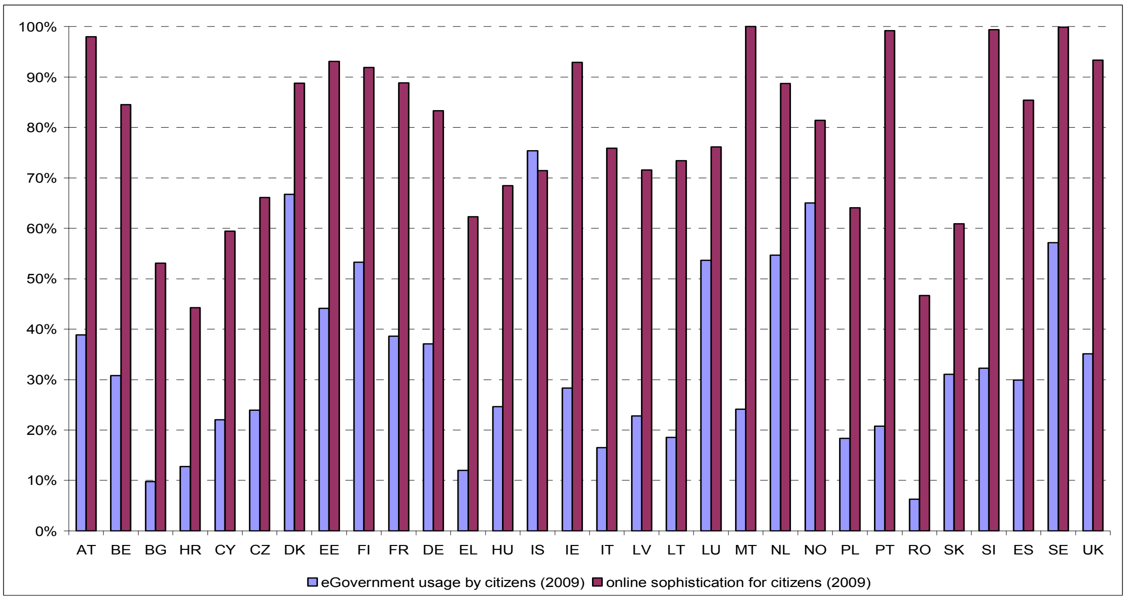
5.1.2. eGovernment for citizens

The take-up of eGovernment services by citizens is less pronounced. The average sophistication level in the EU-27+[81] is 78 %, up from 70 % in 2007. In eleven countries, the sophistication level for citizens is comparable to that for businesses. In addition, many countries that lagged substantially behind in serving citizens have made considerable improvements (PL, RO and CH) in reducing their lag with respect to the best-performing countries.

However, take-up by citizens remains limited (Figure 5.4): in 2009, only 30 % of EU-27 citizens used the internet to access eGovernment services over the previous 3 months (28 % in 2008), with the figure rising to 38 % over the past 12 months. A one-third increase is required to reach the target set by the European Digital Agenda: 50 % eGovernment users by 2015. Moreover the average figure hides considerable variation, with a gap of 69 pp between the best performer (Iceland) and the worst performer. EU citizens are also lagging behind in terms of more advanced modes of interaction with their administrations: only 17 % have downloaded official forms from a public authority website and only 12 % have used the internet to return completed forms.

80 Take-up data for Belgium and Iceland refer to 2008.
81 The EU-27+ aggregate includes the EU-27 countries + Iceland, Norway, Switzerland and Croatia.

Figure 5.4: **Supply vs take-up -- citizens**

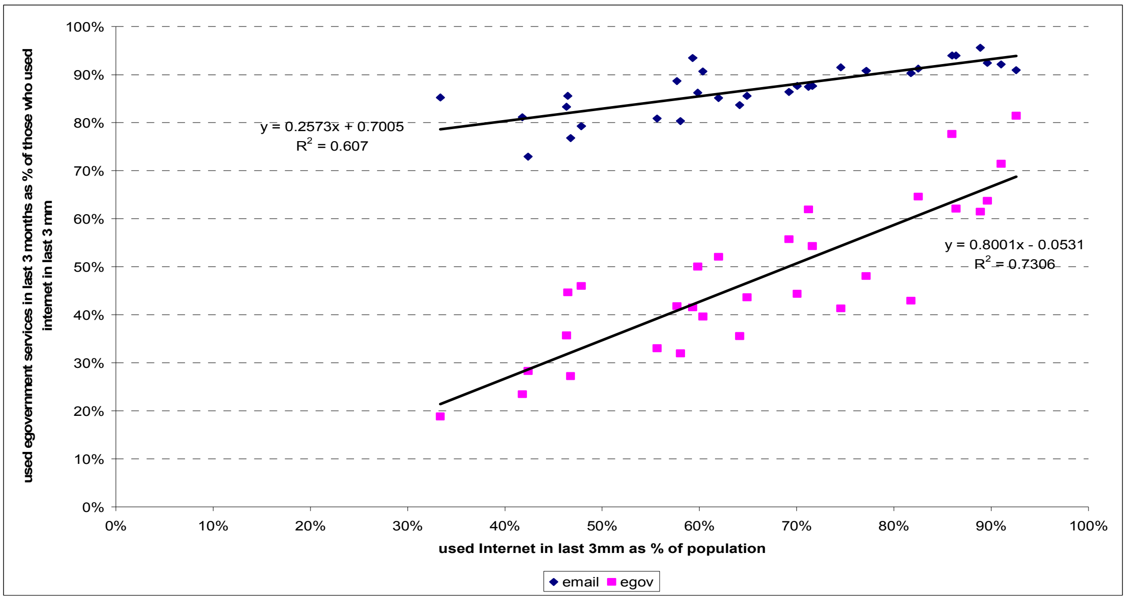


Source: Cap Gemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009, and Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

However, the large disparity in eGovernment use seems to be driven more by the degree of internet penetration in a country than by the degree of sophistication of its online provision. There is a strong correlation across countries between internet use[82] and the percentage of users that take up eGovernment services (Figure 5.5). Unlike a 'basic service' such as email (e.g. a service used by a constant proportion of internet users irrespective of the internet penetration rate), eGovernment can be classified as an 'advanced service'. Countries with high regular internet usage are more likely to exhibit higher average skills, which stimulate the take-up of more advanced services. Moreover, as the number of internet users grows, diffusion effects (i.e. word of mouth) are at work as well, increasing the number of specialised internet applications used by each person as they become aware of their advantages through other users.

[82] i.e. individuals who have used the internet in the last three months.

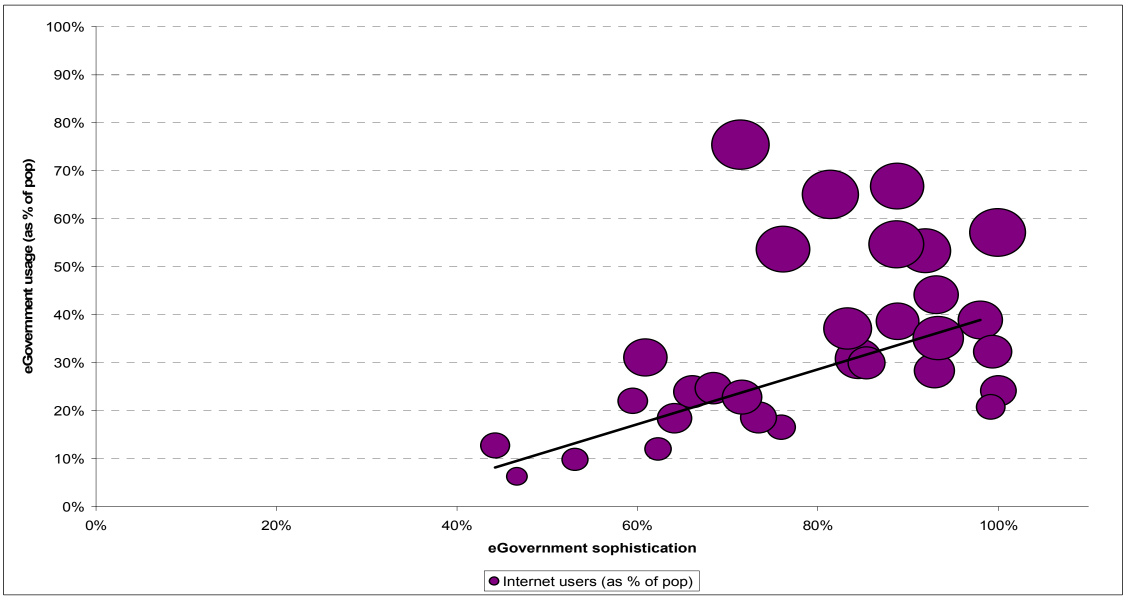
Figure 5.5: **Use of internet vs use of eGovernment (and other) services (2009, EEA countries + Croatia)**[83]



Source: Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

There is a correlation between the sophistication of online public services and eGovernment use (Figure 5.6), although the direction of causality is ambiguous. Sophistication of services stimulates eGovernment take-up but may also be a response to the spread of internet usage. Finally, when internet usage is high, the take-up of eGovernment is high irrespective of the sophistication level.

Figure 5.6: **Supply vs take-up vs internet use (citizens)**



Source: Cap Gemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009, and Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

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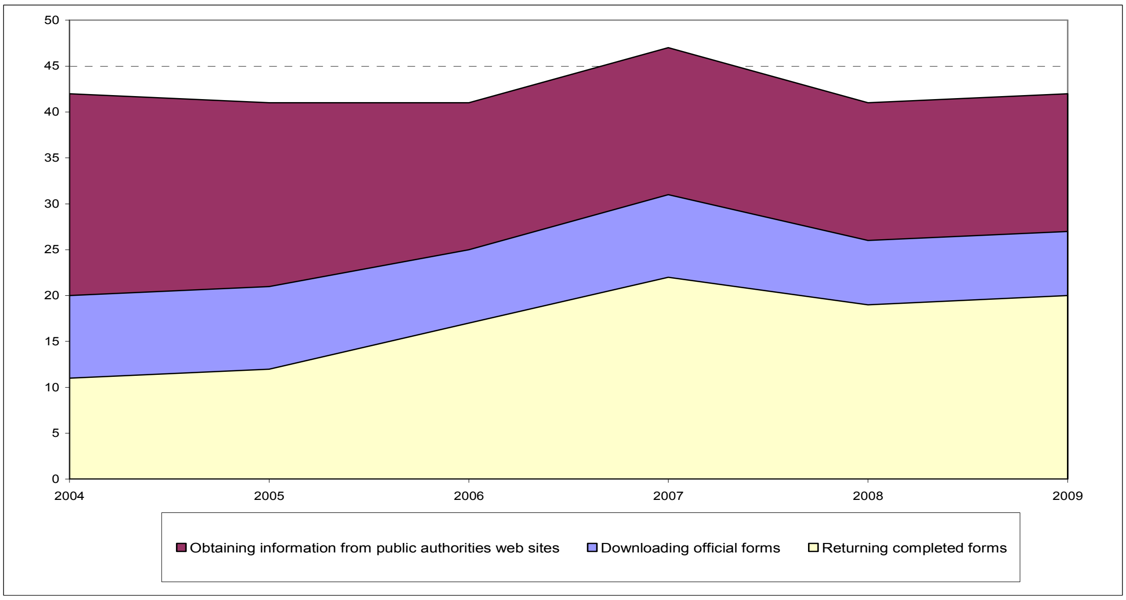
83 x-axis: used internet in last 3 months as % of population. y-axis: used eGovernment (or email) services in the last 3 months as % of (a) people that used internet in last 3 months (b) population.

Finally, data on the use of online public services shows that while the 'passive' use of public authority websites has remained relatively stable over the years, there has been a steady increase in the 'interactive' use of such services. In particular, while the use of public authority websites for obtaining information has remained stable at around 42 % (slightly more in 2007), a steady increase can be seen in the downloading of official forms (from 20 % in 2004 to 27 % in 2009) and returning completed forms (from 11 % to 20 %).

Figure 5.7: **Use of the internet for interaction with public services or administration 2004-2009 — % of internet users in EU-27**



Source: Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

5.1.3. Inclusive eGovernment

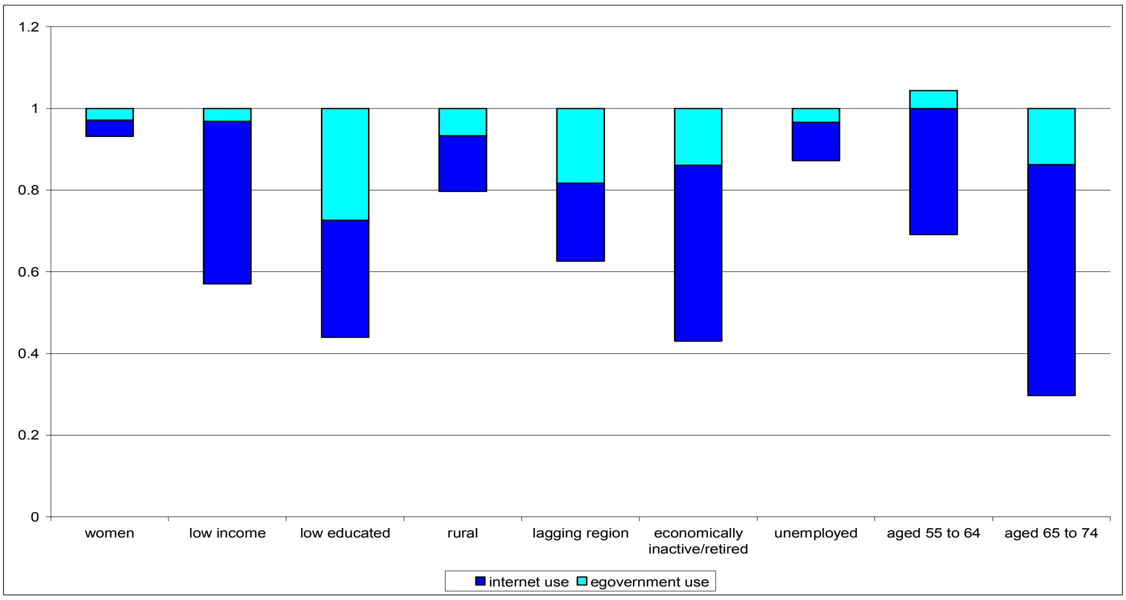
Inclusive eGovernment is addressed by both the Manchester and Malmö eGovernment declarations[84]. The groups at risk of exclusion, however, turn out to be very different from the traditional groups analysed for eInclusion policies (chapter 4). A disparity indicator for eGovernment use[85] (Figure 5.8) shows that, once the different patterns of internet use have been factored in, there is no clearly discernable 'digital divide' in eGovernment use among internet users belonging to traditional groups at risk of exclusion. Indeed, the various groups have a usage only slightly below the population average, while the 55-64 age group shows even greater usage of eGovernment services than the average population. For this latter category, eGovernment usage may even be a major driver of internet use, for example to monitor accumulated pension rights ahead of retirement. The main category at risk of

84 http://ec.europa.eu/information_society/activities/egovernment/docs/pdf/manchester_declaration.pdf
http://ec.europa.eu/information_society/activities/egovernment/conferences/malmo_2009/press/ministerial-declaration-on-egovernment.pdf.

85 This eGovernment disparity indicator is calculated as the proportion of eGovernment users in disadvantaged groups over the proportion of eGovernment users in the population. Therefore, a value of 1 would indicate that the group concerned had a usage pattern equal to that of the population at large, while values closer to zero would indicate significant disparities in use.
The groups not using eGovernment are further split into two subgroups: people who do not use the internet (and therefore do not use eGovernment services either) and internet users who do not use eGovernment services.

exclusion from eGovernment usage (as well as from internet use) is the low-educated. This could signal that people with a low education may lack the skills for the use of 'advanced services'.

Figure 5.8: **Disparity indicator for use of the internet for eGovernment services in the last 3 months. Decomposition of internet use effect and eGovernment use effect (2009, EU-27).**



Source: Commission services on the basis of Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

Finally, the mere provision of a service does not guarantee its usage. Features of government websites can make usage a smooth experience for the ordinary citizen and influence take-up. Alongside online availability/sophistication, a study conducted on behalf of the Commission introduced a pilot multi-dimensional indicator to measure different facets of 'user experience': accessibility (according to WCAG1.0 standards), usability, user satisfaction monitoring, availability of portals for 20 basic services and user-focused portal design[86]. The first results indicate that EU countries are strong in the availability and design of portals while showing room for improvement in usability and doing little to monitor user satisfaction. Given the shift in country priorities from the mere provision of services toward customer-centred solutions, significant improvements in these areas can be expected in the coming years.

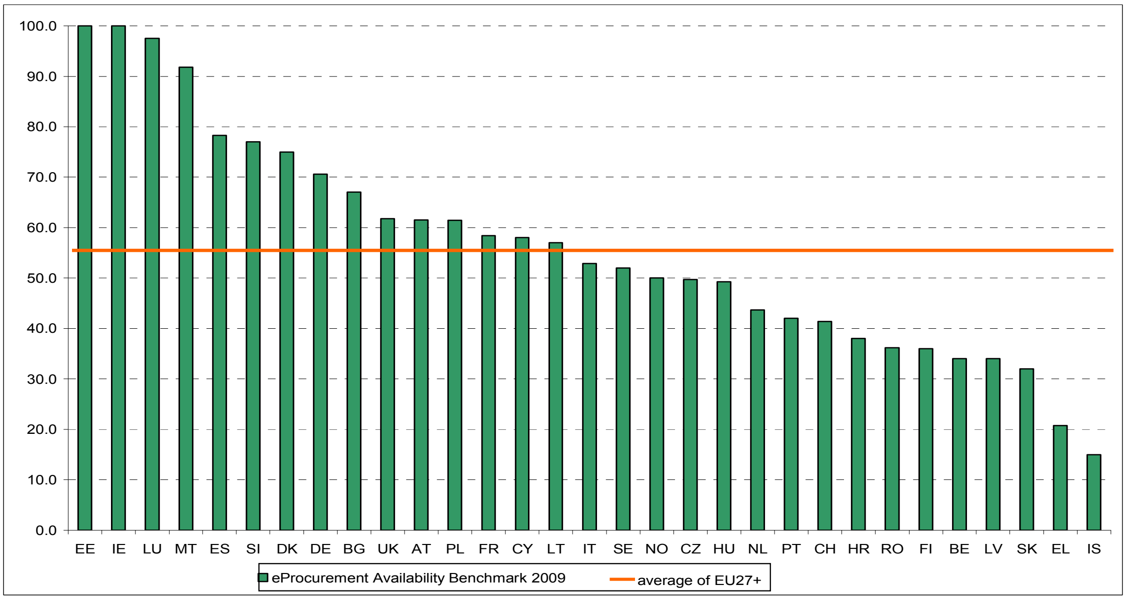
5.1.4. Electronic procurement

Representing more than 16% of EU GDP, public procurement is one of the most important sectors of the economy and therefore an obvious candidate for profiting from the opportunities offered by the single market. The Manchester Declaration of 2005 set two ambitious targets with the aim of creating a single market for eProcurement, namely 100% online availability for public procurement by 2010 and 50% of procurement transactions in electronic form. A detailed eProcurement indicator based on the analysis of 746 national, regional and local EU-27+ public authorities shows that EU countries are still far from the

86 Source: see footnote 74.

availability target, the EU-27+ average being 56 %[87] (Figure 5.9). Only two countries (Estonia and Ireland) guarantee 100 % availability, and another two (Luxembourg and Malta) come quite close. On the other hand, over half of the EU-27+ countries have eProcurement in less than 50 % of the examined public authorities.

Figure 5.9: **eProcurement Availability Benchmark 2009**



Source: Cap Gemini 'Smarter, Faster, Better eGovernment: 8th Benchmark Measurement', 2009.

5.1.5. eParticipation[88]

eParticipation can be generally defined as 'ICT-supported participation in processes involved in government and governance'[89]. Traditionally, initiatives in eParticipation have been initiated by governments, but in recent years a growing number have been launched by citizens or organised groups of citizens. ICT applications in this area can be clustered according to the different phases in the policy process: agenda setting, policy preparation, decision making, policy execution, and policy evaluation. Here, eParticipation is most frequently used in the first phases of the policy process: agenda setting and policy preparation. Some eParticipation practice is also found in the policy evaluation area, where the initiative typically comes from individual citizens or civil society organisations. Governments and public administrations rarely allow intervention in the core decision making and policy executive phases, claiming that this is not in line with the representative political system currently in place nor does it fit in with their responsibilities as currently understood. The main motive for governments to start eParticipation initiatives is to close the perceived gap between governments and citizens and to boost the legitimacy of their policies and administrative decisions. So far, there is no robust evidence that this has occurred. In contrast, eGovernment applications that focus on improving the provision of government services to citizens seem to fare much better. There is evidence to suggest that eParticipation applications stemming from initiatives by individual citizens or civil society organisations, often in

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87 Source: see footnote 74.

88 The material for this section summarises the results of a recent European Commission-funded study on the social impact of ICT.

89 http://en.wikipedia.org/wiki/E-participation.

conjunction with new media developers, have been more successful than those initiated top-down by governments. eParticipation applications that appeal to the everyday interests of citizens in their immediate environment appear to have more appeal to them than initiatives that focus on issues of traditional politics and public affairs, which are often perceived to be abstract and far away.

5.1.6. International comparison

The only internationally comparable indicator for measuring eGovernment at the moment is the eGovernment Development Index developed by UNDESA (United Nations Department of Economic and Social Affairs). This is an indicator of eGovernment readiness, looking at both the supply of public services and the capacity of citizens to effectively use those services (based on the availability and use of ICT infrastructure and human capital)[90]. As highlighted earlier, these are two important factors that contribute, together with supply, to the effective and efficient use of eGovernment services by citizens. This is confirmed by the fact that the EU countries that score highest in the UN ranking are also generally those with the highest take-up of eGovernment services by citizens. Compared with the rest of the world, EU countries are performing well, with ten among the top twenty (Table 5.1).

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[90] The Web Measure Index assesses the sophistication of (mainly) national eGovernment portals on a five-stage scale: emerging, enhanced, interactive, transactional, connected. The Telecommunication Infrastructure Index is based on five indicators: internet users/100 persons, PCs/100 persons, main telephone lines/100 persons, mobile telephones/100 persons, broadband/100 persons. The Human Capital Index is a weighted average of two indicators: the adult literacy rate (2/3) and the combined primary, secondary and tertiary gross enrolment ratio (1/3). These three indexes make up the eGovernment Development Index.

Table 5.1: **eGovernment Development Index, top 20 countries**

eGovernment Development Index	
Country	*Index*
Republic of Korea	0.8785
US	0.8510
Canada	0.8448
UK	0.8147
Netherlands	0.8097
Norway	0.8020
Denmark	0.7872
Australia	0.7863
Spain	0.7516
France	0.7510
Singapore	0.7476
Sweden	0.7474
Bahrain	0.7363
New Zealand	0.7311
Germany	0.7309
Belgium	0.7225
Japan	0.7152
Switzerland	0.7136
Finland	0.6967
Estonia	0.6965

Source: UN Global eGovernment Survey 2010

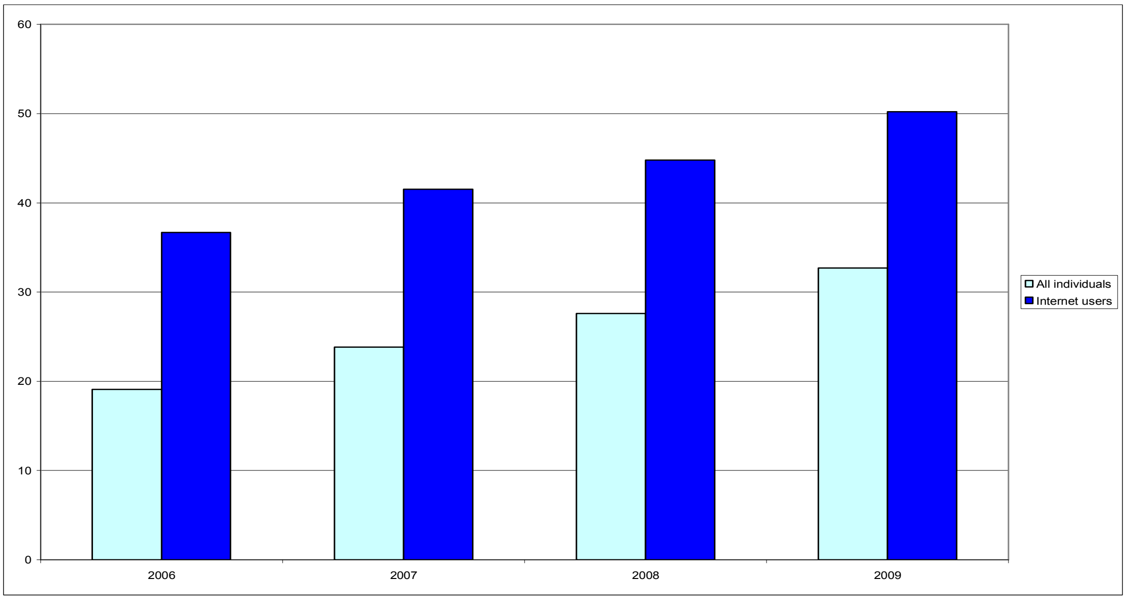
1.30. 5.2. eHealth[91]

5.2.1. Health-on-the-web

Usage of the internet by the general population for health-related purposes has been growing steadily in Europe. In 2009, one third of individuals aged 16 to 74 in the EU-27 had searched online for health information in the past 3 months, although there were wide variations across countries (from 10% in Bulgaria to 56% of the population in Finland). Where searching for health information is concerned, however, it is possible that such an indicator might underestimate the actual extent of activity in the population. For many people, health information seeking is likely to be episodic, linked to irregularly occurring health episodes. Results from other European surveys suggest that up to one-half of European adults may have *ever* searched online for health information.

91 This section is based on *Chapter 5 'Health'* of the *Study on Social Impact of ICT,* Work Research Centre, a study for the European Commission, forthcoming.

Figure 5.10: **Percentage of individuals who searched online for health information in the past 3 months in the EU-27**



Source: Eurostat, Community Survey on ICT use in Households and by Individuals, 2009.

A survey conducted in the US in December 2008[92] showed that 62% of US adults living with chronic diseases have access to the internet, compared to 81% of US adults reporting no chronic disease. Just over half of adults living with chronic diseases have used the internet to look for health information, while two thirds of adults reporting no chronic conditions have done so. However, the difference is explained mainly by lack of internet access, not lack of interest in health information. Regardless of their chronic conditions, US citizens show interest in very similar health topics (Table 5.2). Adults with chronic diseases however are more likely to look for information on a number of topics, though not all. Once people are online, having a chronic disease increases their likelihood of using social media to share what they know and learn from their peers.

Table 5.2: **% of internet users who have looked online for information about health topics in the US**

	No conditions	1+ conditions	2+ conditions
A specific disease or medical problem	65%	69%	69%
Certain medical treatment or procedure	54%	55%	54%
Exercise or fitness	54%	49%	41%
Doctors or other health professionals	48%	43%	42%
Prescription or over-the-counter drugs	43%	48%	53%
Hospitals or other medical facilities	38%	38%	36%
Health insurance	37%	37%	42%
Alternative treatments or medicines	33%	38%	36%
How to lose weight or how to control your weight	33%	35%	30%
Depression, anxiety, stress or mental health issues	28%	28%	30%
Any other health issue not listed above	26%	27%	31%
Experimental treatments or medicines	19%	22%	23%
How to stay healthy on a trip overseas	13%	10%	12%

Source: Pew Internet & American Life Project Survey, November-December 2008.

92 http://www.pewinternet.org/~/media//Files/Reports/2010/PIP_Chronic_Disease.pdf.

Health-on-the-web encompasses the wide variety of formal and informal online health-related services and activities that have emerged in recent years. Two main ‘generations’ of applications can be loosely distinguished, corresponding approximately to ‘Web 1.0’[93] and ‘Web 2.0’ functionalities and usages, respectively. Core consumer/patient activities in the Health 1.0 era have revolved mainly around online (‘read-only’) health information seeking, with usage of more interactive online consultation or direct advice/diagnostic support services also emerging although to a lesser extent. Online purchasing of medication has also become a relevant development, often operating in a ‘grey’ zone as regards regulatory control and legality. The emergence of the Heath 2.0 era has heralded extensive growth in online user-created content (i.e. created by lay persons), peer support groups and other uses of social media for consumer/patient health purposes. However, some of these tools still have to be duly tested and validated.

Although consumers/patients vary in their desire for choice and influence in health matters, the evidence suggests that many feel more empowered as a result of being able to find health-related information and support on the web. Consumers/patients who look for health information online report being better informed, being reassured they can make appropriate healthcare decisions and being more confident in raising questions/concerns with their own doctor. They also have the possibility to use online rating sites to record and voice their experiences of health providers they have used. On the other hand, the internet has extended the reach of various vested interests and their potential to influence consumers/patients, for example, in the advertising and marketing of medications. Some web-based and other eHealth applications also raise the possibility of increased transparency of customers to insurers.

Many people are now researching health information before and after consulting their doctor, and a minority report having made their own health decisions (including sometimes not following their doctor’s advice and consequently taking risks when the quality of the information is not validated) as a result of information found on the web. Health authorities should watch over the quality of information and alert the patient that such information should be checked with a health professional. A sizeable minority of internet users in Europe also report having had an online interaction of some form with a doctor or health professional that they have not met. Although there is currently no robust evidence on the impacts of these developments on the traditional doctor-patient relationship or on ‘gate-keeping’ mechanisms in healthcare, it seems overall that health-on-the-web has not yet led to any substantial bypassing of the existing ‘bricks-and-mortar’ health system. The ‘grey’ area of online marketing and purchasing of medications remains an issue, however.

Finally, there are various health-on-the-web developments (such as provider rating sites and ‘choose and book’ services) that, at least in principle, can give consumers/patients more choice and/or more information to support their choice of hospitals, specialists or other healthcare facilities when such services are needed. Although this can increase the possibilities for informed choice, available evidence suggests that consumers/patients still pay most regard to the recommendations made by their own doctor. In addition, it seems that constraints within the ‘bricks and mortar’ health system can often limit the possibilities for real choices to be exercised in practice.

On the other hand, the internet allows scientific advances to be disseminated faster than ever before. Health care professionals can access and update new knowledge and details of new technology or devices from different countries in minutes.

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93 For instance, at EU level there is now an official ‘Health 1.0’ site for citizens: http://ec.europa.eu/health-eu/index_en.htm.

Overall, the internet has made a lot more health information available, and more easily available, for consumers/patients and professionals. However, the quality may be variable and there can be a risk of overload, so users need good 'eHealth literacy' skills in order to get the most out of the information.

In addition, while health-on-the-web may empower in various ways those who have access to the internet, the flip side of this is that those without internet access may become relatively more disadvantaged in health matters. For them, the experience may be more one of disempowerment through inability to take advantage of new opportunities. Factors linked to existing health divides, including lower health literacy and less proactive health attitudes, continue to contribute significantly to unequal health experiences and outcomes among less advantaged socio-economic groups. There is already some evidence that these groups may be experiencing a 'double jeopardy' as a result of an intertwining of these traditional health divides with the new digital divides.

5.2.2. ICT-based services for healthcare delivery

Enabling fast access to vital information and the sharing of information among health professionals has been an instrumental, technological goal of policy to improve the accessibility, quality and cost-efficiency of care delivering processes. Nationwide examples of such health information networks exist today, are deployed in European countries and have been shown to keep their claimed promises. Europe is a leader in the deployment of health information networks and the usage of ICT in primary care. Now, the target is to link together national and regional information networks across Europe.

Overall, email interaction between general practitioners and their patients, whether for administrative purposes or for health matters, is not yet common in the majority of Member States, although there are some exceptions. A telephone survey of general practitioners (GPs) across the EU-27 in 2007[94] showed that only 4.1% of GPs reported using e-mail routinely for administrative interaction with patients and just 3.5% for health issues. The main exception was Denmark, where almost 60% of doctors reported both types of communication with their patients. More generally, the proportion of general practitioners with websites varies widely across Europe, ranging from almost all (96%) in Finland to only a small minority in Latvia (7%). Sweden, Denmark, Netherlands, Slovenia and the UK also score relatively highly in this regard. In some countries, legal regulations governing advertising or marketing seem to be an inhibiting factor. In Germany, for example, the professional code of conduct requires that a doctor's website may not be used for advertising products or services offered by the practice.

Some countries have well-developed online services in other areas, such as booking appointments with hospital- or clinic-based services. Use of eReminders is becoming quite commonplace, especially appointment reminder by phone or text messaging, and sometimes by e-mail. Medication reminder systems are also being implemented, although on a more limited basis to date. There has also been a growing interest in providing other forms of 'push' services for healthcare information/education, using podcasts, mobile texting, digital TV and other platforms.

Although much is still to be done to achieve fully operational electronic health records, the path has been set out: connecting citizens to the existing health information networks is the next milestone ahead. This is about providing personalised information services on prevention

94 http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/ehealth_ii_bench_final_report.pdf.

or existing health conditions, supporting networking between patients, improving interaction with health services and helping in the choice of medical intervention when needed.

5.2.3. Telemedicine services and support for disease management

Telehealth and telecare involve the remote delivery of health and/or social care to the home on an ongoing or continuous basis. Home telehealth involves continuous (remote) monitoring of the health status and wellbeing of a patient at home, and may include subjective reporting of symptoms and/or objective measurement of various physiological parameters. It has a particular relevance for assuring continuity of care for people with chronic conditions (many of whom are older people) and is seeing growing use for conditions such as diabetes, chronic obstructive pulmonary disease and various cardiovascular diseases.

The available data indicate that first-generation telecare is widely available in many European countries and is often well-integrated into mainstream social care systems. However, levels of take-up among older people vary quite widely across countries, ranging from less than 1 % to more than 15 % of people aged 65 years and older[95]. More advanced telecare services are beginning to be deployed, but have yet to become mainstream in most countries.

Home telehealth has been talked about for some time but seems only recently to be on the verge of becoming a mainstream part of regular healthcare service offerings and, even then, only in some countries and to a limited degree as yet. In general, the numbers currently using home telehealth systems or services are still very low, with the most extensive implementations to date probably to be found in the US and Japan.

The participation of both patients and health professionals in the design of eHealth strategies and tools is particularly important. Procurement and reimbursement policies are key obstacles/promoters of implementation.

1.31. 5.3. Conclusions

Although the online provision of eGovernment services has made great leaps in recent years, it has not been followed by equal progress in take-up, especially on the part of citizens. Overall progress in citizen eGovernment use between 2004 and 2008 was only between 4 pp and 7 pp for the EU-15 and between 3 pp and 4 pp for the EU-12, so that the EU-15–E-12 gap has slightly increased despite the recent decline in EU-15 usage. Set against this, enterprise use of eGovernment services has grown steadily with no recent dip. These data also show that the EU-12 is keeping pace with the EU-15 in terms of enterprise eGovernment use.

Explanations for these variations in eGovernment usage are difficult to pin down, especially given the short period under review. Some of the trend might be explained by the fact that an increasing number of public services are provided by non-public-sector actors. Furthermore, citizens do not necessarily need to contact the public administration on a regular basis. Future measurement exercises will aim to correct any such bias.

The evidence summarised in this chapter suggests that to increase citizen take-up policies designed to increase supply are not sufficient by themselves. On one hand, they should be complemented by policies to increase internet use, and, on the other hand, they should focus on increasing the quality of the services offered by adopting a more user-centred approach rather than an administration-centred approach.

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95 http://www.ict-ageing.eu.

The advent of the internet has turned 'eHealth literacy' for consumers/patients into an important issue. 'Health-on-the-web' has made a lot more health-related information available, and more easily available, to consumers/patients and has provided them with enormous possibilities for enhanced, self-directed, lifelong learning on health matters. However, the quality of information available may be variable and there can be a risk of overload. In addition, the internet has extended the reach of various vested interests and their potential to influence consumers/patients, for example, in the advertising and marketing of medications. To successfully exploit the possibilities offered by 'health-on-the-web', good 'eHealth literacy' skills are needed.

Reasons for inequalities in eHealth are not only a matter of infrastructure, they are often related to other factors such as health literacy and take-up by health professionals and the health system, main drivers to increase access and usage by patients and citizens. Inequalities in eHealth deployment have consequences both for access to services as well as for their quality (safety and coordination of care). In fact, eHealth can bring more value for elderly patients and patients suffering from complicated and/or chronic pathologies. The most fragile patients may suffer the most from the absence of eHealth tools.

To strengthen the evidence available on the deployment of eHealth solutions in Europe, the European Commission has launched a study on 'Benchmarking deployment of eHealth services', whose results will be available in early 2011. The objective of the study is to measure, through a survey, the adoption of ICT and eHealth solutions in hospitals, in order to better understand the current progress in implementing eHealth. It is the first exercise of such a kind in 30 European countries (EU-27, Croatia, Iceland and Norway).

It follows on from a previous benchmarking exercise in 2009, which collated and analysed existing eHealth monitoring and benchmarking sources (in the EU-27, Iceland, Norway, Canada and the United States)[96]. It identified good practices in data gathering and developed an indicator framework for an EU-wide eHealth benchmarking approach covering the main actors, activities and applications in this area.

96 http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/ehealth_ii_bench_final_report.pdf.

6. 6. THE TAKE-UP OF ICT AND ECOMMERCE BY BUSINESSES

The take-up of ICT by businesses is an important component of labour productivity growth and therefore of economic growth (chapters 1 and 7). Furthermore, the use of ICT by businesses strengthens the single market, increasing transparency and efficiency, reducing transaction costs, search and distribution costs, and lowering physical barriers to entry. The availability of electronic commerce allows smaller enterprises to access larger markets at lower cost and is therefore an important driver of growth for companies themselves. However, barriers to more advanced use of the internet persist. As for individuals (chapter 3), the main reported barriers concern privacy and trust, but also lack of awareness of the benefits of online trade.

The level of eBusiness[97] in the EU, as for eCommerce and ICT development, varies across the Member States. Reflecting patterns of internet usage, Northern European countries such as the United Kingdom, Sweden and Denmark have high levels, while Eastern and Southern countries perform poorly. Those countries with the highest levels also compare to or even surpass the EU's major trading partners (Australia, Canada, Japan, Korea, and the United States). As in the past, small and medium-sized firms continue to use eBusiness less than larger firms. Nevertheless, comparing the largest companies in the largest eCommerce markets in Europe with their North American counterparts, large European firms engage in eBusiness and use eBusiness applications to the same extent.

This chapter is organised around four issues: basic ICT equipment; the use of eCommerce; the use of eBusiness applications and their level of sophistication; and opportunities for innovation and further productivity gains through ICT developments.

1.32. 6.1. Basic ICT equipment and its use

Basic equipment in terms of computers, local networks and connections to the internet is widespread. The most rapid changes have been the spread of broadband and mobile connections as well as improvements in their quality. In almost all countries broadband is used by more than three quarters of enterprises (with the exception of Romania, Bulgaria, Poland, Latvia and Lithuania), the EU-27 average being 83 %. The EU average for small enterprises is 81 %. From 2008 to 2009, small enterprises made significant progress in Greece (+10 pp), Bulgaria and Cyprus (+8 pp), Germany (+5 pp), Malta and Portugal (+4 pp).

In Europe, 28 % of all enterprises in 2009 had a mobile connection to the internet. Since 2007, there has been rapid progress in Austria, Denmark, Luxembourg and Hungary, where more than one third of enterprises have opted for this type of connection. In Finland, Sweden and UK about half of enterprises have mobile connections to the internet.

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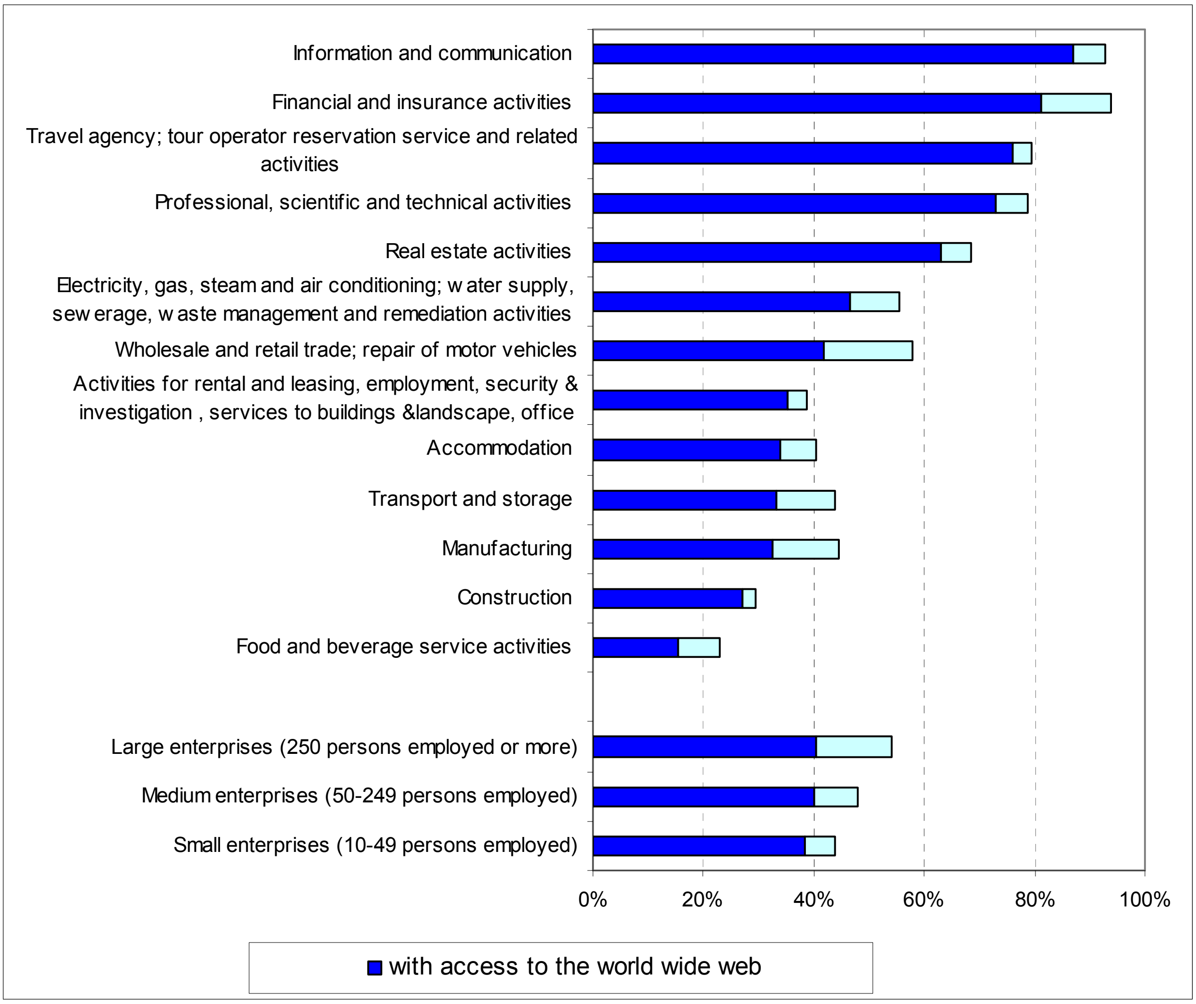
[97] Following an OECD recommendation, eBusiness is defined as 'automated business processes (both intra- and inter-firm) over computer mediated networks'. This definition reflects an understanding of eBusiness that encompasses more than eCommerce transactions. The broad concept of eBusiness also includes the digitisation of internal business processes, as well as cooperative (or possibly even collaborative) processes between companies which are not necessarily transaction-focused.

In general, the lack of basic ICT equipment affects only very small enterprises[98] (1 to 9 employees): data are not available for all EU countries, but for example in Portugal only 63 % of very small enterprises use computers, the figures being 78 % in Spain, 84 % in Slovakia and 87 % in Germany.

The main service sectors make the greatest use of computers with access to the web (Figure 6.1). The size of enterprises does not seem to play an important role. There are a large proportion of unconnected computers in large enterprises in the wholesale and retail sector and in the financial sector, although for different reasons (low-qualified positions for inventory management in the first, and privacy and data protection in the second).

Figure 6.1: **% of persons employed using computers at work (at least once a week) by sector and size, January 2009**



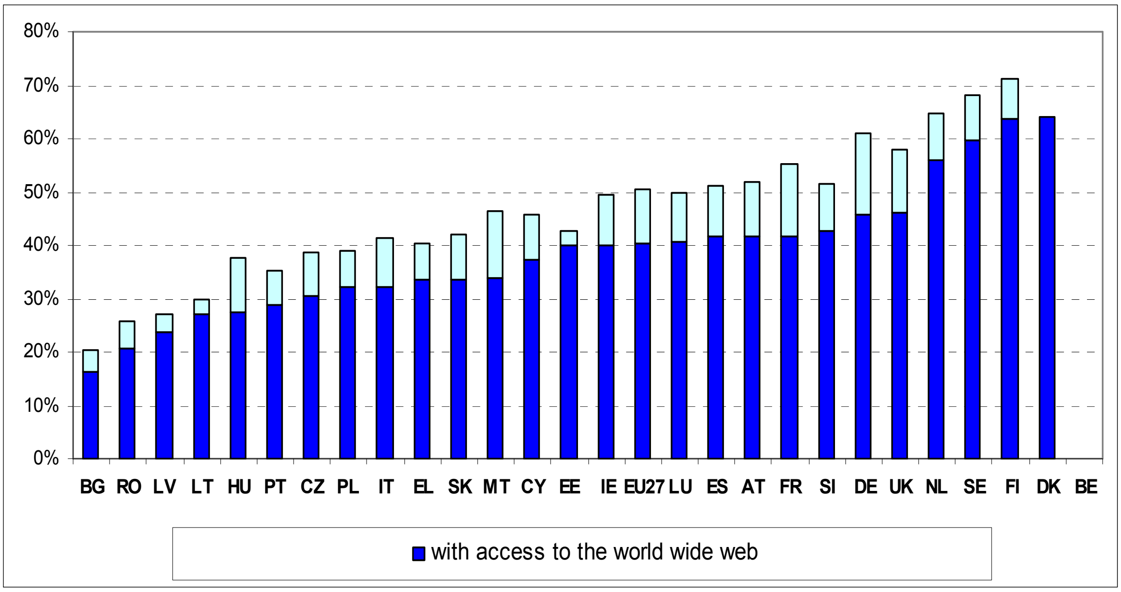
Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

In general the proportion of employees using computers is relatively stable (growing from 48 % in 2005 to 51 % in 2009), and the majority use computers with access to the web (72 %

98 In some countries 'very small enterprises' (1 to 9 employees) represent an important part of the economy.

in 2005 and 79% in 2009). However, there are still some important differences across countries (Figure 6.2).

Figure 6.2: **% of persons employed using computers at work (at least once a week) by country, January 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

The use of computers at work has also to be seen in relation to the skills of workers. A rough analysis of qualifications collected through the Labour Force Survey allows a distinction to be made between ICT specialists and workers with ICT user skills. The first group is relatively stable at around 3% of the workforce. In 2009, the second accounted for 18% of workers (17% in 2000). But some relevant differences exist between countries: DK, LV, LT, UK, LU have higher values, ranging from 24% to 33%. At the opposite end are RO, PT, BG and EL with only 10-13% of the workforce possessing ICT user qualifications. The main positive changes from 2006 to 2009 are observed in the three Baltic countries, SI and LU, all already above the EU average. In contrast, the workforces in IT and AT seem to be gradually losing their qualifications.

1.33. 6.2. Use of ICT by workers and its impact on quality of work[99]

These aggregated indicators do not say much about the complex processes of reorganisation that accompany and follow ICT adoption. Enterprises that introduce ICT undergo many changes. They may explicitly involve employees, but in any event affect their way of working, the skills they use, their professional identity and the relations between different functions and profiles inside the enterprise.

Technological change in the work domain has been dramatic and widespread during the last two decades. In addition to information- and knowledge-intensive areas of work, ICT has been gaining increasing importance in sectors that at first sight do not seem very technology-focused, for example agriculture and fishing, manufacturing, and mining and construction, to

99 This section is based on a chapter of the 'The Social Impact of ICT', a study for the European Commission.

name only a few. Nowadays it is hardly possible to find any area of work where ICT is not present in one way or another, even if it is often not directly visible (e.g. micro-computers in cars controlling car repair and maintenance intervals, and similar devices). Furthermore, new ICT-based industries and services have also grown rapidly.

The implementation of ICT in the workplace has had major impact on both workers and firms. This has created rationalisation effects either based upon a mere automation approach, addressing cost reduction, or oriented towards the use of workforce competences for innovative forms of value generation. It has often contributed to job enrichment and work satisfaction, especially in jobs allowing a certain degree of self-organisation. However, it has also led to call centre work, for instance. User participation in the development of work-related ICT systems and applications (participatory design, end user development) has been shown to increase worker motivation. Furthermore, such activities are more successful if they are supported by the building of communities in which end users can effectively share their knowledge and experience with their peers. The implementation of ICT has also increased qualification requirements for the workforce. A lot of this learning happens through learning-by-doing and informal learning. ICT has given companies new ways to gain, process, store and distribute information. Organisational processes in companies have been re-engineered. Moreover, the division of labour within or between organisations (growing even before the arrival of ICT) has been further influenced by the introduction of ICT applications.

1.34. 6.3. eCommerce by enterprises

The term 'eCommerce' refers to transactions conducted over computer networks, by methods specifically designed for the purpose of placing or receiving orders for the sale or purchase of goods and services[100]. These transactions can take place between enterprises, households, individuals, governments and other public and private organisations. The use of eCommerce by individuals is analysed in chapter 3, together with other internet uses. The adoption by public administrations of different forms of eCommerce, mainly as a platform for electronic procurement, is presented and discussed in the previous chapter.

There has been a consolidation in the number of enterprises selling or purchasing electronically. The percentage is declining (from 15% to 12 % for sales and from 28 % to 24 % for purchases)[101], but the decrease concerns enterprises for which eCommerce represented only a small percentage of turnover.

In 2008, eCommerce accounted on average for 13 % of total EU-27 turnover[102], up from 12 % in 2007.

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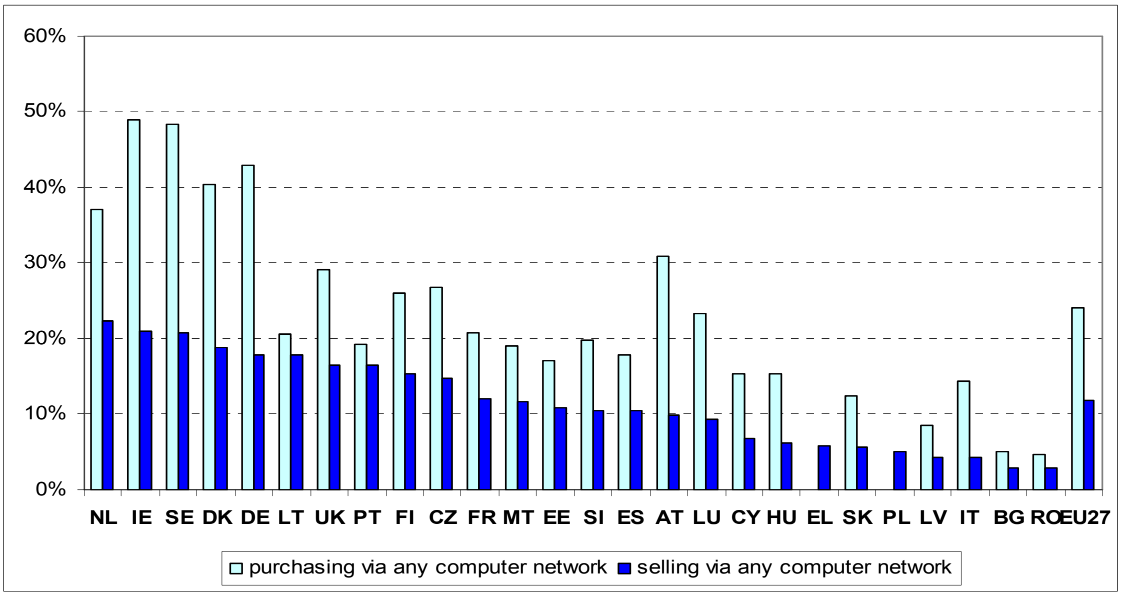
100 OECD definition, recently revised in DSTI/ICCP/IIS(2009)5/FINAL of 12 Feb 2010.

101 Provisional estimation because no data are yet available for Belgium and there is a break in the time series for UK because of a major change in the questionnaire.

102 Estimation for enterprises with 10 or more employees, excluding the financial sector.

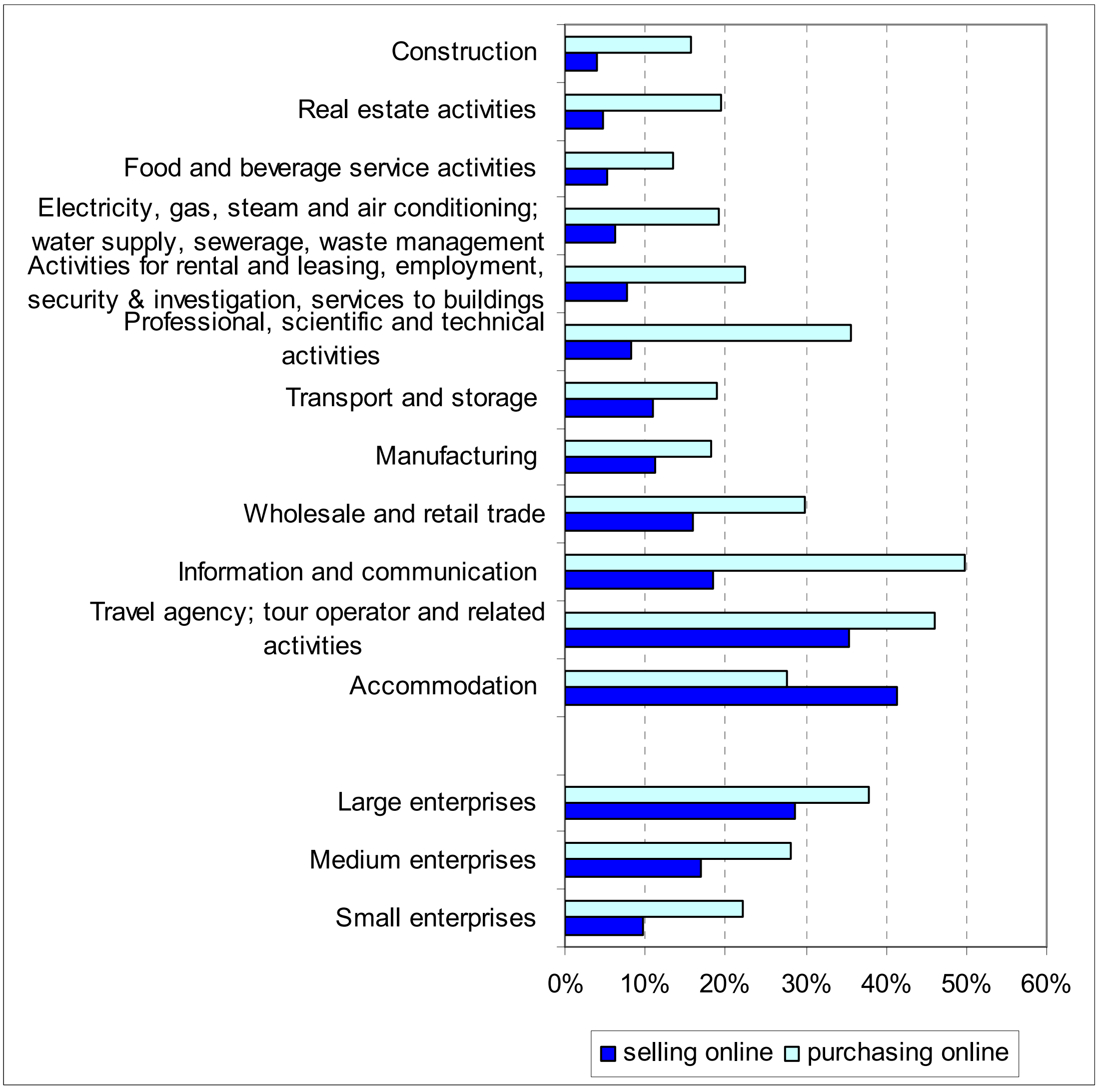
Figure 6.3: **% of enterprises engaged in eCommerce (at least 1% of their total turnover or total purchases), 2008**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

Figure 6.3 illustrates the use of eCommerce in Member State enterprises. Differences in the relative spread of electronic sales compared to electronic purchases are due to various factors, such as the relative share of B2C compared to B2B and economic structure (size of enterprises and economic sectors). In 2009 more enterprises were purchasing online rather than buying, both for small and large enterprises (although for the latter the difference is smaller). This might be explained by the fact that selling electronically requires to set up an IT infrastructure whereas buying online only entails to have access to the Internet.Tourism enterprises are by far the most active online sellers, followed by information and communication and the trade sector (Figure 6.4). Moreover, a large number of enterprises engaged in eCommerce does not necessarily translate into a significant increase in turnover. For example, estimates for 2008 indicate that online sales in the manufacturing of machinery and electric equipment sector represent 23 % of total turnover.

Figure 6.4: **% of enterprises having purchased on-line in 2008 (at least 1 %)**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

eCommerce includes both EDI eCommerce (e.g. an eBusiness tool for sending or receiving business information in an agreed format) as well as web based transactions. EDI eCommerce can be considered as B2B eCommerce whereas web Commerce includes B2B and B2C eCommerce components. EDI eCommerce is currently driving two thirds of the total. Reasons are related to its early introduction, higher security and higher volumes involved in B2B transactions. However, web-based transactions are on the rise, as technological developments in this area allow increasing levels of sophistication. These developments are also reflected in the increasing number of eCommerce facilities on enterprise websites.

In 2009, 81 % of medium and 90 % of large enterprises had a website, the average being 65 % for all enterprises (up from 61 % in 2005). Over time, there has been significant fragmentation in website availability for small enterprises across countries. Small enterprises in AT, BG, DE, EE, ES, FI, HU, LT, LU, LV, NL, PL, PT, SI, SK have seen increases of around 10 pp up to 20 pp, while no relevant progress has been registered in other countries.

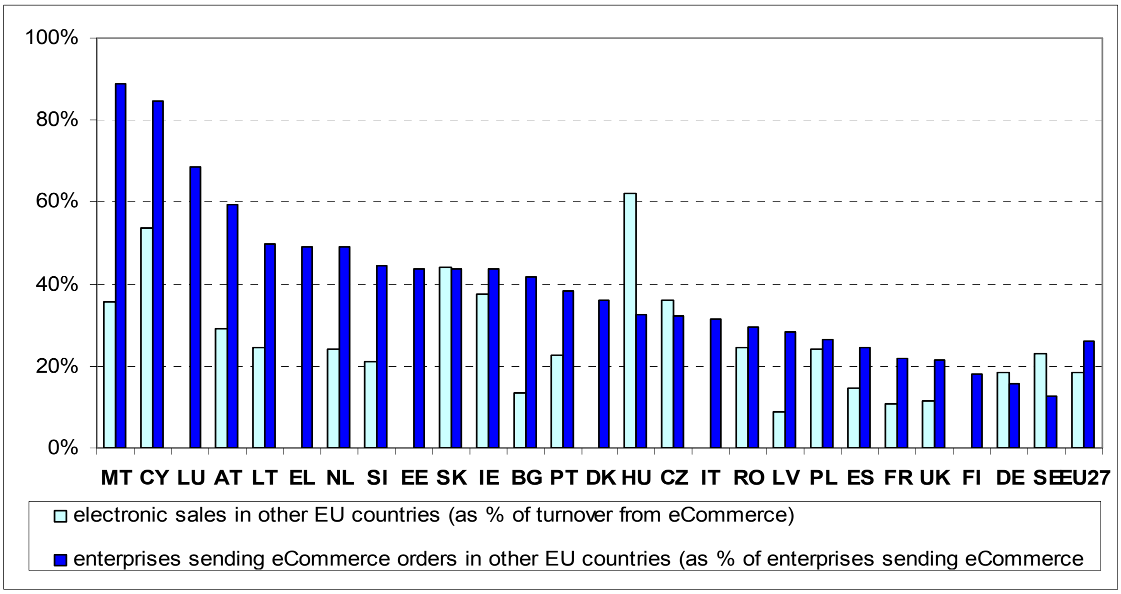
Websites provide the following facilities:

- 45 % of enterprises with a website display a privacy policy statement/seal/certification
- 57 % of enterprises with a website offer a product catalogue or price list
- 23-25 % of enterprises with a website have an ordering, reservation or booking facility
- 11.3 % of enterprises with a website have an order tracking facility

Another indication of efforts made by enterprises to offer eCommerce solutions that can be trusted is the rise in the proportion using a secure protocol for taking orders, such as SSL and TLS. From 2008 to 2009 this rose from 31 % to 37 % of enterprises selling online.

Regarding the cross-border dimension of the internal market, around 20 % of sales are to other EU countries, and 25 % of purchases are from other EU countries. Here too, the size of the country seems to play a key role in motivating enterprises to buy or sell in other countries. Unlike for individuals, the linguistic factor appears much less relevant.

Figure 6.5: **Enterprises engaged in cross-border eCommerce**

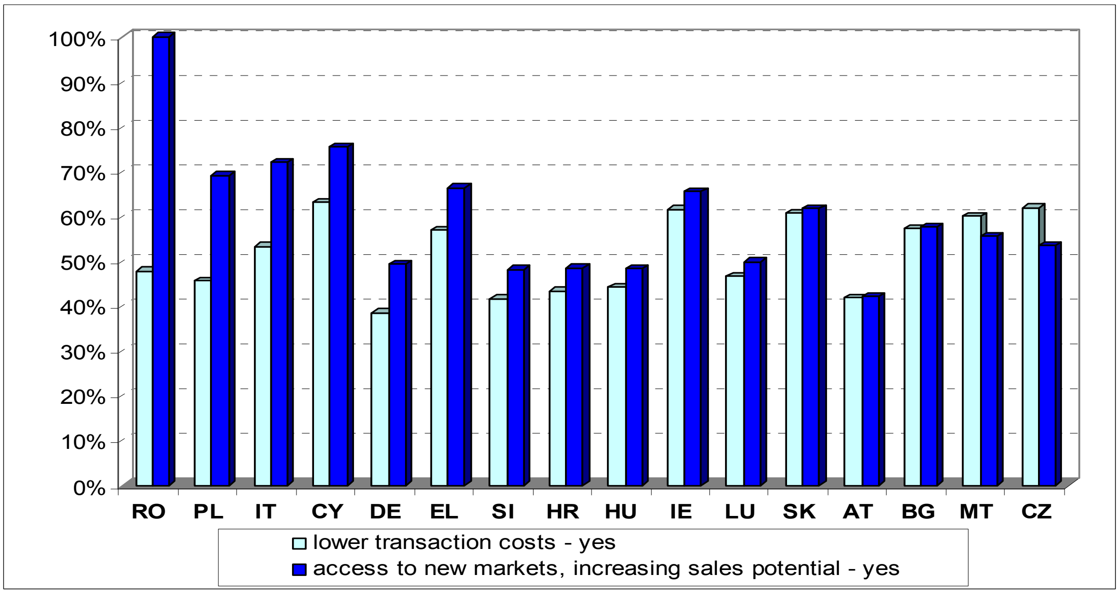


Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises[103]

The adoption of electronic sales is expected to benefit enterprises depending on structural characteristics and business models. Some countries have surveyed this subject. In general, half of enterprises receiving orders electronically report an increase in turnover (the other half reporting no increase). The results for two other relevant categories are presented in Figure 6.6[104]. In the majority of cases, access to new markets appears more important than lower transaction costs, although the reverse seems to be the case for MT and CZ.

103 DK, EE, IT, LU: unreliable data.
104 Optional question: data not available for the not mentioned countries

Figure 6.6: **Effects of the adoption of electronic sales (as % of enterprises receiving orders via electronic networks), 2009**

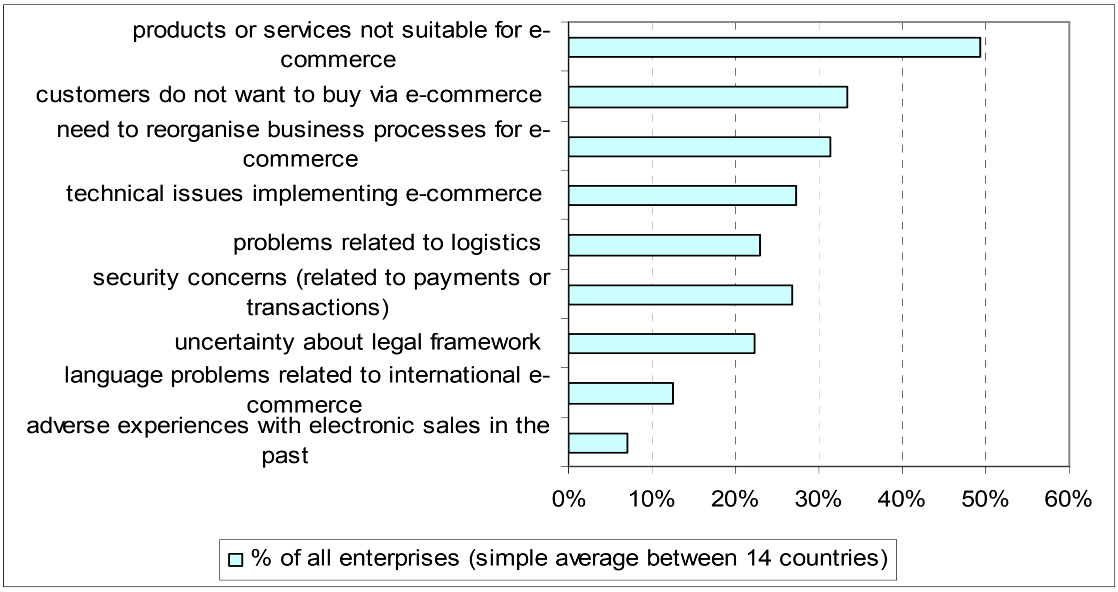


Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

Enterprises in AT, BG, CY, DE, EL, HU, IT, LT, LU, LV, MT, PT, SI, and SK have investigated the main barriers or problems experienced in trying to sell online. The ranking of the suggested barriers is quite consistent and stable across the various countries (Figure 6.7).

At least half of enterprises consider their products or services not suitable for eCommerce and/or do not think customers want to buy them this way. This is followed by three groups citing the costs and technical, economic or professional difficulties, ranging from the need to reorganise business processes to logistic difficulties. More than 25% of enterprises have security concerns and more than 20% point to uncertainty about the legal framework for selling online. Language problems are not often mentioned, and then mainly by small enterprises. Between 2% and 10% of enterprises, depending on the country, mention adverse experiences with electronic sales in the past, which may partly explain the decline noted above in the number of enterprises engaged in eCommerce.

Figure 6.7: **Problems with and barriers to electronic sales, 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

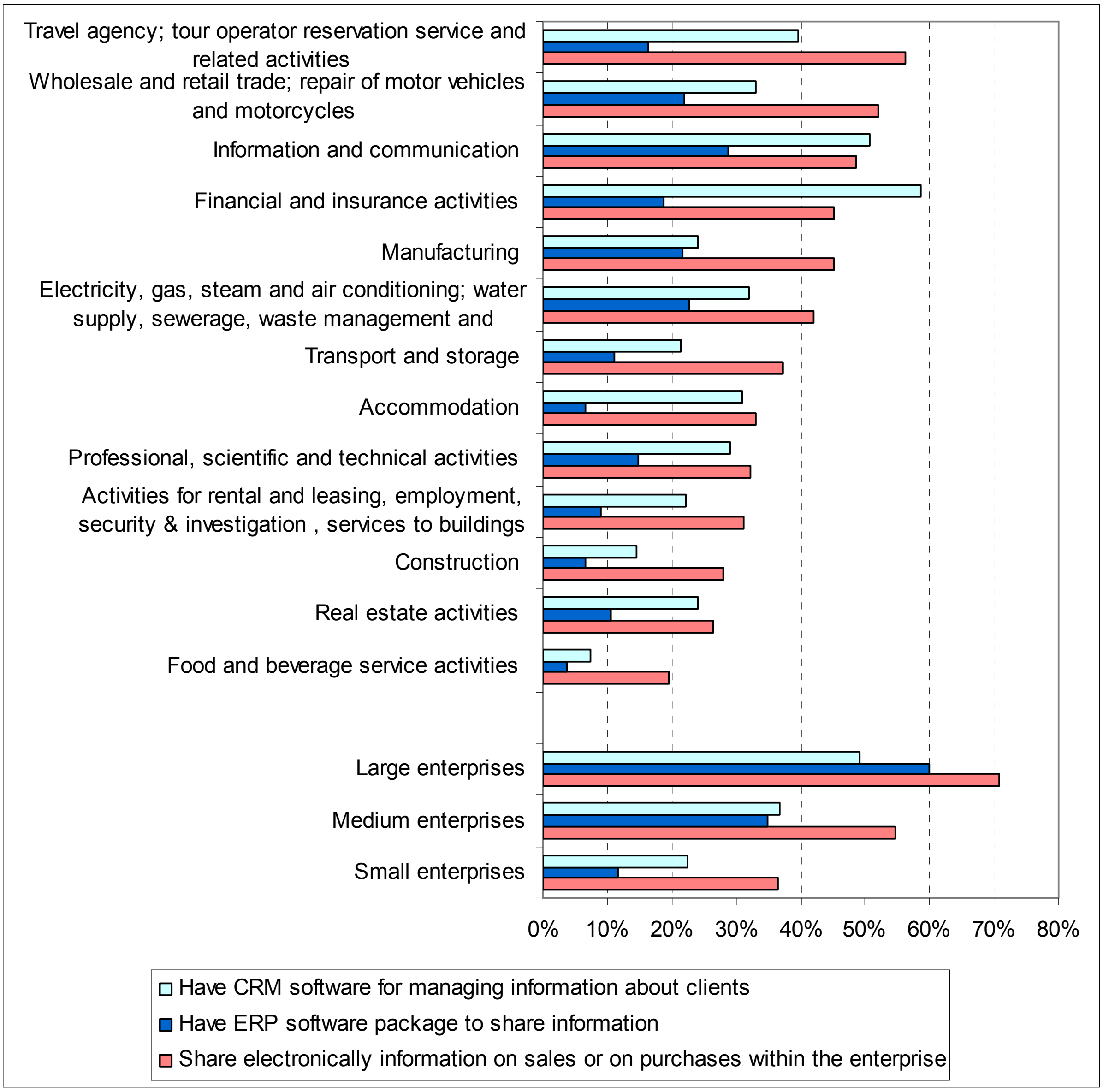
1.35. 6.4. eBusiness applications

The adoption of eBusiness applications is crucial to ensuring productivity gains. Investment in technology is not sufficient if not accompanied by the reorganisation of internal processes. ICT applications that help automate business processes can be an important source of efficiency gains when accompanied by innovative working practices and the appropriate skills. Despite their importance in economic terms, progress in the take-up of such applications in recent years has been slow. This is probably due to the complex organisational challenges that go hand in hand with the introduction of ICT-based automation.

No significant change has been observed since 2008 (Figure 6.8). Large enterprises have a higher propensity to adopt internal applications for integrated information management. Applications to share electronic information within the enterprise have been adopted by 40 % of all enterprises. These applications have been widely taken up across all sectors, not only by the service sectors but also by manufacturing. Nevertheless, while 71 % of large enterprises have adopted information sharing applications, only one third of small enterprises have done so.

Such applications are used mainly for the exchange of accounting information, the management of inventory levels, the management of production processes or distribution management. In some cases, a unique integrated solution, often termed ERP (enterprise resources planning), is adopted (by 16 % of all enterprises, but by 60 % of large firms). Another family of typical applications (CRM software) permit new and better uses of information about clients. 25 % of EU enterprises now make use of such software, in particular in the financial and information/communication sectors.

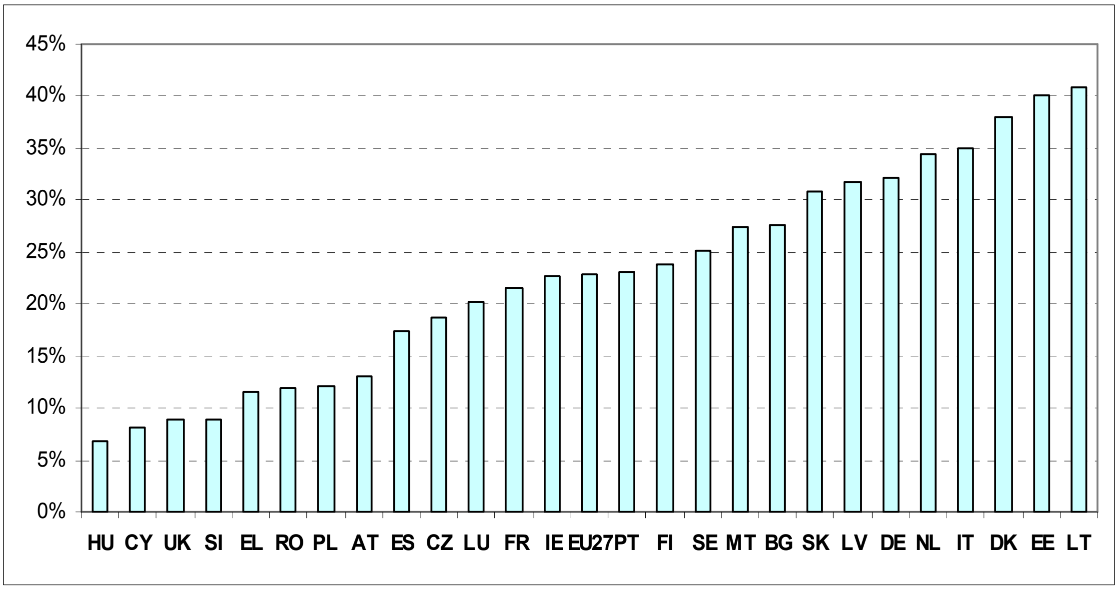
Figure 6.8: **Automated sharing of information within enterprises, by activity sector and enterprise size, 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

Another key application automates relationships with business partners, thus gaining time and reducing paper workload. At EU level, 41 % of enterprises (representing 61 % of total employed persons) have some form of automated data exchange with other IT systems outside the enterprise. These exchanges concern the sending/receiving of orders, electronic invoices, product information, transport documents, payment instructions to financial institutions, and data for public authorities, and can be split into relations with business partners, with financial institutions and with public authorities. Most enterprises engaging in automated data exchange do so with other businesses (86 %), but a significant number also have exchanges with financial institutions (72 %) and with public authorities (68 %), meaning that once the technology is adopted a large proportion of enterprises exchange data with all types of partners. Of particular interest is sending or receiving e-invoices, which in 2009 had been taken up by 23 % of enterprises (up from 18 % in 2007). The prevalence of e-invoicing by country depends not only on the degree of ICT take-up by enterprises but also on the specific legal framework of each country and national invoicing practices (Figure 6.9).

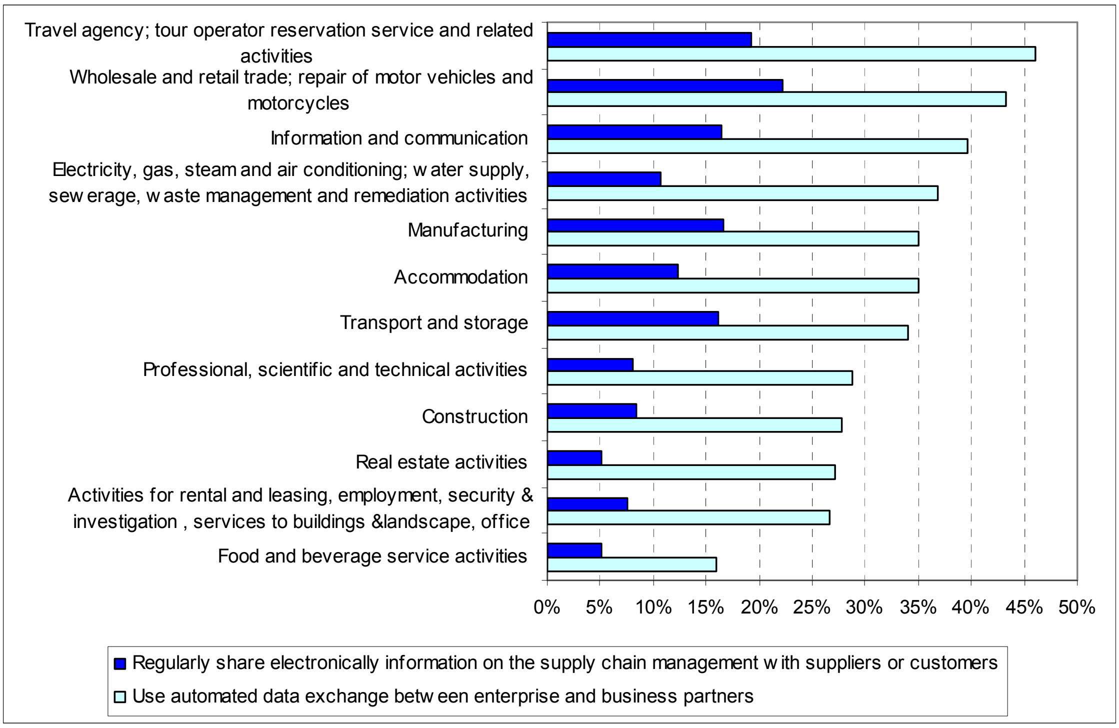
Figure 6.9: **% of all enterprises using automated data exchange for sending or receiving e-invoices, by country, 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

34 % of EU enterprises use ICT to exchange information with business partners (Figure 6.10), but in some cases this exchange of information can go beyond just sales or purchases and can also include information about inventory levels, demand forecasts, production plans or delivery progress, so as to facilitate management of the supply chain. This is the case for 15 % of all enterprises.

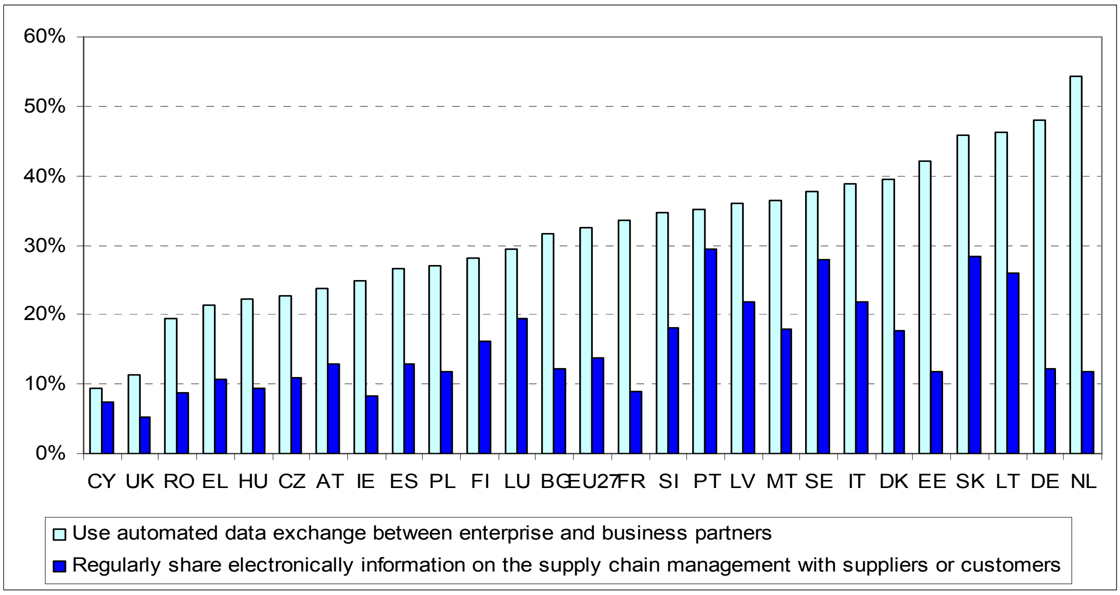
Figure 6.10: **Use of ICT to exchange information with business partners, 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

Such applications are mainly used by large enterprises (68 % of large enterprises for automated data exchange and 33 % for supply chain management). However, an increasing number of small enterprises are also adopting this type of solution (Figure 6.11), partly as a result of the 'hub and spoke' model.

Figure 6.11: **Use of ICT by small enterprises to exchange information with business partners, 2009**



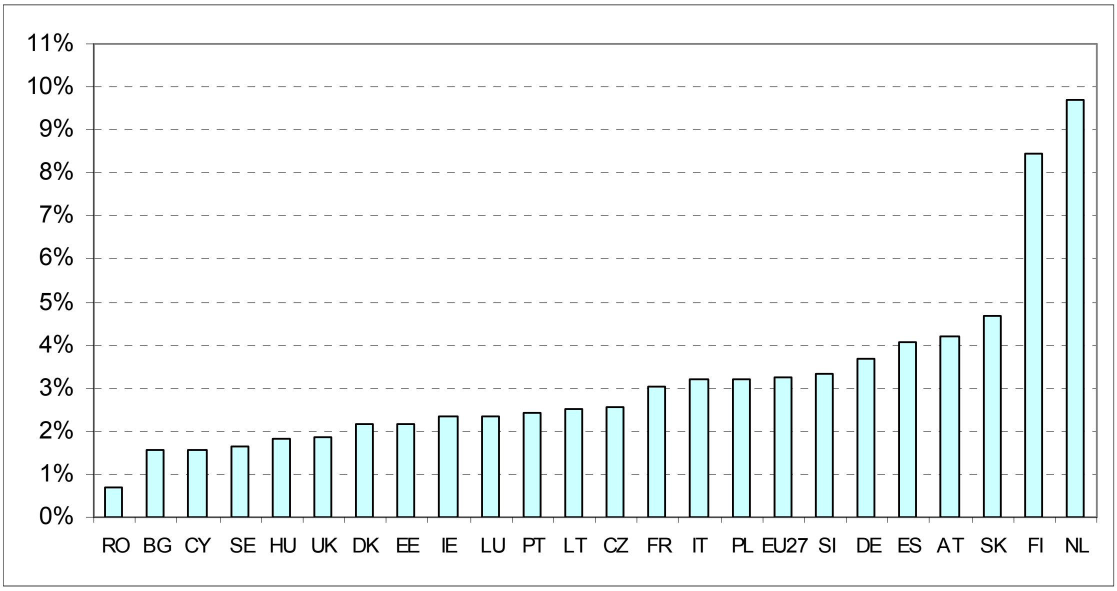
Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

1.36. 6.5. Supporting innovation

Together with applications facilitating the internal reorganisation of business processes, innovative wireless devices such as RFID are also expected to bring significant efficiency gains to the economy. This technology makes use of tags to register and store information. It can be applied to any kind of goods and products, and can be used for contactless payment and personal identification (when used on badges for example).

A first extensive estimate of the spread of RFID-based tags and cards (Figure 6.12) shows that 3 % of all enterprises with more than 10 employees were using this technology in 2009 (representing 14 % of the workforce), though with important differences by sector and in terms of type of use (personal identification, tagging goods in the production process or tracking after sale).

Figure 6.12: **Spread of RFID technologies (% of all enterprises), 2009**



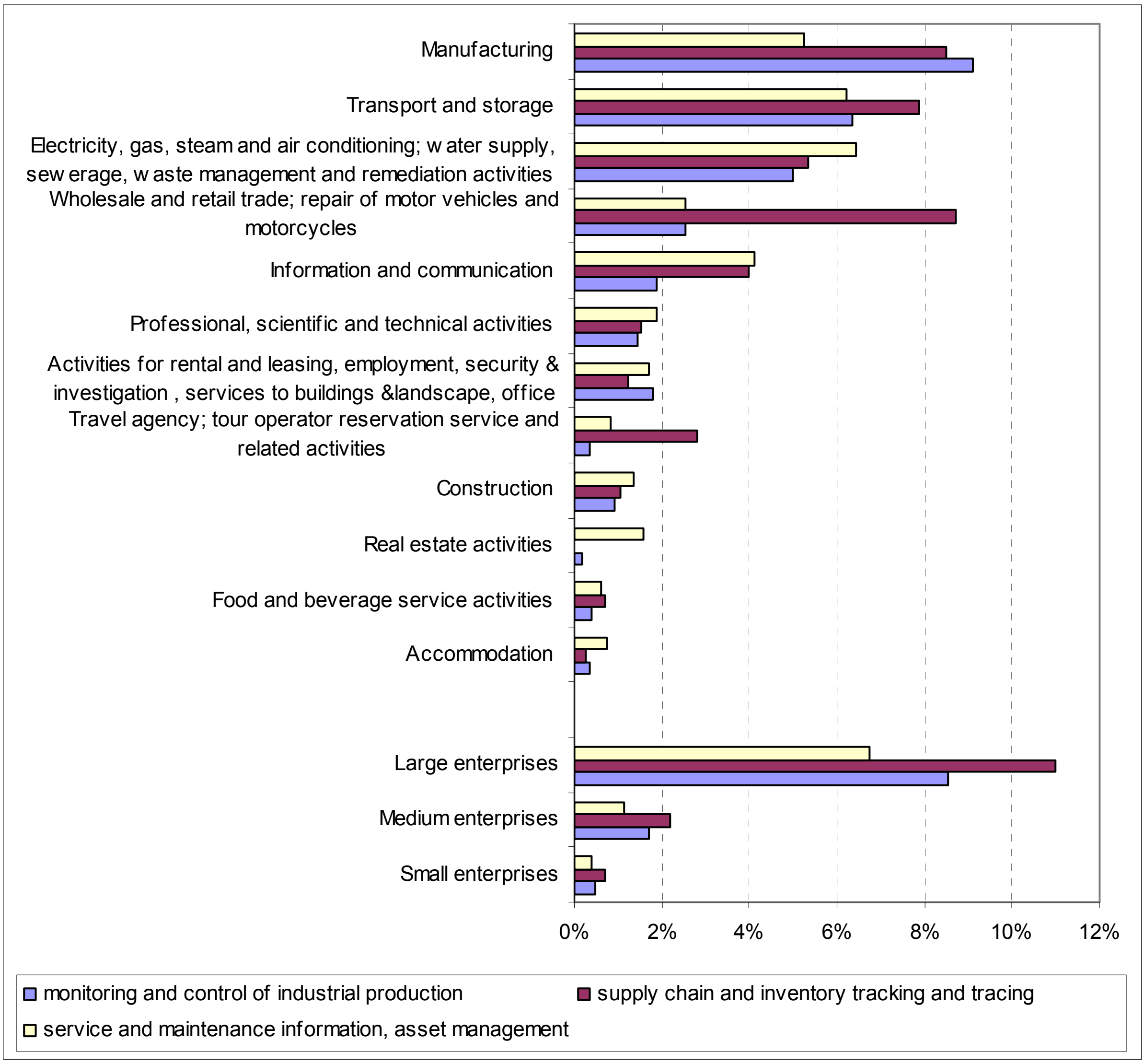
Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises[105]

The most commonly reported application of RFID tags and instruments is for personal identification or access control, particularly in large enterprises, 10 % of which use the technology (employing 15 % of the workforce). However, it is also used by 4 % of medium-sized enterprises in the EU (particularly in Finland and the Netherlands, by between 12% and 15 % of medium-sized enterprises).

Other uses with a potentially greater impact on business organisation are those related to the production process, particularly the tracking of products and other objects in the supply chain or for maintenance and asset management. Manufacturing, transport, wholesale and retail are the sectors most concerned.

105 EL, LV, MT: data not available.

Figure 6.13: **Use of RFID technologies in production processes, by sector and size class, 2009 (enterprises weighted in % of workforce)**



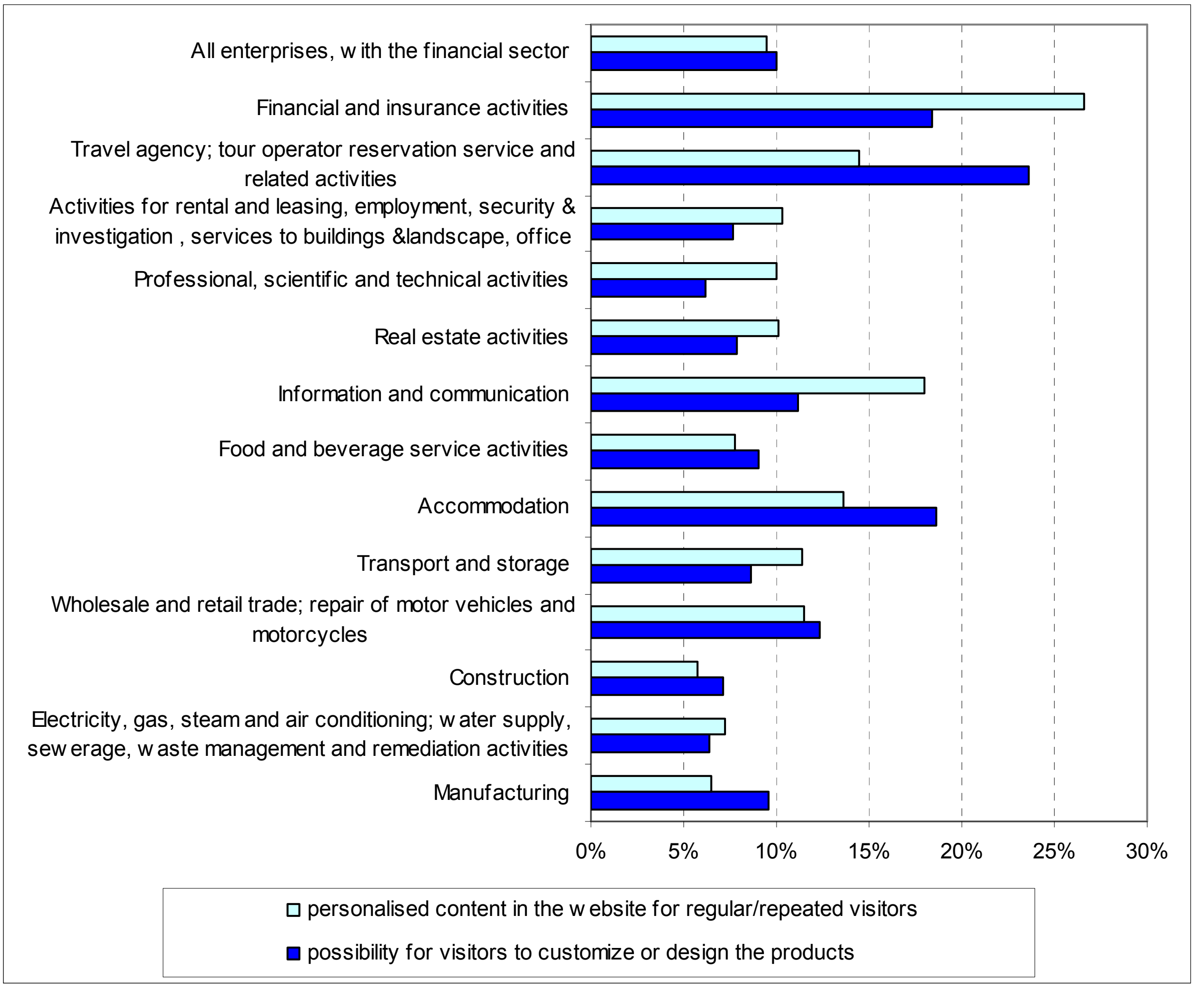
Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

A third family of applications involves the use of RFID tags on goods after sale for product identification. 4% of large enterprises, representing 9% of the workforce employed by all large enterprises, make use of this technology, in particular in sectors like retail and the manufacturing of motor vehicles, computers, machinery & equipment.

The literature has often highlighted the potential of ICT to help bring about new forms of collaborative work, not only inside enterprises and professional networks, but also between production actors and consumers. This can shape the creation of new types of products, personalisation and other forms of user-driven innovation. A rough indication of such developments is provided by two indicators tracking the level of sophistication of enterprise websites (Figure 6.14).

The possibility to customise products is clearly more obviously present in the service sectors, and is offered by around 20% of enterprises having a website which are active in tourism (accommodation, travel agencies and tour operators), followed by the financial and insurance sector. In the manufacturing sector as well, however, almost 10% of enterprises offer this possibility. Financial institutions and telecoms operators score higher on the personalisation indicator, as they use their websites to give clients access to their personal files.

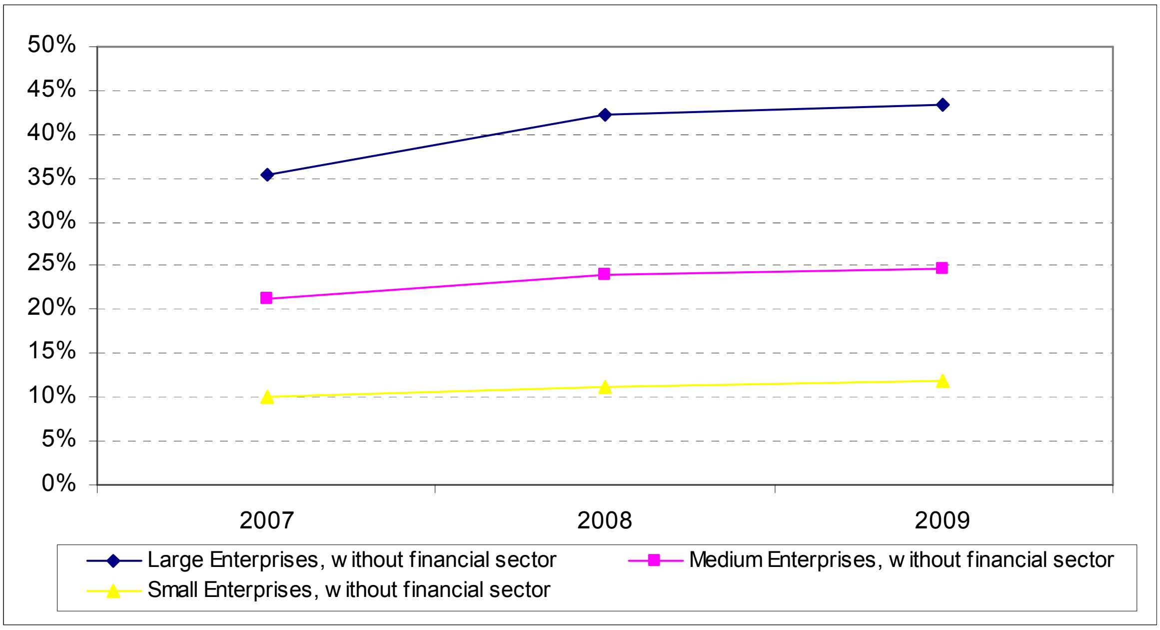
Figure 6.14: **Innovative facilities on websites (in % of enterprises having a website), 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

Another opportunity for innovation is provided by open source software solutions. Europe is the main contributor to the open source software community across the world and is the region where open source software is the most widely deployed. It features some characteristics (such as source code availability, no licensing costs, and the possibility to modify it, (re)distribute it, and/or use it as a component in custom applications) that can help raise productivity and support innovation, not only because of its lower price relative to proprietary software products, but also because it allows for greater customisation of information systems (addressing customer needs with value added solutions). The increasing use of this type of software is exemplified by operating systems such as Linux (Figure 6.15), but a great number of applications also exist for the design of integrated solutions for several eBusiness functions (including ERP, CRM, and other automated information exchange within the enterprise and with suppliers and customers).

Figure 6.15: **% of enterprises that use third-party free or open source operating systems, 2009**



Source: Eurostat Community Survey on ICT Usage and eCommerce by Enterprises

A recent study of the software and software-based services market (SSBS)[106] estimated the value of the European software market at €229 billion in 2008. For 2007, the estimated average software spending by employee (DE, FR and UK) varied from €250 (very small companies <10 employees) to €600 (very large enterprises >2000 employees). In 2008, open source accounted for only €4 billion of the above €229 billion. But it is estimated to grow at a rate of 30-40% per year to reach €12 billion in 2012.

1.37. 6.6. Conclusions

A variety of ICT equipment and eBusiness solutions have been adopted in recent years by European enterprises. This chapter has described the extent of this take-up in different countries and in different economic sectors, giving a picture of perhaps slow but persistent progress.

It is very difficult to assess and describe the effects of such a process. One of the most visible is the proportion of commercial transactions now handled online. But even for this relatively simple effect, the continued evolution of technology makes it quite difficult to develop robust measurements. The impression is of a consolidation phase in eCommerce, with some enterprises exploring and taking advantage of such instruments and others trying and then abandoning them.

At a deeper level, the adoption of ICT and eBusiness applications has had a dramatic and widespread effect on the quality of work. As socio-economic studies have shown over the years, working conditions have been deeply affected in all their dimensions: often

106 EC study on Economic and social impact of software & software based services, by PAC (smart 2009/041).

accompanied by increased job enrichment and work satisfaction, but also tighter control and disempowerment of workers.

Furthermore, the expected effects in terms of productivity gains are not guaranteed: investment in ICT and eBusiness has remained a social and economic cost when not adequately accompanied by re-organisation to involve workers and harness their competence and skills. The next chapter presents the results of an empirical study on this subject.

Nevertheless, as discussed in the last section, technological innovations such as RFID spread quickly and can be adopted and adapted to create business innovation. It is difficult to judge if the process is quick enough, as it involves a collective learning process, not only on the part of entrepreneurs but also for the majority of workers.

Finally, it should be noted that the current maturity of ICT technologies offers opportunities for a large variety of business models. For some enterprises, the path to follow is to exploit automation. Others may want to use eCommerce to open new markets or to add value to goods in the form of services and personalisation. In some cases, enterprises may simply exploit the information available on the net, while in others they can use it to reduce costs and energy consumption. Vertical integration between the enterprises in a sector can also be pursued. This variety of business models, strongly influenced by ICT take-up, will have to be analysed in more depth in the future.

7. 7. THE ECONOMIC IMPACT OF ICT

This chapter looks at the latest evidence of the economic impact of ICT, based on the results of a recent study on the topic commissioned by the European Commission.[107]

The impact of ICT on productivity growth has so far been analysed mainly using growth accounting theories, and the results are widely known: During the mid-nineties the US experienced a productivity 'miracle' not shared by the EU. In particular, the US benefited from higher productivity gains in ICT-producing industries (due to a higher share of the ICT industry in the economy), as well as from a capital deepening effect due to investment in ICT assets throughout the economy. These changes were driven by the rapid pace of innovation in ICT, fuelled by the continuing fall in semiconductor prices. However, the greatest difference between the EU and the US, and for that matter between EU countries themselves, was in the overall efficiency of the production process. In particular, the US experienced more rapid productivity growth in market services, such as trade, and business services than the EU. As the EU experienced a similar fall in ICT prices, this implied that there were barriers to the economic exploitation of ICT in Europe.

The study carried out for the European Commission takes a 'micro-to-macro' approach using a large-scale, cross-country firm-level database on ICT and productivity. In doing so, it is able to test explicitly for firm-level characteristics that might influence productivity gains from ICT. Previous firm-level research showed that the productivity impact of ICT is larger than what would be expected based on economic theory, suggesting that there are unmeasured firm-level complementary factors working together with ICT to influence productivity. However, previous analysis was unable to analyse these factors empirically due to the lack of data.

Indeed, the firm-level analysis carried out confirms the importance of complementary firm-level factors in achieving gains from ICT. In particular, the study finds that complementary organisational change, in the form of better management practice and a more decentralised management structure, is crucial for achieving the productivity potential of ICT. These factors, together with a higher ICT intensity and higher skill levels, account for most of the EU-US productivity gap. Further, greater accumulation of 'organisational capital' in the US compared to the EU is attributed to lower levels of labour and product market regulation. Productivity differences among EU countries are found to be strongly related to the latter.

The rest of this chapter is organised as follows. The next part discusses the US-EU productivity gap by presenting data on productivity developments in the two economic areas and reviewing past literature on the topic. Part two provides a brief overview of the micro-to-macro method, used for the majority of the analysis, and the data used. Part three discusses the findings of the analyses based on this approach as regards productivity. Part four looks at investment and ICT adoption, part five at the impact of ICT on innovation and part six at globalisation. Part seven provides an overview of the results in terms of prices, spatial concentration and job satisfaction. Part eight provides some policy conclusions and an outlook.

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[107] 'The Economic Impact of ICT' conducted by the London School of Economics, a study for the European Commission.

1.38. 7.1. Background

7.1.1. Insights from the growth accounting literature

A large literature now exists on the analysis of the impact of ICT on productivity. The most popular approach used in the literature is the so-called ‘growth accounting’ method. This method breaks down the sources of productivity growth into the different inputs used in the production process: labour, materials and physical capital (including ICT). The remaining unexplained part is attributed to improvements in the efficiency of production due to technology improvements, or so-called ‘total factor productivity’ (TFP).

A recent growth accounting study that analyses the US productivity resurgence is Jorgensen, Ho and Stiroh (2008). They analyse US productivity growth from 1959-2006 and identify two phases in the post-1995 resurgence: 1995-2000 and 2000-2006. The rationale behind these phases can be seen in the table reproduced below (Table 7.1).

Table 7.1: **Source of US productivity growth, 1959-2006**

Source of US Productivity Growth, 1959-2006					
	(1) 1959-2006	(2) 1959-1973	(3) 1973-1995	(4) 1995-2000	(5) 2000-2005
Private output	3.58	4.08	3.08	4.77	3.01
Hours worked	1.44	1.36	1.59	20.7	0.51
Average labour productivity	2.14	2.82	1.49	2.70	2.50
Contribution of capital deepening	1.14	1.40	0.85	1.51	1.26
Information technology	0.43	0.21	0.40	1.01	0.58
Non-information technology	0.70	1.19	0.45	0.49	0.69
Contribution of labour quality	0.26	0.28	0.25	0.19	0.31
Total factor productivity	0.75	1.14	0.39	1.00	0.92
Information technology	0.25	0.09	0.25	0.58	0.38
Non-information technology	0.49	1.05	0.14	0.42	0.54
Share attributed to information technology	0.32	0.11	0.43	0.59	0.38

Source: Jorgenson, Ho and Stiroh (2008) Data are for the US private economy with all figures in average growth rates. Capital includes business capital and consumer durables. Information technology is defined as including hardware, software, and communications equipment.

In the table, growth in output is divided into hours worked and labour productivity, with the latter then broken down into the standard growth accounting components. The first point to notice is the acceleration of ICT-related capital deepening between the periods 1973-1995 and 1995-2000, which increases from 0.40 to 1.01 (two thirds of the capital deepening effect). The TFP contribution of ICT also more than doubled from 0.25 to 0.58 from one period to the next.[108] In the post-2000 period, both ICT capital deepening and ICT-related TFP effects slowed down. However, the non-ICT TFP contribution increased from 0.42 to 0.54. These gains outside the ICT sector are suggestive of a ‘general purpose technology’, i.e. indicating that time and investment in complementary inputs have lead to gains outside the narrowly defined ICT sector.

What the growth accounting literature proposes is that rapid technological progress in the ICT-producing sector, in particular semiconductors, after 1994 led to a rapid fall in quality-adjusted prices for ICT goods. This was reflected by TFP growth in the ICT-producing sectors

[108] Note that this TFP contribution of ICT relates specifically to TFP growth in the ICT-producing industries and their subsequent accounting contribution to TFP rather than to any spillovers to non-ICT industries.

and ICT capital deepening in other sectors (as there was substitution away from other factors of production into ICT capital). This led to productivity growth.[109]

As we know, this productivity resurgence was not shared by the EU. Therefore, there has been much interest in the literature in finding the reasons for this difference. A recent study summarising the work in this area is Van Ark et al. (2008). The analysis identifies three phases in the US-EU productivity differential: 1950-1973, 1973-1995 and 1995-2006. In the first phase, the EU was catching up. EU GDP (5.3 %) grew more quickly than in the US (2.5 %). Key factors behind this period of catch-up were technology imitation and the influence of new post-war institutions. In the second phase, catch-up was slower, due to slower employment growth and a subsequent increase in capital intensity. In the final phase, there was a significant productivity slowdown with average GDP per hour worked being 1.5 % in the EU and 2.3 % in the US (Table 7.2).

Table 7.2: **Average annual growth rates of GDP, GDP per capita and GDP per hour worked, EU-15 and United States, 1950-2006**

Average annual growth rates of GDP, GDP per capita and GDP per hour worked, EU15 and United States, 1950-2006.

	(1) GDP	(2) GDP per capita	(3) GDP per hour worked
1950-1973			
EU-15	5.5	4.7	5.3
US	3.9	2.4	2.5
1973-1995			
EU-15	2.0	1.7	2.4
US	2.8	1.8	1.2
1995-2006			
EU-15	2.3	2.1	1.5
US	3.2	2.2	2.3

Source: van Ark, Mahoney and Timmer (2008). Estimates based on the Groningen Growth and Development Centre, Total Economy Database.

A breakdown of labour productivity growth differences by country and sector (see Table 7.3 — reproduced from Van Ark et al. (2008)) shows that the productivity gap is biggest in ICT production and market services. For the latter in particular, the gap is striking. While the growth rate in this sector was 0.5 % in the EU, in the US it was 1.8 %. Although market services include financial services, the results are not solely driven by this sector. Retail and wholesale trade also posted very high productivity growth throughout this period. These data do however highlight important differences within the EU. The UK's growth rate in market services during this period was 1.6 %, close to that of the US, and is in line with perceptions of the UK's economic similarities to the US in terms of labour and product market regulation.

109 While some authors (Gordon 2000, 2003) have disputed the view that ICT played an important role in US productivity growth after 1995, claiming that productivity growth outside the ICT sector was entirely cyclical, this view now seems implausible. The US economy suffered some cyclical downturns with the stock market crash in 2000, 9/11, the Iraq war, high oil prices and other shocks, but productivity growth continued to power ahead.

Table 7.3: **Major sector contribution to average annual labour productivity growth in the market economy, 1995-2004**

Major sector contribution to average annual labour productivity growth in the market economy, 1995-2004					
	(1) Market economy	(2) ICT production	(3) Goods production	(4) Market services	(5) Reallocation
Austria	2.2	0.3	1.7	0.3	-0.1
Belgium	1.8	0.3	1.0	0.5	-0.1
Denmark	1.4	0.3	0.8	0.3	0.0
Finland	3.3	1.6	1.3	0.4	0.0
France	2.0	0.5	1.0	0.6	0.0
Germany	1.6	0.5	0.9	0.2	0.0
Italy	0.5	0.3	0.3	-0.1	0.0
Netherlands	2.0	0.4	0.6	1.1	-0.1
Spain	0.2	0.1	0.1	0.1	-0.1
United Kingdom	2.7	0.5	0.7	1.6	-0.2
European Union	1.5	0.5	0.8	0.5	-0.2
United States	3.0	0.9	0.7	1.8	-0.3

Source: van Ark, Mahoney and Timmer (2008). Calculations based on the EU KLEMS database. Column (1) is the sum of the components in columns (1)-(5). The European Union aggregate refers to the ten countries covered in the table.

Despite much discussion of the reasons for the US-EU productivity differential, no consensus has emerged. While some authors believe it is only a matter of time before Europe resumes the catching-up process (Blanchard 2004), others point to long-term structural problems in Europe such as over-regulated labour and product markets (Gust and Marquez 2004). While the latest available evidence (2004-2007) from productivity growth accounting (see next section) seems to give credence to the former optimistic interpretation, this still needs to be corroborated by further data to be established as a stylised fact, especially in view of the recent financial crisis.

7.1.2. Insights from firm-level studies[110]

Due to concerns about aggregation and other biases, academic research on the impact of ICT on productivity has shifted towards more micro-level analysis. Micro-level analysis provides a number of important insights into the productivity puzzle. Firstly, most studies find a positive and significant relationship between ICT and productivity.[111]

Secondly, the size of the impact is found to be larger than what would be expected, based on the theoretical assumptions underlying the growth accounting methodology (e.g. in Brynjolfsson and Hitt 2003). The main explanation put forward for above-normal returns to ICT is the presence of complementary organisational capital. That is, the measures of ICT used in these studies are capturing the effect of other inputs in addition to ICT, such as organisational structures, efficient management practices or other advanced non-ICT production technologies. However, until now there have been no studies explicitly testing this theory.

[110] While there are also studies at industry level, results from these studies are often contradictory and therefore provide few useful insights. Accordingly, they are not discussed further here.

[111] This is important because many were undertaken in response to Solow's arguments, the so-called 'Solow Paradox', that there was no productivity impact from ICT.

Thirdly, a few studies do find some evidence of the role of organisational capital in explaining above-average estimated returns from ICT: Bresnahan, Brynjolfsson and Hitt (2002), for example, who conducted a survey with explicit questions on decentralisation within firms. Bloom, Saduna and Van Reenen (2008) find some support for the organisational capital hypothesis as they find much higher returns for ICT in US multinationals than in non-multinationals in a comparison between statistically similar establishments in the UK. Their work also establishes important interaction effects between ICT and aspects of organisation (such as 'people management' practices e.g. promotions, hiring and firing, and reward systems) in predicting productivity. US (and other) multinationals transplant such practices abroad and this leads to higher returns to ICT.

Finally, studies provide a very wide range of estimates of the impact of ICT on output. Stiroh (2004) compares the results from a number of studies. He finds the average impact to be 0.05, which is well above the share of ICT in revenue, as noted above. This suggests that a 10% increase in ICT inputs is related to a 0.5% increase in output. However, estimates vary between more than 25% and minus 6%. This large variation is partly due to methodological differences, but also suggests differences in ICT impact by country, industry and type of firm.

1.39. 7.2. Methodological approach

To address the unresolved puzzles in the existing evidence on ICT and productivity, as well as other impacts, the study described here follows a 'micro-to-macro' approach rooted in microeconomic decision-making at firm level. It is based on the view that in order to understand economic aggregates such as productivity, it is necessary to understand what is happening at firm level and how companies respond to changes in the economic and policy environment.

A key component of the methodology is the compilation and analysis of large-scale, original company databases with hundreds of thousands of observations. Typically, these follow the same companies over a number of years across many countries in Europe and overseas. This allows the estimation of sophisticated econometric models of firm-level behaviour.

Although a number of different databases are used, the main one, AMATECH, has been specially compiled from a number of sources: BVD's Amadeus — containing productivity, investment, employment and wage data, covering nearly all firms in all European countries; Harte Hank's data on ICT — covering hardware, software and ICT personnel data on most EU countries and the US; and European Patent Office data on all European patents and their citations since 1978. These data are used together with many other sources of industry and macro data, as well as the CEP's (Centre for Economic Policy) own surveys of the managerial and organisational structure of firms (involving around 7 000 interviews with plant managers across 17 countries).

1.40. 7.3. ICT and productivity

Empirical estimation[112] of the impact of ICT on productivity results in an ICT productivity coefficient of 0.023.[113] While smaller than estimates obtained from a number of other

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112 *The model* upon which the analysis of the impact of ICT on productivity is based uses a standard neoclassical production function that relates output (Y) to a set of inputs X, where the inputs are ICT capital (C), non-ICT capital (K), labour (L) and materials (M). In addition, a coefficient (A) allows for different levels of efficiency:
$Y = AF(X) = AF(L,K, C, M)$. Assuming the production function can be written in a Cobb Douglas form, it can be re-written in natural logarithms: $y = a + \alpha_l l + \alpha_k k + \alpha_c c + \alpha_m m$. For estimation purposes, this can then be written in the following econometric framework: $y_{ijkt} = \beta^c c_{ijkt} + \beta^k k_{ijkt} + \beta^l l_{ijkt} + \gamma x_{ijkt} + u_{ijkt}$;

specifications, this is however still relatively large. In fact it is still higher than the share of ICT in capital (approximately 1-2% for this sample), i.e. higher than assumed under the growth accounting method.

These results are comparable to those for a similar study for the US (Brynjolfsson and Hitt 2003). Brynjolfsson and Hitt (2003) use a sample of large US firms over the period 1987-1994 and find an ICT capital coefficient of between 0.020 and 0.035 for a specification similar to that used in the above analysis for European firms. Indeed re-estimation of the ICT coefficient for the US following the approach of Brynjolfsson and Hitt (2003) using COMPUSTAT data for the period 1996-2008 results in a coefficient (0.020) similar to that for Europe.

Therefore, the analysis confirms the findings of above-normal returns in other studies. One interpretation is that this indicates the presence of unobservable complementary factors. This hypothesis is examined in depth in the study (see below).

To test for a number of other potential factors influencing the productivity impact of ICT, the basic analysis is extended along a number of lines. The first extension in the analysis for Europe is to test for *firm heterogeneity* in the impact of ICT on productivity across a number of dimensions: firm size, age, time, regions and industries (ICT-intensive versus non-ICT-intensive).[114] No significant effects could be found for firm size, age or high-tech region. However, a significant effect is found for ICT-intensive industries. In particular, ICT-intensive industries are found to have an elasticity of output with respect to ICT which is about twice that of non-ICT-intensive industries (with this difference significant at the 5% level). According to Van Ark et al. (2002) it is these industries that help explain the acceleration of US productivity growth compared with European productivity growth. The last point is important because the rapid growth in US productivity after 1995 occurred in the ICT-intensive service sector.

The second extension is to test for the presence of *productivity spillovers* from ICT, i.e. the idea that there might be spillovers on a firm's productivity from the ICT of other firms in the economy (after controlling for the firm's own ICT inputs). Tests are made for two types of spillovers: those from the ICT of firms in the same region and those from firms in the same industry and region. However, no strong evidence of either type is found. This is consistent with Stiroh (2004), who finds no robust evidence of ICT spillovers in the US data. It is also in line with the general literature on physical capital, which reports little evidence of spillovers, rather than the R&D literature, which finds strong regional and industrial knowledge spillovers.[115] In terms of theory the absence of spillovers is not that surprising. R&D expenditure represents a highly uncertain investment in an activity that may create knowledge

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where the variables y, c, k and l again denote the logarithms of real output, ICT capital, non-ICT capital and labour. The term x represents a vector, or set, of other possible variables. The subscripts denote industry j, country k and time t. The u term is a stochastic error term.

This production function is estimated for a panel of European firms drawn from the AMATECH database. The panel includes approximately 19 000 firms across 13 countries covering the period 1998-2008. The measure used for ICT is the number of laptops and PCs per worker. Descriptive statistics for this dataset show that the median firm size is 140 employees, with a mean of just under 400, and that the average PC intensity is 0.5 (i.e. one computer per two employees).

113 Results obtained using the preferred specification, which controls for unobservable factors at firm level (e.g. unmeasured managerial or technological ability specific to the firm), using the 'within groups' method.

114 It was not possible to test for heterogeneity in the US sample because COMPUSTAT only contains large, publicly listed firms, resulting in a smaller sample.

115 On R&D spillovers see, for example, Griffith (2000).

and innovation in the future. Other firms are then able to benefit from this R&D through imitation, adoption or the development of further related innovations without necessarily paying a large cost to the firm performing the R&D. Since ICT investment is based on existing, embodied technology and knowledge there are fewer channels for such spillovers to operate.

Finally, the analysis is extended to explore *country differences* in the impact of ICT on productivity. The differential impact of ICT across countries is a major issue in the existing literature. Such contributions have concentrated on how cross-country differences are determined by compositional differences (i.e. differences in industrial specialisation), in particular the relative contributions of the ICT-producing and -using sectors (Van Ark 2008). Testing for country differences in the impact of ICT on productivity, using the UK as a baseline, a coefficient for the UK of about 0.24 is found, while other European countries have a significantly lower ICT coefficient, ranging from around 0.10 to 0.15. About half of the difference is accounted for by industrial composition and the rest can be explained by unobservable firm-level characteristics (such as human capital, intangible capital or firm-specific capital).

In terms of country effects, this pattern of unobservables can matter for policy if they are systematically related to country-level institutions. For example, labour and product regulation can influence the way firms are able to combine their complementary firm-specific inputs with ICT, thereby affecting the estimated results. Testing for this, by interacting indices of regulation with ICT, shows that both labour and product market regulation have significant negative effects. However, the effect of product market regulation (PMR) is around a fifth of the effect of labour market regulation (LMR). In particular, while LMR offsets the main effect of ICT by -45 %, PMR offsets it by -16 %. As the magnitude of these effects is consistent with the extent of cross-country differences in ICT and productivity, this implies that regulation could play a large role in explaining these differences. The results thus provide support for the idea that country-level factors (such as labour and product market regulation) shape the overall impact of ICT in terms of productivity.

Evidence on US multinationals operating in Europe suggests that approximately half of the US-EU productivity differential over the period 1995-2005 can be accounted for by *organisational capital*. Direct measures of different types of management practices interact significantly with ICT in determining firm-level productivity — US firms have better management practices, particularly in the area of 'people management'. This part of the gap represents the US-specific advantage in using a given level of ICT capital. The remaining half of the gap can be attributed to the advantage US firms have by possessing higher levels of ICT (25 % of the gap) and to other firm characteristics such as skills (25 %).[116]

In particular, management and organisational practices such as people management (better hiring, firing, promotion and pay practices) and decentralisation (giving more power to employees further down the managerial hierarchy) appear to complement ICT. In addition, skills are highly complementary to ICT.

ICT is found to have a significant role in influencing productivity through *reallocation*, i.e. the ongoing process of selection and relative firm growth in the economy. More ICT-intensive firms appear to grow faster and are less likely to die than other types of firms. That is, 'high-tech' firms rich in ICT capital are more likely to grow and survive than other types of firms,

[116] This evidence represents a major innovation of the report, in that it is able for the first time to directly measure important dimensions of firm-level organisational and human capital. Analysis of this depth was not possible in previous industry-level and macro growth accounting frameworks.

even after controlling for other important characteristics such as wages (a proxy for skill) and initial productivity. For example, the top two quintiles among high-tech firms are found to grow around 25-30 % faster in terms of employment and are also 3 % more likely survive over a 5-year period. This implies that the environment favours such firms and that they contribute to overall productivity growth through this reallocation effect. In terms of cross-country variation in Europe, technological selection effects are strongest for the UK and weakest for Austria, Finland and Switzerland.

In line with the production function results, the study also finds that labour and product market regulation are found to play a significant role in blunting technologically based selection effects in reallocation. In terms of employment growth, LMR reduces the ICT selection effect by one third while PMR reduces it by approximately one fifth. Again, the magnitude of these LMR and PMR effects suggests that these institutions could be a systematic driver of cross-country differences in reallocation and, therefore, productivity.

1.41. 7.4. Investment and ICT adoption

There is relatively little work on modelling *ICT as investment*. However, understanding it is crucial for examining policies to influence ICT adoption (for example, the magnitude of the impact of tax policies will depend on the elasticity of ICT with respect to its user cost of capital).

Therefore, following the micro-to-macro approach, the study considered here outlines the first investment equation for ICT capital in the literature and contrasts its dynamics with those of physical capital. The analysis shows that demand, as measured by the growth in firm sales, is an important determinant of both ICT and physical capital investment. It also shows that ICT responds more quickly to demand shocks than other forms of physical capital investment (e.g. in buildings and machinery).

ICT adoption is analysed by estimating ICT adoption models based on three well-established methods: the macro-diffusion, micro adoption and micro-timing approaches. These models provide information on different aspects of ICT adoption, so the authors of the study employ all three of them in order to obtain a detailed picture for the US and Europe.

The first approach, the macro-diffusion approach, is based on the estimation of a logistic diffusion curve, normally assumed to be S-shaped.[117] The estimated model provides information on three parameters of the diffusion process: the diffusion speed (β), i.e. how quickly maximum penetration is approached; the inflection point of the diffusion curve (γ); and the likely proportion of long-term adopters (τ). The model is estimated for PC diffusion in the manufacturing sector at country level, using non-linear least squares. The results show that while the γ and τ coefficients are significant, β is not. This is because technology adoption is not ideally suited to logistic diffusion functions. Nevertheless, results for the other parameters show that adoption ceilings are quite heterogeneous, with the Scandinavian countries and the UK indicating higher long-term penetration rates. By contrast, inflection points are similar across countries, with the exception of Austria and Norway. Regressions for the EU and US show that the EU exhibits a faster penetration rate, but has a long-run maximum penetration rate lower than for the US. As the estimated long-run maximum penetration rate has already

117 $DIFF_{kt} = \frac{ADOPT^*}{1+\exp(-\beta(t-\tau))}$; where $DIFF_{kt}$ measures the change in the adoption levels of a technology between period t and (t-1) and $ADOPT^* = \gamma POP_k$ denotes the number of eventual adopters as a proportion of the population of country k.

been reached in the EU, this suggests that European firms will not continue to expand their ICT use much. By contrast, the process of diffusion is still ongoing in the US.

Turning to the *micro-adoption approach*, this approach models a firm's decision to adopt a technology with a certain intensity, depending upon different firm-specific characteristics.[118] Versions of this model are estimated both for a general measure of ICT (PC intensity) and for specific software and equipment (DBMS — database management systems, and ERP — enterprise resource planning systems). With regard to general ICT adoption, PC intensity is found to be positively associated with high wages and firm size. A 10% increase in wages corresponds to a 1% increase in PC intensity. However, multinational status is associated with a 10% premium in terms of PC intensity. Further, cross-country differences are minimal. Western European firms have 2 PCs more per 10 employees than eastern European firms, but differences between western European firms are negligible. In terms of software adoption, larger firms are more likely to adopt earlier and firms are more likely to adopt if others have adopted widely the previous year. While this could be considered as evidence of ICT spillovers, it is more likely due to other factors such as better expected demand conditions or other industry-wide improvements in the environment. One interesting difference between DBMS and ERP is in the role played by PC intensity. While PC intensity is important for the adoption of DBMS, it is not for ERP. This could because of the 'expert' nature of ERP users, while DBMS are used by a broader set of employees.

Under the *micro-timing approach*, the method is to model how long it takes before a non-adopter adopts a technology, depending on firm-dependent characteristics (as in the micro-adoption approach).[119] Such a model is estimated using the same dependent variables and the same technologies (DBMS and ERP) as in the micro-adoption model. The propensity to adopt is found to increase over time, at a decreasing rate, implying that a technology will be adopted eventually in most firms that have not yet adopted it. Further high penetration in a region decreases the likelihood of adoption. This runs counter to the evidence found using the micro-adoption approach and strengthens the authors' conclusion that the earlier 'spillovers' were not robust. Otherwise, the estimated coefficients from this approach are found to be similar to those of the micro-adoption approach.

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118 The model is based on the following probit specification: $\Pr(y_{ijklt}=1)=\beta x_{jt}+\beta x_{lt-1}+\delta_j x_j+\delta_k x_k+x_t+\alpha_i+u_{it}$; where y is a technology outcome that can be expressed as a discrete or continuous indicator (in this case discrete) and the x's represent the following vector of variables:

- x_{it} firm-specific and time-varying observables (Employees, PC intensity, ICT Employee intensity),
- x_{kt} time-varying country-specific observables (e.g. GDP per capita),
- x_{lt} time-varying regional specific observables (NUTS1 penetration),
- x_k time-invariant country dummy,
- x_j time-invariant sector dummy,
- α_i firm-specific error term,
- u_{it} idiosyncratic error term.

119 The model has the following Weibull hazard rate specification for a firm i: $h_i(t,X_i)=pt^{p-1}e^{(\beta' X_i)}$, where X_i corresponds to the regressors of the micro adoption model and the sample is restricted to the manufacturing sector only. The parameter p indicates if the baseline hazard increases (p>1) or decreases (p>1) over time.

1.42. 7.5. The impact of ICT on innovation

Analysis of the impact of ICT on innovation, as measured by patents,[120] shows that there is no significant effect. However, this measure of innovation (patents) is narrow and does not capture the full range of product and process innovations where ICT plays a major role. ICT also contributes to the stock of intangible capital that underpins innovation activities at firm level.

Using a new approach, different types of tangible and intangible ICT capital are identified, and their relationship with productivity is examined in a microeconomic production function framework. The 'own-account software' component of intangible ICT capital is strongly associated with firm productivity. In addition, network hardware (here categorised as another type of tangible ICT capital) is also strongly associated with productivity. Finally, the 'purchased software' component of ICT capital appears to have a limited relationship with firm productivity. This may be due to the 'co-invention costs' of deploying new software systems and again emphasises the need for complementary assets in making ICT investment fully effective.

In a study of the French car dealer industry, the role of ICT as a vehicle for product and process innovation is investigated in more detail. Specifically, the effects of a change in product market regulation on technological adoption in the industry are examined. This change in product market regulation increased competitive pressure and, subsequently, scale in the industry. That is, firms expanded in size as new markets opened up due to deregulation. In terms of innovation, this increase in scale was associated with the increased adoption of product innovations by firms, but fewer process innovations. In practical terms, this suggests two things: firstly, that product innovation is preferred when firm scale is a consideration; and, secondly, that product and process innovation are seen as substitutes by firms. This latter finding may be the result of managerial or financial constraints on the simultaneous adoption of the two types of innovation.

1.43. 7.6. Globalisation

New evidence shows how multinational firms divide their activities across countries.[121] This evidence supports the idea that multinationals are locating their low-tech activities in low-wage countries. Specifically, it is found that a multinational subsidiary located in China (the major global site for low-wage production) is 11 % more likely to be classified as 'low-tech'. This effect is evident even when controlling for the global ultimate owner, meaning that this is a strong 'within-firm' phenomenon. Major multinationals are 6 % more likely to keep high-tech activities in their home country. However, this finding is not as strong in terms of within-firm effects. Multinational firms appear to use ICT much more than domestic firms. Interestingly, the subsidiaries of US multinational firms in Europe appear to use more ICT and obtain higher productivity from their ICT than subsidiaries of other multinationals in

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120 For this purpose, they define and estimate the following innovation equation: $In(PATSTOCK) = X'_{jkt}\beta_1^p + Z'_{ijkt}\beta_2^p + \beta_3^p SPILL_{jkt} + \eta_i + \tau_t$, where In(PATSTOCK) is a measure of the patent stock and X is a vector representing firm-level characteristics that could affect knowledge production (i.e. firm size, sales, capital), Z is a vector of industry characteristics such as R&D inputs and import competition, and SPILL is a measure of ICT spillovers (measured as 4-digit industry ICT intensity).

121 Detailed industry and subsidiary information for the top 100 multinationals active in Europe are examined — which collectively own 21 000 subsidiaries around the world. These subsidiaries are classified according to the technological intensity of their industry activities. This enables a 'technology ladder' to be defined for low- to high-tech industries.

Europe. This is consistent with the aggregate 'productivity miracle' data, suggesting that the US is more effective at using ICT. Analysing this further using the CEP management and organisation surveys, it is found that the US ICT advantage is due to people management practices — US firms appear to make better use of incentives in their promotion, pay and personnel decisions, complementing the use of ICT.

The example of US firms in Europe allows some of the observed differences in US-EU labour productivity to be calibrated. Firstly, production function results for the UK sample indicate that US firms experienced 0.8% faster labour productivity growth per year in 1995-2004. When weighted by the proportion of ICT-using firms, this then accounts for half of the US-EU labour productivity growth differential. A similar productivity is observed for US multinationals in the European panel. The differential can be unpacked further when considered in conjunction with detailed data on management practices. This shows that half of the US productivity advantage is explained by more effective people management practices. Hence, this supports the idea that a large fraction of the US-EU labour productivity differential can be explained in terms of organisational capital. This is the first decomposition of US-EU productivity differences that is explicitly based on measured differences in organisational capital.

Trade is found to be an important driver of innovation in general and ICT adoption in particular. The growth of import competition from China has forced firms to adopt ICT and innovate to avoid the 'commoditisation' of low-wage country competition. Low ICT-intensive firms are much more likely to shrink and die when faced by Chinese competition than higher-tech firms. Thus, trade has the benefit of inducing faster technical change, both for surviving firms and through a reallocation effect. Overall, increased low-wage country trade can account for 15% of the increase in ICT intensity among European manufacturing (from 2000-2007), with 11% due to within-firm upgrading and the remainder a result of reallocation.

Another aspect of globalisation is whether distance matters less. For university-based inventions, distance does matter — patent citations are much less likely the further firms are from the university that made the breakthrough. Local policies can influence this — a university required to have more of a local focus does not see its ideas spread out so quickly. This effect of distance has declined in recent years, however, consistent with lower communication costs. Further, distance is much less important for ICT innovations, suggesting that these do spread much more quickly.

As basic economic theory would predict, the largest multinational firms establish their Chinese subsidiaries in low ICT-intensive industries, presumably to use cheaper labour. By contrast their subsidiaries in developed countries are in more ICT-intensive sectors.

1.44. 7.7. Other results concerning spatial concentration, prices and job satisfaction

7.7.1. Regional inequality

Policy makers have been concerned whether ICT could lead to greater disparities across regions in the EU. The effects on spatial concentration are theoretically ambiguous. A geographic concentration of economic activity ('agglomeration') could rise if ICT makes clustering stronger (e.g. one 'Silicon Valley' instead of many smaller clusters). But ICT could decrease spatial inequality if lower communication costs mean that workers can be based even in geographically isolated areas.

Analysis of the 'digital divide' in technological adoption shows that regional characteristics, and industry controls, explain around 50-70% of differences (at the NUTS1 level) for Germany, the UK and France. Again, like the cross-country results, this suggests that interregional differences are limited after controlling for observable characteristics. This finding is important because it sets a bound on how much policy makers can influence technological adoption given existing patterns of industrial composition.

Furthermore, analysis of ICT and spatial concentration patterns for the UK indicates a negative relationship for manufacturing and a positive relationship for services. That is, higher levels of ICT are associated with less spatial concentration for manufacturing and vice versa for services. While the result for manufacturing is robust to the inclusion of industry controls, the relationship disappears for services.

7.7.2. ICT and prices

ICT investments in Europe and the US have been associated with major falls in producer prices — the 'factory gate' prices that underpin retail prices. These falls have taken place not only in the ICT-producing sectors but also across other manufacturing industries. An analysis of the impact of ICT investment on producer prices shows that ICT investment is associated with around a 0.3% per year fall in European producer prices. By comparison, low-wage import penetration (specifically Chinese imports) is also associated with a 0.3% fall in producer prices. The most likely mechanism for this ICT-led fall in prices relates to productivity growth. That is, by increasing productivity ICT has expanded 'potential output' and relieved supply-side pressures on producer price inflation.

Popular debate regarding the impact of ICT on consumer prices has focused on the availability of cheaper electronic goods and the rise of online retailing and delivery. Evidence can be found of significant falls in prices for recorded media and for electronic goods and equipment. These falls have been of the order of -3.5% per year for recorded media and -9% per year for electronic goods and equipment. In contrast, the prices of books and newspapers have either moved neutrally with overall prices or increased slightly. However, the markets for books and newspapers could be affected by quality and compositional changes as publishers adjust their formats in response to online competition. Overall, cross-country variation in these product price changes is minimal and in this case does not seem to be related to any trends in broadband penetration or labour and product market regulation. Furthermore, it must be noted that given the evidence on producer prices, it seems that ICT is having an effect on prices outside the obvious consumer price categories considered here.

Evidence on household expenditure indicates that ICT-related goods only represent a small fraction of total expenditure — approximately 5% with minimal variation across countries. Hence, the direct impact of potential ICT-induced price falls is limited, even when considering possible substitution and income effects. However, the findings for producer prices indicate that their price impacts outside narrowly defined ICT-related goods may also feed into household expenditure.

7.7.3. Work-life balance and job satisfaction

The links between ICT and work-life balance (WLB) depend on how and when ICT is used. The use of company ICT for private purposes during working hours is found to be positively correlated with perceived WLB. However, the use of company ICT after hours is found to be negatively associated with ICT. This latter finding is also associated with higher working hours, indicating that job attributes may be driving the relationship between ICT usage and WLB. However, there is also a positive relationship between WLB and the after-hours use of company ICT when this ICT is used in conjunction with flexible work practices.

Family-friendly work practices are found to have a strong positive relationship with profitability measures such as the return on assets (ROA) and the return on sales (ROS). In contrast, flexibility-enhancing ICT only shows a strong relationship with firm performance when it is combined with family-friendly work practices. Overall, these results indicate that there may be strong complementarities between ICT usage and firm organisational practices where WLB is concerned.

1.45. 7.8. Policy conclusions and outlook

The latest evidence on the economic impact of ICT shows that, in order to make the most of the productivity gains from ICT investment, ICT on its own is not sufficient. To unleash the productivity potential of ICT within the firm, firms need to invest in other *complementary organisational changes*, including management practices — adopting better hiring, firing, pay and promotion practices — and decentralised management structures — allowing for more decision-making at lower levels of the hierarchy.

The recent study for the European Commission shows that the two key factors which appear to influence people management and decentralisation are the levels of *product and labour market competition in a country*. Product market competition is an important driver of better people management because competition tends to drive out the poorly managed firms and gives surviving firms an incentive to upgrade their management skills. Competition also encourages decentralisation because firms need to make decisions more quickly.

In this respect, reforms to widen the single market, particularly through the stalled Services Directive, are highly relevant. The product market reforms contained in the Directive could enhance competitive pressure. They are also important because evidence shows that ICT has a higher productivity impact in a number of ICT-using service industries. Thus, the Directive could be an important policy mechanism for encouraging ICT adoption and enhancing productivity. However, competition policy in general is important and trade is also a competition lever.

Labour market competition also has an important impact on people management. Tough labour market regulations impede a firm's ability to hire, fire, pay and promote in a way that maximises its productivity. In this respect, Europe has much stronger labour market regulations than the US, and this is potentially why people management practices are weaker than those of American firms.

In addition to these factors, *human capital is an important complementary investment* for reaping the productivity gains from ICT. Thus reforms to universities, improvements in schooling and better business education and training can have a 'triple win' effect. First, human capital will become more productive in its own right, independently of ICT. Second, more skills will increase the diffusion of ICT, as discussed. Third, increased human capital will reduce inequality pressure.[122]

Lack of strong evidence of spillovers from ICT implies *little need for direct subsidies to ICT* in the form of tax breaks or subsidies.

However, the greater sensitivity of ICT investment to demand suggests that if there are *stimulus programmes* for investment in response to downturns (such as the current global recession), ICT investment will respond more quickly than other forms of capital investment.

[122] Price falls for ICT increase the demand for skilled workers, pushing up their wages relative to low-skilled workers and leading to increased inequality. Pro-ICT policies (such as tax subsidies) in the absence of greater skills will therefore tend to increase inequality among individuals (if not between regions).

As the recession appears to be ending, however, the value of further demand stimulus programmes is unclear.

Openness to trade is found to be a powerful force for stimulating ICT. The evidence shows that, for the period 2000-2007, greater trade with China accounted for 15 % of ICT upgrading in Europe. Trade also has positive effects on organisational forms complementary to ICT, such as decentralisation. Thus, in addition to the standard positive benefits of lower prices from further trade liberalisation, there is an under-appreciated positive trade effect on innovation and technological adoption. Consequently, re-invigorating the Doha round and unilateral removal of European trade barriers would be desirable on ICT grounds.

Removing barriers to foreign ownership would help spread ICT, especially by reducing barriers to US ownership. Multinationals are one of the key routes through which management practices and know-how on how best to use ICT are spread internationally. The crisis has led to more government involvement in the economy and, while necessary in the short run, this should not lead to a return to 'national champions'.

Finally, universities are a major source of innovation, in the ICT sector and beyond. From a pan-European perspective, restrictions on the ways universities operate reduce the speed at which their innovations spread across Europe and benefit firms further away from where the university is located. Therefore, allowing greater autonomy for universities, incentivising academics to upgrade research quality, and allowing university financing to be boosted by charging student fees that reflect true costs would also be beneficial.

Going forward, if ICT prices continue to fall sharply, as they have done in the past, lower levels of organisational capital in the EU will likely lead to a permanent productivity gap with the US. If improvements in semiconductors are accompanied by other major breakthroughs, in areas such as network-based applications, this outlook could well become a reality. Already emerging trends such as infrastructure convergence (e.g. internet-TV convergence and 'smart phones'), human-computer convergence (e.g. RFID) and utility convergence (e.g. cloud computing) are extending the economic reach of ICT applications. These technological trends are likely to have a positive effect on the extent and intensity of ICT usage in sectors that already use ICT intensively, and may also result in new industries.

Against this background, the policy areas identified here will be of crucial importance to unleashing the full productivity potential of ICT over the next decade. The implementation of the actions identified in the European Digital Agenda will provide the necessary support for achieving this goal.

8. ANNEX

Table A1: **Index of regular internet use by risk groups and country in 2009**

	women	aged 55 to 64	aged 65 to 74	low-educated	inactive	un-employed	Convergence region	rural	low income	total at risk 'Riga'[123]	change 2008-2009
AT	0.92	0.68	0.28	0.63	0.51	1.04	0.93	0.93	0.73	0.71	0.01
BE	0.94	0.74	0.37	0.69	0.54	0.87	0.88	0.88	0.61	0.72	0.02
BG	0.96	0.35	0.08	0.39	0.17	0.55	1.24	0.66	0.13	0.45	-0.06
CY	0.93	0.36	0.18	0.42	0.34	0.75	n/a	0.82	0.38	0.54	0.02
CZ	0.96	0.56	0.20	0.77	0.38	0.82	0.96	0.91	0.37	0.66	0.05
DE	0.93	0.76	0.43	0.84	0.58	0.86	0.86	0.89	0.74	0.75	0.01
DK	0.98	0.87	0.59	0.86	0.70	0.93	n/a	0.95	0.98	0.84	0.06
EE	1.02	0.62	0.19	0.79	0.43	0.98	1.00	0.93	0.60	0.71	0.00
EL	0.88	0.30	0.05	0.32	0.27	0.96	1.00	0.76	0.37	0.50	0.04
ES	0.92	0.48	0.17	0.52	0.34	0.91	0.88	0.79	0.42	0.59	0.03
EU-27	0.95	0.68	0.33	0.63	0.48	0.87	0.79	0.85	0.56	0.68	0.03
FI	1.00	0.81	0.38	0.78	0.62	0.92	n/a	0.94	0.77	0.78	0.02
FR	1.01	0.73	0.38	0.74	0.54	0.93	n/a	0.91	n/a	0.75	0.00
HR	0.91	0.34	0.17	0.44	0.31	0.82	n/a	1.39	0.31	0.63	0.21
HU	0.97	0.62	0.13	0.59	0.40	0.90	0.95	0.89	0.42	0.64	0.00
IE	1.00	0.57	0.25	0.50	0.52	0.95	n/a	0.85	n/a	0.66	0.03
IS	0.98	0.90	0.56	0.92	0.58	1.06	n/a	0.97	0.77	0.85	0.03
IT	0.88	0.56	0.16	0.50	0.30	0.97	0.80	0.86	n/a	0.60	0.04
LT	0.99	0.41	0.12	0.75	0.27	0.74	1.00	0.71	0.36	0.57	0.01
LU	0.93	0.89	0.56	0.84	0.71	0.79	n/a	1.03	0.73	0.82	0.06
LV	0.99	0.50	0.13	0.83	0.32	0.89	1.00	0.93	0.56	0.65	0.06
MT	0.97	0.38	0.44	0.65	0.48	1.12	1.00	0.73	0.59	0.68	0.07
NL	0.96	0.90	0.57	0.82	0.75	1.12	1.08	0.97	0.87	0.87	0.02
NO	0.96	0.87	0.65	0.90	0.72	1.11	0.59	0.96	0.85	0.88	0.06
PL	0.96	0.45	0.12	0.70	0.34	0.74	0.76	0.85	0.48	0.59	-0.04
PT	0.90	0.45	0.13	0.61	0.24	0.89	0.73	0.76	0.30	0.57	0.03
RO	0.96	0.31	0.06	0.49	0.20	0.82	n/a	0.63	0.20	0.50	0.05
SE	0.98	0.93	0.51	0.83	0.64	1.11	n/a	0.97	0.80	0.85	0.02
SI	0.98	0.51	0.11	0.62	0.27	0.80	1.00	0.94	0.50	0.60	0.05
SK	0.99	0.47	0.12	n/a	0.35	0.78	0.99	0.97	0.41	0.61	0.06
UK	0.96	0.84	0.48	0.55	0.67	1.00	0.92	1.03	n/a	0.79	0.09
min	0.88	0.30	0.05	0.32	0.17	0.55	0.59	0.63	0.13	0.45	0.03
max	1.02	0.93	0.65	0.92	0.75	1.12	1.24	1.39	0.98	0.88	0.01
range	0.14	0.62	0.60	0.61	0.58	0.57	0.66	0.76	0.85	0.43	-0.02
s.d.	0.04	0.20	0.19	0.17	0.17	0.13	0.14	0.14	0.22	0.12	0.01

Source: Commission services on the basis of Eurostat Community Survey on ICT Usage by Households and by Individuals

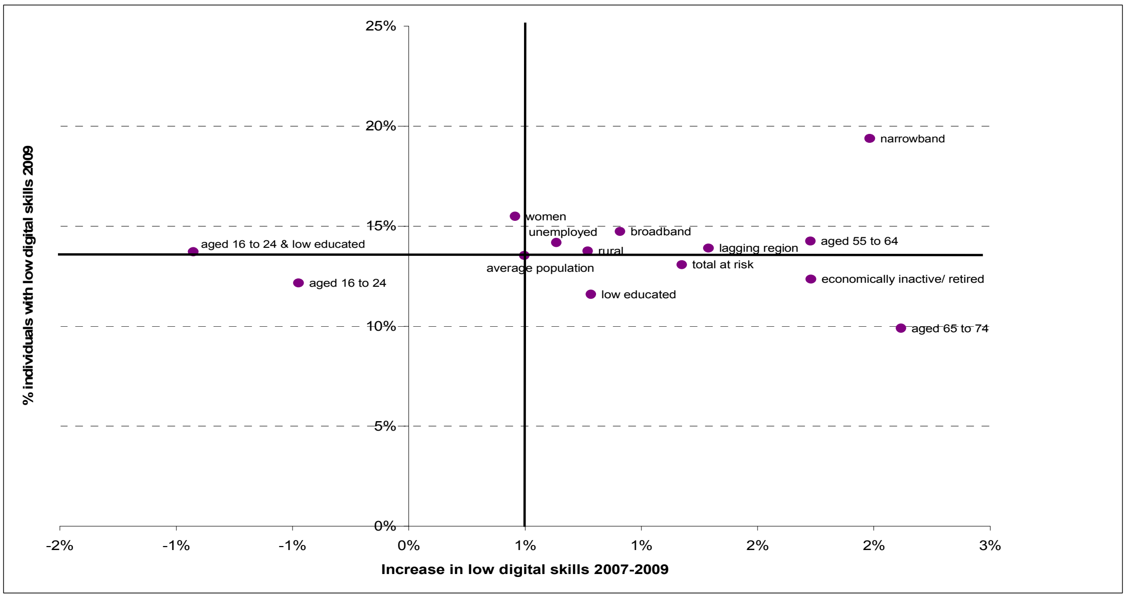
123 Average of the disadvantaged groups identified under Riga: women, aged 55-64, aged 65-74, retired and inactive, low-educated and rural.

Table A2: **Index of digital literacy by risk groups and country in 2009**

	women	aged 55 to 64	aged 65 to 74	low educated	inactive	un-employed	Convergence region	rural	low income	total at risk "Riga"	change 2007-2009
AT	0.92	0.73	0.32	0.67	0.58	1.04	0.92	0.94	0.77	0.74	0.04
BE	0.92	0.67	0.34	0.63	0.49	0.88	0.92	0.91	0.56	0.69	0.01
BG	0.99	0.41	0.10	0.37	0.17	0.55	1.24	0.62	0.17	0.46	0.03
CY	0.97	0.40	0.20	0.41	0.41	0.84	n/a	0.85	0.41	0.58	-0.02
CZ	0.95	0.60	0.27	0.77	0.41	0.76	0.95	0.88	0.46	0.66	0.02
DE	0.93	0.83	0.54	0.83	0.66	0.97	0.95	0.91	0.88	0.81	0.00
DK	0.97	0.88	0.56	0.88	0.69	0.96	n/a	0.94	0.98	0.84	0.02
EE	0.99	0.53	0.09	0.79	0.40	0.90	1.00	0.90	0.56	0.66	-0.02
EL	0.93	0.34	0.06	0.35	0.30	1.00	1.00	0.77	0.43	0.54	-0.05
ES	0.94	0.49	0.21	0.58	0.39	0.98	0.91	0.85	0.48	0.64	0.02
EU27	0.95	0.70	0.38	0.67	0.52	0.92	0.80	0.86	0.62	0.71	0.02
FI	0.97	0.76	0.40	0.80	0.60	0.98	n/a	0.94	0.80	0.78	0.05
FR	0.99	0.77	0.41	0.81	0.61	0.86	n/a	0.91	n/a	0.77	0.03
HR	0.90	0.34	0.18	0.42	0.32	0.80	n/a	1.40	0.35	0.62	0.12
HU	0.98	0.69	0.21	0.63	0.49	0.92	0.96	0.91	0.49	0.69	0.07
IE	1.04	0.58	0.25	0.46	0.50	0.90	n/a	0.89	n/a	0.66	0.01
IS	0.97	0.83	0.49	0.85	0.49	1.03	n/a	0.94	n/a	0.80	0.00
IT	0.90	0.60	0.19	0.54	0.36	1.04	0.85	0.92	n/a	0.65	0.03
LT	0.99	0.40	0.12	0.79	0.28	0.79	1.00	0.74	0.44	0.59	0.05
LU	0.93	0.90	0.62	0.86	0.76	0.79	n/a	1.02	0.76	0.84	0.07
LV	1.00	0.49	0.13	0.85	0.29	0.83	1.00	0.91	0.62	0.64	0.05
MT	0.95	0.37	0.47	0.62	0.42	1.08	1.00	0.62	0.53	0.65	0.03
NL	0.95	0.86	0.55	0.78	0.70	1.07	1.06	0.97	0.85	0.84	0.03
NO	0.94	0.88	0.65	0.89	0.69	1.05	n/a	0.96	0.83	0.87	0.04
PL	0.94	0.40	0.12	0.73	0.32	0.76	1.00	0.86	0.53	0.59	0.01
PT	0.92	0.57	0.15	0.71	0.35	1.01	0.93	0.80	0.38	0.64	0.03
RO	0.96	0.38	0.08	0.49	0.23	0.91	1.00	0.71	0.23	0.54	0.09
RS	0.90	0.39	0.13	0.51	0.67	0.71	n/a	n/a	n/a	0.55	0.02
SE	0.96	0.86	0.58	0.79	0.67	1.04	n/a	0.94	0.82	0.83	0.00
SI	0.99	0.53	0.17	0.58	0.33	0.92	1.00	0.96	0.57	0.64	0.04
SK	0.98	0.53	0.22	1.05	0.45	0.91	0.99	0.98	0.48	0.73	0.10
UK	0.97	0.85	0.42	0.50	0.65	0.72	0.99	1.05	0.00	0.74	0.05
min	0.90	0.34	0.06	0.35	0.17	0.55	0.80	0.62	0.00	0.46	-0.05
max	1.04	0.90	0.65	1.05	0.76	1.08	1.24	1.40	0.98	0.87	0.12
range	0.14	0.55	0.58	0.70	0.59	0.52	0.44	0.78	0.98	0.41	0.17
s.d.	0.03	0.19	0.18	0.18	0.16	0.12	0.08	0.14	0.23	0.10	0.03

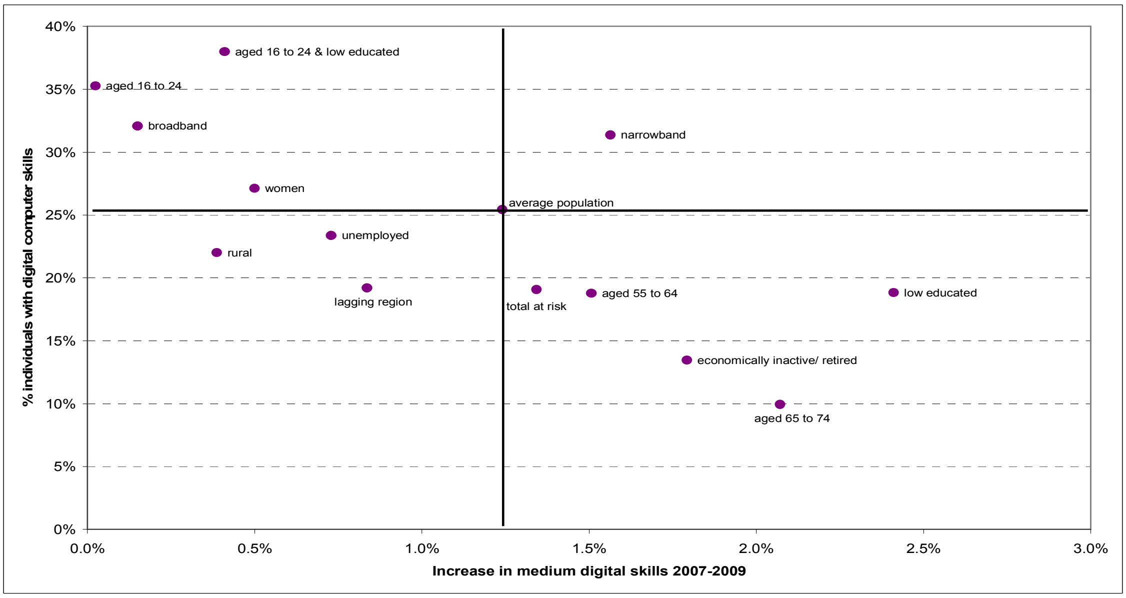
Source: Commission services on the basis of Eurostat Community Survey on ICT Usage by Households and by Individuals

Figure A1: **Trend in % low digital skills, 2007-2009**



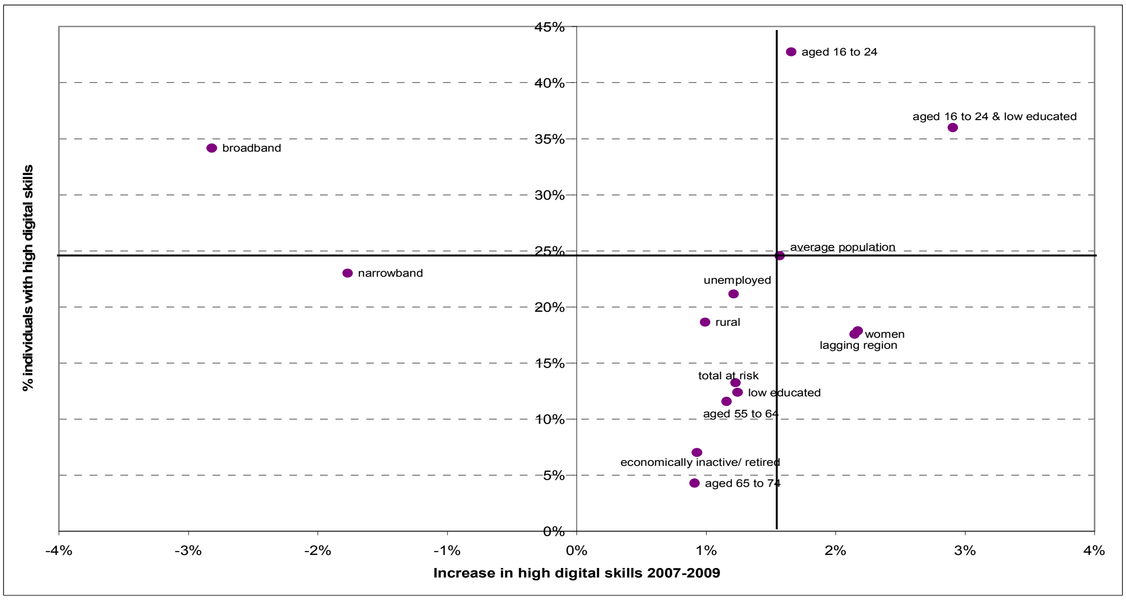
Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Figure A2: **Trend in % medium digital skills, 2007-2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals

Figure A3: **Trend in % high digital skills, 2007-2009**



Source: Eurostat Community Survey on ICT Usage by Households and by Individuals