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A COMPARATIVE OVERVIEW AND EXPLANATORY FACTORS 1980-2004

by Anatoli Annenkov
and Christophe Madaschi

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ABSTRACT

This paper analyses the differences in hourly labour productivity growth rates and levels between the Nordic EU countries (Denmark, Finland and Sweden) and four larger euro area countries (Germany, France, Italy and Spain). Additional information for the euro area as a whole, the UK and the US is also provided. Given that the economic and social models developed in the Nordic EU countries are in many ways closer to those of the larger euro area countries than that of the US, the experience of these countries is particularly interesting. Since the mid-1990s, the Nordic EU countries, particularly Sweden and Finland, have experienced stronger labour productivity growth than the larger euro countries. Like in the US, innovation and technological changes have played a major role in explaining the higher labour productivity growth in the Nordic EU countries compared with the larger euro area economies. Information and Communication Technology (ICT) diffusion is a key element to explain these differences. A number of institutional indicators, relating to market regulation, human capital, R&D investments and venture capital, show that the Nordic EU economies are better positioned than some of the larger euro area countries to exploit the opportunities provided by ICT in terms of productivity growth. However, remaining labour market rigidities may not allow the Nordic EU countries to fully enjoy the benefits of ICT diffusion in terms of increased employment.

EXECUTIVE SUMMARY

The aim of this Occasional Paper is to determine the extent to which hourly labour productivity growth rates and levels have been higher in the Nordic EU countries (Denmark, Sweden and Finland) compared with the larger euro area countries (Germany, France, Italy and Spain), and to examine the driving forces behind the different patterns.

Since the mid-1990s, the Nordic EU countries, particularly Sweden and Finland, have experienced stronger hourly labour productivity growth than the larger euro area countries. Combined with a high level of labour utilisation, this has resulted in a "structural" labour productivity level that is relatively high compared with some of those larger euro area countries. As has also been the case in the United States, innovation and technological changes have played a major role in raising labour productivity growth in the Nordic EU countries.

In Denmark ICT and non-ICT capital deepening have been the main contributors to hourly labour productivity growth. While TFP growth has played a smaller role than in the two other Nordic EU countries, the contributions of both ICT and non-ICT capital deepening to labour productivity growth have been much higher than in the larger euro area countries. Denmark has also tended to outperform the largest euro area countries in the ICT-using service sectors, but it lags significantly behind Germany and France with regard to the ICT-producing manufacturing sectors.

In Sweden hourly labour productivity growth has been mainly driven by the contribution of TFP and, to a lesser extent, ICT capital deepening. The stronger labour productivity growth patterns compared with the larger euro area countries have mainly been driven by the relatively high TFP and ICT capital deepening contributions to aggregate labour productivity growth, with a high contribution of the ICT-using service sectors. The ICT-producing manufacturing sector has also contributed to widening the labour productivity gap with the larger euro area countries.

In Finland the relatively high hourly labour productivity growth compared with the larger euro area countries is mainly a result of the high contribution of TFP growth and, at the sectoral level, the high contribution of the ICT-producing manufacturing sectors. The hourly labour productivity growth observed in the ICT-using service sectors has also contributed to raising labour productivity growth relative to the larger euro area countries.

Only a few countries may have the necessary comparative advantages to succeed in the ICT-producing sectors that are characterised by very rapid technological progress, strong competition, price declines and high labour productivity growth. Much of the interest in the potential impact of ICT on growth is, therefore, not linked to the ICT-producing sector, but to the potential benefits arising from its use in the production process elsewhere in the economy. From a policy point of view, given the higher potential for employment creation in the services sectors combined with the evidence that there is no apparent trade-off in the medium term between labour productivity and employment growth thanks to increased ICT use, ICT diffusion appears to be particularly relevant in the services sectors. As a result, the key issue for the larger euro area countries is how to increase their future capacity to promote the diffusion of innovation and, in particular, technological changes in the service sectors, a field in which the Nordic EU countries have performed particularly well.

The high degree of product and financial market competition, a highly skilled workforce, high investments in R&D and the availability of venture capital, all areas in which the Nordic countries are among the best performers, seem to be the main explanatory factors behind the relatively strong performance of the Nordic EU countries. These "comparative advantages" probably facilitated

the expansion of ICT-production and diffusion and may explain why the structural characteristics of these economies were more conducive to exploiting the opportunities provided by new technologies than the larger euro area countries. At the same time, remaining labour market rigidities in these countries may inhibit the full realisation of employment gains from greater competition and innovation, as product and labour market features can have important complementary effects.

Looking ahead, and given the need to further increase the level of labour resource utilisation in the larger euro area countries, the gap in labour productivity growth between the larger euro area countries and the Nordic EU countries may widen further, unless appropriate structural reforms take place in the euro area. In this respect, the experience of the Nordic EU countries provides some useful insights and lessons.

I INTRODUCTION

Since the second half of the 1990s the widening gap observed between Europe and the United States in terms of hourly labour productivity growth has become a major source of concern for European policy-makers. This widening mainly reflects acceleration in the United States and a simultaneous slowdown in Europe. Several studies have shed light on the driving forces behind the relatively poor performance of Europe. Overall, there appear to be two main reasons for the divergence in labour productivity growth between Europe and the United States: on the one hand, in the United States the production and diffusion of information and communication technology (ICT)[1] seems to have played a larger positive role.[2] On the other hand, wage moderation and labour market reforms in Europe, aimed at increasing the employment intensity of growth, might have temporarily resulted in weaker labour productivity growth.[3] However, the European aggregate data hide important disparities across countries. The Nordic EU countries (Denmark, Finland and Sweden) have also achieved higher labour productivity growth than most of the larger euro area countries since the mid-1990s. Given that the economic and social models developed in these countries are in many ways closer to those of the larger euro area countries than that of the United States, the experience of these countries is particularly interesting.

The aim of this Occasional Paper is to determine the extent to which hourly labour productivity changes and levels have been higher in the Nordic EU countries compared with the four larger euro area countries (Germany, France, Italy and Spain), and to examine the driving forces behind the different patterns. Additional information for the euro area as a whole,[4] the United Kingdom and the United States is also presented. Chapter 2 deals with labour productivity growth and levels per hour worked over the period 1980-2004. Chapter 3 provides a decomposition of labour productivity growth over the period 1991-2004 into its underlying components: capital deepening (separating between ICT and non-ICT) and total factor productivity growth (TFP). Chapter 4 presents a sectoral decomposition of the labour productivity growth performance, focusing more particularly on the ICT-producing and using sectors in manufacturing and services. Finally, Chapter 5 highlights some key figures from structural indicators that may explain these patterns.

It is important to mention a number of caveats related to the measurement of labour productivity. Indeed, data on labour productivity and ICT are surrounded by considerable uncertainty and caution is therefore required when interpreting the

1 For simplicity, the term ICT will be used as a general term although some studies often refer more specifically to only IT.
2 See Oliner and Sichel (2002), Jorgenson, Ho and Stiroh (2002), and Jorgenson (2003).
3 See IMF (2004).
4 See also ECB (2004) and ECB (2005).

results. In order to be consistent across countries, this paper uses a database developed by the Groningen Growth and Development Centre (GGDC),[5] which also allows for a sectoral breakdown. Aggregate data are available up until 2004, while data for the sectoral breakdown are only available until 2002, which means that sectoral developments in the most recent years are not covered. It is also important to mention that other databases, such as the OECD STAN database, or national sources sometimes show significant discrepancies for some countries compared with the GGDC database.

2 LABOUR PRODUCTIVITY: A COMPARATIVE OVERVIEW 1980-2004

2.1 AGGREGATE LABOUR PRODUCTIVITY GROWTH

Given the significant decline in working time over the last decades in almost all EU15 countries,[6] it is useful to measure labour productivity in terms of hours worked. However, statistics for hours worked are generally considered to be of poorer quality than total employment statistics. Differences in labour productivity per hour worked across countries may consequently reflect the still imperfect harmonisation of annual working hour estimates.

Bearing this in mind, Table 1 shows the aggregate changes of labour productivity per hour worked in the selected EU countries, the euro area as a whole and the United States over the period 1980-2004.

The data in Table 1 reveal that *Finland* has been among the countries with the highest hourly labour productivity growth throughout the period. Labour productivity growth in Finland has even been higher than in the United States, with the exception of the last period. In addition, the gap in labour productivity growth between Finland and the larger euro area countries and the euro area as a whole widened in the second half of the 1990s, reflecting both the increase in Finland and the weakening labour productivity growth performance observed in Germany, Spain and Italy.

Over the same period, hourly labour productivity growth in *Sweden* accelerated significantly and became higher than the hourly labour productivity growth observed in the second half of the 1990s in the larger euro area countries and the euro area as a whole. Hourly labour productivity growth in Sweden was also higher than in the United Kingdom as

5 This database was developed for a study on EU Productivity and Competitiveness entitled "An Industry Perspective; Can Europe Resume the Catching-up Process?" by O'Mahony and van Ark (2003).

6 See, for instance, Leiner-Killinger, Madaschi and Ward-Warmedinger (2005).

Table 1 Labour productivity growth per hour worked

(average annual % change)

	1980-1989	1990-1995	1996-2000	2001-2004
Germany	2.4	2.9	2.3	1.3
Spain	3.7	2.2	-0.3	0.3
France	2.9	1.5	1.7	1.9
Italy	2.0	2.0	0.9	-0.2
Finland	2.9	2.5	2.8	2.2
Euro area	2.4	2.1	1.5	0.9
Denmark	2.2	2.2	1.6	1.9
Sweden	1.1	1.9	2.4	2.4
United Kingdom	2.2	2.5	2.1	2.0
United States	1.3	1.2	2.1	2.9

Source: GGDC.
Note: Prior to 1990, data for Germany (and the euro area) refer to West Germany.

of the mid-1990s but, like in Finland, it fell behind the US performance over the period 2001-2004.

In *Denmark* hourly labour productivity growth tended to follow the euro area performance until around 2000. In a similar manner to most of the larger euro area countries, labour productivity growth weakened markedly in the second half of the 1990s. However, over the period 2001-2004 hourly labour productivity growth in Denmark strengthened again.

2.2 AGGREGATE LABOUR PRODUCTIVITY LEVEL

Turning to the situation in terms of levels, comparisons of hourly labour productivity can provide useful information on the relative standing of a country and can also yield useful insights into the potential for further productivity growth and catch-up.[7] However, uncertainty related to the measurement of labour productivity levels is even higher than that for growth rates. It is, therefore, important to remember that caution is required when comparing the results across countries and, in particular, that small differences across countries are not significant.

Table 2 shows the hourly labour productivity levels in 2003 relative to the euro area average. The hourly productivity level is defined as GDP at constant prices expressed in PPP relative to total hours worked. Overall, the data on observed labour productivity levels provide a more mixed picture compared with growth rates. First, among the Nordic EU countries, while Denmark was at a similar level to the euro area average, Sweden and Finland lagged slightly behind. Second, the Nordic EU countries were more or less in line with Italy although, more significantly, they lagged behind Germany and, in particular, France, while they recorded significantly higher levels than Spain.

However, the average annual hours worked per worker and/or the employment rate is usually higher in the Nordic EU countries than in the euro area. Adjusting for the diminishing returns of these two components of labour utilisation, Table 2 also reports a "structural"

7 See Pilat (1996a).

Table 2 Observed and structural hourly labour productivity levels: 2003

	Observed hourly labour productivity level (index) (a)	Employment rate (in %)	Average annual hours worked per worker	Adjustment effect (in %) of the gap with the euro area in employment rate (b)	Adjustment effect (in %) of the gap with the euro area in working time (c)	Structural hourly labour productivity (index) (a + b + c)
Germany	106	65.0	1,441	1.9	-2.4	105
Spain	80	59.8	1,799	-2.2	5.6	83
France	122	63.2	1,429	0.5	-2.7	120
Italy	97	56.1	1,609	-5.2	1.4	93
Finland	96	67.7	1,635	4.1	1.9	102
Euro area	100	62.6	1,549	0.0	0.0	100
Denmark	99	75.1	1,519	10.0	-0.7	108
Sweden	95	72.9	1,553	8.2	0.1	103
United Kingdom	95	71.5	1,624	7.1	1.7	104
United States	107	71.2	1,817	6.9	6.1	120

Sources: GGDC and European Commission.
Note: The hourly labour productivity levels are calculated by using PPPs from 2002. The observed labour productivity level for France is unusually high when compared with other databases. The main reasons for that are the lower level of hours worked per worker and, to a lesser extent, the lower employment level.

hourly labour productivity level, which compares productivity levels under the assumption of equivalent levels of average working hours and employment rates in all countries and in the euro area.[8] This measure provides a more positive picture for the Nordic EU countries. Indeed, Finland, Sweden and, more specifically, Denmark are now at the higher end of the spectrum compared with the larger euro area countries and the euro area as a whole, with the significant exception of France.[9]

2.3 SUMMARY

Since the second half of the 1990s the Nordic EU countries, and Sweden and Finland in particular, have, like the United States, experienced stronger hourly labour productivity growth than the larger euro area countries. In addition, these countries have relatively higher levels of labour utilisation than the larger euro area countries. When adjusting for the differences in labour utilisation across countries, the labour productivity levels of Denmark, Finland and Sweden (and the United Kingdom and the United States) improve significantly, while the levels in the larger euro area countries decrease somewhat, with the exception of Spain. Accordingly, in terms of potential for further productivity growth, there is still plenty of scope for increasing labour productivity to the levels prevailing in the United States, in particular in some of the larger euro area countries. Given the sizeable differences across countries in labour productivity, both in terms of changes and levels, and the apparent pattern of higher labour productivity growth in the Nordic EU countries compared with the larger euro area countries, a pattern which may see further convergence towards the high levels prevailing in the United States, one important question arises: what are the driving forces behind these developments?

3 DECOMPOSITION OF LABOUR PRODUCTIVITY GROWTH

3.1 CONCEPTUAL FRAMEWORK

In the context of standard growth accounting frameworks, labour productivity growth can be decomposed in terms of the contributions from capital deepening and total factor productivity (TFP) growth.[10] Capital deepening denotes the changes in the use of physical capital per worker in the production process and can be seen as a measure of capital productivity. It can also be linked to labour market and labour cost developments. In the following analysis, we will draw a distinction between ICT and non-ICT capital deepening. TFP growth or the so-called "Solow residual" is usually attributed to innovation and to technological and organisational improvements. From the viewpoint of analysis and policy relevance, it is important to make the distinction between *embodied technological change,* which arises from changes in the composition of production inputs (capital and labour), and *disembodied technological change* (TFP growth), which reflects shifts in the production function. Embodied technological change represents advances in the design and quality of new vintages of capital and intermediate inputs and its effects are attributed to the respective production factor as long as the factor is remunerated accordingly. Disembodied technological change comes in the form of applying general knowledge, blueprints, network effects or spillover from other factors

8 For more details on the concept and methodology of "structural" hourly productivity levels, see Cette (2004).

9 The same computation with the OECD data provides different results, in particular for France, where the "structural" hourly productivity level is significantly below that observed in the United States but still the highest among the above EU countries.

10 The computation of TFP is based on a Cobb-Douglas production function, $Y=L^{\alpha} K^{(1-\alpha)}$ TFP, where Y is real GDP, K is total capital input (net capital stock or capital service), L is total labour input (either total employment or total hours worked), TFP is Total Factor Productivity and α is the labour share. As a result, labour productivity growth can be decomposed as follows: $\Delta(Y/L) = (1-\alpha)\Delta(K/L) + \Delta TFP$. For further explanations of the growth accounting framework, see Musso and Westermann (2005).

of production, including better management and organisational change.

This type of presentation facilitates the interpretation of labour productivity developments and can provide a first indication of the driving factors behind the diverging labour productivity growth patterns in the Nordic EU countries and the larger euro area economies. However, the measurement of production inputs and TFP growth is surrounded by considerable uncertainty. For instance, given the problem of properly measuring and capturing improvements in capital and labour input, measured TFP growth, which is calculated as a residual, does not only include disembodied technological change but also part of the embodied technological change and improvements in the skill composition of the workforce (for more details, see Box 1). Furthermore, TFP growth is not necessarily caused by technological change. Indeed, other non-technology factors will also be picked up by the residual. Such factors may include adjustment costs and scale and cyclical effects, as well as pure changes in efficiency and measurement errors.

Box 1

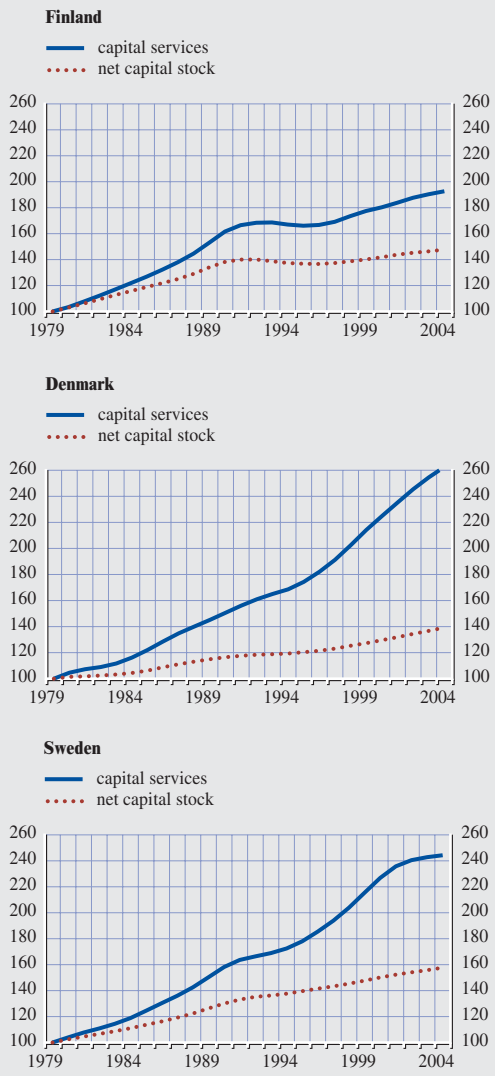
CAPITAL SERVICES AND LABOUR QUALITY

Using the concept of capital services (as in the GGDC database) instead of net capital stocks for the calculation of TFP may solve some of the measurement issues mentioned above. While the net capital stock, which is a measure of wealth, is often used for data availability reasons, economic theory suggests that the wealth concept of capital is not appropriate for a production function and, hence, for TFP calculations. For this purpose, a measure of aggregate services yielded by the capital stock is needed. Based on the economic theory of production, the concept of capital services relates back to the work of Jorgenson and Griliches (1967).[1] One important insight is that the vast heterogeneity of capital inputs must be accounted for. For any given type of asset, there is a flow of productive services from the cumulative stock of past investments. This flow of productive services is called capital services of an asset type. For instance, investment in new computer equipment provides different productive services per period than investment in a new building. The main difference between the capital service and the wealth measures is the way in which different types and ages of asset are aggregated together. In capital services, each item of capital (an asset of a particular vintage) is weighted by its rental price (or user cost)[2]. The rental price is the price that the user would have to pay to hire the asset for a period. By contrast, in wealth measures of capital stock each item is weighted by the asset price (i.e. the price at which it could be sold to another user). Some authors use "capital quality" to denote the difference between capital service flows and capital stock, as it reflects the changing composition of investment towards assets with higher marginal products. As a result, a shift in investment towards high-tech equipment with a higher marginal product leads capital services to grow more quickly than the capital stock. As an illustration, the chart below plots the capital service and net capital stock indices for Denmark, Sweden and Finland. As can be seen, net capital stocks tend to underestimate capital accumulation, especially in times of rapid technological change and falling prices, and, as a consequence, overestimate TFP growth.

1 With further developments by Jorgenson (1995), Hulten (1990), Triplett (1996,1998), Hill (2000) and Diewert (2001).
2 $UC = P * (r + D - \Delta P)$, where UC represents the user cost or the rental price of a type of asset, P is price, r is the rate of return, D is the depreciation rate and ΔP is the growth of P.

Capital service and net capital stock indices for Denmark, Sweden and Finland, 1979-2004

(index 1979 = 100)



Sources: GGDC database and Eurostat.

However, even if the concept of capital services provides a significant improvement for productivity analysis, the computation of capital services raises a number of challenges, and important measurement problems remain. Indeed, given that producers usually own their capital goods, no market transaction is recorded when the capital good "delivers" services to its owner. The measurement of these implicit transactions – whose quantities are the services drawn from the capital stock during a period and whose prices are the user costs or rental prices of capital – is one of the challenges of capital measurement for productivity analysis.

Another important extension (not taken into account in the GGDC data) is the explicit inclusion of the contribution of changes in labour quality. Economists have long recognised the importance of investment in human capital, and expenditure on education, job training and health care all increase the quality of human labour and, hence, enhance productivity. Griliches (1960), Denison (1962) and Jorgenson and Griliches (1967) pioneered the use of wage data to weight heterogeneous workers and construct constant quality indexes of labour. Similar to the treatment of capital, this approach captures substitution between different types of labour and results in a flow of labour inputs appropriate for the production function analysis. While there are few studies calculating the effects of labour quality on productivity on a comparable basis, a study for the Nordic Council (2005) showed that improvements in labour quality could explain around 0.2 percentage point of total labour productivity growth in Denmark, Sweden and Finland in the second half of the 1990s.

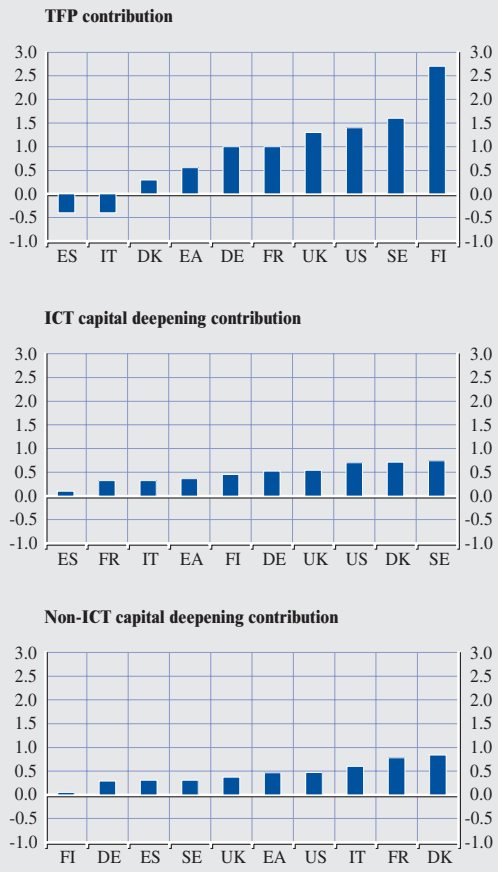
3.2 DECOMPOSITION RESULTS

As shown in Figure 1,[11] the TFP contribution to labour productivity growth (disembodied technological change such as product innovations) has, since 1996, been considerably stronger in *Finland* than in the larger euro area countries, the United Kingdom and the United States, explaining in turn the diverging patterns of labour productivity growth between Finland and the larger euro

11 Based on GGDC data, which use the concept of capital services but are not corrected for labour quality changes.

Figure 1 Contributions to hourly labour productivity growth: 1996-2004

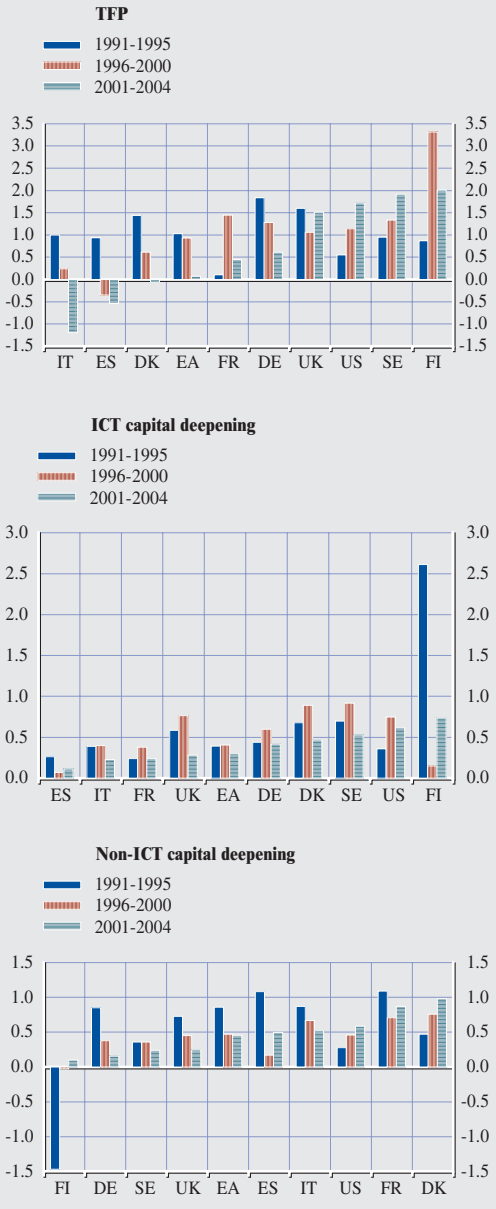
(in percentage points, euro area = EA)



Source: GGDC.

Figure 2 Changes in contributions to hourly labour productivity growth: 1991-2004

(in percentage points)



Source: GGDC.

area countries. In *Sweden* the TFP and ICT-capital deepening contributions (embodied technological change) over the same period have been significantly stronger than in the larger euro area economies. Finally, in *Denmark* ICT and non-ICT capital deepening have been the main contributors to total labour productivity growth and both have been significantly higher than in the larger euro area countries. By contrast, the contribution of TFP to labour productivity growth has been significantly lower than in most larger euro area economies and also lower than in the other Nordic EU countries, the United Kingdom and the United States.

Studying the way in which these components have evolved over time across countries also reveals some interesting results. Figure 2 shows the different contributions to labour productivity growth over the periods 1991-

Table 3 Share of ICT-capital services relative to total capital services

(in %)

	1990	1995	2000	2004
Germany	12.4[1)]	11.4	10.3	9.2
Spain	10.1	8.8	8.4	8.1
France	6.8	6.2	6.4	7.6
Italy	10.7	9.8	9.2	9.8
Finland	11.1	13.2	13.3	14.1
euro area	10.3	9.5	8.9	8.9
Denmark	14.4	15.5	13.6	12.4
Sweden	12.9	16.3	18.2	16.4
United Kingdom	9.8	13.4	15.2	13.6
United States	18.2	19.3	19.9	18.8

Source: GGDC.
1) 1991.

1995, 1996-2000 and 2001-2004. While it is clear that the contribution of TFP and ICT capital deepening moderated in most countries in the period 2001-2004, partly resulting from cyclical effects and, in particular, the collapse of the ICT sector, the only countries to experience acceleration in TFP growth in the same period were Sweden, the United Kingdom and the United States. This could be partly related to relatively high level of ICT investments in the preceding period (1996-2000). Indeed, a number of papers have highlighted the fact that increased use of ICT generates spillover effects with some delay, raising TFP growth (Bartelsman and Hinloopen, 2002). This also seems to have occurred previously in Finland, during the periods 1991-1995 and 1996-2000. However, developments in Denmark run counter to this idea. Indeed, while the ICT capital deepening contribution to labour productivity growth was, on average, similar to the levels observed in Sweden, the United States and the United Kingdom during the period 1991-2004, TFP growth has decelerated significantly over time.

The figures in Table 3 on the share of ICT capital services in total capital services tend to confirm the stronger effort in ICT investment and in diffusing ICT products in the economy in the Nordic EU countries, as well as in the United Kingdom and the United States. This is particularly the case in Sweden, where the share of ICT capital services in total capital services increased significantly between 1990 and 2004 to reach a level close to that seen in the United States, while it represented barely half of this level in the larger euro area countries and in the euro area as a whole and has even declined in some larger euro area countries (Germany, Spain and Italy) compared with 1990.

4 SECTORAL LABOUR PRODUCTIVITY GROWTH 1996-2002

4.1 THE IMPORTANCE OF SECTORAL DEVELOPMENTS

Aggregate and decomposed estimates of labour productivity do not provide insights into the sectoral composition of productivity. It is possible for countries to be highly productive and to enjoy strong labour productivity growth in one sector while remaining among the less well-performing countries in another sector. Such differences are important in helping to determine the sectors in which there may be scope for additional productivity growth to catch up with other countries. In addition, the opportunities offered by adopting new technologies may be completely different across sectors and may have very different impacts on output, employment and productivity performance. For instance, in

some manufacturing industries ICT has largely contributed to rationalising production processes by raising productivity growth through the use of less input, in particular unskilled labour. By contrast, in some service sectors increased use of ICT may result in increasing both labour productivity growth and employment, in particular employment of unskilled workers. Finally, information on sectoral developments makes the links between labour productivity changes and product market competition more straightforward.

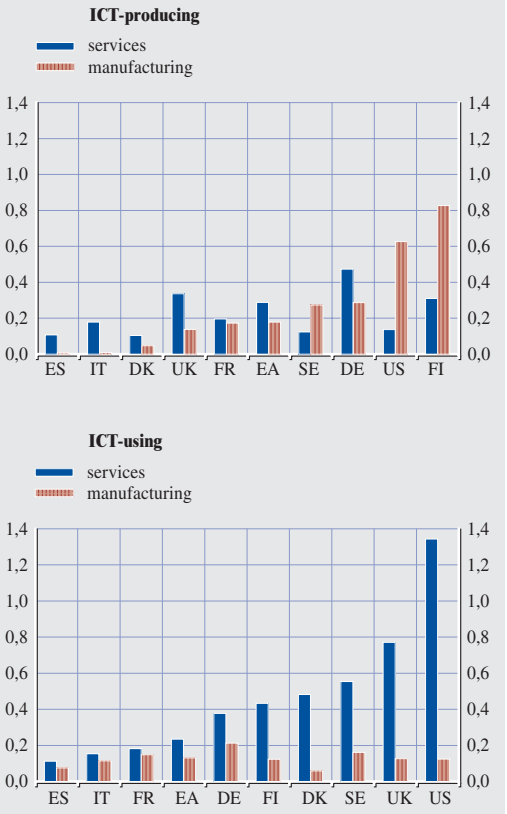
This section focuses mainly on the distinction between the ICT-producing and ICT-using sectors. In particular, the ICT-producing manufacturing sectors and the ICT-using service sectors (see the Appendix for an overview of the sectors) seem to be the key sectors in explaining diverging labour productivity growth developments between the Nordic EU countries and the larger euro area countries. In addition, within a neoclassical framework it is critical to distinguish the use of ICT and the production of ICT. ICT is both an output from ICT-producing industries and an input to ICT-using industries, so there are two effects. The massive quality improvements in ICT contribute to faster growth in the ICT-producing industries and faster input accumulation in the ICT-using industries. Thus, the neoclassical model predicts rapid capital deepening and higher average labour productivity growth in ICT-using industries. In the ICT-producing industries, it predicts higher technical progress and TFP growth (Stiroh, 2000).

4.2 SECTORAL DEVELOPMENTS IN 1996-2002

As shown in Figure 3, the contribution of the ICT-producing manufacturing sectors over the period 1996-2002 in *Finland* was significantly higher than in the larger euro area economies (and higher also than in Denmark, Sweden, the United Kingdom and, to a lesser extent, the United States). The contribution of the ICT-producing manufacturing sectors to aggregate labour productivity growth was four times higher than in the euro area as a whole and three times higher than in Germany, which had the highest contribution of ICT-producing manufacturing sectors among the larger euro area economies. Looking at changes in labour productivity and the weight of the sectors, it can be seen that the higher contribution in Finland is explained by both stronger labour productivity growth and a higher GDP share (see Table 4), which reflects a stronger efficiency and specialisation in Finland compared with the larger euro area countries. Although the ICT-producing manufacturing sectors are small (4% of total GDP), they contributed almost one-third of the aggregate labour productivity growth.

Figure 3 Sectoral contribution to aggregate hourly labour productivity growth: 1996-2002

(average annual percentage points)



Source: GGDC database.

Table 4 Sectoral hourly labour productivity growth and GDP share at current prices 1996-2002

(annual average)

ICT-producing

	Labour productivity growth (%)			GDP share (%)		
	Manufacturing	Services	Total	Manufacturing	Services	Total
Germany	20.3	11.9	14.1	1.4	4.0	5.4
Spain	0.6	3.1	2.7	0.7	3.4	4.1
France	12.6	5.0	6.9	1.4	4.0	5.3
Italy	1.0	4.9	4.1	1.0	3.7	4.6
Finland	20.9	7.1	13.7	4.0	4.4	8.3
Euro area	13.9	7.4	9.1	1.3	3.9	5.1
Denmark	4.4	3.0	3.3	1.1	3.5	4.6
Sweden	13.8	2.7	6.1	2.0	4.6	6.5
United Kingdom	8.0	6.6	7.0	1.7	5.1	6.8
United States	29.6	2.8	10.9	2.1	4.9	7.0

ICT-using

	Labour productivity growth (%)			GDP share (%)		
	Manufacturing	Services	Total	Manufacturing	Services	Total
Germany	2.9	1.8	2.1	7.4	20.7	28.1
Spain	1.7	0.6	0.8	4.4	17.8	22.1
France	3.1	0.9	1.3	4.8	20.4	25.2
Italy	1.7	0.7	0.9	6.7	22.9	29.6
Finland	1.8	2.8	2.5	6.9	15.7	22.6
Euro area	2.1	1.1	1.4	6.1	20.9	27.0
Denmark	1.0	2.4	2.1	5.9	19.9	25.9
Sweden	2.7	3.1	3.0	5.9	18.0	23.9
United Kingdom	2.1	3.6	3.3	6.0	21.2	27.2
United States	2.6	5.5	5.0	4.7	24.6	29.3

Source: GGDC database.

In addition, the contribution of the ICT-using service sectors to aggregate labour productivity growth in Finland was stronger than in the larger euro area countries, mainly thanks to higher labour productivity growth. Together these two sectors accounted for around 50% of aggregate labour productivity growth, while they only accounted for 20% of GDP.

In *Sweden* the contribution of the ICT-using service sectors was significantly higher than in the larger euro area economies. The contribution of the ICT-using service sectors to aggregate labour productivity growth was twice as high as in the euro area as a whole and 50% higher than in Germany, which again achieved the highest contribution of the ICT-using service sectors among the larger euro area economies. Only the United Kingdom and the United States had higher contributions of the ICT-using service sectors. The strong contribution of the ICT-using service sectors to aggregate labour productivity growth in Sweden was only driven by higher labour productivity growth (see Table 4). As was also the case for Finland, the GDP share was significantly below the ratio observed in the larger euro area countries, reflecting higher efficiency but not higher specialisation in this sector compared with the larger euro area countries. This sector has contributed almost one-third to aggregate labour productivity growth in Sweden, while it has represented only 18% of total GDP.

In addition, the contribution of the ICT-producing manufacturing sector to aggregate labour productivity growth in Sweden was stronger than in the larger euro area countries, with the exception of Germany, mainly thanks

to a higher GDP share (see Table 4). Together these two sectors accounted for almost 50% of aggregate labour productivity growth, while they only represented 20% of total GDP. However, even if these ratios are similar to the ratios observed in Finland, when looking at these sectors in Sweden it seems that a larger number of sub-sectors contributed to this performance than was the case in Finland. In Germany the ratios represented one-third and 22% respectively, compared with two-thirds and 27% in the United States.

Finally, *Denmark* also tended to exceed the largest euro area countries in the ICT-using service sectors, but lagged significantly behind Germany and France with regard to the ICT-producing manufacturing sectors. Like in Finland and Sweden, the stronger contribution of the ICT-using service sectors to aggregate labour productivity growth in Denmark was driven by higher labour productivity growth. The ICT-using service sectors contributed almost one-third to aggregate labour productivity growth, while they accounted for only 20% of total GDP.

In sum, the sectoral analysis tends to confirm the findings observed in section 3, that technological changes and innovation have played a major role in explaining diverging labour productivity growth developments between the Nordic EU countries (mainly Finland and Sweden) and the larger euro area countries.

5 SOME POLICY CONSIDERATIONS

5.1 IMPORTANCE OF ICT DIFFUSION IN SERVICE SECTORS

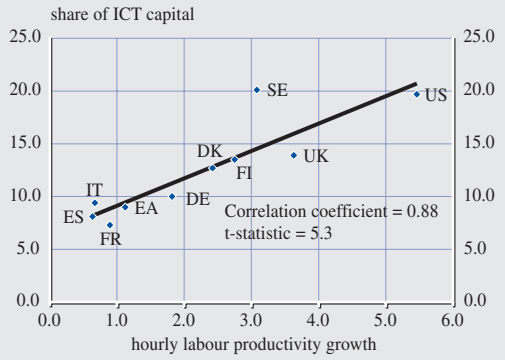
As seen from the analysis above, ICT appears to have been one of the main factors explaining the underlying rise in labour productivity in the Nordic EU countries since the middle of the 1990s. Various studies have shown that rapid technological developments in the ICT-producing industries play a major role in the revival of TFP growth (see Oliner and Sichel (2002) and Jorgenson, Ho and Stiroh (2002)), while the increased use of ICT is the main factor driving the acceleration in labour productivity growth in the service sectors. Given the large economies of scale and high costs of research and development involved with new ICT products, only a few countries will have the necessary comparative advantages to succeed in producing them. Moreover, the ICT-producing sectors are characterised by very rapid technological progress, strong competition, price declines and high labour productivity growth. This is not necessarily a problem for other countries as a substantial part of the benefits of ICT production accrues to importing countries and to users who can benefit from rapid declines in the price of investment and consumer goods (Bayoumi and Haacker, 2002). Much of the current interest in ICT's potential impact on growth is, therefore, not linked to the ICT-producing sectors, but to the potential benefits arising from its use in the production process elsewhere in the economy (see Pilat, Lee and van Ark, 2002).[12] Therefore, and in light of the results above, the main issue for the larger euro area countries is their lower capacity to diffuse ICT products, in particular in the service sectors. By contrast, the Nordic EU countries have performed particularly well in terms of labour productivity in the ICT-using services sectors, despite the somewhat smaller size of these sectors (in relation to GDP) compared with the larger euro area countries.

Figure 4 would seem to confirm the great importance of ICT diffusion for labour productivity growth by showing a positive correlation between ICT investment, as reflected by the share of ICT capital relative to total capital services, and hourly labour

12 For instance, the use of ICT may help firms expand their product range, customise the services offered, or respond better to client demand – in short, to innovate. Moreover, ICT may help reduce inefficiency in the use of capital and labour, e.g. by reducing inventories. All these effects might lead to higher productivity growth.

Figure 4 ICT-capital share and hourly labour productivity growth in ICT-using service sectors: 1996-2002

(annual average; in percent)



Source: GGDC database.

productivity growth in the ICT-using service sectors.

Looking at labour productivity growth in selected ICT-using service sectors in the period 1996-2002 (see Table 5), it appears that, similar to the United States, the Nordic EU countries have outperformed the larger euro area countries in wholesale and retail trade[13], as well as in the different sectors of financial intermediation.

5.2 IMPLICATIONS FOR EMPLOYMENT

On the basis of the sectoral analysis, one important question arises relating to the implications for employment growth of the developments in sectoral labour productivity growth. While the complexity and diversity of factors affecting employment growth extends beyond the scope of this paper, the development of employment in various sectors can provide a first insight. The data presented in Figure 5 seem to suggest different patterns between the manufacturing and service sectors. The labour input (total hours worked) increased more in the service sectors than in the manufacturing sectors in all countries over the period 1996-2002. This is in line with the long-term trend of the manufacturing sector declining in importance in the higher income countries. In the manufacturing sectors the countries with relatively stronger hourly labour productivity growth have, generally, also had negative labour input growth, with the exception of Finland and the United States in the ICT-producing sectors and Spain in the ICT-producing and using manufacturing

13 For an analysis of the reasons behind the high productivity growth in the United States in retail and wholesale trade, see van Ark, McGuckin and Spiegelman (2005).

Table 5 Hourly labour productivity growth in ICT-using service sectors: 1996-2002

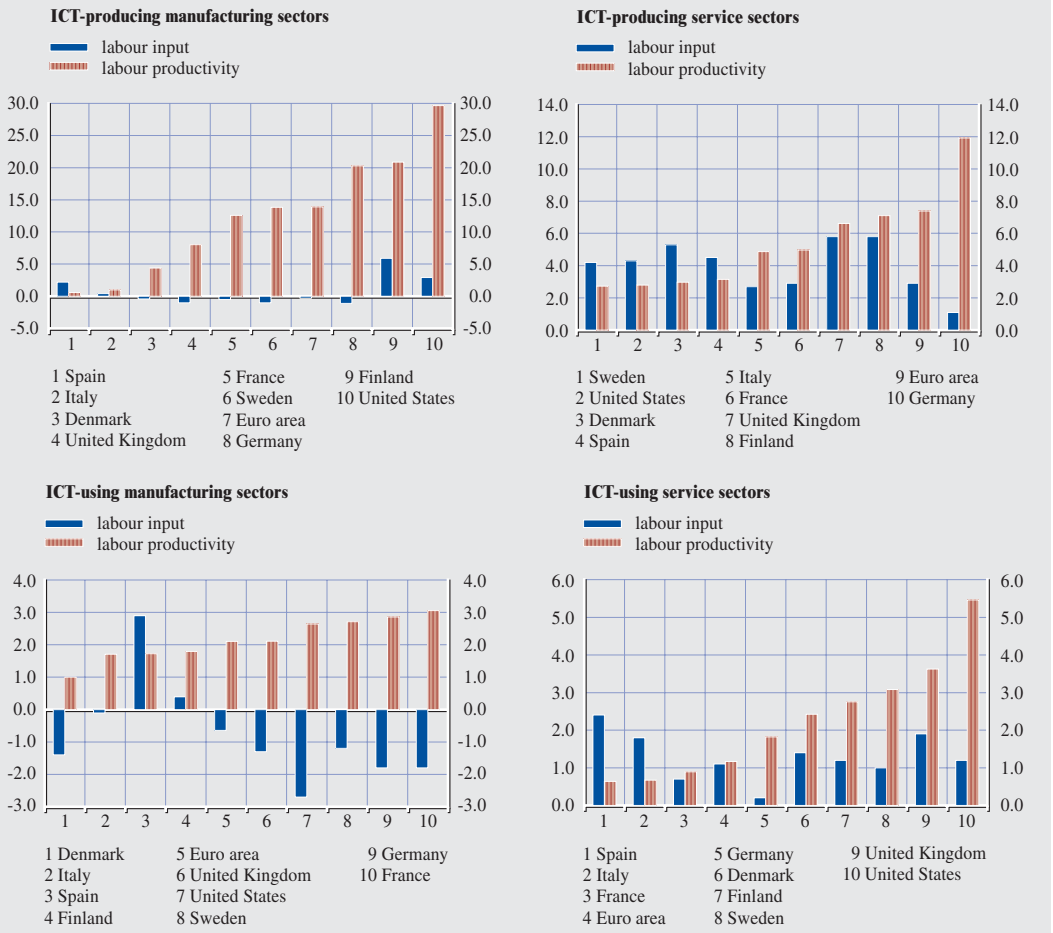
(in %)

	DE	ES	FR	IT	FI	EA	DK	SE	UK	US
Wholesale trade and commission trade. except of motor vehicles and motorcycles	1.6	0.2	1.1	0.2	2.3	1.1	4.6	2.8	3.0	8.5
Retail trade. except of motor vehicles and motorcycles; repair of personal and household goods	1.3	0.5	1.4	0.3	2.5	0.9	-0.7	4.1	3.2	7.4
Financial intermediation. except insurance and pension funding	6.5	2.2	0.5	2.3	7.2	3.4	5.1	-0.1	4.5	3.9
Insurance and pension funding. except compulsory social security	-4.5	-2.1	2.3	2.4	6.5	-1.1	5.9	7.0	0.4	1.3
Activities auxiliary to financial intermediation	1.3	5.1	3.0	-2.5	2.8	1.4	1.1	7.8	2.1	10.6
Renting of machinery and equipment	0.7	-0.3	1.0	-5.0	2.0	0.5	-2.3	7.2	-0.1	5.6
Research and development	2.6	-3.0	0.3	1.6	-0.5	0.6	0.3	-0.7	-3.0	2.4
Legal. technical and advertising	-1.3	0.1	0.3	-0.5	2.4	-0.8	-0.1	1.9	6.8	-0.2
Total ICT-using services	**1.8**	**0.6**	**0.9**	**0.7**	**2.8**	**1.1**	**2.4**	**3.1**	**3.6**	**5.5**

Source: GGDC database.

Figure 5 Sectoral hourly labour productivity and labour input growth rates: 1996-2002

(annual average in %)



Source: GGDC database.

sectors. By contrast, in the service sectors clear positive developments in both labour input and hourly labour productivity growth can be observed, with the exception of Germany in the ICT-producing sectors, where the relatively strong hourly labour productivity growth was accompanied by relatively weak labour input growth. Finally, in the ICT-using service sectors, the Nordic EU countries, the United Kingdom and the United States have generally managed to combine both high labour productivity growth and high labour input growth, in contrast to the larger euro area countries.[14] At the same time, those countries have also reached a higher ICT capital deepening and/or a higher ICT capital share as percent of total capital.

In sum, given the higher potential for creating employment in the service sectors combined with the fact that there is no apparent trade-off between labour productivity and employment growth thanks to increased ICT use in the service sectors, ICT diffusion appears to be particularly relevant in the service sector from a policy point of view.

14 A report by Cahuc and Debonneuil (2004) highlights the fact that it was possible for France to increase employment, in particular unskilled employment, and labour productivity growth in some service sectors such as hotels and restaurants and wholesale and retail trade thanks to increasing use of ICT.

5.3 FACTORS EXPLAINING HIGH PRODUCTIVITY GROWTH IN THE NORDIC EU COUNTRIES

The ability to take advantage of the possibilities offered by new technology depends on a mix of interdependent factors, such as the conditions for innovation, the possibilities for developing new goods and services commercially, and the available financing and human capital. Policies targeted at increasing innovation and technological diffusion can be grouped into three broad categories. First, there are policies aimed at *easing regulations*. Indeed, regulations limiting competition in goods, services, labour and capital markets, for instance by limiting entrepreneurial activities, imposing entry restrictions or affecting labour market adaptability such as hiring and firing rules, have negative repercussions on innovation and technological advancements (see Scarpetta et al, 2002). Second, policies aimed at *improving human capital* are usually considered to be of utmost importance. Technological advancements imply that jobs shift from low to high-skilled workers through a process of "creative destruction". Therefore, measures favouring improvements in skills and lifelong learning contribute to further innovation, facilitate the use of advanced technologies and allow technological change to translate into more jobs. Griliches (1969) was the first to put forward the idea of the capital-skill complementarity hypothesis. Since then, the connection between ICT and human capital has mostly been disregarded in assessments of the productivity effects of ICT. However, Kaiser (2003) finds strong evidence for complementarity between expenditure on ICT and outlays for ICT personnel. One possible explanation, commonly mentioned in the literature, is that the diffusion of ICT is associated with learning costs that decrease over time, as a function of the increasing number of users. More widespread knowledge about how to exploit ICT seems to speed up the rate of diffusion. Finally, policies aimed at promoting *venture capital* and *investment in R&D* are also important drivers of innovation and technological change.[15] While private venture capital markets can allow for a greater role of the market mechanism in financing innovation as an alternative or complement to traditional financial R&D support, thereby providing greater efficiency in the allocation of finance, higher outlays on R&D should, ceteris paribus, yield higher results in terms of innovation.

In all these categories, the Nordic EU countries are particularly well positioned in international comparisons. By contrast, some of the larger euro area countries which have performed relatively poorly in terms of labour productivity are also less well positioned in terms of regulations, human and venture capital, and R&D. Denmark, Finland and Sweden are small, open and well integrated economies, with low transposition deficits with regard to EU Directives and relatively low barriers in the form of product market regulation (see Table 6). This partly reflects a process of early liberalisation of several network industries, such as rail and air transport, the postal, telecommunications[16] and

15 See A. Bassanini, S. Scarpetta and P. Hemmings (2001).

16 The emergence of two world-leading telecommunications companies in Finland and Sweden is significant in explaining labour productivity developments in these two countries.

Table 6 OECD Structural indicators: Product Market Regulation (PMR) and Employment Protection Legislation (EPL) indicators: 2003

	PMR	EPL on regular contracts	EPL on temporary contracts
Germany	1.3	2.7	2.0
France	1.6	2.5	3.6
Spain	1.5	2.9	1.8
Italy	1.8	1.8	2.1
Finland	1.3	2.2	1.9
Euro area	1.4	2.5	2.1
Denmark	1.1	1.5	1.4
Sweden	1.1	2.9	1.6
United Kingdom	0.9	1.1	0.4
United States	1.0	0.3	0.2

Source: OECD.
Note: A higher number reflects stronger regulation.

electricity markets, and the financial markets, which mostly took place in the 1980s and early 1990s. In terms of labour market regulations, the Nordic countries are more similar to the larger euro area countries, although there exist significant differences among them (see Table 6). While Denmark is considered to have a relatively flexible labour market combined with a high degree of income protection, Sweden and Finland have made relatively less progress on reforming incentive structures in favour of work (OECD, 2004a and 2004c). Nevertheless, the use of temporary contracts increased significantly in both Finland and Sweden in the aftermath of the severe recession in the early 1990s. As can be seen in Table 6, employment protection has tended to be lower for this type of contract. As product and labour market features can have important complementary effects, remaining labour market rigidities may inhibit the full realisation of employment gains from greater competition and innovation. In particular, there seems to be an inverse relationship across OECD countries between tight product market regulation and high employment protection legislation on the one hand and the share of ICT investment in total fixed investment on the other hand (see Pilat and Devlin, 2004). This could potentially explain the relatively weaker capital deepening, both for ICT and non-ICT, in Finland in the late 1990s compared with Denmark and Sweden (as seen in Figure 2 above).

In terms of educational attainment, the Nordic EU countries traditionally rank high in international comparisons. Schools and universities in the Nordic EU countries are mostly free and governments provide generous student grant and loan systems at university level. Interestingly, the highest levels of education may not yield the greatest effects on productivity. In a study by Gunnarsson et al. (2004), the largest indirect effects of ICT on productivity are associated with workers having upper secondary education relative to workers with only nine years of education. While Denmark and Sweden have a relatively large share of persons with upper secondary education, as also do Germany and the United States, all three Nordic EU countries have a relatively high share of persons with tertiary education, although they still lag behind the United States in this regard (see Table 7).

Finally, in terms of venture capital and innovation, as measured by R&D, the Nordic EU countries are again positioned among the best performers. As can be seen in Figure 6, Sweden and Finland, together with the United States, have recorded much higher volumes of venture capital investment on average in the period 1995-2003 in the early stages for start-up companies, while Sweden also had higher volumes of venture capital for expansion and replacement, outperformed only by the United Kingdom and the United States.

Similarly, R&D expenses between 1995 and 2003 were clearly the highest in Sweden and Finland, followed by the United States and Germany, with private sector R&D dominating (see Figure 7).

These underlying factors also figure in various rankings of countries in terms of competitiveness, where Denmark, Finland and

Table 7 Educational attainment of the population aged 25-64 years

(% shares; 2000)

	Below upper secondary	Upper secondary and post secondary	Tertiary
Germany	17.4	59.4	23.2
Spain	59.7	16.2	23.6
France	36.1	40.6	23.0
Italy	56.7	33.2	10.0
Finland	26.2	41.5	32.3
Euro area	39.7	39.8	20.4
Denmark	19.8	53.7	26.5
Sweden	19.4	49.0	31.6
United Kingdom	37.1	36.9	26.1
United States	12.3	50.3	37.3

Source: OECD.

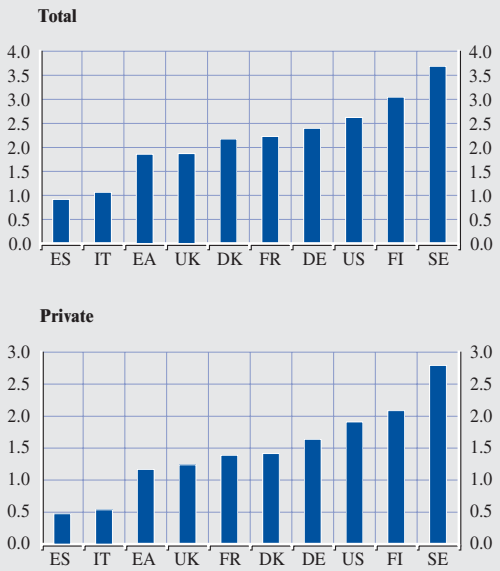
Figure 6 Venture capital investment

(average 1995-2003, as % of GDP)

Source: Eurostat.
Note: Venture capital investment is defined as private equity raised for investment in companies; management buyouts, management buyins and venture purchase of quoted shares are excluded. Data are broken down into two investment stages: the early stage (seed and start-up), and expansion and replacement (expansion and replacement capital).

Figure 7 R&D as a percentage of GDP

(average 1995-2003)



Source: European Commission.

Sweden are often listed among the best performers. In a recent study by the World Economic Forum and Insead (2005), the three Nordic EU countries all came within the highest six places in an index evaluating the relative level of ICT development among 104 nations (the Networked Readiness Index).[17] This index, compiled by measuring the relative strength of factors such as the environment for ICT development, readiness and usage by individuals, businesses and government, measures the propensity for countries to exploit the opportunities offered by ICT.

While the above-mentioned factors offer some insights into why the Nordic EU countries have been successful in diffusing ICT at an early stage, they do not provide a complete account of the underlying reasons for the success of these countries in implementing measures favouring competitive product markets, human and venture capital, and R&D. It is noteworthy that other factors, relating to labour market rigidities, high tax levels and generous welfare benefits, are often put forward in the context of the Nordic EU countries as factors that hamper the efficiency of their economies and the development of new businesses and innovation. Moreover, a complete account also needs to include the declining trend in ICT prices, which for Sweden and Finland, as important ICT exporters, results in a much less favourable development of per capita GDP due to declining terms of trade (OECD, 2004c).

In terms of structural changes in the economy, one specific feature relates to Finland and Sweden. The severe recession in the early 1990s was indeed large by historical standards in those countries,[18] leading to sizeable

17 Singapore, Iceland and the United States were also among the six highest, with the United Kingdom in 12th position, Germany 14th , France 20th, Spain 29th and Italy 45th.

18 In Finland GDP fell by more than 10% in volume between 1990 and 1993, while it fell by around 4% in Sweden.

depreciation of their currencies and the emergence of structural unemployment comparable to other European countries for the first time. The recession included asymmetric elements, such as sizeable banking crises and, in Finland, the disruption of trade relations with the Soviet Union. Cost-cutting measures implemented in production and the rapid decline in labour input can explain most of the rapid improvement in productivity growth in the years following the recession, although there was also considerable scrapping of the capital stock. Many low-skilled workers left the labour market and have not been fully reintegrated, as reflected by the lower employment rates than had been the case prior to the crisis and the higher number of inactive people.[19] In both Sweden and Finland the rise in the number of people outside the labour force in the 1990s coincided with a rise in the number of people in early retirement and disability benefit schemes as well as in education.

In response to the crisis, a number of structural changes, initiated by both the government and social partners, were implemented in Finland and Sweden and they could explain the improvement in long-term productivity growth. In both countries a rapid redistribution of the labour force took place, from low to high-productivity sectors as labour-intense production was moved to emerging markets, and from the public to the private sector. The fact that the size of the public sector in the economy stopped increasing in the early 1990s is also likely to explain higher productivity growth, as productivity in the public sector is normally lower than in the business sector. Moreover, as in the euro area, increased macroeconomic stability was achieved in both Finland and Sweden by focusing more strongly on an institutional framework favouring price stability and fiscal prudence.[20] Although already very open economies, competition was increased further by accession to the EU. In Sweden other measures, such as a liberalisation of opening hours, increased use of temporary employment contracts and, toward the latter part of the 1990s, an increase in the number of university places and tax deductibility for purchases of home computers, may also have played an important role. In recent years increased openness and integration with the global economy, which has allowed for streamlining and outsourcing of labour-intensive stages of the production of goods and services to some of the new EU Member States, in particular the Baltic States, and Asia, appears to have had a renewed effect on productivity growth in both Sweden and Finland (see, for example, Sveriges Riksbank, 2004).

In Denmark, labour productivity did not accelerate in the same way as in Sweden and Finland in the late 1990s and the early part of this decade, reflecting a much less dynamic transition to high-tech sectors than in Sweden and Finland. Instead, non-ICT capital deepening explains most of the labour productivity growth, although ICT capital deepening was also higher than in the larger euro area countries in the late 1990s (see Figure 2). Compared with other countries, Denmark was unusually capital-intensive in the late 1990s, which could be linked to relatively generous wage levels for low-skilled workers leading firms to substitute capital for labour (OECD, 2004b). Another explanation could be the relatively tight labour market and the insufficient labour supply, causing substitution towards capital investment.

In sum, the relatively higher labour productivity growth in the Nordic EU countries appears to confirm the beneficial effects on productivity of a high degree of product and financial market competition, combined with a high level of R&D and highly skilled human capital. While many of these features have traditionally been present in the Nordic EU countries, the crises in Finland and Sweden certainly accelerated the modernisation of the economies and led to significant structural

19 The employment rate in Sweden in 2004 was more than 9 percentage points lower than in 1990, while it fell by 6.6 percentage points in Finland over the same period.

20 Finland has been a member of the euro area since 1999.

changes. Combined with stability-oriented economic policies, with a strong focus on price stability and sound public finances, a favourable climate for ICT investments and innovation appears to have been created. These "comparative advantages" probably facilitated the expansion of ICT production and diffusion and may explain why the structural characteristics of these economies were more conducive to exploiting the opportunities provided by new technologies than was the case in the larger euro area economies. At the same time, remaining labour market rigidities may inhibit the full realisation of employment gains from greater competition and innovation, given that product and labour market features can have important complementary effects.

6 CONCLUSION

Since the second half of the 1990s, the Nordic EU countries, particularly Sweden and Finland, have experienced stronger hourly labour productivity growth than the larger euro area countries. Combined with a high level of labour utilisation, this has resulted in a "structural" labour productivity level that is relatively high compared with some of the larger euro area countries. Like in the United States, innovation and technological changes have played a major role in explaining the higher labour productivity growth in the Nordic EU countries compared with the larger euro area economies since the mid-1990s.

The results of the decomposition of labour productivity growth show that both ICT and non-ICT capital deepening have been the main contributors to hourly labour productivity growth in Denmark. These two components have also been much higher than in the larger euro area countries. In terms of the sectoral composition, Denmark has tended to outperform the largest euro area countries in the ICT-using service sectors, but it lags significantly behind Germany and France with regard to the ICT-producing manufacturing sectors.

In contrast, TFP growth has played a greater role in Sweden and Finland. In Sweden the stronger hourly labour productivity growth compared with the larger euro area countries was mainly driven by the contribution of TFP and, to a lesser extent, of ICT-capital deepening. At the sectoral level, there was a high contribution of the ICT-using service sectors, while the ICT-producing manufacturing sector also contributed to widening the labour productivity gap with the larger euro area countries. In Finland the high hourly labour productivity growth is mainly explained by a high contribution of TFP growth. At the sectoral level, the high contribution of the ICT-producing manufacturing sectors was the main reason for increased labour productivity growth relative to the larger euro area countries, although the contribution of the ICT-using service sectors has also been greater than in the larger euro area countries. In both Sweden and Finland these two sectors accounted for around 50% of aggregate labour productivity growth while they only account for 20% of total GDP. However, while the ratios are similar, when looking within these sectors it seems that a larger number of sub-sectors have contributed to this performance in Sweden than in Finland.

Given that only a few countries may have the necessary comparative advantages to succeed in the ICT-producing sectors that are characterised by very rapid technological progress, strong competition, price declines and high labour productivity growth, much of the interest in the potential impact of ICT on growth is linked to the potential benefits arising from its use in the production process elsewhere in the economy. From a policy point of view, given the higher potential for employment creation in the services sectors combined with the evidence that there is no apparent trade-off in the medium term between labour productivity and employment growth thanks to increased ICT use, ICT diffusion appears to be particularly relevant in the services sectors. As a result, the key issue for other countries is how to increase their future capacity to promote the diffusion of innovation. This relates in particular to

technological changes in the service sectors, such as wholesale and retail trade as well as different sectors of financial intermediation, in which the Nordic EU countries have performed particularly well.

In the Nordic EU countries, the high degree of product and financial market competition, resulting from early liberalisation of key markets and relatively low barriers in the form of product market regulation, a highly skilled workforce, high investments in R&D and the availability of venture capital, all areas in which the Nordic countries are among the best performers, seem to be the main explanatory factors behind the rise in productivity growth. By contrast, some of the larger euro area countries which have performed relatively poorly in terms of labour productivity are also lagging behind in terms of these factors. These "comparative advantages" probably facilitated the expansion of ICT production and diffusion and may explain why the structural characteristics of these economies were more conducive to exploiting the opportunities provided by new technologies than the larger euro area countries. In Sweden and Finland structural changes leading to these favourable conditions were partly triggered as a response to the severe recession in the early 1990s, while in Denmark structural change appears to have been more gradual. Importantly, remaining labour market rigidities in the Nordic EU countries may inhibit the full realisation of employment gains from greater competition and innovation, given that product and labour market features can have important complementary effects.

Looking ahead, and given the need to further increase the level of labour resource utilisation in the larger euro area countries, the gap in labour productivity growth between the larger euro area countries and the Nordic EU countries may widen further, unless appropriate structural reforms occur in the euro area. In this respect, the experience of the Nordic EU countries provides some useful insights and lessons.

APPENDIX

ICT-producing and using sectors

	Manufacturing	Services
ICT-producing	Office machinery Insulated wire Electronic valves and tubes Telecommunication equipment Radio and television receivers Scientific instruments	Communications Computer and related activities
ICT-using	Clothing Printing & publishing Mechanical engineering Other electrical machinery and apparatus nec Other instruments intermediation Building and repairing of ships and boats Aircraft and spacecraft Railroad equipment and transport equipment nec Furniture, miscellaneous manufacturing; recycling	Wholesale trade and commission trade, except of motor vehicles and motorcycles Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods Financial intermediation, except insurance and pension funding Insurance and pension funding, except compulsory social security Activities auxiliary to financial Renting of machinery and equipment Research and development Legal, technical and advertising

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