CHAPTER 6

THE MICROECONOMIC IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN EUROPE
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1. INTRODUCTION

In early 2000, technology stocks were riding high, the US economy was in its tenth consecutive year of expansion, and a consensus seemed to be building around the proposition that trend productivity growth had increased, thanks in large part to the rapid development and use of ICTs. There was speculation of further structural benefits such as smoothed business cycles or a permanently improved trade-off between unemployment and inflation. The issue in the EU was if and when the "new economy" might materialise in Europe.

Eighteen months later, this vision was called into question as technology stocks fell and some of the dot.com firms that symbolised the new economy failed. Estimates of any trend increase in productivity were revised downwards as the US economy moved close to recession. The bursting of a speculative bubble is one thing but, for some, the deflation of new economy myths cast doubts on the real economic benefits of ICTs. This was equally true in Europe, as press comment turned to over-capacity in fibre-optic transmission and a radical reassessment of the prospects for third-generation mobile telecommunications services.

The present chapter argues that recent developments do not compromise the long-term expected economic benefits of ICTs. It is at the level of individual firms, product markets and labour markets where the immediate impact may be most apparent. The chapter therefore moves beyond aggregate data to examine the available microeconomic evidence on ICT take-up and the impact of ICT on the functioning of markets. It is also at the micro level where the economic, social and legal framework for the information society must be established. The chapter also looks at selected issues relating to how the functioning of markets and institutions may affect the take-up of ICT.

Section 2 sets the macroeconomic context by offering an interpretation of recent developments and the implications for estimates of growth potential. Moving to the microeconomic channels, Section 3 discusses the impact of ICTs on business processes, raising a number of key product market issues. Section 4 looks at the consequences for employment and the role of labour markets in the transition to a knowledge-based economy. Section 5 concludes and summarises ICT-related policy challenges.

2. THE MACROECONOMIC CONTEXT

2.1 STOCK PRICES

Graph 1 shows the rise and fall of the main listings for high technology "growth" stocks. These are not exclusive to ICT firms, and many of the larger ICT firms are listed in the broader indices. Nevertheless, these markets came to be seen as symbolic of the new economy. The value of the US Nasdaq nearly quadrupled between March 1997 and March 2000, and nearly quartered between March 2000 and September 2001. Most commentators have explained this at least partly in terms of irrationality, or a speculative bubble which burst when "the supply of bigger fools ready to buy overvalued stocks had dried up". At any rate, the significance of the "new economy" for the profits of the high technology firms quoted on the Nasdaq appears to have been grossly over-estimated.

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1 Last year’s EU Economy Review reviewed various growth-accounting exercises designed to estimate the contribution of ICTs to economic growth. It concluded that similar benefits to those observed in the USA could be expected in the EU as a whole, albeit with a lag of several years.


3 The term ‘new economy’ has been used to refer not only to the rapid development, adoption and use of ICTs but also to changes in work organisation, globalisation, more intense competitive pressure and a favourable economic policy
Recent history has been even more turbulent in the case of the (smaller) European markets with the rise and fall of the Neuer Markt particularly steep, and the Nouveau Marché in Paris falling below its initial level when established in March 1996.

Graph 1: Selected high technology stock listings, 1997-2001

Share prices are supposed to reflect the expected profitability of companies, not productivity per se. Higher productivity growth with a constant rate of profits should lead to a larger expected stream of profits. But additional factors would be needed to explain the boom in new economy stocks, such as expectations of rapid growth in market share or a higher rate of profitability.

The apparent overvaluation of these stocks may in part be rationally explained. It seems that investors greatly overestimated the potential of the new economy to create market power and thus to increase the rate of profits. In addition, it became clear during 1999 and 2000 that “traditional” firms could employ new technologies as well as, if not more productively than, start-ups. This led investors to revise their view of the potential for start-ups to acquire market share at the expense of incumbents. However, neither of these points detracts from the real economic benefits of ICTs.

It follows that much of any shareholder value from the new economy should be reflected in the broader indices. The main blue chip indices have also suffered from the decline of telecoms, media and technology stocks and weakening general economic prospects. But recent falls should not obscure the fact that markets remain highly valued by historical standards and well above levels in December 1996 when the US Federal Reserve Chairman warned of “irrational exuberance”.

4 Although higher productivity growth should translate into an increase in the number of profitable investment projects seeking funds, leading to upward pressure on real interest rates, which would have a negative effect on equity prices.

5 Even after recent falls, markets remain highly valued according to traditional benchmarks such as dividend yields, price-earnings ratios or Tobin’s $q$. This applies to European markets almost to the same extent as it does to the US; see e.g. PricewaterhouseCoopers (2001). This picture may be consistent with the view that markets are pricing in expected productivity gains, although of course if recent events show anything it is that firm conclusions cannot be drawn on the basis of valuation benchmarks or short-term movements in equity prices.
A further point is that the impact of innovation, compared to that of existing technologies, tends to extend further into the future and is almost by definition more uncertain. It is therefore not surprising to find over-estimation, under-estimation and higher volatility of the expected benefits. This parallels historical experience with railways and electricity. Booms and busts in the stock of the original infrastructure builders and operators had very little to do with the diverse economic benefits which panned out over the following decades. Thus, economic history suggests that the wider benefits of a general purpose technology will not be reflected in share prices.

2.2 AGGREGATE PRODUCTIVITY ESTIMATES

Falling stock markets in 2000 were closely followed by a general deterioration of the economic outlook. As the US economy moved close to recession in 2001, recent national accounts figures were revised, including a reduction in the figures for investment in IT equipment and software in 1999 and 2000. Box 1 recalls the three main channels through which ICT investments may affect productivity, and some of the main results.

Box 1: The growth contribution of ICTs: main channels and US evidence

The first main channel through which ICTs may affect growth is capital deepening – investment in ICTs, as with any other investment good, increases the stock of capital and thus boosts labour productivity, even in the absence of technical improvements.

The second channel is rapid technical progress in ICT production, measured by growth in total factor productivity (TFP) in the ICT sector.

The third channel is technical progress in other industries due to the use of ICTs. This category includes, for example, any productivity increases that result from improved business organisation enabled by ICTs, or other spill-over effects such as network externalities. Productivity gains through this channel would show up in the form of increased TFP growth in non-ICT sectors.

Evidence from the USA suggests that capital deepening was the most important factor behind the acceleration of labour productivity between 1995 and 2000. Real investment in ICTs surged during the 1990s. The US results point to a slightly smaller but significant contribution from technical progress in ICT production. Although progress was extremely rapid in some sub-sectors, especially computers and semiconductors, the entire ICT sector accounts for only around 8 per cent of US production, hence the limited direct impact on overall labour productivity. But technical progress did produce a rapid fall in (quality-adjusted) prices, which paved the way for capital deepening. TFP growth also increased in non-ICT sectors. While many researchers were optimistic that this was partly due to the diffusion of ICTs, there was no clear evidence of this.

Recent sectoral evidence has uncovered a clearer link between overall labour productivity growth and intensive ICT use. Some sectors such as finance and retail trade, where heavy ICT investments have been made and the greatest benefits from ICT are expected, do show a substantial acceleration in productivity between from 1989-95 to 1995-99. However, productivity gains are surprisingly small in most sectors which account for the majority of ICT investment, including certain areas where large gains might have been expected, such as retail.

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6 See Freeman (2001).
7 On general purpose technologies, see Bresnahan and Trajtenberg (1995).
8 See European Commission (2000) for further details, and also Baily (2001) where updated versions of some of the US studies are discussed.
banking and hotels (McKinsey, 2001). In addition, productivity gains in sectors such as wholesale, retail and telecommunications can be attributed to several factors, including competition, regulatory reform and cyclical demand conditions, as well as ICT investment (ibid).

1. See Baily (2001), Table 3. Baily does not distinguish here between capital deepening and TFP growth.

Comparative European evidence has been harder to come by because of data limitations, but several authors have employed tactics such as applying US quality-adjusted deflators to European prices or using industry sources on ICT spending in order to arrive at estimates for EU countries. These studies have found that a sharp increase in the use of ICTs made a significant contribution to increased GDP growth via capital deepening in several countries, notably Ireland, Finland, Sweden and the UK, as well as the USA (and to a lesser extent Canada and Australia). Others, including the large euro-area countries, fared less well, on account of lower growth in ICT investment and a lower initial share of ICT capital in total capital.

Table 1 provides estimates from some of these studies of GDP growth due to ICTs over the late 1990s. These results are not comparable between the different studies because the methodologies are not identical, but the table does provide an idea of the comparative picture between countries. Graph 2 and Table 2 illustrate the sizeable EU-US gap in expenditure on ICTs that had opened up by the mid-1990s.

Table 1: The contribution of ICT capital to GDP growth, annual percentage points

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>0.5</td>
<td>0.49</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.3</td>
<td>0.65</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Germany</td>
<td>0.3</td>
<td>0.45</td>
<td>0.29</td>
<td>0.96</td>
</tr>
<tr>
<td>Greece</td>
<td>0.2</td>
<td>0.46</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spain</td>
<td>0.3</td>
<td>0.34</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>France</td>
<td>0.4</td>
<td>0.44</td>
<td>0.36</td>
<td>0.75</td>
</tr>
<tr>
<td>Ireland</td>
<td>1.6</td>
<td>0.96</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Italy</td>
<td>0.4</td>
<td>0.35</td>
<td>0.32</td>
<td>0.71</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.6</td>
<td>0.72</td>
<td>-</td>
<td>1.92</td>
</tr>
<tr>
<td>Austria</td>
<td>0.3</td>
<td>0.43</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.5</td>
<td>0.49</td>
<td>-</td>
<td>-</td>
</tr>
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<td>Finland</td>
<td>0.5</td>
<td>0.74</td>
<td>0.58</td>
<td>2.50</td>
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<td>Sweden</td>
<td>0.6</td>
<td>0.85</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>0.5</td>
<td>1.17</td>
<td>-</td>
<td>1.50</td>
</tr>
<tr>
<td>Norway</td>
<td>0.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Australia</td>
<td>-</td>
<td>-</td>
<td>0.61</td>
<td>-</td>
</tr>
<tr>
<td>Canada</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.23</td>
</tr>
<tr>
<td>Japan</td>
<td>-</td>
<td>-</td>
<td>0.33</td>
<td>0.78</td>
</tr>
<tr>
<td>USA</td>
<td>0.9</td>
<td>1.45</td>
<td>0.88</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Notes: a software excluded, assumes elasticity of substitution of ICT with other factors equal to 1.5 and productivity acceleration in ICT production in EU 50% of US; b business sector GDP only; c figures for France, Germany and Japan are for 1995-98.


1. The experience of some countries (e.g. Australia) suggests that a large ICT-producing sector is not a necessary condition for reaping the benefits of ICT use. Nevertheless, ICT production does play a role in explaining the differential contribution of ICTs to growth in the USA and the EU as a whole. As shown in Table 3, the ICT manufacturing sector in the USA is more than double the size of that in the euro area, so that even if technical progress in the latter was similarly rapid, the contribution to overall productivity growth would be less than half that in the USA. It is notable that there is less...
of a gap in the size of sectors that use ICT intensively, yet productivity growth, particularly in ICT-using services, has been higher in the USA.

Most of these analyses focus on productivity, but a further point that emerges strongly is that employment performance in ICT-producing and -using sectors in the EU has been dismal relative to the USA. This explains a substantial part of the difference in the contribution of these industries to gross value-added.

Table 3: Sectoral developments in the euro area and in the USA, 1995-98

<table>
<thead>
<tr>
<th>Sector</th>
<th>Share in nominal value-added (1998, %)</th>
<th>Growth in real-value added (%)</th>
<th>Growth in employment (%)</th>
<th>Growth in labour productivity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EURO</td>
<td>USA</td>
<td>EURO</td>
<td>USA</td>
</tr>
<tr>
<td>ICT-producing sectors in manufacturing</td>
<td>0.7</td>
<td>1.8</td>
<td>11.5</td>
<td>25.6</td>
</tr>
<tr>
<td>ICT-producing sectors in services</td>
<td>4.2</td>
<td>4.8</td>
<td>8.1</td>
<td>7.8</td>
</tr>
<tr>
<td>ICT-using sectors in manufacturing</td>
<td>3.9</td>
<td>3.0</td>
<td>1.6</td>
<td>2.9</td>
</tr>
<tr>
<td>ICT-using sectors in services</td>
<td>12.0</td>
<td>13.1</td>
<td>3.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>18.6</td>
<td>16.4</td>
<td>1.5</td>
<td>4.1</td>
</tr>
<tr>
<td>Business services</td>
<td>51.8</td>
<td>52.7</td>
<td>2.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Total economy</td>
<td>100</td>
<td>100</td>
<td>1.9</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Notes: Calculations for the euro area are based on data for Germany, France, Italy and Finland. Manufacturing and business services include ICT.


To sum up in very broad terms, US macroeconomic evidence has tended to suggest a trend increase in labour productivity growth of around 1 percentage point. Around half of this, or more according to some studies, could be due to ICTs. In the EU as a whole, the contribution of ICT capital to productivity growth would appear to have been rather smaller and to have occurred mainly through capital deepening, with a limited contribution from technical progress in ICT production. Moreover, while productivity growth went hand in hand with employment growth in the USA, the same was not true of the euro area. The EU average conceals differences among the Member States, however, with some more closely paralleling the US experience.

As far as short-term prospects are concerned, this assessment changes somewhat with the current economic downturn. Productivity growth is clearly tailing off at present with the turn in the economic cycle and the signs are that investment, particularly in ICTs, has been severely curtailed. Revisions to US GDP figures mean that the acceleration in labour productivity in the second half of the 1990s was smaller than it seemed in 2000. Baily (2001) judges that some estimates of TFP growth in non-computer sectors may have been too high. The downward revisions of investment data will also reduce the measured contribution of ICTs via capital deepening. Nevertheless, in qualitative terms, the assessment stands: technical progress in ICT production and an investment boom driven by rapid falls in quality-adjusted prices were major drivers of increased labour productivity growth from 1995.

Recent assessments are optimistic that the long-run impact of the new economy is still likely to be highly beneficial, on the grounds that the pace of underlying technological developments in recent decades shows no signs of abating. The latter years of the 1990s may have been a period of exceptionally rapid technical progress. Jorgenson (2001) points out that this can be traced to the shift in 1995 in the product cycle for semiconductors from three years to two as a result of

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intensified competition, although it cannot be assumed that this situation will persist indefinitely. Developments in the quality-adjusted price deflators in the USA may suggest reversion to a longer-term trend. Nevertheless, Graph 3 shows that this is still one of steep decline. Computer prices declined by around 12 per cent during the first half of the 1990s, by 17 per cent from 1995 to the end of 1999, and by around 11 per cent from 2000 to August 2001. In France, where a similar (though not fully comparable) quality-adjusted index is used, computer prices fell dramatically over most of the 1990s and, as in the USA, slightly less steeply over the past two years.

Graph 3: US and French computer price indices

![Graph showing US and French computer price indices](image)

Notes: US 'electronic computers', France 'micro-ordinateurs'.
Source: BLS and INSEE.

Depreciation of computer equipment and software is rapid, so countries that find themselves lagging behind are not destined to remain so for ever. The data for 2000 on ICT spending indicate that the gap between the EU and the USA was closing (see Graph 2 and Table 3). Under present circumstances, there may be a certain advantage in not being the first mover. The apparent boom-bust cycle in investment may be dampened to some extent in the EU, while conditions for putting in place ICT infrastructure are more favourable in some respects (e.g. lower hardware and software prices). The key policy issues would seem to be, first, why economic agents apparently had less of an incentive to invest in ICTs and, secondly, why the EU as a whole has a lower comparative advantage, compared to the USA, in the production of ICTs.

In conclusion, it is clear that higher growth in the USA and in a number of other countries in recent years has been driven in part by technical progress in ICTs, and the expectation remains that, following the current downturn, labour productivity growth will pick up in both the USA and Europe to levels above the trend of recent decades. If the studies undertaken in 2000 and early 2001 suggested a trend increase in productivity growth of around one percentage point, then recent developments would imply a somewhat lower figure. On the other hand, periods of rapid change are associated with factor adjustment costs, which may mean that productivity growth in recent years has understated true technological progress. Furthermore, macroeconomic analysis still does not provide clear evidence of TFP gains resulting from network externalities or improvements from the reorganisation of production. As far as the long-term effects of the new economy are concerned, the key issue for both the EU and the USA is whether and when these wider benefits – the subject of the following sections – will materialise.

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11 See Basu et al. (2001).
3. **BUSINESS PROCESSES AND THE IMPACT OF ICTs ON PRODUCT MARKETS**

Because of its “general-purpose” characteristics, information technology applications are characterised by enormous diversity. This raises the probability that the technology affects and gradually transforms those microeconomic processes through which economic growth is created. Such a transformation, in so far as it occurs, will come about as the result of changes arising both in the relatively narrow field of economic transactions, and more broadly through alterations in the wide range of activities involved in conducting business.

The first, narrow source of change originates from the effect of digitisation on the speed of economic transactions and the costs of executing them. Commonly referred to as the transactional impact of ICTs, or “e-commerce”, it is likely to change economic structures through its effect on market transparency and market power. But although it is potentially very powerful, the ramifications of e-commerce are bound to be overshadowed by another source of ICT impact captured in the term “e-business”. Based on the use of information technology for all manner of business activities, e-business should have an enhancing effect on economic efficiency. Starting with e-commerce, this section explores some of the mechanisms through which ICTs affect the functioning of product markets.

### 3.1 ELECTRONIC COMMERCE AND THE IMPACT ON TRANSPARENCY AND PRICES

The core of the economic impact of information technology springs from its capacity to break down information into bits that can be digitally processed, transmitted, and stored on computer networks. In the e-commerce domain, these features are expected to facilitate economic transactions on those interfaces where sellers and buyers meet. Specifically, as mentioned above, the impact should show up in improved market transparency, and either reinforcement or erosion of market power. Initially, the transparency effect is discussed before returning to the market power issue in sub-section 3.2.

Market transparency is the determining factor for how efficiently buyers can scan the market in search of deals that maximise value for money. On the supplier side, transparency is what shapes the effectiveness of product advertising. Because information technology thus yields visibility advantages on either side of the market, it shows all the signs of triggering an overhaul of many existing vehicles for market exchange.

In conventional markets, sellers rely on multiple channels for advertising products, including shop-windows, catalogues, and radio- and television-commercials. But whether buyers respond to this advertising depends on how accessible the information is and on the costs incurred by buyers in gathering and processing information. For buyers the rational strategy would seem to be to keep searching until the lowest price is found. However, buyers are generally constrained by search costs, and these must be weighed against any potential savings from continuing the search to find a cheaper price. Thus the multitude of offline channels suggests that buyers face relatively high search costs.

Online, that seems destined to change because of the critical capacity of e-commerce to automate the various steps in a transaction, from search and matching to execution and, for digital products, even delivery.

For suppliers, the creation of a common platform for pitching products on the Internet, potentially enables them to advertise products more transparently. Equally persuasive is the possibility for expanding the “reach” of marketing efforts to customer segments, who before were constrained by
geographical barriers, for instance. Extending the market in this fashion should, as a first-order effect, increase the number of suppliers that cater to individual buyer groups, thereby enhancing competition.

Likewise for buyers, provided their only search constraints are time and the bandwidth of the connection, the number of suppliers they are able to scan vastly exceeds what is possible in the physical world.

A particular source of cheaper market searches are price comparison-sites, or “shopbots”. These are electronic search engines that allow users to scan markets for the best buy on a product. Another innovation due to ICT are electronic marketplaces. By creating a common market arena for suppliers and buyers, and by aggregating and, in the case of online auctions, matching supply and demand, electronic marketplaces heighten transparency and speed up economic exchange in the process.

But the final purchase does not even have to be made online for e-commerce to be effective. Since buyers have the freedom to conduct market searches on the Internet prior to purchase in a bricks-and-mortar outlet, the chances of finding the right match are markedly improved. The upshot of this is that for transactions initiated on the Internet, the total search costs are likely to be drastically reduced, provided transparency is not compromised by restrictions on trading.

But as with other technologies that rely on interconnectivity, the impact of e-commerce depends on uptake. Benefits from the technology are a function of the total number of users, which explains why there are network effects in the diffusion process. As more users connect, utility increases exponentially because more connections can be made.

With more than 350 Mio users worldwide, the Internet has, however, long passed its critical mass. But far from assuring a full embrace of e-commerce, the diffusion of Internet access has pushed e-commerce forward at speeds resembling small steps more than the giant leap that many were predicting a few years ago. This pattern is particularly true for Europe (see Graph 4).

The upsurge in US e-commerce in the last two years has been somewhat like a steep increase whereas the same cannot be said about Europe. Nevertheless, it seems as though a positive trend in diffusion is discernible for Europe.

Business-to-business (B2B) e-commerce is by far the largest component, accounting for, on average, more than 80 per cent of electronic sales across countries. The balance is made up of business-to-consumer (B2C). But even in countries where enthusiasm runs relatively high, for example the USA and Sweden, total e-commerce accounts for less than 2 per cent of all sales. Thus, the full impact on prices and competition remains on the distant horizon.
True to form, the empirical findings cited in Box 2 indicate a rather protracted evolution of price effects. At first, the experimental nature of e-commerce and the paucity of user communities allow for some deviation from competitive market outcomes. But pressures on firms’ pricing power have been mounting on the heels of a gradual spread of e-commerce practices and the multiplication of users.

**Box 2: Empirical evidence on e-commerce price impact**

Early work by Bailey (1998) found that the level of prices was higher on-line than off-line. But because the user community was very small at the time the data was collected, this result was widely believed to reflect the immaturity of the market. As expected, results on price levels have since been largely reversed. Brynjolfsson and Smith (1999) find on-line discounts of 9-16 per cent for books and CDs compared to conventional markets. In the aggregate, these savings are far from trivial given that books and CDs are among the most heavily traded products online.

Bailey (1998) and Brynjolfsson and Smith (1999) find that rather than eliminate price dispersion, online markets allow for systematic price spreads for books and CDs of up to 33 per cent and 25 per cent respectively. For airline tickets, Clemons, Hann, and Hitt (1998) find variations of up to 20 per cent across online agents. Customer segmentation and price discrimination might offer clues as to the counter-intuitive findings in these studies.

One study (Goolsbee, 1998) finds consumers in US states with high local sales taxes are more sensitive to prices on-line. Moreover, their purchasing frequency is higher than that of consumers in low-tax states. This would indicate that price responsiveness is stronger online compared to conventional shopping. More recent work by Lynch and Ariely (2000) corroborates this result. Online price sensitivity is found to be higher for standard products, carried by many sellers. Conversely, and in line with the argument that e-commerce leads to more search for quality, price sensitivity drops for non-common, unique foods.

Regarding menu costs, which are the costs incurred each time the price on a product is changed, Bailey (1998) finds that the frequency of price changes by Internet retailers is significantly higher than for their conventional counterparts. Brynjolfsson and Smith (1999) report further supporting evidence, citing price changes up to 100 times smaller in internet retailers than in conventional markets.

In a Swedish study, Friberg et.al. (2000) find that prices on a basket of books and CDs, respectively, were 15 per cent lower online compared to conventional stores. Including fixed transport costs reduces the price differential to 10 per cent as transport costs generally diminish online cost savings. When buying only one item at a time, the gain from online purchasing completely vanishes. Consumers therefore must be prepared to buy several items at once to spread thinly transport costs. Interestingly, the price differential between online and offline markets is not present with retailers who sell through both channels. This reflects the “channel decision” that firms are facing - whether to sell products online and/or offline, and how to apportion marketing efforts between the two. Afraid that they might cannibalise on their own profits, firms seem to opt for charging the same price in both markets.

Empirically, it seems that prices are beginning to budge under the influence of e-commerce although it far from resembles the frenetic race to the bottom that some commentators had been predicting. Instead, the decline in price levels is modest, and when it comes to dispersion there seems to a good deal of persistence across many markets. One of the main factors accounting for these findings, is that, despite significant advances, online markets remain underdeveloped. Thus the coming of age of these should resolve several of lingering price anomalies.

But shrouded in the data may also be the effects of business strategies that are designed to mitigate the competitive impact of e-commerce. For example, a high price which at first sight may look like a firm capitalising on a strong brand (or consumers’ inexperience) may in reality be the result of
unobserved bundling. Hence, it is important to consider the options conjured up by e-commerce for marketing and pricing products strategically.

3.2 BUSINESS RESPONSE, PRODUCT DIFFERENTIATION AND MARKET POWER

Chief among the relevant business strategies probably are product differentiation and price discrimination. But contrary to conventional wisdom, economic welfare does not necessarily suffer from the employment of these strategies.

Product differentiation is particularly suitable for online markets. Compared to the off-line world where sellers are normally constrained in what features they can attach to products, online markets impose fewer constraints on design and quality. This added flexibility explains why bundling and unbundling is spreading as a means of differentiating products that conventionally are sold as “one-size-fits-all”. Especially, the use of “versioning”, where the range of versions available for a composite product is increased, is growing in online marketing. By modifying products along various dimensions, for instance, convenience of use, speed of delivery, or after-sale-service, firms can tailor products to individual tastes. Examples of such customisation are personally configured computers or made-to-measure clothing from specialised vendors.

Price discrimination, because of the fine-grained analysis of buyer behaviour that information technology permits, is the obvious extension to a differentiation strategy. Through compelling differentiation of products, firms may entice buyers to “self-select” into separate segments, which are subsequently charged different prices based on their idiosyncratic willingness to pay. In welfare economic terms, this enables firms to extract a larger share of the consumer surplus.

Normally, product differentiation connotes anti-competitive behaviour, because it might create barriers to entry. If used deliberately to stifle competition, bundling or versioning is therefore a cause for concern. Economides (1993) legitimates this concern by showing how a strategy of “pure bundling” (products available only as a package) restricts consumer choice and distorts market outcome. Evidently, if these types of differentiation were to spread widely, the impact on competition would be negative, irrespective of the gains from transparency.

But product differentiation should not be denounced without scrutiny. On the contrary, it can be welfare-enhancing if it satisfies consumers’ demand for variety. In the same paper, Economides (1993) demonstrates how a strategy of mixed bundling (products available both as a package and individually) indeed makes consumers better off. For price discrimination a similar word of caution is merited, because the traditional assumption of different customers being charged different prices for the same product seems to be losing its relevance. As De Long and Summers (2001) recall, “(we) may come to see price discrimination as an essential mechanism for attaining economic efficiency and social welfare”.

Going back to the empirical evidence on prices, it cannot be excluded therefore that some of the results are driven by firms differentiating products. Analogous to the challenge of demarcating product markets, if the value of peripheral features is not disentangled from the core product, as hard as it may be, it is impossible to avoid biases in data on prices.

Thus, overall, the message is that more work is needed before conclusions may be drawn about the market impact of e-commerce and its implications for welfare. As work progresses in this direction, it is important to keep in mind that product differentiation may be compatible with market efficiency. In that respect, the Lynch and Ariely (2000) result for non-standardised goods is
consistent with the view that consumers are benefiting from greater choice and lower cost of search for quality information.

3.3 E-BUSINESS, REORGANISATION AND PRODUCTIVITY

Without doubt e-commerce will have a tangible impact on market functioning. But the economic ramifications are likely to be dwarfed by e-business – or what amounts to a large-scale automation of business processes. To see why this is, it is worth recalling that e-commerce is limited to the interfaces for buying and selling which account for only a fraction of business activity. In contrast, the overwhelming majority of the business processes that value chains are configured around involve no monetary transactions. Moreover, many of these processes are readily adaptable to information technology. Because of this amenability, it is reasonable to expect the pervasiveness of ICTs in the value chain to affect economic efficiency. Three main properties account for this.

First, *information handling* can be made more efficient by using information technology to build data systems that pool information from across the supply chain and make it readily available to everyone connected to the network. Second, *resource allocation* can be improved by seamlessly exchanging information about production, for instance, between front-office and back-office units. Comprehensive information systems allow managers to make more informed decisions about operations and to execute them faster. Third, *employee interaction* can take on more flexible forms as staff units that are physically separated from each other can work more flexibly together through the sharing of databases and by communicating on a common electronic network.

Internal to individual firms, the automation of production processes enhances efficiency. This partly is due to the introduction of stand-alone computers, which increases throughput at a particular point in the production line. But the richest source of efficiency gains is the “interconnection” across computer-mediated networks. By electronically linking internal business processes that span most or all of the production chain, firms can increase output, exploit resources more efficiently, and enhance innovation.

It seems evident that the gains on efficiency and speed will be magnified if external partners are integrated with the systems. This opens a way of taking advantage of the fact that firms rely on other firms for sourcing inputs or selling output. In most industries, such business interaction occurs at high frequency in strategically placed nodes across the value chain. In contrast, the netting of claims in e-commerce transactions is less frequent.

Since every e-business interaction involves transactions costs, each node in the value chain represents a potential source of value added if costs can be reduced. Therefore, the closer suppliers and customers are associated to each other, the easier it should be to tap this potential. In addition, because firms remain separate, they are not forced to sacrifice the comparative advantage that made them enter into the transaction initially.12

Consistent with the above, the external impact of ICTs should be felt both on the supply and demand side of the firm. On the supply side, software applications can achieve a degree of flexibility that is comparable to what a firm enjoys on its internal operations. Production orders can be fed direct to the supplier either over proprietary links or via electronic marketplaces. Online collaboration on product development is also made possible. On the demand side, firms can use ICTs to upgrade customer relationship management. By monitoring customers and through various feedback mechanisms, it is possible to better track consumption patterns. Moreover, ICTs make

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12 The integration that ICTs deliver across external nodes may, of course, lead to mergers if transactions costs become low enough that separation is no longer economically optimal.
distribution services scalable too, even when distribution is outsourced. Hence, “time-to-market” performance should improve on the back of supplier distribution services.

However, the adjustment costs that firms have to bear in order to adapt to a changed business environment will weigh on markets. Because the impact of new technologies is sometimes rather uncertain, visibility about future developments is diminished, which might have a delaying effect on investment. Alternatively, it leads to investments in inferior technology, drawing out the adjustment process.\footnote{For example, in the heyday of the dot.com era, old-economy firms were being criticised because, in the eyes of many analysts, they were not embracing the new reality of e-business. Now, market sentiments seem instead to favour the same old-economy firms that enjoy brand recognition and consumer confidence, but who are gradually complementing their offline presence with e-business activities.}

A significant part of adjustment costs is related to turning ICT systems into value-adding business tools. This is not done by simply plugging in fancy, new information systems. Employees must be motivated to actively engage in using the systems before it is possible to reap any efficiency gains. Most of the time, however, this requires that firms abandon old, retentive work practices and replace them by organisational structures that allow the sharing and exchange of information across the firm. This suggests that there is an integral connection, a complementarity, between ICTs and workplace reorganisation.

### 3.4 The Complementarity of Workplace Reorganisation

In a revealing analysis, Brynjolfsson and Hitt (2000) assert that “a significant component of the value of information technology is its ability to enable complementary organizational investments such as business processes and work practices”. Indeed, firm-level productivity gains due to ICTs may only begin to materialise several years after ICT capital investment, once organisational changes have taken place.

A large body of case studies and surveys of firms provide evidence of the impact of ICTs on work organisation. Bresnahan et al. (2001) find that greater use of information technology is associated with increased delegation of authority to individuals and teams and greater levels of skill and education in the workforce. Lindbeck and Snower (2000) highlight a shift from specialisation by tasks towards “multitasking”, featuring job rotation, integration of tasks and learning across tasks, due in part to advances in ICTs.

The creation of cross-functional teams is another innovation among organisation-conscious firms. Often, team-members are recruited for a particular project requiring special skills. When the project is completed, members move on to new teams. A third strand of organisational change relates to remuneration, which explains the profusion of salary supplements such as share ownership, stock options, and profit-sharing schemes.

It is important to recognise that investments in workplace reorganisation and other complementary assets far exceed what firms pay out to acquire ICT equipment and software. For example, Brynjolfsson and Hitt (2000) report that average spending on computer hardware accounts for less than 5 per cent of start-up costs for a typical new firm. Significantly though, the propensity for ICT investment to be accompanied by workplace reorganisation is unmistakable. According to OECD work, the incidence of ICT-use is higher in firms that implement new work practices than in firms that do not. Further, recent data reveals how ICTs continue to diffuse rapidly in the workplace, albeit at different rates across Member States. From Graph 5 it is plain to see how the Netherlands and Scandinavia rank highest in terms of computer incidence in the workplace. Close to 70 per cent...
of the workforce in these countries use a computer at work. Elsewhere, computers are used more sparingly, keeping the EU average below 50 per cent.

Graph 5: Computer use in workplace, 2000

Source: Commission Services.

Because it still requires a computer to be connected to the network, a precondition for e-business gains to materialise is that enough workers have one. It follows that high-penetration Member States probably represent more fertile ground for reaping gains from ICTs than low-penetration countries. Indeed, Graph 6 suggests that a positive correlation exists between business investment in information technology and work reorganisation.

Graph 6: ICT investment, work reorganization and labour productivity

The size of each bubble indicates average labour productivity growth, 1996-2000. Work reorganisation and ICT investment refer to 1996. The trend line indicates the correlation between work reorganization and ICT investment.

Moreover, the graph indicates that this virtuous cycle raises productivity levels overall. With Ireland as a notable outlier, the joining of ICTs and work reorganisation seems an essential building block for achieving stronger productivity growth. Because growth opportunities are available to existing as well as new firms, pressure from new entries will cause a shakeout in the market. The mechanism works by making it increasingly difficult for less efficient firms to survive in the market as firms become more skilled and as competitive pressures build up. Gradually, low-efficiency firms are weeded out, leaving in the market only high-efficiency firms. In the aggregate, productivity start to climb as the selection process propagates throughout the economy.

Interestingly, the source of efficiency gains varies across industries. According to work done by the OECD, new firms account for a considerable portion of productivity gains in ICT-related industries, whereas, in more mature industries, the strongest contribution comes from restructuring “within” existing firms and the exit of inefficient firms.

But initial competitive conditions are critical for determining when the virtuous competition-technology cycle starts, and how fast it advances. Hence, by virtue of its effect on take-up, competition encourages diffusion and, as a corollary, has a positive influence on productivity. This concurs with the view proposed in Baily (2001). He reports ongoing work to suggest that inadequate competition partly explains the relatively modest productivity gains in Europe in the second half of the 1990s compared to the USA.

The view that competition remains restrained in Europe resonates also with official European positions. It corresponds, for example, to the findings in European Commission (1999) that mark-ups are generally higher in European markets compared to the USA, especially in large Member States.

Armed with a vast array of analytical evidence, Member States therefore have had sufficient grounds for launching their combat on market inefficiencies. In response to the challenge, which has been common to all Member States, albeit at varying intensity, policymakers have put together a long list of initiatives. This list encompasses major policy accomplishments such as the Single Market Programme, EMU, and ongoing structural reforms, which have proven rather effective at knitting markets closer together. Nevertheless, there is still room for improvement. This is where added transparency from e-commerce and heightened efficiency from e-business might fit in as possible carriers of further market integration and stronger competition.

3.5 E-BUSINESS AS A FACILITATOR OF MARKET INTEGRATION IN EUROPE

At around 15 per cent, price dispersion in the EU remains high. Apart from differences in standards living across Member States, the main culprit is persistent segmentation in a range of markets. But how each of these markets will respond to e-commerce and e-business depends, essentially, on the characteristics of the industry supplying the market and how well it lends itself to digital integration.

European Commission (2001a) reports considerable variation in the way industries are assimilating e-commerce and e-business practices. Basic and intermediate industries are expected to reap only modest gains. In contrast, the potential for integration and networking seems under-exploited in manufacturing industries. The impact on service industries is probably more heterogeneous than in manufacturing even, while transport and logistics, arguably, are among the most amenable industries.
With a fairly simple business model – receiving and executing delivery orders – these industries adapt easily to an online environment.

For purposes of predicting the impact on European market integration, it is useful to separate the likely first-order effects from effects of a second-order nature. As described above, e-business and e-commerce should have palpable first-order effects on market functioning. The spread of ICT-supported business processes is expected, in most cases, to augment transparency, reduce transactions costs, and strengthen competition. Based on the resulting cost savings it should be feasible to derive temporary rises in productivity.

In the longer term, the structural and behavioural adjustments by firms and consumers, and the attendant policy responses, raise the probability of more permanent changes to economic efficiency. In theory, it is possible to estimate the aggregate impact of these second-order effects. But to do it, would require very detailed knowledge about complex dynamics for structural developments, something that is not readily available. Thus although the macroeconomic findings cited in subsection 3.2 embody microeconomic forces on the restructuring of firms and markets it is difficult analytically to reconcile the two.

For forecasting future developments, the preferred analytical approach therefore confines the impact to first-order effects. In this context, it is relatively easy to handle the narrow transactional effect of e-commerce, because it can be divided into savings on procurement costs and reductions in the share of markets where products are traded conventionally. In contrast, the largely indirect nature of e-business effects generally means that the part of it, which is not subsumed into the cost-savings from e-commerce, remains unaccounted for.

In a comprehensive and oft-cited analysis, Brookes and Wahhaj (2000) estimate the effect of B2B e-commerce on potential GDP in the USA, France, Germany, UK, and Japan. The study suggests that the immediate impact on prices, other things equal, would be close to a 4 per cent decline in inflation over the period, equivalent to a 0.4 per cent decline in annual inflation. Allowing for second-round effects on industry restructuring and monetary policy adjustment, the projections for Europe show potential GDP rising to around per cent per year in the course of a decade. However, these second-efforts reduce the overall impact on inflation. Unibank (2000), reporting similar estimates for Denmark, estimate that the diffusion of e-commerce might trigger up to a 0.5 percentage-point decrease in annual inflation over a decade.

Taken at face value, the estimates on national economies suggest that price levels in Europe could fall substantially on the back of digitisation. In a study launched by the European Commission, Cambridge Econometrics (2001) provide a rough prediction on this price impact and the effects on output and employment associated with it. Using an econometric model for the whole of the EU, the study shows a dampening effect on prices from B2B and B2C separately. By 2005, consumer prices should be 0.3 per cent lower than they would otherwise be on account of lower industry costs from B2B. By comparison, lower retail costs due to B2C are forecast to produce a decline in consumer prices of about 0.2 per cent. Moreover, both B2B and B2C result in increases in EU GDP of about 0.1 per cent above reference. However, the impact on employment is different between the two effects. Lower intermediate prices from B2B cause real wage costs to rise relative to other inputs resulting in lower employment. Conversely, the number of jobs increases from B2C owing to the stimulation to consumer demand.

Whether the future conforms to these projections is largely a question of how eagerly firms and consumers embrace the new activities involved. Notably, the recent downturn in technology markets, which has strongly affected the economy, has not been accounted for in the above analyses. Still, future ICT developments in Europe depend on creating a common mindset toward e-commerce and e-business.
3.6 **OBSTACLES TO THE FURTHER DEVELOPMENT OF E-COMMERCE AND E-BUSINESS IN EUROPE**

Encouragingly, the community of Internet users is still growing in most Member States as is shown in Graph 7. However, the mode of diffusion varies greatly. As with most other measures of technology penetration, the Nordic countries, the Netherlands and the UK are leading the pack. Germany, France, Ireland, and the remaining Benelux countries all enjoy intermediate penetration, while Southern Member States exhibit the least diffusion.

![Graph 7: Internet access in households](image)

Source: Eurobarometer.

Combined with the data on computer access (Graph 5), the numbers on household Internet access show a diffusion process, which leaves something to be desired. But even if diffusion was greater in Europe, indications are that the commercial gains would not be fully exploited. This is so, because as Graph 8 reveals, even Internet uses have reservations about e-commerce. Less than half of European users have bought anything on the Internet; and of these only a tiny fraction do it regularly. Until such reservations are assuaged, it is hard to imagine a boom in e-commerce and e-business in Europe.
Similar reservations are relevant for most aspects of ICT development in Europe. E-commerce and e-business push market integration forward only if they succeed in unlocking the network effects embedded in the technology. For this to happen, firms, households, and governments must be prepared collectively to assume the costs of investing in the technology. Referring to this type of scenario, Bresnahan (2001) talks about the “co-invention costs” of implementing and improving ICTs. Users are supposed to make investments more or less simultaneously, but the investment process remains largely uncoordinated across firms and individuals. This indicates that “co-invention costs” may be the true constraints on ICT diffusion. Thus, recent indications that for the first time in years Europe invests and spends more on ICT than the USA bodes well for the regions’ endeavours to catch up with the US technology lead.

4. LABOUR MARKETS

Earlier sections have covered the finding that complementary investments in work reorganisation or human capital may be a necessary condition for realising the potential productivity benefits of ICTs. Some observers have suggested that a lack of labour market flexibility in Europe and insufficient human capital may be behind the seemingly delayed reaction to the information revolution. This section examines these issues after first reviewing the potential impact of ICTs on overall employment and unemployment.

4.1 TECHNOLOGY, UNEMPLOYMENT AND EMPLOYMENT

If technological progress is modelled as a productivity shock, then standard economic theory suggests a neutral effect on unemployment in the long run. It is not a miracle cure for unemployment – even if technical breakthroughs lead to an economic boom, wages should eventually adjust to keep unemployment at around its structural level. Nor does the information economy spell the “end of work” – some people may lose their jobs because of the introduction of

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14 See e.g. Layard et al. (1991).
new technologies but many other jobs will be created. With sound macroeconomic management, human resources are reallocated to more productive uses.\textsuperscript{15}

A major caveat is that in practice the effects of recent technological change, in particular computerisation, are not homogeneous. They affect different workers in different ways and, in particular, developments in recent decades seem to have exacerbated labour market inequalities by increasing demand for higher-skilled workers while reducing demand for lower-skilled workers.\textsuperscript{16} In the presence of institutions such as unemployment and social assistance benefits, unionised wage bargaining and statutory minimum wages, skill-biased technical change can raise structural unemployment. It is argued that this is exactly what has happened in Europe.\textsuperscript{17}

The impact on employment is also ambiguous in the basic framework. A rise in productivity increases wages, which persuades some people to join the labour market or to work more, but allows others to leave or to work fewer hours. Again, in assessing the possible employment impact, it is important to take account of the impact of technical changes on different groups of (potential) workers, and the nature of the job opportunities created or destroyed. Skill-biased technical change could push some workers into inactivity or early retirement. Older working-age people may be vulnerable in areas where generic ICT skills are sought (although it is argued below that other generic skills are just as important).

But ICTs may also facilitate more flexible work organisation, allowing inactive people to join or return to the workforce, including some from groups typically most under-represented. In particular, women could stand to benefit most from a move towards “multitasking” work environments and conditions (including telework) that allow better reconciliation of work and family life. In addition, empirical evidence tends to suggest that the wage elasticity of labour supply for married women is positive.\textsuperscript{18} Thus, higher productivity (leading to higher wages), together with improvements in the organisation of work, could be key in terms of meeting EU objectives for female employment, though further research is necessary to quantify the potential impact.

There are grounds for cautious optimism that the spread of ICTs, if the risks are well-managed and the benefits are exploited, could have a moderate positive effect on employment in the EU. However, technical progress alone will be far from sufficient to meet the EU’s employment objectives.

4.2 THE ROLE OF LABOUR MARKET FLEXIBILITY IN ECONOMIC ADJUSTMENT AND ADOPTION OF NEW TECHNOLOGIES

Several commentators have suggested that a lack of flexibility in product and labour markets could explain why productivity gains from the use of ICTs have not materialised in Europe.\textsuperscript{19} In broad terms, flexibility refers to the adjustment capacity of employment levels, wages and working practices. For various economic and social reasons, labour market flexibility is restricted by means of institutionalised bargaining over pay and working conditions, statutory employment contracts and other government regulations and policies, for example on maximum working time or minimum

\textsuperscript{15} There may be caveats to the standard view. For example, if higher productivity growth results in wage increases above workers’ aspirations, there may be reduced pressure on unit labour costs until workers’ aspirations catch up (Baily, 2001, p. 26). This could lead to a temporary improvement in the unemployment-inflation trade-off.

\textsuperscript{16} See e.g. Autor et al. (1998), Machin and Van Reenen (1998).

\textsuperscript{17} See Roeger and Wijkander (1999).

\textsuperscript{18} See e.g. Blundell and MaCurdy, (1999).

wages. At the same time, flexibility is promoted through the establishment of norms, often through collective bargaining, in areas such as flexitime, telework and work organisation more generally.

Flexibility thus defined is relevant to the adoption of ICTs in two ways. First, there is the general point that in any period of rapid technical change, a relatively high degree of creative destruction is to be expected. Secondly, as discussed in Section 3, the microeconomic evidence suggests that complementary investments in work reorganisation may be necessary to realise the full productivity potential of investments in ICTs.

Box 3: Employment protection and wage flexibility

Theoretical labour market search models generally reflect the intuition that employment protection is expected to reduce both job creation and job destruction (Garibaldi et al., 1997). However, well-designed, flexible employment protection can play a positive role in insuring workers against the risk of income loss (conventional insurance being unavailable because of moral hazard). This need not adversely affect job creation, since risk-averse employees prefer to pay a premium in the form of a wage reduction in return for a period of notice and/or severance payments upon termination of employment (Pissarides, 2001). But high and inflexible levels of employment protection, including various administrative procedures, legal obstacles and additional costs for collective redundancies, unambiguously reduce labour turnover. In addition, the insurance function is partly redundant in countries with adequate unemployment insurance.

A recent review of empirical evidence found that, even if there is no clear effect on overall employment and unemployment, stricter employment protection tends to reduce labour turnover (OECD, 1999). The available data do not reveal higher rates of gross job turnover in the supposedly more flexible labour markets of North America (Burda and Wyplosz, 1994; OECD, 1996). There are, however, two main differences. First, flows into and out of unemployment tend to be greater in the USA and Canada. In Europe, more or less as many jobs seem to be created and destroyed without people passing through a spell of unemployment. Secondly, movement of people between ongoing jobs appears to be much higher in the USA and Canada. This seems to be due partly to higher numbers of people moving between short-term jobs and brief periods of unemployment in North America, whereas in many EU Member States both job tenure and periods of unemployment tend to be longer (OECD, 1996). But it does not necessarily follow that European labour markets manage to avoid “precarity” at no cost in terms of dynamism.

First, the role of movements between ongoing jobs in facilitating the adoption of new technologies should not be underestimated. Hammermesh et al. (1996), in a study of the Dutch labour market, found that almost one quarter of firms simultaneously hired and fired in the same year, and interpret this as evidence of the significance of failed job matches in labour turnover. Job protection legislation specified in terms of traditional occupational categories may allow resistance to changes in work organisation, while at the same time failing to offer any protection to the growing number of part-time and contract workers (Snower, 1999). Focusing only on firms that remain in business, Garibaldi et al. (1997) do find a clear negative correlation between job reallocation and the strictness of employment protection legislation.

Secondly, there may be other factors in Europe that lead to inefficient job turnover, one suggestion in particular being the role of wage-setting institutions (Bertola and Rogerson, 1997). Wages in most of the EU are generally held to be less flexible than in North America and, to some extent, the UK in two ways. First, they have responded slowly to negative productivity shocks in the past, leading to higher unemployment over the medium term. Secondly, the overall wage distribution is more compressed, making it harder to employ relatively low-productivity workers. Both of these factors tend to make unemployment, rather than real wages, more likely to serve as the variable of adjustment when industries, firms or particular skills and occupations are subject to relative productivity shocks.

It is not clear whether greater wage flexibility could have improved ICT take-up in Europe. The experience of some Member States, notably Finland and Sweden, suggests that a wide earnings distribution cannot be a necessary condition. Indeed, Roeger (2001) points out that a compressed wage distribution should encourage firms to invest in unskilled labour-saving technologies. Baily (2001) recalls the finding that 81 per cent of job growth in the USA between 1993 and 1999 was in categories paying above-median wages. Indeed, in the EU as well, it has been noted that 60 per cent of the 10 Mio jobs created between 1995 and 2000 were in sectors considered to be either high-tech or requiring highly educated workers (European Commission, 2001b). Some
infer from this that the knowledge-based economy can bring both productivity growth and employment growth without a more unequal distribution of earnings.

But lower-productivity occupations are also important for the take-up of ICTs. The US-Europe comparison is misleading because of the very different starting positions – the obverse of high-skill job growth in Europe is a continued failure to create jobs for lower-skilled people, whereas this is not true of the USA. Secondly, high-wage net job creation in the USA does not imply that the labour market for below-median wage jobs was any the less dynamic in terms of gross flows. Human capital across the whole skill and productivity spectrum plays a role in sectors that produce ICTs or use them intensively (see sub-section 4.3).

1. See, for example, OECD (2000). The increase in unemployment is in principle temporary, but may be prolonged in the presence of hysteresis effects.

2. Indeed, if wages react slowly to positive productivity shocks as well as negative ones, then it could be argued that any temporary reduction in unemployment will be longer-lasting (see sub-section 4.1 above).

Box 3 looks at employment protection legislation and wages, two of the most commonly discussed elements of flexibility. Other important aspects include performance-related pay, working time and other forms of modernised work organisation. Lindbeck and Snower (2000) discuss a general shift, driven partly by technological developments, towards more “holistic” work organisation involving job rotation, integration of tasks and learning across tasks. These developments have implications for the effectiveness of labour market policies and institutions. For example, if jobs become less uniform, then the principle of “equal pay for equal work” will be harder to apply, making centralised wage-setting less efficient.

Collective bargaining may play a crucial role. On one hand, bargaining institutions need to take account of the changing nature of work. On the other hand, well-functioning institutions are likely to enhance the effectiveness of work organisation. Indeed, there is some evidence that new work practices are more prevalent among unionised firms. The countries that have been most successful so far in exploiting ICTs fall into two groups. In Ireland, the UK and the USA, unionisation and coverage of collective bargaining is relatively low, and bargaining tends to be decentralised at company level. The experience of the Scandinavian countries and Finland, however, suggests that this is not the only model (see Box 4).

**Box 4: Bargaining and flexibility in the Nordic countries**

High levels of union membership and a long tradition of co-operation between the social partners and the government are the norm in all of the Nordic countries. As elsewhere, unionisation tends to be lower in the ICT sector (especially software and IT services, as opposed to the more traditional hardware and telecoms segments). Nevertheless, the unions in these countries have taken the lead in developing new recruitment methods aimed at attracting ICT workers, particularly young professionals. In addition, there are special sectoral bargaining agreements for IT services in Finland and protocols on ICT work in other sector-wide agreements in Denmark. In Sweden, specific agreements cover parts of the ICT sector, notably white collar employees of the IT and telecoms employers’ association (ITA) (EIRO, 2001).

There is some evidence to suggest that the “Nordic model” of flexible work organisation is associated with higher productivity, employment and working conditions. The Swedish Business Development Agency (NUTEK, 1999) drew this conclusion from a comparative study of firms in Denmark, Finland, Sweden and Norway. Front-runners in applying five key features of flexibility (delegated responsibility, organised human capital development, use of teams, organised job rotation and compensation based on results or quality) performed better on average.

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21 See Arnal et. al. (2001).
The same research shows that, according to the enterprises themselves, trade unions had on balance made a positive contribution and were felt to have hindered organisational development only in a very small minority of cases (see table below).

| Proportion of workplaces where attitudes of unions or shop stewards have influenced organisational development |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| no. of workers | Positive/furthered | Negative/hampered | Not at all, not relevant or don't know |
| Denmark 50+ | 12.5 | 25.4 | 3.5 | 6.2 | 52.4 |
| 10+ | 7.3 | 17.2 | 1.9 | 3.8 | 69.9 |
| Finland 50+ | 29 | 21 | 50 |
| 10+ | 23 | 22 | 55 |
| Sweden 50+ | 32.3 | 36.7 | 6.4 | 7.3 | 17.1 |


In sum, there are good reasons to believe that labour market flexibility in its various forms is important for the take-up of ICTs and the realisation of productivity gains. Graphs 9 and 10 suggest a clear correlation between various measures of flexibility and the contribution of ICTs to growth. Of course, this does not prove a causal relationship, which would be difficult to isolate empirically not least because of the manner in which different policies and institutions interact. In any case, the implications for policy are not straightforward. On one hand, ICT take-up is hardly the sole objective of labour market policy and, on the other, different combinations of policies may be appropriate in different countries. Nevertheless, there is a clear case for a careful examination of labour market policies and institutions with a view to ensuring that they are not unduly restricting the adaptability of the economy to technical progress.

Furthermore, as noted in section 2, job creation in sectors that produce ICTs or use them intensively has been disappointing in Europe compared to the USA. This could be partly due to a shortage of human capital, although as noted below there is no indication that skill shortages are more severe than they have been in the USA. The key difference may be Europe’s failure to employ a substantial share of its human capital.
The microeconomic impact of information and communication technology in Europe

Graph 9: Employment protection legislation strictness vs. growth contribution of ICTs

Accelerance of GDP due to ICTs (% points)

Strictness of employment protection legislation (EPL)

USA  CAN  DK  NL  F  D  JAP

Note: EPL strictness is a subjective index designed by the OECD. 

Graph 10: Average job tenure and the growth contribution of ICTs

Acceleration of GDP due to ICTs (% points)

Average employee tenure in years, 1998

USA  CAN  NL  D  JK  UK  DK


4.3 Human Capital

It seems almost self-evident that the move towards a knowledge-based economy demands investment in human, as well as physical, capital. But, as Capelli (2000) puts it, arguments about the need for more skilled and educated workers often seem to be “of the ‘chicken soup’ variety: it couldn’t hurt”.

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Much of the public debate has focused on the perceived shortage of skilled ICT workers. At the EU-level, this has been particularly influenced by the reports from International Data Corporation for Microsoft (IDC, 2000) and for the European Information Technology Observatory (EITO, 2001).22 IDC do not make the full methodology used to generate these figures publicly available but, from the information that is provided, it appears that there are several problems.23

A number of other studies carried out at national level mainly by ministries or government agencies conclude that shortages are much smaller.24 Box 5 provides some data on job vacancies across different sectors and occupations in selected EU Member States. The recent downturn in the ICT sector and the consequent massive redundancies announced mean that skill shortages in the short-term may now be among the least of our worries. But, even before these developments, there were reasons to think that public attention may have been focused unduly on specialist ICT skills.

Box 5. ICT vacancies in selected EU Member States

Evidence from employer surveys in the few member states where these are conducted provides information on the scale of skill shortages in ICTs compared to other sectors and occupations. The figures from the Netherlands and Ireland (see tables below) show that, while there have been genuine shortages of specialist ICT skills in recent years, the situation seemed if anything to be easing in 2000. ICT occupations are not the only ones where shortages have emerged. Moreover, ICT specialists make up a small proportion of total employment so that, in absolute terms, the number of vacancies is dwarfed by that in other sectors and occupations.

<table>
<thead>
<tr>
<th>Employment and vacancies in the Netherlands by sector. 1998-2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>First quarter vacancies ('000s)</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Mining and quarrying</td>
</tr>
<tr>
<td>Manufacturing</td>
</tr>
<tr>
<td>Energy and water supply</td>
</tr>
<tr>
<td>Construction</td>
</tr>
<tr>
<td>Trade, hotels, restaurants and repair</td>
</tr>
<tr>
<td>Transport, storage, communication</td>
</tr>
<tr>
<td>Financial and business activities</td>
</tr>
<tr>
<td>-- Computer services etc. (SIC 72)</td>
</tr>
</tbody>
</table>

Source: CBS labour accounts and vacancy survey.

22 IDC (2000) forecasts a shortage of 1.7 Mio ICT professionals by 2003, unless urgent action is taken. EITO (2001) includes e-business and call centre professionals in addition, and concludes that there was already a shortage of 1.9 Mio in 1999, forecast to rise to 3.8 Mio by 2003.

23 In particular, it is far from clear that “shortages” really represent excess demand at current wages. Labour demand is gauged by asking employers about their recruitment needs on the basis of technical requirements. There is no comparison with other economic sectors or occupations, nor is any account taken of high labour turnover in ICT professions (which generates a stock of vacancies even if skill shortages are zero). Nor is full account taken of the potential response of labour supply and wages.

24 See European Commission (2001c, annex III) or WITSA (2001) for surveys.
Falk’s careful analysis of unfilled vacancies in Germany (table below) suggests that the figures produced by IDC may overstate the problem by a factor of four. Falk takes account of labour turnover partly by counting only vacancies that remained unfilled during the 6-month survey period and partly by adjusting the figures to exclude rotation of workers between different firms.

### Unfilled ICT vacancies in various sectors, Germany, 2000

<table>
<thead>
<tr>
<th>no. of ICT workers</th>
<th>unfilled vacancies</th>
<th>unfilled vacancy rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>('000)</td>
<td>('000)</td>
</tr>
<tr>
<td>Manufacturing (excl. ICT industries)</td>
<td>150/160</td>
<td>13</td>
</tr>
<tr>
<td>Energy, Water, construction*</td>
<td>35/37</td>
<td>2</td>
</tr>
<tr>
<td>Trade and transport</td>
<td>148/145</td>
<td>8</td>
</tr>
<tr>
<td>Banking and insurance</td>
<td>80/81</td>
<td>11</td>
</tr>
<tr>
<td>ICT sector (OECD definition)</td>
<td>390/444</td>
<td>34</td>
</tr>
<tr>
<td>Business services</td>
<td>171/188</td>
<td>16</td>
</tr>
<tr>
<td>Public sector (health, education etc.)*</td>
<td>309/330</td>
<td>10</td>
</tr>
<tr>
<td>Germany totalb</td>
<td>1,283/1,384</td>
<td>93</td>
</tr>
</tbody>
</table>

Notes: * Estimated. Including firms with less 4 and less employees. The number of ICT workers in firms with 4 or less employees is estimated using information on the share of core ICT-employees across firm size as well as industries based on German Labour Force Survey. The unfilled vacancy rate in firms with four or less employees is assumed to be equal to the neighbouring size class (5-9 employees). a) Excluding replacement vacancies. b) Catering and restaurants are included but not listed.
ICT production and use creates the potential for employment opportunities across a range of occupations and skill levels. Certain other specialist skills, such as engineering, may be in even greater demand. The vacancy data in Box 5 leave little room for doubt that those displaced by skill-biased technical change are far more likely to find jobs in occupations not directly linked to ICTs. Many of the jobs created in recent years in sectors where ICT use has had a significant impact – such as retail, wholesale or financial services – clearly do not require specialist skills. One of the strengths of the work by IDC and others is that it has highlighted the variety of skills required in order to enable e-business and other information society applications. Many workers in these areas – from call centre operators to website designers – need ICT skills beyond the basic level, but not necessarily specialist ICT skills.

The available evidence on basic ICT skills indicates that these are important. The majority of the workforce uses ICTs on a regular basis, and a basic competence is increasingly important for employability and adaptability across sectors. However, there is little to suggest a genuine shortage relative to other skills. Work by the UK Skills Task Force (2000), among others, shows that employers indeed find ICT competence and awareness among adults lacking, but not markedly more so than other generic skills such as communication skills, numeracy and team-working ability. A lack of IT skills among 16-17 year-old new recruits does not seem to be an issue. Acquiring a basic competence in ICT should be a key objective of general education (including adult education and lifelong learning), but not to the exclusion of other core skills.

There is evidence of an emerging “digital divide”. Graph 11 shows, for example, that Internet access in the EU is correlated with age, gender, education and employment status. There seems to be a clear role for policy to address this issue, which relates as much to social inclusion as it does to employability.  

Graph 11: Internet access in the EU

<table>
<thead>
<tr>
<th></th>
<th>June 2001 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>students</td>
<td>73.1</td>
</tr>
<tr>
<td>EU average</td>
<td>34.3</td>
</tr>
<tr>
<td>women</td>
<td>28.5</td>
</tr>
<tr>
<td>unemployed</td>
<td>24.3</td>
</tr>
<tr>
<td>low income</td>
<td>19</td>
</tr>
<tr>
<td>low inc. women</td>
<td>13.8</td>
</tr>
<tr>
<td>low education</td>
<td>10.8</td>
</tr>
<tr>
<td>retired</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Source: Eurobarometer.

Nevertheless, when it comes to reaping potential productivity gains, training in generic skills is no substitute for specific training. The key human capital policy issue, in view of the changes in work organisation discussed earlier, is whether employers and employees have appropriate incentives to provide and to acquire their own specific training. As the demand for versatility, cognitive skills, general aptitude and so on grows, so does the transferability of employees among firms. This could

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reduce employers’ incentives to invest in training for fear of having employees poached. Yet, at the same time, employees may not have sufficient incentive to invest in their own training, in part because their skills are of use to a larger but still limited number of employers, who therefore retain a degree of bargaining power over pay and conditions.

5. CONCLUSIONS AND POLICY CHALLENGES

5.1 RECONCILING THE MACROECONOMIC AND MICROECONOMIC PICTURES

The available evidence at both macroeconomic and microeconomic levels suggests that the rapid development and deployment of ICTs remains likely to have a significant positive effect on productivity growth. The developments of the past 18 months do not fundamentally change this, although the estimated impact is smaller now than it seemed it 1999-2000.

However, there is a puzzle still to be resolved. The analysis in Section 3 suggests that tangible improvements in business and work organisation should be observed. Yet the measured economic impact of the new economy hardly picks up these effects. Some of the recent US evidence has demonstrated a clearer link between intensive ICT use and productivity gains, but this does not seem to apply to all sectors, even some that have invested heavily in ICT. One reading of this is that the potential benefits of ICTs have been exaggerated. But the microeconomic evidence so far available suggests a more optimistic interpretation.

There are several reasons why macroeconomic growth accounting exercises may understate the true productivity potential of ICTs. These include measurement error, a failure to capture quality improvements in final products (e.g. retail banking) and dissipation of benefits in the form of “on-the-job consumption” (e.g. use of the Internet at work for personal purposes).

However, a more fundamental point is that the economic history of similar periods of apparent all-purpose technological progress shows that it may take several decades for the wider benefits to emerge.26 The lag between, say, the introduction of the Intel microprocessor in 1972 and the year 1995 would be short by the standards of previous revolutions. The analysis of productivity gains post-1995 can hardly purport to measure the full impact of the latest wave of innovation in ICTs, centred on the Internet.

The microeconomic evidence suggests that there is a good reason for a delay between investments in ICTs and any subsequent productivity gains. Complementary investments – notably in business organisation, work organisation and human capital – are required to realise the potential, and these take time to make. In terms of policy, this suggests that it is essential to focus as much on the institutions that may help or hinder organisational changes as on the technologies themselves.

5.2 THE OUTLOOK IN EUROPE

Last year’s EU Economy Review tentatively concluded that the same driving forces behind the apparent productivity acceleration in the USA were at work in the EU as well, albeit with a delay of several years. This chapter provides some further support for that view. First, the (albeit limited) empirical evidence on business and work organisation in EU countries reaches similar conclusions to

the US evidence. Secondly, there are direct signs that ICT investment spending and overall ICT expenditure were catching up with US levels in 2000 or indeed had already done so. Thirdly, later adoption of technology may confer certain advantages, especially where depreciation is rapid.

Competitive advantage in the production of certain ICTs provides part of the explanation for the US’s lead and indeed the strong position of some EU Member States. But, in a longer term perspective, the use of ICTs is much more important. This chapter has found some support for the view that rigidities in product and labour markets are liable to delay both the diffusion of ICTs and the organisational changes required to secure the full productivity potential from the use of ICTs.

In a sense, this could mean that Europe has more to gain: “it could be argued that paradoxically, it is precisely in Europe, with its still very fragmented markets, inefficiencies and protection in many sectors, that a further digitisation of the economy and organisational restructuring is likely to bring much more scope for productivity gains than in the USA”.27 Thus, an important message is that ICTs and organisational change are complementary. But the introduction of ICTs will not be sufficient; further progress on economic reforms in order to facilitate organisational change is also necessary. Some of the specific issues that follow from the analysis in Sections 3 and 4 are as follows.

The appropriate response in the area of competition policy calls upon competition authorities to be vigilant in monitoring markets. Their analytical capacity must keep up with technological development. In particular, the enforcement of competition rules should be used to frustrate efforts to use new technologies to restrict competition.

Smother regulations are needed to stimulate the take-up of e-commerce. Policy measures must be designed to target consumer reservations about the security of online systems. Moreover, appropriate initiatives should instil confidence about redress mechanisms to handle complaints in online commerce. Unlocking market integration through e-commerce also necessitates adjustments to make national regulations mutually compatible. Substantial efforts are being made at Community to achieve these objectives. But beyond this, Member States must continue to scrutinise regulatory frameworks to identify and remedy impediments to the uptake of ICT. In pursuing this, it is imperative that compliance costs are kept at a minimum.

Reform efforts in telecoms markets and access costs must be sustained to improve market functioning. In particular, broadband technology holds a promise for expanding the user community through faster, more reliable access. But the key to successful dissemination is cheaper network access for operators, which underlines the importance of completing the task of unbundling the local loop. Accordingly, Member States are obliged to reinforce pressure on incumbents to cede control of local loops.

Turning to labour markets, the adoption of ICTs will not be sufficient for the EU to achieve its employment objectives. Increased productivity growth will raise real wages, but is not expected to have a major impact on unemployment or employment in the longer term. ICTs do enable the creation of knowledge-based job opportunities, skills development and modernised work organisation, and could therefore enhance the adaptability of employees. This could encourage increased labour supply and exert some downward pressure on structural unemployment. However, there are also substantial risks that need to be managed, in particular the risk of greater numbers of lower-skilled people being displaced.

Certain labour market policies and institutions may be far from optimal when it comes to securing the potential productivity gains of technological progress. This needs to be taken into account in the structural reform agenda, particularly in areas such as employment protection and

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wage bargaining. Social partners have a key role to play in introducing workable frameworks for practices such as job rotation, telework or flexitime.

The importance of skills is paramount, both in introducing ICTs and changes in work organisation, and in minimising the potentially negative impact on unskilled workers. There is a need to recognise that information society skills are much broader than ICT skills, essential though the latter are. There is also a need to focus on how changes in work organisation might affect incentives to provide training and to acquire skills, including individuals’ incentives to invest in their own training. The emphasis placed in the European Employment Strategy on lifelong learning and the responsibility of social partners and employers to provide information society skills is a positive first move.
6. REFERENCES


FALK, M. (2001), What drives the vacancy rate for information technology workers?, mimeo, ZEW.

FREEMAN, C. AND F. LOUCA (2001), As time goes by: From the industrial revolutions to the information revolution, Oxford: OUP.


IMF (2001), World Economic Outlook, October, Washington D.C.


WITSA (2001), Inventory on IT skills and workforce initiatives, World Information Technology and Services Alliance, interim compilation, April, www.witsa.org.