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NEW SOURCES OF ECONOMIC GROWTH IN EUROPE?

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1. Introduction

The conjunction of a number of economic developments in the United States has contributed to an impression that something fundamental may have changed in that country. These developments include: strong non-inflationary growth, coupled with high labour utilisation; the spread of information and communication technology (ICT); and microeconomic evidence of continued restructuring of production processes. Taken together, these developments have been seen as representing the emergence of a "New Economy". At this juncture, the nature and durability of changes in the US economy remain uncertain. Equally, it is not clear to what extent similar patterns will spontaneously emerge in Europe.

This paper aims to shed some light on output and productivity growth over the 1990-98 period, and attempts to identify the role played by traditional growth determinants as well as new forces largely related to ICT.[2] In doing so, it will contrast US and European experience. It also aims to give some pointers as to the policy settings which could help Europe to emulate the US experience.

The second section of the paper examines patterns of growth across the OECD area over the past decade and compares them with previous trends. The third section focuses on labour productivity, labour utilisation and the evolution of human capital. In the fourth section, the paper discusses the role of ICT as a driver of growth. The fifth section examines multi-factor productivity growth in an attempt to identify significant shifts in the rate of technological progress and, thus, in growth potential. The sixth section discusses the policy orientations for European countries to emulate US performance and the final section sums up.

2. Growth patterns over the 1990s

International comparisons of recent productivity and growth patterns are constrained by a number of measurement issues. First, the focus of the New Economy discussion is on very recent developments for which data coverage remains limited. Second, despite major efforts by national statistical offices and international organisations, data problems still limit the possibility of comparing growth performance across countries and over time.[3] Among these difficulties, statistical methods

2. The paper is adapted from the presentation of recent growth trends in OECD (2000*a*) and draws heavily on the more comprehensive analysis in Scarpetta *et al*. (2000) and Bassanini *et al*. (2000). More generally, the paper draws on evidence produced and interpretations made in the context of the OECD Growth Project, which was launched in 1999.

3. Comparability problems have always affected international analyses of growth performances but are particularly relevant at present because of the different pace and comprehensiveness with which different countries have adopted new measurement techniques in their national accounts (see BoxI.3 in OECD, 1999*a*).

differ in the extent to which production of and investment in computers is adjusted for quality changes. Third, output is notoriously difficult to measure in the service sector, which is a heavy user of ICT and where quality aspects of output are important. Finally, changes in trends are difficult to disentangle from cyclical developments at the best of times but particularly so when the focus is on the most recent observations. To control for these problems, this paper relies, where feasible, on cyclically-adjusted trend series.[4]

For the OECD area as a whole, both actual and trend GDP growth were, on average, lower in the 1990s compared with the previous two decades, continuing the well-documented long-run slowdown in growth rates (Table 1). However, while EU average growth continued to decline, the trend was reversed in the United States and in some smaller OECD countries (most notably Australia, Ireland, the Netherlands and Norway, see Annex Table A1).[5] As demographic changes are generally slow, trend growth rates in GDP per capita -- which are more relevant from a living standard perspective -- presented broadly the same picture (Table 1).[6] On this measure, average annual growth in the United States was more than ½ percentage point faster than in both the EU and Japan over the 1990s.

Evidence for shorter periods of time needs to be interpreted with caution. With that caveat, there was some evidence of an acceleration in trend GDP per capita between the first and the second half of the 1990s (only the period up to 1998 is considered). The increase in growth was quite strong for the United States but most EU countries also saw a rise. The main exceptions to this trend were Japan, Italy and Korea.

Reflecting these growth trends, data for 1998 show the United States at the top of the OECD income distribution followed by Norway and Switzerland with GDP per capita about 15-20 percentage points below the US level (Figure 1).[7] The bulk of the OECD, including all the other major economies, lag behind per capita GDP in the United States by 25-35 percentage points. The European Union as a whole was about a third lower than US per capita GDP.

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4. Trend series of output, employment and labour productivity have been estimated using an extended version of the Hodrick-Prescott filter (Hodrick and Prescott, 1997). The extended version of the H-P filter tries to overcome the well-known in-sample phase shift problem by extending actual data out of the sample using the observed average growth rate over the 1980-98 period. However, if past growth rates are not reasonable proxies for future growth patterns, this extension may lead to a bias at the end of the filtered series. As a limited test of this procedure, the use of an alternative method of extending the data - using the projections in the OECD Medium Term Reference Scenario, (MTRS) - provided broadly similar results for the majority of countries. There are, however, a few exceptions. In the case of Germany, France and Canada the use of OECD MTRS projections yields a somewhat higher trend growth rate over the 1990s; by contrast, they lead to a lower trend growth rate in output in Japan.

5. Denmark also figures in Annex Table A1 with an acceleration in trend GDP growth. However, the data used in this paper do not include the latest (May 2000) revisions of the Danish National Accounts. These revisions suggest a somewhat slower GDP growth rate in the 1990s.

6. Strictly speaking, per capita GNP growth would be an even better measure, but in practice there is little difference between the two concepts in trend growth rates terms. There are, however, a few exceptions, including Switzerland and Ireland: for the former actual annual growth rate of GNP was 0.2 percentage points higher than the GDP growth rate (0.5 per cent); for Ireland, it was 0.6 percentage points lower than the GDP annual growth rate (6.3 per cent).

7. Luxembourg actually has higher GDP per capita than the United States but is a special case, not least given the size of the country, the role of the financial services sector and the importance of trans-border commuting.

In the 1950s and 1960s many OECD countries grew rapidly towards the much higher US income levels, partly through imported US technologies and knowledge but also, in some cases, as a result of post-war reconstruction. The process of convergence slowed in the 1970s and 1980s, and considering both levels and growth rates, there are now only a few countries (*e.g.* Ireland, Korea) that seem still engaged in a process of catch-up to the United States. Indeed, strong US growth in the 1990s meant that the gap between its per-capita income levels and those of most other OECD countries started to widen again over the decade. These developments seem to contrast with some evidence of continued intra-EU convergence.

3. The role of labour

3.1 Demographics, labour productivity and labour utilisation

Growth in GDP per capita can be decomposed into three major components, comprising contributions to growth from demographic factors, employment and labour productivity. Concretely, Figure 2 presents the contribution to per capita growth from: *i)* the share of persons of working age (15–64 years) in the total population (the "demographic component"); *ii)* the ratio of employed persons to the working age population (the "employment rate"); and *iii)* labour productivity (measured per person employed).

For the vast majority of OECD countries, demography played only a minor role for trend growth in GDP per capita over the 1990s. The only countries where demographic change made a positive and significant contribution were Korea and Ireland, the latter having experienced a reversal in traditional migration flows in the 1990s (OECD, 1999*c*). However, in Japan and some European countries, demographic trends have begun (in this accounting sense) to act as a slight drag on growth in GDP per capita. This tendency is set to strengthen in the future - again affecting mainly Europe and Japan within the OECD area - due to more rapid increase in the share of older persons in total population.

Rising labour productivity, defined as GDP per person employed, was the main contributor to per capita growth, accounting for well over half of GDP per capita growth in most OECD countries over the 1990s. Compared with the previous decade, it picked up in a number of countries, including the United States, Germany, Australia, Finland, Norway, Portugal and Sweden (see Annex Table A1). However, for the European Union as a whole trend labour productivity decelerated, driven not least by the outcomes for France, Italy and Spain.

Since hours worked continued their trend fall in most countries over the 1990s (Table 2), especially in Continental Europe, labour productivity growth was higher on a hourly basis than when measured on a head-count basis.[8] Declines in hours worked reflect both shorter statutory (or collectively agreed) working weeks as well as, especially in a number of European countries, a substantial increase in part-time work. Strong growth in part-time working has generally been associated with growing female labour-force participation (OECD, 1999*b*). The United States was a significant exception to the tendency for working hours to fall.

8. It follows from the trends in hours worked that employment developed more weakly on an hourly basis than on a head-count basis. Thus, in terms of Figure 2 the contributions from productivity would have been generally stronger and those from employment weaker had the decomposition been made in terms of hours - the United States being the main exception.

The 1990s witnessed striking differences in the evolution of employment rates. Indeed, different trends of employment rates were a main factor behind different outcomes for growth of per capita GDP. Amongst the major regions, increases in the United States and Japan contrast sharply with declines in the European Union. Even stronger contrasts are found between individual EU countries: strong upward trends in employment rates in Ireland and the Netherlands compare with declines in Finland and Sweden.

Labour utilisation is also an important factor in accounting for differences in the *level* of GDP per capita across countries. This is illustrated in Figure 3, which suggests that for many countries lower labour utilisation (employment rates combined with hours worked) is the main factor behind a lower income level than the United States. For the EU as a whole, lower labour utilisation accounts for about three-quarters of the gap to US levels of GDP per capita. Low employment rates in some countries (*e.g.* Austria, Belgium, France, Germany, Italy and Spain), combined with relatively low hours account for more than 20 percentage points of the gap between their per capita output and that of the United States. The Nordic countries, by contrast, have even higher employment rates than in the United States, but this is offset by lower hours worked. At the bottom of the income scale, however, it is productivity rather than labour utilisation that accounts for most of the difference *vis-à-vis* the United States. Different demographic situations matter little in the overall picture.

3.2 The role of skills and labour utilisation in labour productivity growth

Growth in output per employed person is partly attributable to increases in the average level of skills, or "human capital", of those in employment. Figure 4 presents estimates of the impact of changes in the average human capital of workers on growth in trend GDP per hour worked. The human-capital adjustment is based on a measure of labour input which sums groups of workers with different levels of formal education, each weighted by their relative wage. The rationale behind this measure is, first, that educational attainment accounts for a good proportion of human capital embodied in workers; and second, that relative wages between different levels of education provide a reasonable quantitative proxy for the relative productivity of workers with different levels of education.[9] Given the secular increase in educational attainment in OECD countries, it is not surprising that for most countries human capital made a positive contribution to growth in GDP per person employed;[10] and as a corollary, "quality" adjusted growth rates in labour productivity are typically lower than those based on crude calculations. In terms of magnitude, the data suggest that in most countries rising average human capital accounted for between 0 and 1 percentage point of trend growth in GDP per hour worked.

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9. Data availability constrains the country coverage and the time period (1985-98). Moreover, the need for cross-country comparability made it necessary to rely on a somewhat crude classification of labour into six categories: by gender and by three educational levels (below secondary, secondary, and tertiary). In addition, workers are assumed to work the same number of hours across education levels and variation in relative wages over the period is not allowed for. It should be stressed that the assumption that wages reflect human capital is commonly made but, strictly speaking, only holds where firms operate under constant returns to scale in competitive input and product markets, and maximise their profits by equating compensation with each worker's contribution to output. The Bureau of Labor Statistics (BLS, 1993) discusses how deviations from these conditions affect the relationship between the contribution to output and compensation.

10. The result for Germany reflects the discrete fall in the average education level of the workforce because of the unification with the Eastern Länder.

Skill upgrading amongst workers seems to have been particularly marked in the major European countries, where it was accompanied by sluggish employment growth.[11] Indeed, productivity gains in many European countries were achieved in part by dismissing or not employing workers with low skills. By contrast in the United States, Australia, Denmark and the Netherlands, skill upgrading has played a relatively modest role in GDP growth per employed person. Improving labour-market conditions have widened the employment base in these countries, especially in the 1990s, allowing low-skilled workers to get a foothold into employment.

In order to shed further light on this, Figure 5 plots changes in the share of persons with upper-secondary education or above in employment against changes in their share in the total working-age population. While up-skilling among the employed is largely associated with a generalised improvement in the educational level of the working-age population (*i.e.* countries cluster along the diagonal in Figure 5), there has been a general tendency for employment changes to be biased towards the better educated (most countries are located above the diagonal). However, this is not a generalised phenomenon: countries which maintained favourable labour-market conditions or experienced significant improvements have had a more balanced relative employment performance (they tend to be located at or below the diagonal in Figure 5).

The relationship between overall employment levels, average human capital of workers and their average productivity is important for interpreting cross-country differences in GDP per capita. In terms of Figure 3, the contributions of labour productivity and labour utilisation to GDP per capita are inter-related. First, non-employed people of working age generally have lower education levels -- and thus potential productivity -- than those in employment. Convergence towards the high US level of labour utilisation might therefore be associated with a drop in average productivity relative to the US level. Second, low employment may often reflect structural policies that boost real wages which give incentives to substitute capital for labour. If moves towards higher US employment levels arise in conjunction with lower real wages, the capital intensity of production might drop and, in consequence, labour productivity may decline.

3.3 The role of sectoral shifts in aggregate labour productivity growth

In the past, shifts in employment from less to more productive sectors have often contributed significantly to overall growth in output and labour productivity. However, evidence for the 1990s suggests that the most important contribution to overall productivity growth came from productivity changes within industries, rather than as a result of significant shifts of employment across industries. This is illustrated in Figure 6, which shows a decomposition of labour productivity growth into a within-industry effect, a between-industry effect and an interaction effect.[12] The within-industry labour productivity growth accounted for most of the overall productivity growth over the 1990s, although the rather broad industries used in the decomposition may have some bearing on the result.[13] The

11. From the discussion in the previous paragraph, skill upgrading should be interpreted as a shift in the composition of the workforce towards better educated workers, and not as an improvement of individual workers' human capital.

12. A negative contribution from the interaction effect occurs when industries with growing relative productivity decline in size or when industries with falling productivity grow in size. The data are from the OECD ISDB-STAN database (2-digit ISIC for services and a 3-4 digit ISIC for manufacturing).

13. The evidence of a strong within-industry contribution is, however, confirmed by firm-level studies. For a recent summary of firm-level data on productivity see Bartelsman and Doms (2000).

upshot is that explanations for observed productivity trends at the aggregate level have to relate to developments that affect individual industries.

4. The role of information and communication technology

Much of the current discussion about growth and the "New Economy" focuses on the role of information and communication technology (ICT). There are three main channels through which ICT can affect growth rates of GDP per capita: *i)* an acceleration of productivity in the ICT-producing sectors themselves and, despite what was said above about the limited role for shifts between broad economic sectors, a growing size of ICT-producing sectors in the economy; *ii)* capital deepening across the economy, driven by rapid investment in ICT equipment, and resulting in a boost to labour productivity; and *iii)* widespread spillover effects on productivity arising from the use of IC technology. This section focuses on the first two contributions of ICT, while the third is discussed in the next section in the broader context of multi-factor productivity trends. The role of measurement in affecting the allocation of growth between these factors is also discussed in that context.

4.1 Productivity growth in the ICT-producing sector

The share of the ICT sector itself in aggregate output remains small in most OECD countries (Figure 7). Internationally comparable data on value added originating in the three principal segments of the ICT sector (but excluding software) show that it did not reach 5 per cent of GDP in 1997 in any of the countries for which data are available. Higher contributions in some countries have been obtained using more comprehensive, but not internationally comparable, data (including *inter alia* software): on this basis, more than 7 per cent of GDP in the United States and Japan is estimated to have originated in broadly defined ICT sectors. However, in most continental European countries, the ICT sector remains small even on an extended definition. Moreover, even a narrowly defined ICT sector includes segments and outputs that do not have any strong New Economy flavour. These arguments suggest that direct effects of productivity growth in the ICT sector on overall productivity are likely to be smaller in Europe than in the United States, at least for some time.

No matter how it is defined, the ICT-producing industry experienced a major surge in productivity in the United States, especially in the latter part of the 1990s.[14] Notwithstanding the small share of ICT in total value added, this within-sector acceleration is estimated to have raised labour productivity growth in the US business sector as a whole by 0.2 to 0.3 percentage point in the 1995-99 period compared with the first half of the 1990s.[15] Furthermore, there is preliminary evidence of strong productivity growth in the ICT-producing sector in other countries. For example, the electronic equipment industry in Finland increased its share of total-economy value added from less than 2 per cent in 1990 to more than 6 per cent in 1999, with labour productivity growing at an average annual rate of 15 per cent, and the sector contributing ¾ percentage points to annual GDP growth over the period 1995-99. In assessing this evidence, it should be stressed that countries differ strongly in their statistical treatment of quality improvements in ICT goods (see Box 1 and text below). Bearing this in mind, industrial statistics confirm that labour productivity in the two sectors most heavily engaged in the production of ICT equipment (office, accounting and computing equipment; and radio, television and communications) typically rose significantly faster than in the manufacturing sector at large, especially in the latter part of the 1990s (Table 3).

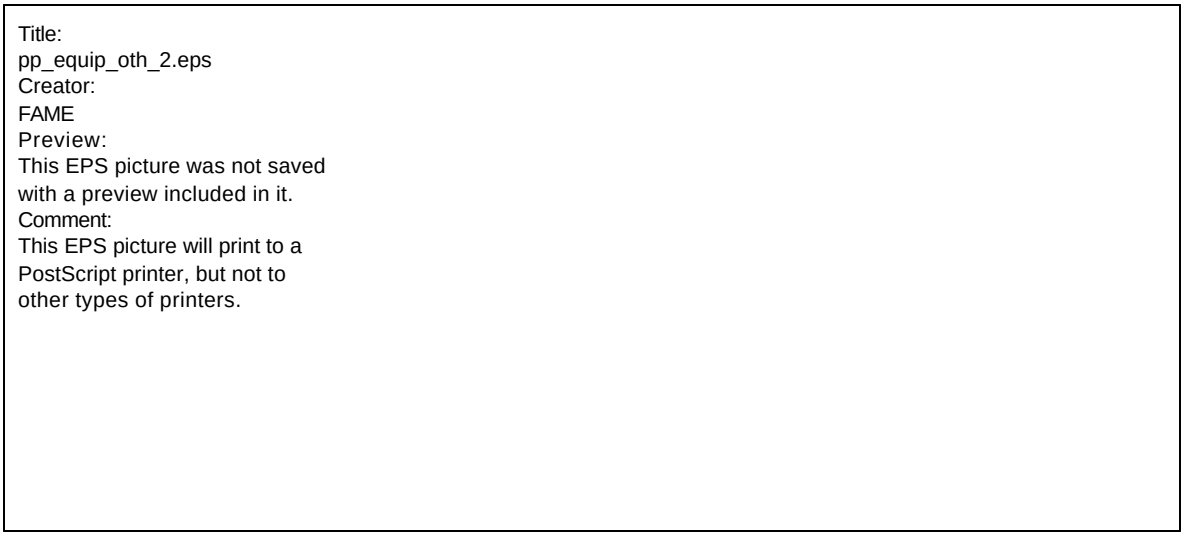
14. For a description of the recent US experience, see also OECD (2000*b*).

15. See Gordon (1999); Oliner and Sichel (2000); Council of Economic Advisors (2000).

Box 1. **Accounting for quality changes of computers**

The rapid pace of technological advance in the computer industry complicates the split of nominal changes into volume and price developments. Over the 1990s the standard microprocessor speed of personal computers has increased 16-fold, and both the standard storage capacity and the transmission speed have risen more than 200 times. With these quality changes in a basic personal computer, it is difficult to equate one unit today with one unit a decade ago or with an even more distant relative. There have been striking developments also in the price/quality characteristics of telecommunications equipment.

Different methods are applied to measure price and quantity developments in computer production and spending (see also Schreyer, 2000). They range from no effort to adjust for quality changes, over judgmental approaches to more complete quality adjustments with "hedonic" and similar methods. When no adjustment is made, the price index computed from the price per computer unit, and the quantity index is based on the number of units produced or sold. The "hedonic" method unbundles the market price of the computer into its most important technical characteristics, and prices each characteristic separately, using regression analysis. The "hedonic" price index is the average price of all the characteristics, and the quantity index is based on nominal values deflated by this price index. The large discrepancies in producer price developments in the office, accounting and computing equipment sectors across countries are likely to reflect to a large extent different methodologies. Thus, the sharp measured drop in prices of such goods in the United States reflects the use of "hedonic" methods. By contrast, the modest fall or even increases in producer prices of office, accounting and computing equipment in many European countries may be due to the predominant "conventional" methods in deriving price indices. This suggests that quantities produced, and productivity trends, in the office, accounting and computing equipment sector are under-estimated in these countries. If computer prices are upward biased, a downward bias enters volume measures, such as real investment or consumption. The extent to which overall GDP measures are affected depends on the importance of a country's ICT industry, and on its propensity to import ICT equipment.



4.2 Falling prices of ICT equipment and capital deepening

Capital deepening is the second channel through which ICT affects output and labour productivity. Technological progress has manifested itself, in part, through falling prices of ICT equipment (especially when prices are adjusted for quality, see Box 1). When appropriate adjustment is made for quality improvements, annual declines in prices of IT equipment have typically exceeded 10 per cent. The falling prices have not only induced substitutions from other assets to ICT equipment, but also increased the overall level of investment, *i.e*. led to capital deepening.

Investment in ICT equipment has increased tremendously across OECD countries. In the G-7 countries, the share of IT capital goods in total investment expenditure rose steadily over the 1990s and by 1996, the latest year for which internationally comparable figures are available, total non-residential gross fixed capital formation ranged from 4-6 per cent in Japan and continental Europe up to 13 per cent in the United States (Table 4). The share of communication equipment also rose, though less rapidly, and accounted for around 5 per cent of total non-residential investment.[16] Moreover, volumes of IT capital investment rose at annual rates ranging from 11 per cent in France to 24 per cent in the United States in the 1990-96 period. Recent evidence for the United States points to an acceleration in IT investment to a growth rate of about 38 per cent annually in the 1996-99 period. The share of ICT (broadly defined to include also software) in US non-residential gross fixed capital formation amounted to almost 35 per cent in 1999.

Strong investment in ICT has led to a rapid rise in the stock of ICT capital equipment. That said, high depreciation rates of ICT equipment have meant that the share of these goods in the total business sector capital stock has remained moderate - at 7 per cent in the US in 1996 and less in most other countries (Schreyer, 2000). The sharply increasing ICT capital stock has made a rising contribution to overall output growth. During the 1980s, ICT capital (hardware only) accounted for only about 0.1-0.2 percentage points per year of trend business-sector output growth (Figure 8).[17] The growth contribution from ICT was relatively small since the already high rate of growth of ICT capital applied to a small base. In the first half of the 1990s the contribution of ICT capital to output growth increased in most countries, and particularly so in the United States where it reached 0.4 percentage point per year, corresponding to about 14 per cent of total output growth.

More recent evidence for the United States (Oliner and Sichel, 2000) suggests that the contribution of ICT to output growth in the non-farm business sector surged in the second half of the 1990s due to a strong acceleration in the rate of growth of ICT capital: in particular, the growth rate of hardware and communication equipment doubled in the 1996-99 period as compared to the first half of the decade. The overall contribution of ICT capital (including software) to output growth was about 1.1 percentage points, *i.e*. more than a third, almost double that recorded in the early 1990s. Broadly consistent with these findings, despite some differences in methodology, Jorgenson and Stiroh (2000) found that the contribution from ICT capital services to growth in private domestic output doubled from 0.4 per cent per year in the 1990-95 period to 0.8 per cent over 1995-98. A further increase in the contribution from ICT capital to growth is also likely to have occurred in Europe in the second half of the 1990s, though from a lower level and though it cannot be statistically supported at this stage. More

16. The figures reported in Table 4 are based on a harmonised deflator constructed on the assumption that the differences between price changes for ICT capital goods and non-ICT goods are the same across countries. See Schreyer (2000) for more details.

17. The output share of the ICT sector across the G7 countries averaged only 1 to 3 per cent (Schreyer, 2000).

generally, to the extent the fall in prices of ICT equipment is passed through to purchasers, Europe should be able to experience a rise in the intensity of ICT capital use with associated effects on labour productivity.

5. The role of multi-factor productivity

In addition to the effects that ICT has on output and labour productivity *via* the production and use of capital goods, ICT equipment can generate spillover or "network" effects in the economy. For example, the economic benefits of improved communication and access to information through the Internet do not all arise directly from quality improvements in the stock of individual computers but also from different -- and more efficient -- ways of organising production and sales (*i.e.* some gains from ICT are disembodied). These network effects and other disembodied aspects of technological change should, in theory, show up in estimates of multi-factor productivity (MFP) growth, *i.e.* the residual output growth once the direct contribution of changes in the quantity and quality of capital and labour are accounted for. In practice, however, the paper cannot apply this clear definition of multi-factor productivity for at least two reasons: *i)* quality and compositional changes in the labour force and the capital stock go beyond the applied breakdown into six categories of labour and six types of fixed capital and are therefore to some extent captured by the productivity residual; and *ii)* for countries outside the G-7, available data do not even allow the assessment of the effects from compositional/quality changes in the capital stock (including the effects of ICT) but, again, these are captured by the productivity residual.

5.1 MFP growth over the 1990s

Following these arguments, Table 5 presents different measures of multi-factor productivity growth in the business sector for most OECD countries over the past decades. The first measure is computed as the residual growth after controlling for aggregate hours worked and the gross capital stock but not adjusting for changes in the quality of labour and capital inputs. This is the broadest measure of multi-factor productivity growth given that it incorporates not only disembodied technological progress, but also the effects of increased human capital per worker as well as changes in the composition of physical capital. The second measure corrects for the general rise in education levels among workers by using a quality-adjusted measure of labour input and therefore generally shows a lower growth rate of MFP. Finally, the third measure of the residual also takes into account changes in the composition of the capital stock input (obtained aggregating over six types of assets). This measure can be considered as a proxy for the truly disembodied technological progress, although the decomposition of both educational categories and capital assets is still very limited and thus does not capture shifts occurring at a finer level of disaggregation.[18] For the smaller countries, only the first two measures of MFP could be calculated (see Annex Table A2).

Comparisons of the different MFP estimates in Table 5 indicate significant variation amongst the G-7 countries. The United States and Canada recorded a recovery in MFP growth over the 1990s that reversed a longstanding downward trend.[19] Conversely, all measures of MFP growth

18. A number of assumptions were also made in computing capital stocks by asset, in deriving user costs expressions and in aggregating across assets. For example, particular effort was made to derive a set of internationally harmonised price indices (based on hedonic adjustments) for investment in the asset type "information and communication technology" (see Schreyer, 2000 for more details).

19. Germany also had somewhat higher MFP growth rates based on labour quality adjusted measures in the 1990s compared with the 1980s, although reversion to the mean can be observed in the most

rates decreased significantly in France and Italy. As a result, the narrow measure of MFP which may be interpreted as the impact of disembodied technical progress grew more rapidly in the United States than in the other G7 countries over the first half of the 1990s - a reversal of the situation in the 1980s.

In interpreting these MFP growth rates, the role of deflators for computers (described in Box 1) need to be kept in mind. For the sake of cross-country comparability, the investment goods deflators used for deriving asset stocks for the narrow measure of MFP are all based on hedonic price adjustments for computers. As a result, investment and the capital stock are augmented by quality improvements of computers. This embodied technological progress therefore does not show up in the narrow measures of MFP. By contrast, the broad measure of MFP is based on national investment series and therefore differs across countries as to whether it includes technical progress embodied in computers. For a country like Germany, which does not use hedonic price adjustment, the stock of computer capital is not quality augmented and broad MFP therefore includes embodied technological progress. For the United States, by contrast, this element of technical progress does not show up even in the broad measure of MFP.

Figure 9 presents estimates for the United States to illustrate this effect. The indicator of disembodied technical progress corresponds to the narrow measure in Table 5. The indicator of disembodied and embodied technical change was calculated in the same way, but the capital stock was calculated from investment series that did not include any quality augmentation.[20] As can be seen from Figure 9, the embodied part of technological progress gave a significant and rising contribution to business sector MFP growth - getting close to ½ percentage point annually in the mid-1990s. The third indicator adds in compositional change in the capital stock and, consistent with Table 5, this adjustment accounts for some 0.1-0.2 percentage points. The fourth and final indicator in Figure 9 corresponds to the broadest MFP measure in Table 5 *i.e.* the one that also includes changes in human capital - except that in Figure 9 this measure is based on a capital stock without augmentation for computer quality.

The corrections for changes in the composition of labour inputs tends to reduce measured MFP insofar as part of the productivity growth is assigned to improvements in the quality of labour. These effects differ strongly in magnitude across the G7 countries. Thus, improved human capital contributed fairly little to MFP growth in the United States and Canada but the decline in employment of low-skilled labour in France and Italy boosted the broad measure of MFP by about ½percentage point annually. It should be underlined that the adjustment for changes in human capital is based only on changes in the educational characteristics of the employed. Human capital may well have impacts on growth that go beyond this. For example, it may well be the case that the general level of education plays a role for how rapidly and efficiently ICT becomes integrated in the economy.

As concerns the smaller countries, MFP growth unambiguously and significantly increased in only a few over the 1990s compared with the previous decade. Thus, Australia, Finland, New Zealand, Norway and Sweden all experienced increases in average growth rates of MFP of at least 0.5 percentage point (in most cases from relatively low rates in the 1980s).[21]

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recent years. It should be stressed, however, that quality adjusted measures for Germany are somewhat less reliable because reunification implied a slump in input quality at the beginning of the 1990s that was subsequently recovered, without changes of equal magnitude on output.

20. Concretely, the German deflator for ICT was used as a benchmark to calculate this investment series because no hedonic adjustment is used in German statistics. While in principle output growth in computer manufacturing should also have been adjusted, no such adjustment was undertaken.

21. This was also the case in Denmark, but recent data revisions throw some doubts on this result.

5.2 US MFP growth in the most recent years

Particular interest attaches to developments in the United States over the most recent years. It should be stressed that trend series such as those used in Table 5 could underestimate the pick-up in output and productivity that might have occurred towards the end of the 1990s. According to a very recent study (Jorgenson and Stiroh, 2000), the acceleration of MFP in the ICT industry in the second half of the 1990s was sufficiently strong to positively affect the economy-wide MFP growth rate in the United States, but the authors found little evidence of MFP spillover to ICT using sectors. Two additional studies (Whelan, 2000; Oliner and Sichel, 2000) relate the growing utilisation of computer hardware and software to faster aggregate MFP growth in the United States. Their estimates suggest an almost doubling in labour productivity growth in the 1996-99 period as compared with the first part of the decade: the use of information technology and the production of computers accounted for about two-thirds of this acceleration. The crude MFP indicator in Figure 9 is also suggestive of a pick-up in growth towards the end of the 1990s. However, common to all of these studies is that they do not correct for cyclical influences which is a reason for being cautious in drawing conclusions.

5.3 MFP effects in ICT using sectors

With somewhat mixed trends across countries in aggregate MFP growth, and little direct macroeconomic evidence of disembodied technical progress as a result of ICT use, it is tempting to search elsewhere for such evidence. However, available data do not allow a clear identification of such effects in ICT-using sectors, partly reflecting measurement difficulties. In particular, there are serious problems associated with the recording of output in some of the industries using ICT most intensively. For example, measurement of the output of banks and financial institutions, which are heavy users of information technology, is generally regarded as poor, and any productivity-raising effects of computers in these sectors could go largely unrecorded in national accounts.

More generally, it is difficult to assess the impact of innovative ICT-based businesses and markets, most of which are at an early stage of development. For example, any productivity gains from business reorganisation to take advantage of Internet and other networks are likely to become clearly visible only after a certain threshold in network use has been passed. However, there is anecdotal evidence that Internet - which became available for business use only in the mid-1990s - is now producing significant changes in several parts of the economy, especially in business-to-business transactions.[22] Businesses are taking greater advantage of better real-time information systems, rationalising costly precautionary inventory stocks and the distribution of their products. Businesses have also started to reduce costs by integrating their suppliers more closely in the design and manufacturing of products. At the same time, anecdotal evidence suggest that tasks previously organised within hierarchical structures now may be the subject of market transactions with firms using the web to outsource tasks previously carried out internally. With greater information exchange between customers and producers, companies are likely to reduce labour hoarding required to meet unanticipated increases in product demand.

As regards business-to-consumer transactions (B2C), electronic commerce is still in its infancy and unlikely to have had much effect on aggregate productivity to date. In the United States, where most Internet transactions take place, they account for about two-thirds of 1 per cent of retail sales (Table 6). In Europe, and a few countries apart, B2C e-commerce is much lower still. Across sectors, it is really only in financial services, computer and software purchases, book-selling and event tickets, that B2C e-commerce has an important market share. Nevertheless, fast expansion in the future

22. See the chapter on electronic commerce in OECD (2000*a*).

could have major effects on distribution efficiency and work to strengthen competition, with beneficial effects on productivity as well as on consumer choice.

6. Policies to strengthen European growth

Based on the evidence presented above, sensible people may disagree as to whether there is a "New Economy" in the United States. Perhaps it would be more accurate to say that there is strong evidence that the parameters in the old economy have changed. Basically, labour productivity growth has been boosted by ICT in two ways: MFP growth in the ICT sector and substitution towards capital elsewhere. Evidence of spillover and network effects, boosting MFP in ICT using sectors, is so far scant - even if the recent up-trend in MFP growth may be seen as pointing in that direction. In any case, it is clear that something has happened in the United States but, a few countries apart, it is difficult to identify any tendencies for rising growth in Europe. The question is then whether there is some policy action that might enhance European growth. It will be addressed in two steps: focusing first on policies to raise employment and then on policies to maximise the gains from ICT. As it happens, policy orientations arising in the two areas appear to be either overlapping or complementary but not contradictory.

6.1 Raising the employment rate

To some extent, low rather than high productivity growth may be part of the solution to Europe's problems. As argued above, strong past growth of labour productivity in Europe has come as a result of not employing the least productive workers and of a substitution towards capital forced by high labour costs. The skill-biased employment trend was illustrated by Figure 5; Table 7 illustrates the development in capital intensities in the United States and Europe. Raising the employment rate in Europe towards the US level, even at the price of some lowering of average productivity, would make a substantial contribution to the level of output which possibly could be in the same order of magnitude as any effects from a New Economy.

A thought experiment may illustrate the magnitudes. Lower utilisation of labour contributes more than 20 percentage points to the gap in GDP per capita in the European Union compared to that of the United States (Figure 3). Even if labour productivity at the margin is only half the average productivity level, the unwinding of a 20 per cent gap in labour utilisation would lead to a level increase in GDP by 10 per cent, or the equivalent of growth being about ½ percentage point higher over a 20-year horizon. This may not be much smaller than the growth contributions from some major technological breakthroughs in the past.[23]

23. Gordon (2000) attributes the outstanding MFP growth in the period 1913-72 to five major waves of inventions including the production and use of electricity, the internal combustion engine, the mastering of chemical processes, the entertainment, communications and information complex, and running water, indoor plumbing and urban sanitation. He sees these as responsible for annual MFP growth in the period being some 0.8-1.0 percentage points higher than in the surrounding periods. The implication is that these five waves raised MFP by some 60-80 per cent over the period (the effects on output would have been augmented by impacts occurring via a larger capital stock, but more employment may also be associated with some capital widening investment). It follows that individual waves may have been of the same magnitude as the gains European countries might reap from approaching US levels of labour utilisation.

An important aspect of Europe's employment problem is illustrated in Figure 10. Basically, the contribution to the overall employment rate coming from the core troops on the labour market - prime-age males - differs only little across countries. This reflects that this group tends to have high employment rates everywhere. By contrast, the typical outsiders - young, old and women - have much lower employment rates in continental Europe. The Nordic countries have relatively high employment rates for these groups but, as discussed above, labour utilisation is reduced by low working hours.

Raising employment rates among labour market outsiders will take concerted policies across several fields to stimulate both demand and supply at the bottom of the labour market as well as to maintain a high, sustainable labour demand more generally.[24] There is some evidence that some of this is beginning to happen:[25]

- A number of countries have either introduced or strengthened policies to make work pay (*e.g.* France, Belgium, Netherlands, United Kingdom). By either granting employment-conditional tax credits to low-wage employees or payroll tax rebates to employers hiring such people, governments are trying to strengthen supply and demand in this segment of the labour market. While these policy measures should not be oversold and may face diminishing marginal returns as they are expanded to wage earners higher up in the wage distribution, there is some evidence that they are effective (OECD, 1999*a*). That said, there is a question as to whether high wage floors remain a hindrance to the employment of marginal groups. This certainly seems to be the case for the impact of minimum wages on youth employment (OECD, 1998). More generally, public transfer schemes may in many cases act to truncate the wage distribution at the bottom.

- A number of countries have also eased up on some aspects of their employment protection legislation (EPL). This has mostly taken the form of easing conditions for fixed-term contracts and temporary work whereas few countries have eased up on EPL affecting permanent workers (Spain being a notable exception). While the concentration of employment growth on flexible contracts suggests that these steps have been useful there is a real question as to whether easing on the margin can be a substitute for action affecting permanent workers. Apart from any considerations of unfairness in the discrimination between different groups, workers on permanent contracts tend to be more influential in wage setting and having a buffer of workers on flexible contracts may in fact increase the job security of permanent workers and thereby their wage-raising power.[26]

- Many countries have tightened up on eligibility rules for unemployment insurance (UI). There is some support for this having an effect on unemployment (Grubb, 2000). However, few countries have been prepared to touch the main parameters of UI - duration

24. The recent US experience where a tight labour market has disproportionately benefited weaker groups suggests that aggregate labour market problems may be prone to show themselves more strongly at the bottom of the labour market.

25. An overview of recent labour market initiatives is presented in the chapter on recent labour market trends in OECD (2000*a*). A more general presentation of policies affecting labour market outcomes is given in OECD(1999*b*).

26. There is some evidence that EPL puts upward pressure on unemployment in particular in countries where wage bargaining institutions are such that individual unions have considerable bargaining power but do not take into account the economy-wide spillover effects of their bargaining stance (Elmeskov *et al*.,1998).

and level of benefits. Generosity on these parameters strengthens the bargaining position of labour-market insiders and tends to lengthen job search.[27] Moreover, UI schemes may interact with other structural features. For example, replacement income is usually based on past wages which implies that workers previously employed by firms with some market power may be compensated not just for not earning their market wage but also for a lost rent component - effectively leading to an excessively high replacement rate. But the role of public transfer policies is more pervasive than just UI. Policies concerning retirement (including the prevalence of early retirement schemes) contributed to Europe in 1995 having an average effective retirement age of 61 against 64 in the United States (Blöndal and Scarpetta, 1998). In some countries, invalidity schemes also act as extensions of UI, and within UI schemes there are provisions which effectively eliminate any job search requirements on older workers. Moreover, early retirement schemes often include provisions barring labour market participation.

- Wage setting is a complex matter and recent wage outcomes in Europe may give rise to some hope of wage moderation. That said, unemployment has tended to be above estimated structural rates in many European countries in recent years and it is therefore not so surprising to see wage moderation - the question is whether we see more wage moderation than would be expected. Moreover, a number of particular institutions remain that are unfavourable to wage moderation. Thus, minimum wages remain high relative to average wages in a number of countries (above 50 per cent in France, Belgium, Greece and Luxembourg) and the practice of administratively extending wage agreements to cover all workers/employers in one or more sectors remains (France is the extreme case with union membership below 10 per cent of the workforce but more than 90 per cent of the workforce covered by collective agreements). Moreover, wage setting institutions may interact with other policy settings. Thus, there is evidence suggesting that increased payroll taxes have been particularly detrimental to unemployment in countries where wage bargaining institutions are prone to create real wage rigidity.

The above policies are far from the only ones that affect employment outcomes. For example, there is reasonably robust evidence that active labour market policies can play some positive role and policies affecting product market competition may also contribute. Tax policies obviously also affect labour supply. In sum, while some progress is being made more needs to be done and there is a fairly clear agenda for moving further on structural reforms. At the same time, there is some hope that with inflation now low and public budgets in better shape than they have been for decades, macroeconomic policies could be playing a more positive role than they have in the past.

6.2 The right framework conditions for a New Economy

Policy settings in many areas are important to foster growth in general but become even more crucial at times of rapid technological change because they increase the agility and dynamism of economies.[28] Exploiting new IC technology calls for reinventing existing enterprises, discovering new business opportunities and starting new enterprises. Indeed, new enterprises, having no history, no existing structure and no vested interests, may sometimes be better at harnessing the new technology, including by achieving the most efficient form of organisation. The most important role for policy in

27. The effect of UI generosity is one of the most robust parameters in cross-country time-series regressions to explain unemployment (Scarpetta, 1996; Elmeskov *et al*., 1998)

28. See OECD, *Implementing the OECD Jobs Strategy -- Assessing Performance and Policy*, Paris, 1999.

this context is to provide a framework that enables entrepreneurship to flourish. Conditions in this area vary markedly across OECD countries, including within Europe.

There are many aspects to providing an enabling framework for entrepreneurship. One is to ensure a competitive environment by facilitating new entry in markets which are inherently competitive. The regulatory reforms that have swept telecommunications and a range of sectors across the OECD provide graphic examples of the benefits from such an approach. Public administration is important so as to avoid excessive administrative burdens and red tape affecting enterprises. Indeed, and for what it is worth, there are some signs of correlation between trends in broad MFP growth across countries and indicators of the regulatory burden in the administrative and market competition fields (Figure 11, panels A and B).[29] Likewise, excessive or strongly distortive taxation is also detrimental to entrepreneurship. And basic legal aspects of the enterprise environment such as company and bankruptcy laws need to strike the right balance between encouraging entrepreneurial behaviour and the interests of those saving and lending the money to finance new investment. Finally, a particular issue concerning ICT is that barriers to network access are likely to have detrimental effects and may often be the result of inappropriate government intervention, the effects of which seem to linger on even after liberalisation such as in the case of Internet access costs (Figure 12).

Financial systems have important roles to play. They mobilise and pool individual saving to finance investment. They allocate finance to the activities generating the highest return. They diversify and reallocate risk among individual investors. And, in the context of wider corporate governance arrangements they act to monitor and discipline managers of existing enterprises. A particular focus in the context of the New Economy has been the financing of new, innovative enterprises. Equity is a better source of finance than traditional debt in many of these cases, given the often limited cash flow, the absence of collateral, and the high risk (the upside of which does not benefit lenders). The success of venture capital in nurturing the growth of the US ICT industry have led to efforts in many European countries to stimulate venture finance. Whether public support can be effective in this field is not quite clear. Moreover, policies can provide the right framework conditions for venture capital, such as ensuring easy exit possibilities through stock market listing.

An efficient labour market is also important so as to achieve a swift reallocation of labour between enterprises. Reaping the efficiency gains of ICT may require the shedding of labour. Exits of low-productive enterprises and plants sets labour free to be redeployed in more effective uses.[30] Across countries, and again meant mainly as an illustration, trends in broad MFP growth seem to be negatively correlated with the strictness of job protection (Figure 11, panel C).

7. Concluding remarks

This paper provides evidence that faster growth of output and labour productivity in the United States over the 1990s was associated with significant technological change, as estimated by faster growth rates of MFP -- especially in the most recent years. Evidence is accumulating that most of the productivity acceleration results from the spread of ICT. Steeply rising productivity in the ICT-producing industry itself made a significant contribution to the speed-up of labour and multi-

29. These indicators have been elaborated as part of the OECD project on regulatory reform. For an introduction see OECD (1999*a*) and for a detailed description Nicoletti *et al.* (1999).

30. In a recent study based on enterprise data for the UK manufacturing industry, Disney *et al.* (2000) finds that a very large part of overall MFP growth originates from enterprises closing low-productive units.

factor productivity at the macro level in the 1990s. Moreover, ICT capital deepening in other industries made a contribution to aggregate output and productivity growth, rising in the most recent years. In addition, some scattered evidence suggests a rapid growth in "network" aspects of ICT in the United States *via* the penetration of Internet and e-commerce, although its impact on MFP growth is yet to be unequivocably demonstrated, and is complicated by measurement problems. Some of these trends are likely to continue and could signal a move towards relatively higher potential growth rates for some time to come.

There is also evidence of a speed-up in ICT investment and a growing role of the ICT-producing industry in other OECD countries, though generally starting from a lower level than in the United States. Likewise, ICT-related networks have spread in most countries, rendering possible substantial changes in the way businesses operate and potentially creating new opportunities for growth.

But ICT is only part of the story behind diverging growth trends between Europe and the United States. Weak employment, especially among traditional outsider groups, also contributed. And in terms of levels of GDP per capita, low utilisation of labour is the main component of the large, and now widening, gap between the European Union and the United States. Even if closing the employment gap should come at the price of some decline in average productivity, as low-skilled get a foot-hold in the labour market, it represents an enormous growth potential for Europe.

In these conditions, it may be appropriate to focus the policy effort in Europe on raising employment levels. The policy requirements in this field are reasonably well understood and, indeed, a number of countries are taking steps in the right direction. Moreover, more flexible labour markets are, if anything, likely to help reaping the gains from ICT.

The appropriate policy settings to reap the full benefits from ICT are generally less well understood. However, they likely include framework conditions that allow a flexible reallocation of resources within economies. This will help the processes of identifying new business opportunities, starting new enterprises and changing the organisation of existing ones.

BIBLIOGRAPHY

BARTELSMAN, E.J. and M. DOMS (2000), "Understanding Productivity: Lessons from Longitudinal Microdata", *Journal of Economic Literature*, forthcoming.

BASSANINI, A., S. SCARPETTA and I. VISCO (2000), "Knowledge, Technology and Growth: Recent Evidence from OECD Countries", *National Bank of Belgium, Working Papers Series*, May, forthcoming.

BLÖNDAL, S. and S. SCARPETTA (1998), "The retirement decision in OECD countries", *OECD Economic Department Working Papers*, No. 202.

BUREAU OF LABOR STATISTICS (1993), "Labor Composition and U.S. Productivity Growth, 1948-90", *U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2426*. December.

COUNCIL OF ECONOMIC ADVISERS (2000), "Economic Report of the President-2000", February.

DISNEY, R., J. HASKEL AND Y. HEDEN (2000), "Restructuring and productivity growth in UK manufacturing", mimeo.

ELMESKOV, J., J.P. MARTIN and S. SCARPETTA (1998), "Key lessons for labour market reforms: evidence from OECD countries' experiences", *Swedish Economic Policy Review*, Vol. 5/2.

GORDON, R.J. (1999)"Has the "New Economy" Rendered the Productivity Slowdown Obsolete?", Northwestern University, mimeo.

GORDON, R.J. (2000), "Does the 'New Economy' measure up to the great inventions of the past?", *Journal of Economic Perspectives* (forthcoming).

GRUBB, D. (2000), "Eligibility criteria for unemployment benefits", *OECD Economic Studies, 31.*

HODRICK, R.J. and E.C. PRESCOTT (1997), "Post-War U.S. Business Cycles: An Empirical Investigation", *Journal of Money, Credit and Banking*, Vol. 29, No. 1.

JORGENSON, D.W. and K.J. STIROH (2000), "Raising the Speed Limit: U.S. Economic Growth in the Information Age", May, mimeo.

NICOLETTI, G., S. SCARPETTA and O. BOYLAUD (1999), "Summary indicators of product market regulation with an extension to employment protection legislation", *OECD Economics Department Working Papers*, No. 226.

OECD (1998), *Employment Outlook*, Paris.

OECD (1999*a*), *Economic Outlook 66*, Paris.

OECD (1999*b*), *The OECD Jobs Strategy: Assessing Performance and Policy*, Paris.

OECD (1999*c*), *OECD Economic Surveys - Ireland*, Paris.

OECD (2000*a*), *Economic Outlook 67*, Paris (forthcoming).

OECD (2000*b*), *OECD Economic Surveys - United States*, Paris.

OLINER, S.D. and D.E. SICHEL (2000), "The Resurgence of Growth in the late 1990s: Are Computers the Story?", *Journal of Economic Perspectives*, forthcoming.

SCARPETTA, S., A. BASSANINI, D. PILAT and P. SCHREYER (2000), "Economic Growth in the OECD Area: Recent Trends at the Aggregate and Sectoral Level", *OECD Economics Department Working Paper*, forthcoming.

SCHREYER, P. (2000), "The Contribution of Information and Communication Technology to Output Growth: A Study of the G7 Countries", *OECD STI Working Paper* 2000/2.

SOLOW, R.M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*, Vol. 39, pp. 312-320.

WHELAN, K. (2000), "Computers, Obsolescence and Productivity", February, mimeo.

Table 1. **Growth performance in OECD countries**
Average annual rates of change

	Actual growth of GDP				Trend growth of GDP		Trend growth of GDP per capita		
	1970-80	1980-90	1990-98	1999	1980-90	1990-98	1980-90	1990-98	1995-98
United States	3.2	3.2	3.0	4.2	2.9	3.1	2.0	2.2	2.7
Japan	4.4	4.0	1.4	0.3	3.8	1.9	3.3	1.6	1.1
European Union [a]	3.0	2.4	1.7	2.3	2.3	1.8	2.0	1.5	1.7
OECD total [a, b]	3.4	3.0	2.3	2.7	2.8	2.4	2.1	1.8	2.0

a) Growth rate for European Union and OECD total is computed as a weighted average of country growth rates, using country GDP levels expressed in 1993 EKS PPPs as weights.
b) Excluding Czech Republic, Hungary, Korea and Poland.
Source: OECD.

Table 2. **Average annual working hours**

Total economy

	1980	1990	1998
United States	1831	1819	1833
Japan	2121	2031	1842
Germany	1742	1625	1580
West Germany	1742	1611	1562
France	1792	1652	1599
Italy	1724	1674	1648
United Kingdom	1704	1613	1587
Canada	1805	1790	1768
Australia	1818	1809	1801
Austria	..	..	1515
Belgium	..	1699	1635
Czech Republic	..	..	2003
Denmark	..	1492	1527
Finland	1755	1677	1674
Greece	..	1912	1930
Hungary	1930	1710	1788
Iceland	..	1772	1747
Ireland	..	1922	1797
Korea	2603	2433	2313
Luxembourg	..	1724	1648
Mexico	..	2063	2145
Netherlands	1719	1454	1368
New Zealand	..	1676	1681
Norway	1512	1432	1401
Portugal	..	1882	1732
Spain	2003	1824	1821
Sweden	1439	1480	1551
Switzerland	..	1627	1579
European Union	1755	1659	1620

Source: Scarpetta *et al.* (2000).

Table 3. **Labour productivity in manufacturing and two ICT sectors in third quarter 1999**
1995 = 100

	Office, accounting & computing equipment	Radio, television & communications equipment	Manufacturing
United States	460	172	125
Japan	..	112	104
Germany	186	129	117
France	..	128	115
United Kingdom	160	..	103
Canada	97	141	105
Austria	116	134	130
Denmark	99	151	109
Finland	127	193	119
Korea	454	322	150
Mexico	117	144	119
Portugal	..	195	122

Source : OECD (1999), Indicators of Industrial Activity, No. 4.

Table 4. **The evolution of investment in ICT, G7 countries**

		Canada	France	Western Germany	Italy	Japan	United Kingdom	United States
Share in non-residential Gross Fixed Capital Formation:								
IT equipment								
	1985	6.9	6.1	3.4	3.4	3.4	5.2	6.3
	1990	7.3	5.0	3.5	4.1	3.8	7.5	8.7
	1996	10.1	6.0	6.1	4.2	4.6	11.7	13.4
Communication equipment								
	1985	4.2	4.0	3.7	2.4	0.8	5.2	5.8
	1990	5.3	3.8	3.7	3.6	1.5	5.8	7.0
	1996	6.1	4.9	4.8	5.4	3.5	6.6	6.5
Average annual rate of growth of constant price expenditure on:								
IT equipment								
	1985-90	17.2	16.2	18.8	20.8	23.6	25.5	19.6
	1990-96	17.6	11.0	18.6	12.9	14.5	17.6	23.8
Communication equipment								
	1985-90	20.6	19.0	18.4	25.6	34.7	20.3	16.7
	1990-96	4.3	2.1	3.4	9.2	15.0	2.2	5.1
Price deflator[a]:								
IT equipment								
	1985-90	-9.4	-10.2	-10.3	-8.1	-12.0	-6.7	-10.4
	1990-96	-11.1	-9.2	-10.7	-9.1	-12.5	-9.1	-11.5
Communication equipment								
	1985-90	1.3	0.5	0.4	2.7	-1.3	4.0	0.3
	1990-96	-0.7	1.2	-0.4	1.3	-2.2	1.2	-1.1

a) Figures refer to "harmonised" deflator indices based on the assumption that the differences between price changes for ICT capital goods and non-ICT capital goods are the same across countries.

Source: Schreyer(2000).

Table 5. **Estimates of Multi-Factor Productivity growth rates in the G7 countries, 1980-98**

Average annual growth rates

(based on trend series time-varying factor shares)

		1980-90	1990[a] -98[b]	1995-98[b]	1990[a] -96
United States	MFP growth	0.8	1.0	1.0	1.0
	with control for human capital	0.8	0.8	1.0	0.9
	... and composition/quality of physical capital	0.6	..	..	0.8
Japan	MFP growth	2.0	1.6	1.6	1.5
	with control for human capital	..	..	..	..
	... and composition/quality of physical capital	..	..	..	..
Germany [c]	MFP growth	1.6	1.4	1.5	1.4
	with with control for human capital	1.6	1.9	1.3	2.0
	... and composition/quality of physical capital	1.5	..	..	..
France	MFP growth	2.1	1.1	1.1	1.1
	with control for human capital	1.9	0.7	1.0	0.5
	... and composition/quality of physical capital	1.5	..	..	0.4
Italy	MFP growth	1.5	1.2	1.0	1.2
	with control for human capital	1.4	0.6	0.7	0.5
	... and composition/quality of physical capital	1.3	..	..	0.4
United Kingdom	MFP growth	..	1.3	1.4	1.3
	with control for human capital	..	0.5	1.2	0.5
	... and composition/quality of physical capital	..	..	..	0.3
Canada	MFP growth	0.4	0.8	0.8	0.8
	with control for human capital	0.4	0.8	0.8	0.8
	... and composition/quality of physical capital	0.2	..	..	0.4

For each country, the first line shows estimated MFP growth rate without control for composition/quality changes in labour and capital; the second controls for changes in the composition of labour; while the third also controls for composition/quality changes in physical capital.

a) 1991 for Germany.

b) 1997 for Italy and United States, 1996 for United Kingdom.

c) Western Germany before 1991.

Source: OECD.

Table 6. **B2C e-commerce in selected OECD countries**

	Value of transactions - 1999, $US million	Value of transactions - growth rate (1999/98)	Penetration rate, per cent of retail sales	Number of buyers, thousand, end 1998	Number of buyers, as a per cent of Internet users	Number of buyers, as a per cent of working age population
United States	24 170	195	0.48	19 666	39	11.1
Japan	1 648	334	0.06	..	..	..
Germany	1 199	200	0.30	1 370	13	2.4
France	345	215	0.14	310	8	0.8
Italy	194	145	0.09	360	12	0.9
United Kingdom	1 040	280	0.37	970	11	2.5
Canada	774	166	0.26	811	12	4.0
Australia	..	..	..	803	13	6.4
Austria	96	210	0.23	120	13	2.2
Belgium	82	420	0.16	90	11	1.3
Denmark	46	220	0.20	90	8	2.5
Finland	51	160	0.22	160	10	4.7
Greece	..	..	..	30	11	0.4
Ireland	..	..	..	40	13	1.6
Netherlands	182	210	0.34	320	13	3.0
Norway	61	200	0.26	100	10	3.5
Portugal	70	185	0.06	50	11	0.7
Spain	70	185	0.06	220	11	0.9
Sweden	232	170	0.68	260	10	4.6
Switzerland	127	110	0.29	130	12	2.7

Sources: OECD Secretariat; Boston Consulting Group; Warburg Dillon Read; Retail Council of Canada; MITI (Japan); and Australian Bureau of Statistics.

Table 7. **Evolution of capital stocks and capital intensities** [a]

(Average annual growth rate)

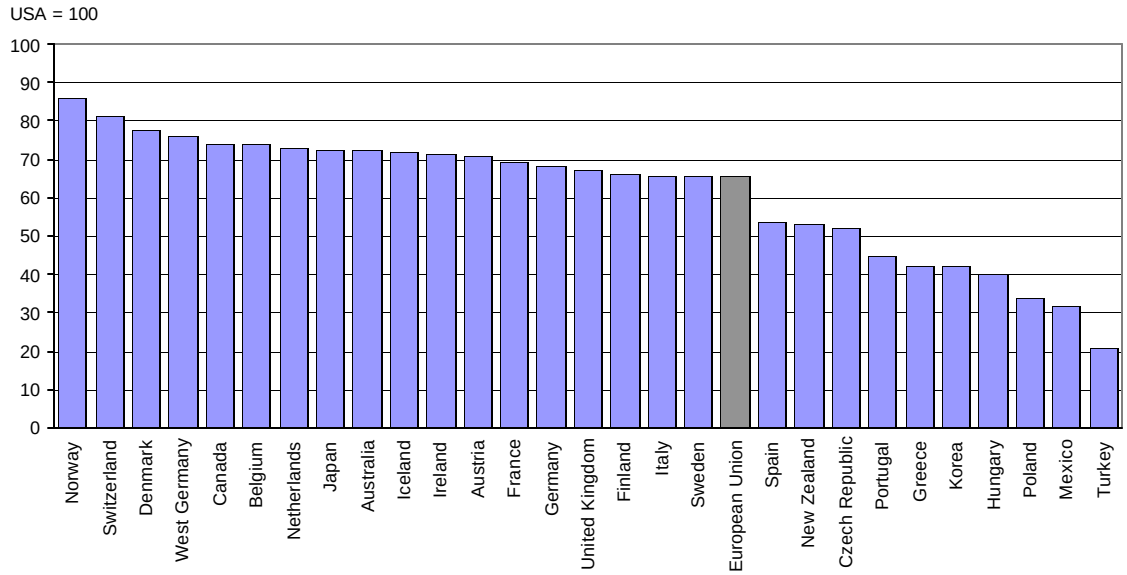
		1980-90	1990-98	1995-98
United States	Capital stock	3.0	2.6	3.3
	Capital/labour ratio	1.1	0.6	1.0
European Union[b]	Capital stock	2.6	2.5	2.4
	Capital/labour ratio	2.8	2.7	2.3
Japan	Capital stock	5.7	4.2	3.6
	Capital/labour ratio	4.9	4.7	4.4

a) The capital/labour ratio is adjuted for hours worked.

b) Growth rate for European Union is computed as a weighted average of available EU country growth rates, using country GDP levels expressed in 1993 EKS PPPs as weights.

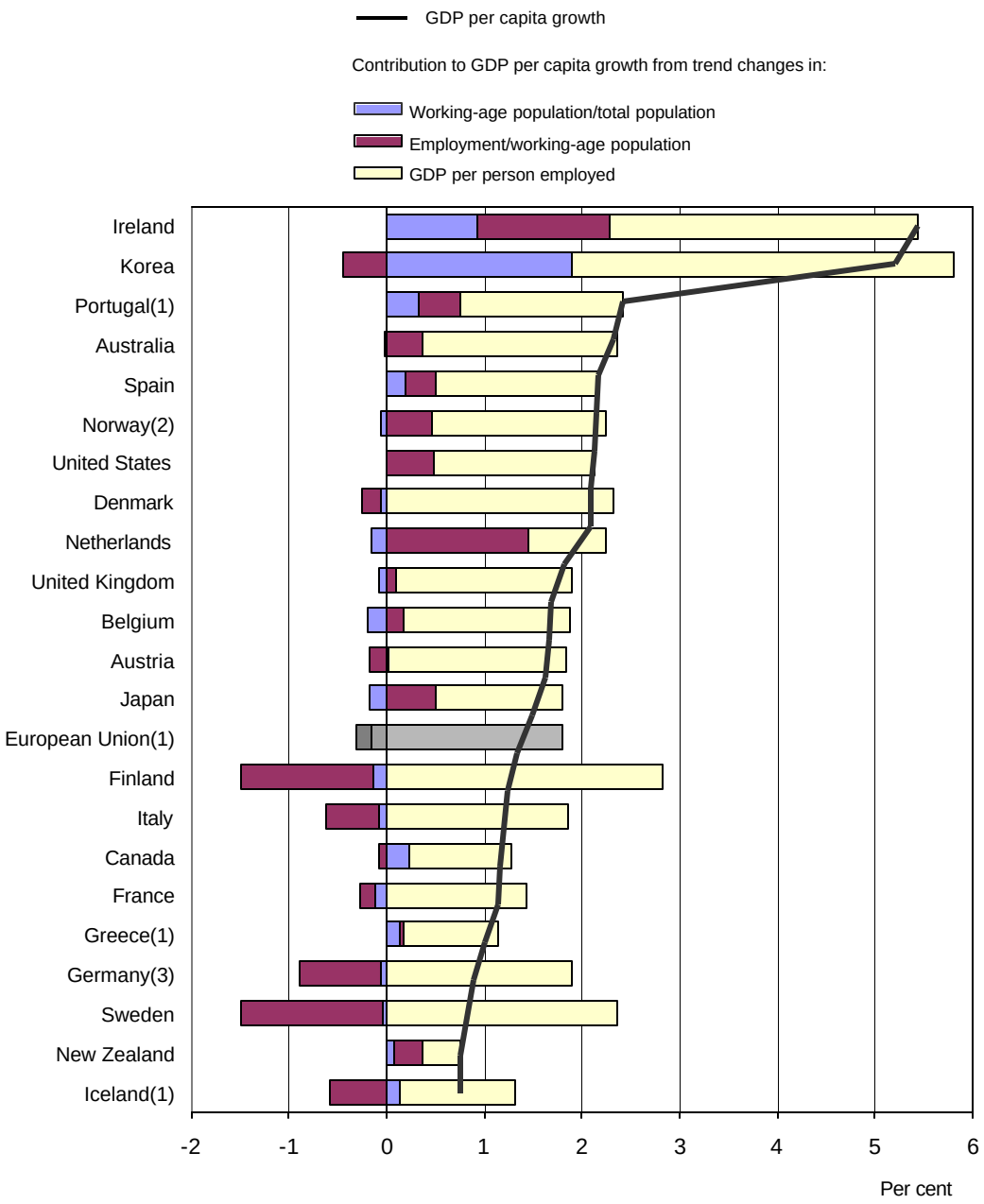
Source: Scarpetta et al. (2000).

Figure 1. **GDP per capita, 1998**
United States = 100



Note: Measured at 1993 PPPs.
Source: OECD.

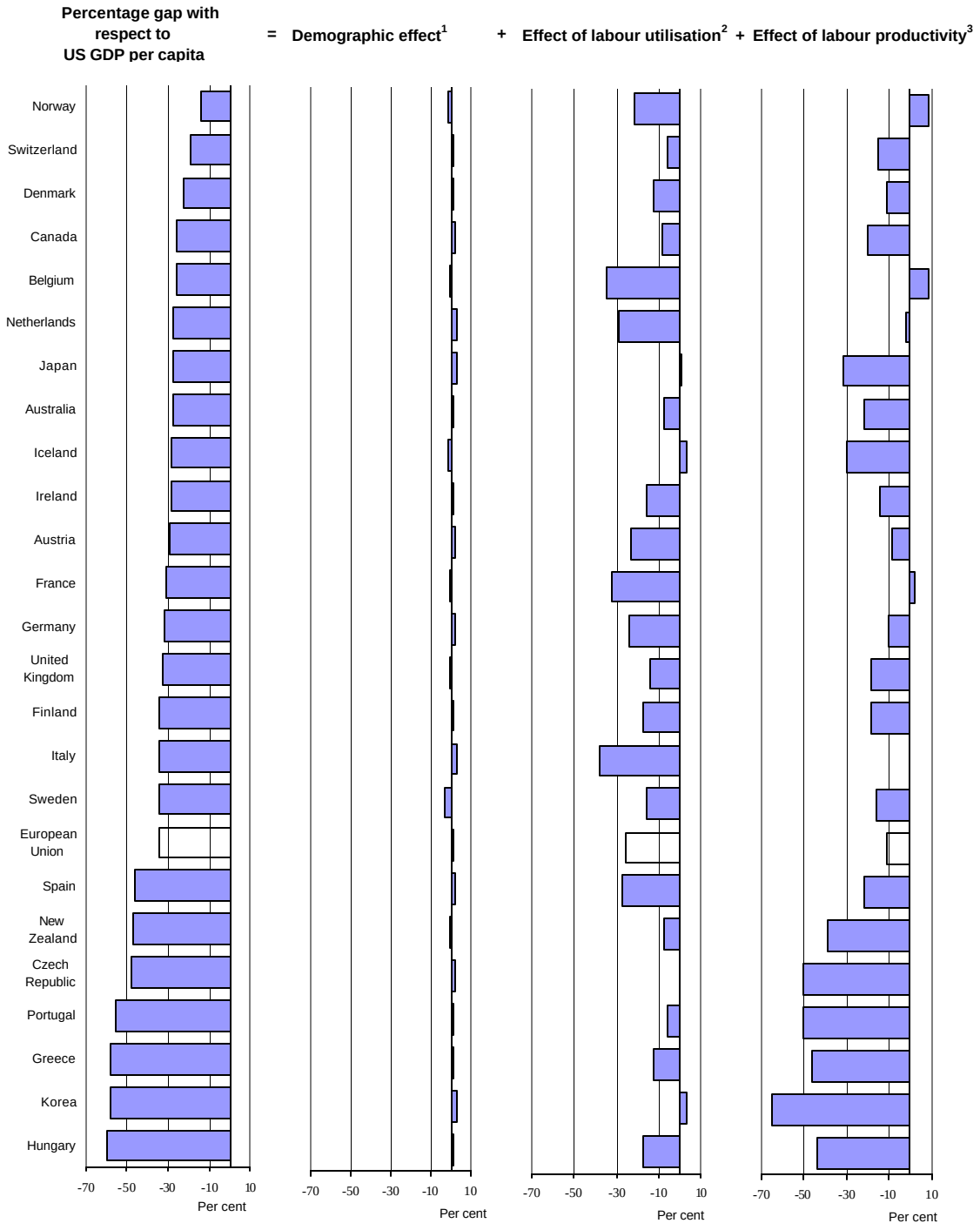
Figure 2. **Trend growth in GDP per capita and its components, 1990-98**
Average annual percentage change



1. 1990-97.
2. Mainland only.
3. 1991-98.
Source: OECD.

Figure 3. **Accounting for differences in GDP per capita, 1998**

Percentage point differences in PPP-based GDP per capita with respect to the United States

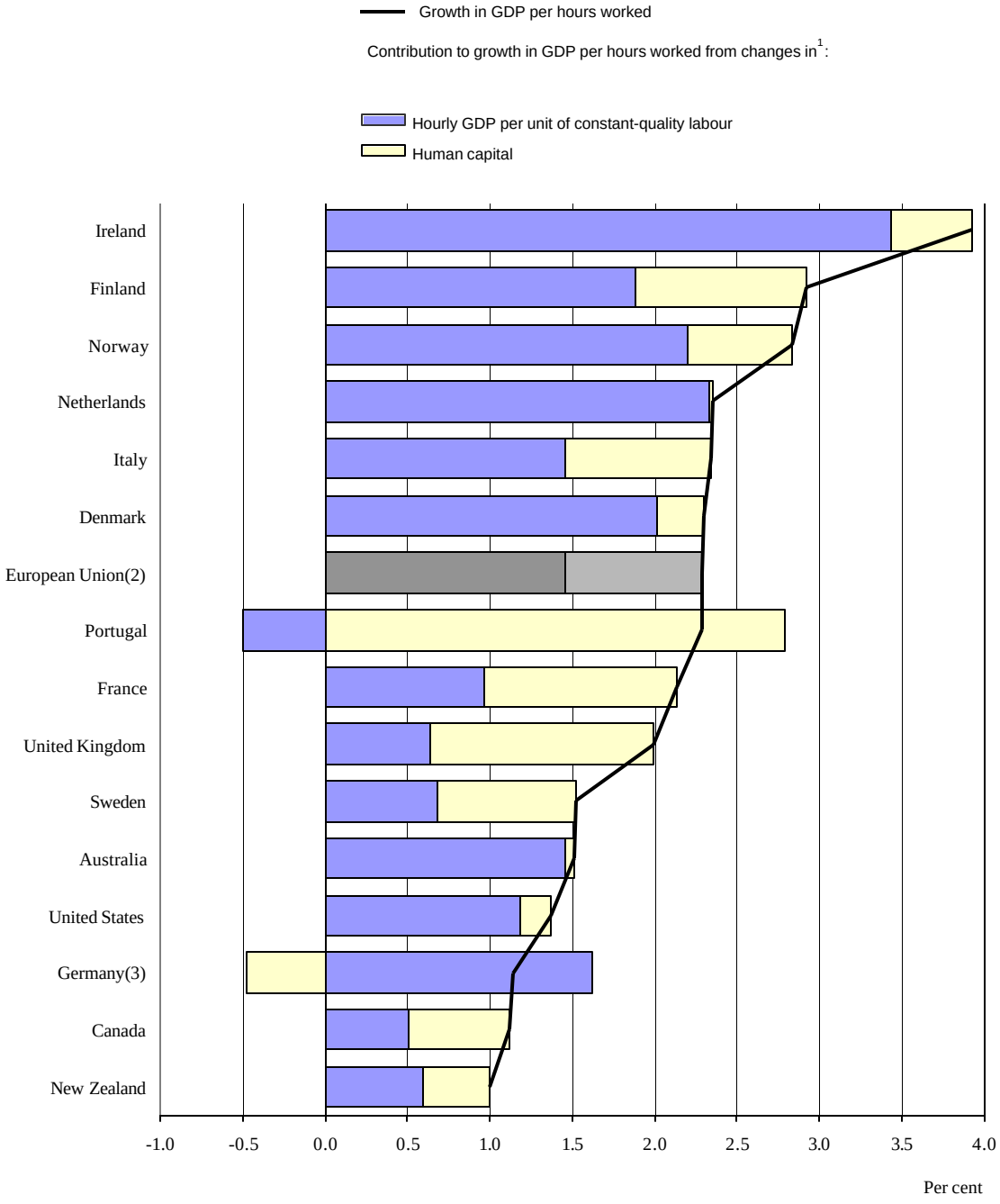


1. Based on the ratio of working age population (15-64 years) to total population.
2. Based on employment rates and average hours worked.
3. GDP per hour worked.

Source: OECD.

Figure 4. **Effects of human capital on growth of hourly labour productivity, 1985-96**

Average annual percentage change

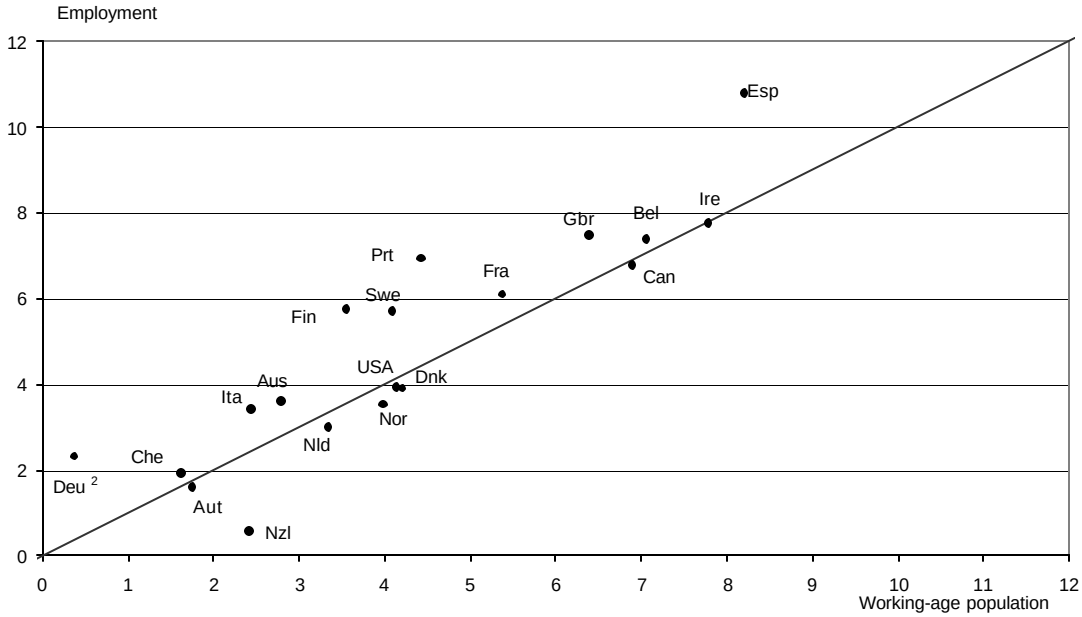


1. This is based on a simple quantitative decomposition: growth in GDP per person employed = (labour productivity adjusted for hours and human capital)+(growth in human capital). Changes in human capital are proxied by changes in the education composition of employment, see main text.
2. Simple average of available EU countries.
3. Before 1991, data refers to Western Germany.

Source: OECD.

Figure 5. **Human capital growth in total working-age population and in employment, 1989-96**

Percentage point change of the share of individuals with higher educational levels[1] in total



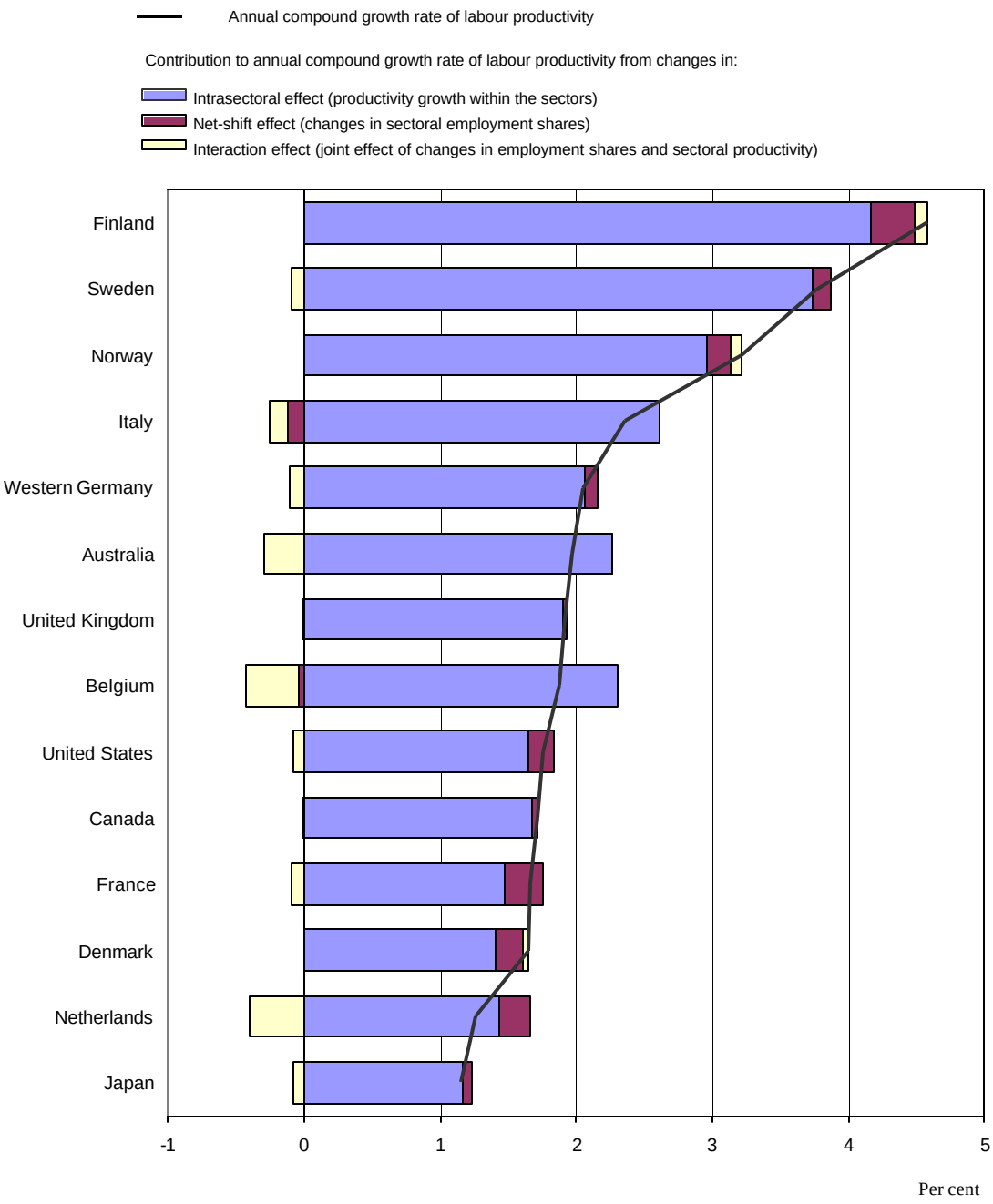
1. Higher education levels refer to ISCED codes 5, 6 and 7.

2. 1991-96.

Source: Calculations based on data from OECD, *Education at a Glance,* various issues.

Figure 6. **The contributions of sector-shifts and intra-sectoral effects to overall labour productivity growth, 1990-97**

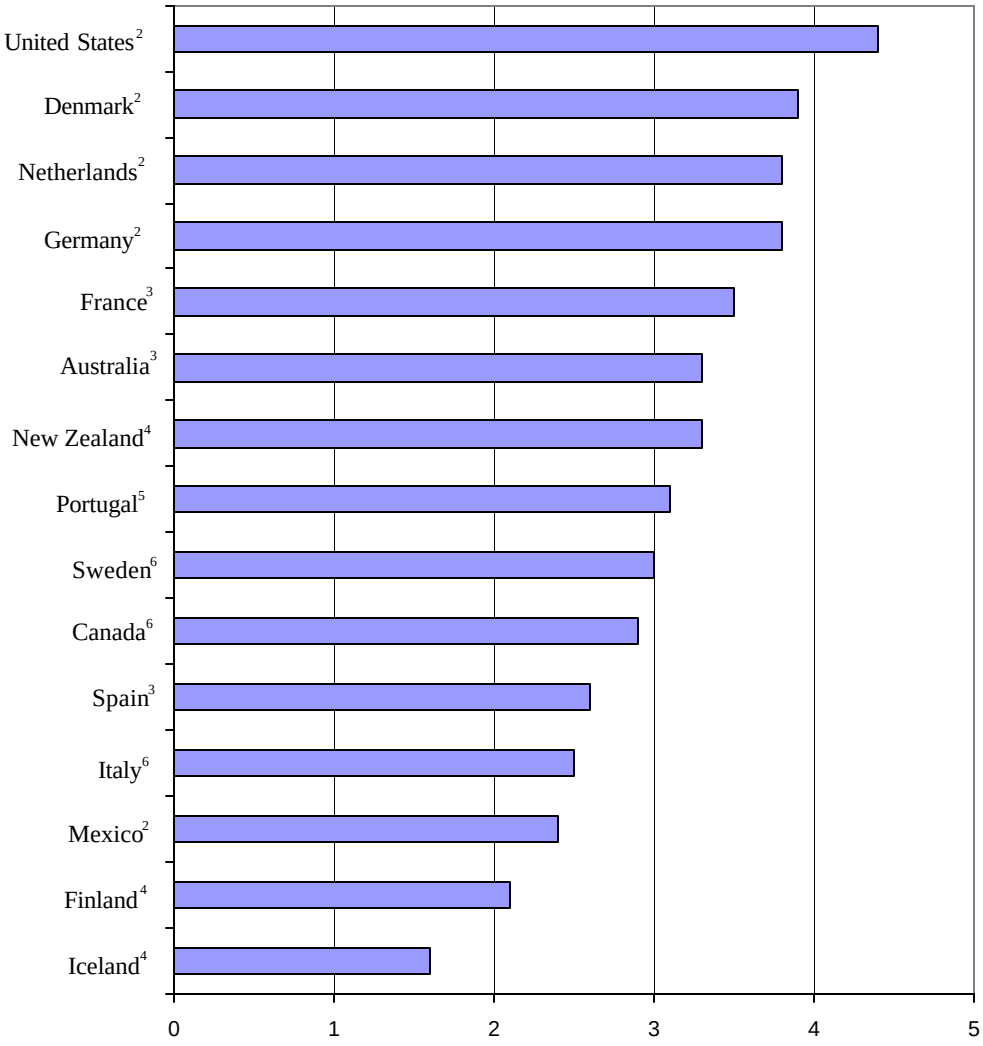
Non-farm business sector



Source: OECD.

Figure 7. **Share of ICT industries[1] in total GDP, mid-1990s**

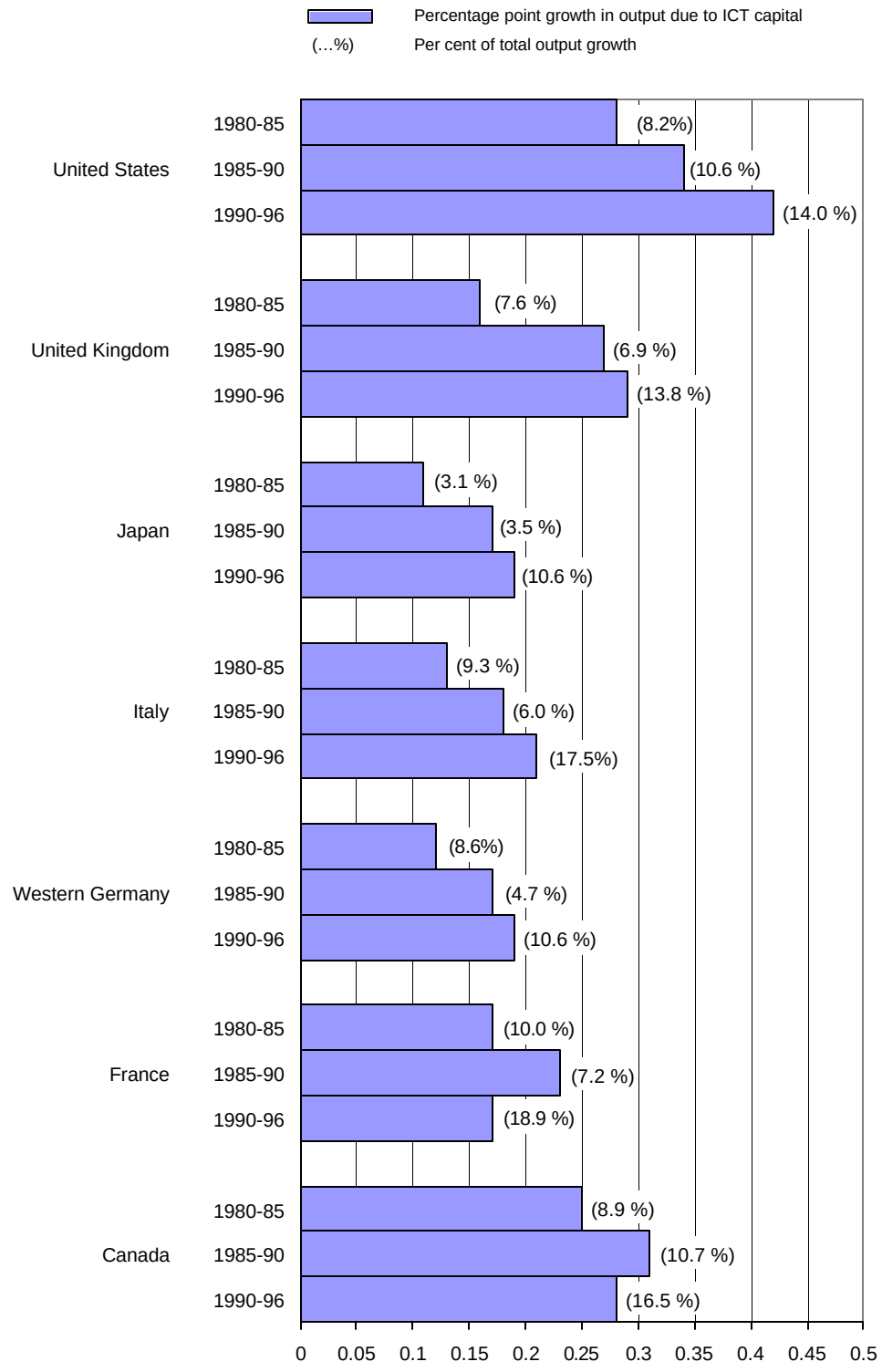
Per cent of GDP



1. Defined as ISIC Rev.2 classes 3825 (Office and computing equipment), 3832 (Radio, TV and communication equipment) and 72 (Communication services).
2. 1996.
3. 1997.
4. 1995.
5. 1993.
6. 1994.

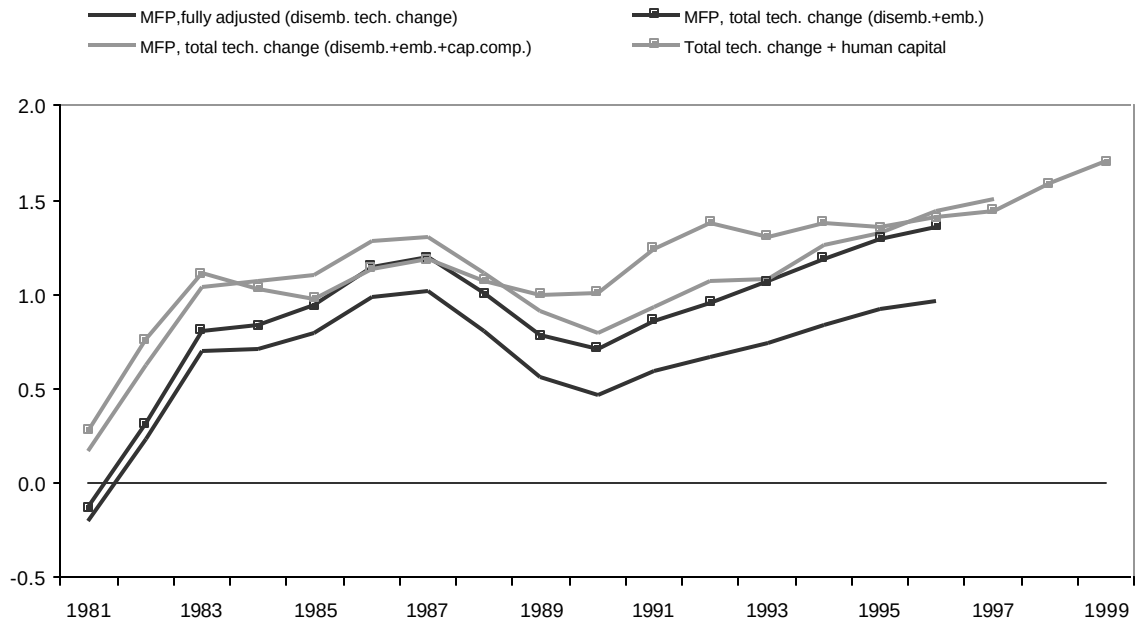
Source: OECD(2000), *OECD Information Technology Outlook* , Paris.

Figure 8. **The contribution of ICT capital to output growth**
Total industries, based on harmonised ICT price index



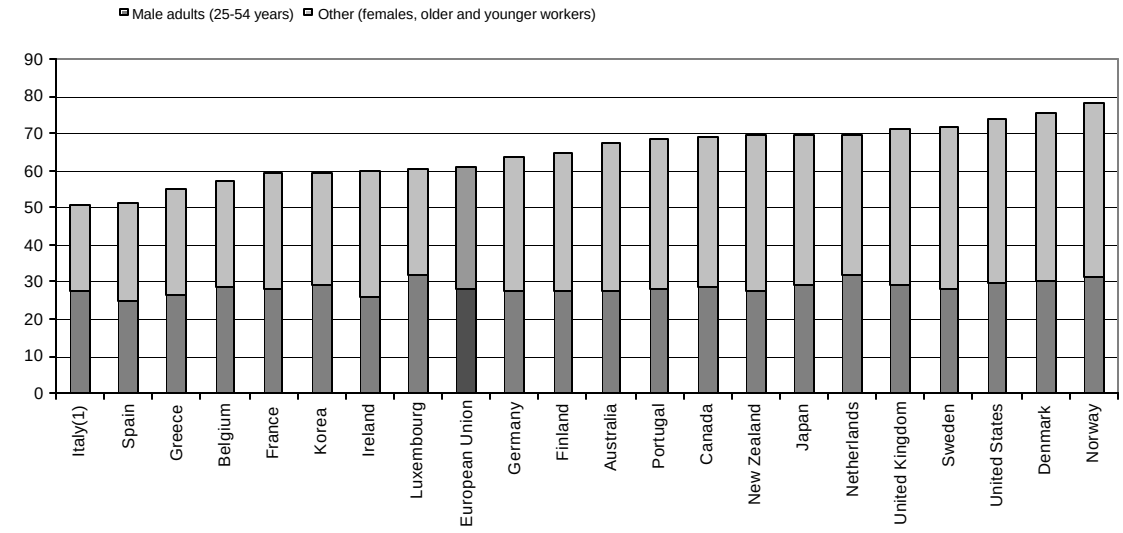
Source: Schreyer (2000)

Figure 9. **Different measures of MFP growth rates for the United States, 1981-99**
Annual growth rates



Source: Bassanini et al. (2000).

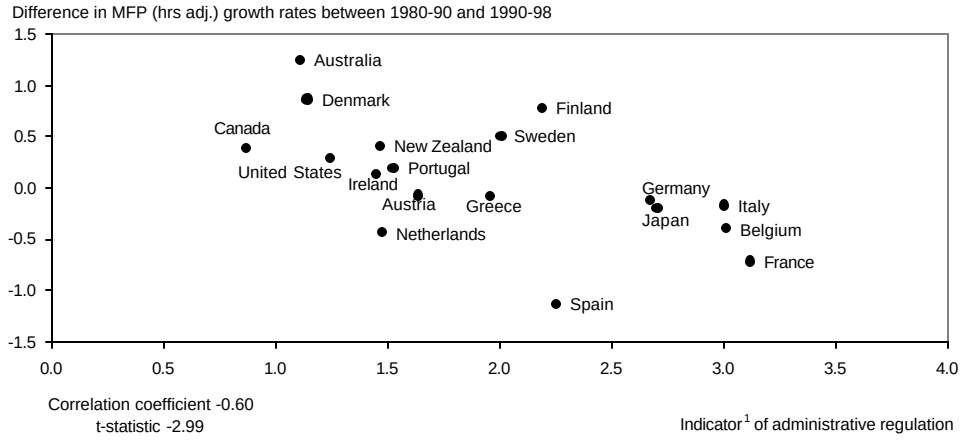
Figure 10. **Employment rates in OECD countries, 1998**
Per cent of working-age population



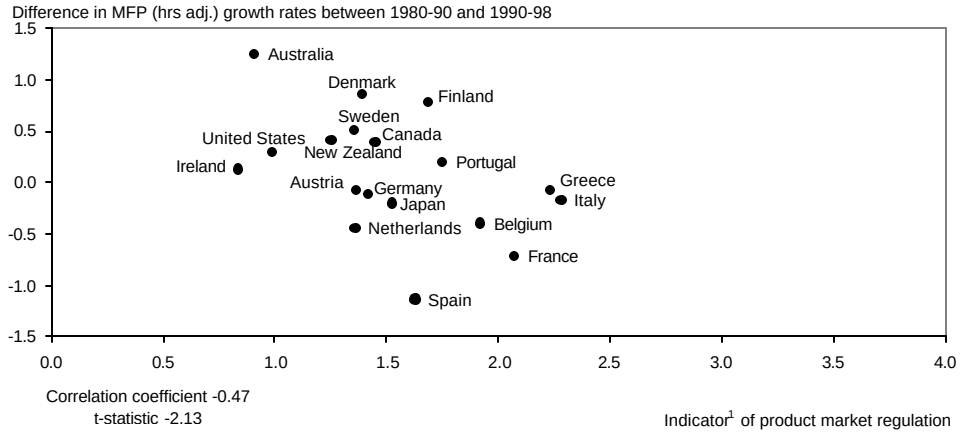
1. Adults, 25-59 years of age.
Sources: OECD *Labour Force Statistics*; OECD *Employment Outlook,* 1999.

Figure 11. **Changes in MFP growth: Bivariate correlations with policy indicators**

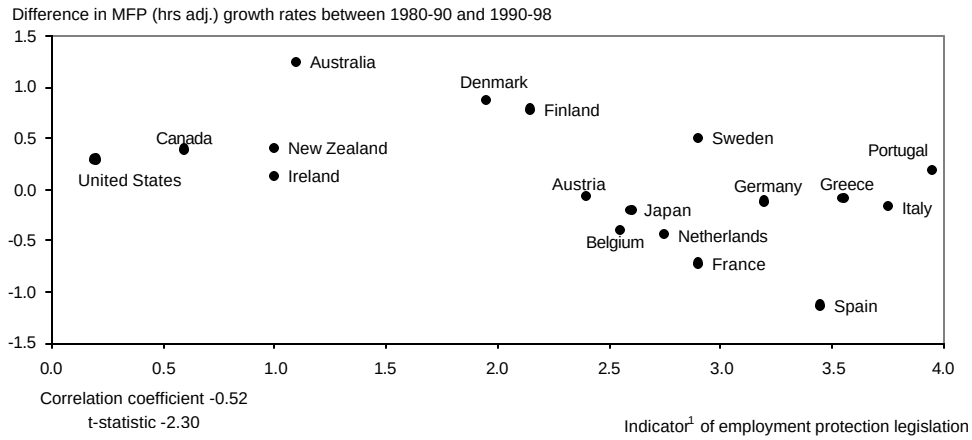
A. **Indicator of administrative regulation**



B. **Indicator of product market regulation**

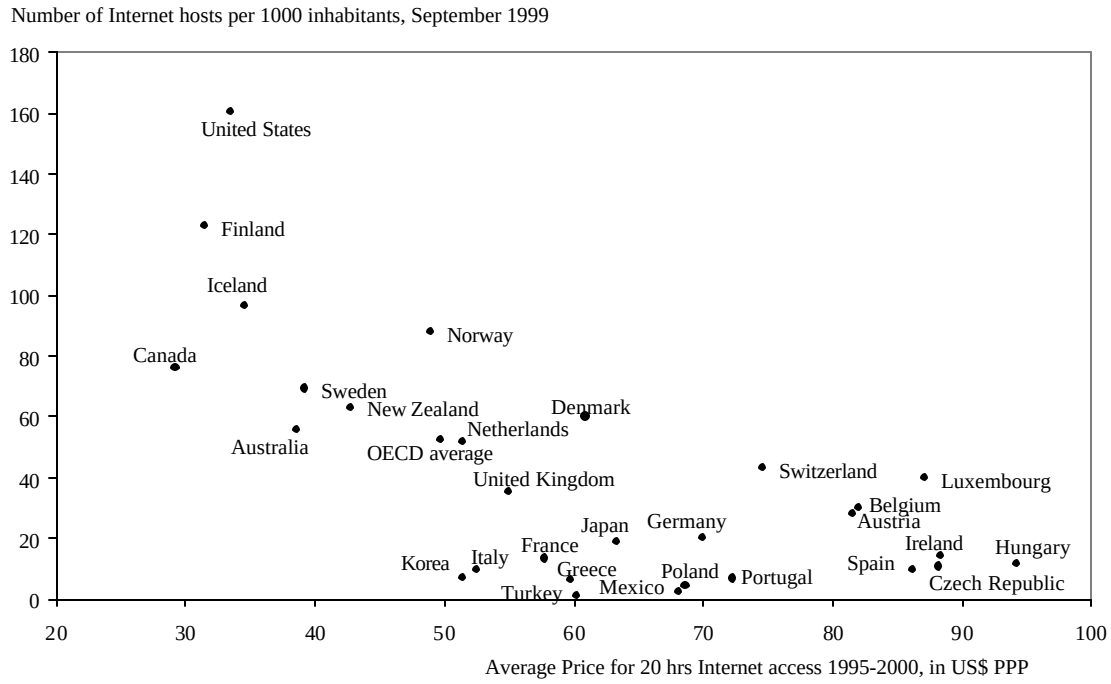


C. **Indicator of employment protection legislation**



1. The scale of indicators is 0-6 from least to most restrictive.

Figure 12. **Access costs and usage of the Internet, 1999**



Note: Data on hosts for Luxembourg is from mid-1999. Internet access costs include VAT.
Source: OECD (www.oecd.org/dsti/sti/it/cm) and Telcordia Technologies (www.netsizer.com)

Annex table A1. **Growth performance in OECD countries**
Average annual rates of change

	Actual growth of GDP				Actual growth of GDP per capita				Trend growth of GDP per capita		Trend growth of GDP per person employed	
	1970-80	1980-90	1990[a] -98	1999	1970-80	1980-90	1990[a] -98	1999	1980-90	1990-98	1980-90	1990-98
United States	3.2	3.2	3.0	4.2	2.1	2.3	2.0	3.2	2.0	2.2	1.1	1.7
Japan	4.4	4.0	1.4	0.3	3.3	3.4	1.1	0.1	3.3	1.6	2.6	1.3
Germany	2.7	2.2	1.4	1.5	2.6	2.0	1.0	1.4	1.9	0.9	1.6	1.9
France	3.3	2.4	1.4	2.9	2.7	1.8	0.9	2.5	1.6	1.2	1.9	1.4
Italy	3.6	2.2	1.3	1.4	3.1	2.2	1.2	1.3	2.3	1.3	2.2	1.9
United Kingdom	1.9	2.7	2.0	2.1	1.8	2.5	1.7	1.7	2.2	1.8	1.9	1.8
Canada	4.3	2.8	2.2	4.2	2.8	1.6	1.1	3.4	1.5	1.2	1.0	1.1
Australia	3.3	3.3	3.5	4.4	1.9	1.7	2.3	3.1	1.6	2.4	1.2	2.0
Austria	3.7	2.3	1.9	2.2	3.5	2.1	1.3	2.1	2.1	1.7	2.0	1.8
Belgium	3.4	2.0	1.8	2.5	3.2	1.9	1.5	2.3	1.9	1.7	1.8	1.7
Czech Republic	..	..	0.4	-0.2	..	..	0.4	-0.1	..	..	..	..
Denmark	2.2	1.9	2.3	1.6	1.8	1.9	1.9	1.2	2.0	2.1	1.5	2.4
Finland	3.4	3.1	1.5	3.5	3.1	2.6	1.0	3.2	2.2	1.3	2.4	2.9
Greece	4.7	1.6	2.0	3.2	3.7	1.1	1.4	2.9	1.3	1.3	0.9	1.0
Hungary	..	..	-0.2	4.5	..	..	0.1	4.9	..	..	..	..
Iceland	6.3	2.7	2.2	4.4	5.2	1.6	1.3	3.3	1.7	0.8	1.3	1.2
Ireland	4.7	3.6	6.3	8.7	3.3	3.3	5.5	7.4	3.0	5.6	3.5	3.2
Korea	7.6	8.9	5.2	10.7	5.8	7.6	4.1	9.7	7.2	5.3	5.6	4.0
Luxembourg	2.6	4.5	5.3	4.9	1.9	3.9	3.9	3.6	4.0	4.0	2.8	2.4
Mexico	6.6	1.8	3.0	3.7	3.4	0.0	1.3	1.4	0.3	1.2	..	-0.2
Netherlands	2.9	2.2	2.6	3.6	2.1	1.6	2.0	3.0	1.6	2.1	1.1	0.8
New Zealand	1.6	2.4	2.2	3.9	0.5	1.7	0.7	3.4	1.2	0.8	1.6	0.4
Norway [b]	4.2	1.5	3.1	0.8	3.6	1.1	2.6	0.2	1.4	2.2	2.1	2.5
Poland	..	..	3.5	4.0	..	..	3.4	4.0	..	..	..	..
Portugal	4.7	2.9	2.4	3.0	3.4	2.9	2.3	2.7	2.9	2.5	1.6	1.7
Spain	3.5	3.0	2.1	3.7	2.4	2.6	1.9	3.6	2.3	2.2	2.4	1.7
Sweden	1.9	2.1	1.1	3.8	1.6	1.8	0.6	3.7	1.5	0.9	1.6	2.4
Switzerland	1.9	2.1	0.5	1.7	1.7	1.5	-0.3	1.5	1.6	0.1	0.4	0.4
Turkey	4.1	5.2	4.2	-5.0	1.8	2.8	2.4	-6.6	2.0	2.3	2.8	2.6
European Union	3.0	2.4	1.7	2.3	2.6	2.1	1.3	2.1	2.0	1.5	2.3	1.8
OECD [d]	3.4	3.0	2.3	2.7	2.5	2.3	1.6	2.1	2.1	1.8	2.8	2.4

Coefficients of variation of trend series [c]

	GDP		GDP per capita		GDP per person employed		GDP per hours worked	
	1980-90	1990-98	1980-90	1990-98	1980-90	1990-98	1980-90	1990-98
OECD [d]	0.47	0.54	0.56	0.66				
European Union	0.28	0.58	0.31	0.61	0.33	0.33	0.28	0.32
OECD 24 [e]	0.28	0.51	0.32	0.61	0.40	0.41	0.35	0.40

a) 1991 for Czech Republic and Germany.
b) Mainland only.
c) Calculated as the ratio of the standardised deviation to the mean of trend growth rates across countries.
d) Excluding Czech Republic, Hungary and Poland.
e) Excluding Czech Republic, Hungary, Korea, Mexico and Poland.
Source: OECD.

Annex table A2. **Estimates of Multi-Factor Productivity growth rates, smaller countries, 1980-98**
Average annual growth rates
(based on trend series time-varying factor shares)

		1980[a]-90	1990-98[b]
Australia	MFP growth	0.9	2.1
	with control for human capital	0.9	2.0
Belgium	MFP growth	1.4	1.0
	with control for human capital	..	..
Denmark	MFP growth	1.0	1.8
	with control for human capital	0.9	1.9
Finland	MFP growth	2.4	3.2
	with control for human capital	2.2	2.8
Greece	MFP growth	0.6	0.3
	with control for human capital	..	..
Ireland	MFP growth	3.9	3.9
	with control for human capital	3.8	3.6
Netherlands	MFP growth	2.2	1.7
	with control for human capital	2.2	1.7
New Zealand	MFP growth	0.7	1.1
	with control for human capital	0.6	1.2
Norway[c]	MFP growth	1.1	2.1
	with control for human capital	0.9	1.9
Portugal	MFP growth	1.9	2.2
	with control for human capital	1.9	..
Spain	MFP growth	2.2	0.6
	with control for human capital	..	..
Sweden	MFP growth	0.8	1.3
	with control for human capital	0.6	1.0
Switzerland	MFP growth	..	0.2
	with control for human capital	..	0.2

Note: For each country, the first line shows estimated MFP growth rate without control for composition/quality changes in labour and capital; the second does control for changes in the composition of labour.

a) 1984 for Denmark, 1986 for New Zealand and Portugal.

b) 1997 for Australia, Belgium, Norway and Spain, 1996 for Finland, Greece, Ireland, New Zealand and Sweden, 1995 for Switzerland, 1992 for Portugal.

c) Mainland only.

Source: OECD.